FOREWORD

Prior to 2000, localized and selected population specific data showed that micronutrient malnutrition was common in Malawi, but representative national statistics were not available. Thus, a national survey was planned to generate data for evidence based advocacy, social marketing and resource mobilization for micronutrient interventions, to assess the impact of micronutrient interventions implemented in the 1990s and to provide baseline data for planning, programming, monitoring and evaluation of micronutrient interventions. Specifically, the survey was conducted to assess the prevalence of vitamin A, iron and iodine deficiencies in the population. The study also aimed at validating the appropriateness of food vehicles for micronutrient fortification through estimation of the prevalence of use and levels of consumption of these centrally processed foods.

This report presents the findings of the Malawi Micronutrient Survey that was conducted in September and October 2001. Based on the recommendations, a 5-year national plan of action to combat micronutrient deficiencies will be developed.

As micronutrient deficiencies are completely avoidable, I am hopeful that the results will bring to the limelight the problem of micronutrient malnutrition in Malawi, and that concerted effort will be made to eliminate these deficiencies.

Dr. Richard Pendame
Secretary for Health and Population

EXECUTIVE SUMMARY

This report summarizes the findings of the Malawi Micronutrient Survey conducted in households and schools in Malawi in September and October 2001. The collaborating partners included the Ministry of Health and Population (MOHP), the National Statistics Office (NSO), the United Nations Children's Fund (UNICEF), and the Centers for Disease Control and Prevention (CDC). Funding was provided by the CDC through a cooperative agreement with UNICEF.

SURVEY OBJECTIVES

The objectives of the Malawi Micronutrient Survey were:

1. To determine the prevalence of vitamin A deficiency in preschool children aged 6-36 months, in school children 6-12 years, in women of childbearing age 15-45 years and in adult men 20-55 years, and to determine the relationship between malaria and vitamin A deficiency.
2. To determine the prevalence of anemia and iron deficiency in preschool children aged 6-36 months, in school children 6-12 years, in women of childbearing age 15-45 years and in adult men 20-55 years. In addition, to determine the relationship between anemia and iron deficiency with parasitic infection in 6-12 year old school children.
3. To determine the coverage of iodized salt in households and the prevalence of iodine deficiency in school children aged 6-12 years.
4. To validate the appropriateness of food vehicles for micronutrient fortification through estimation of the prevalence of use and levels of consumption of centrally processed foods (sugar, oil, maize meal and complementary foods).

A two-stage cluster sampling design with stratification of Malawi by Northern, Central, and Southern regions was employed in the national household survey. Probability proportional to size (PPS) was used to select 30 clusters per region, making a national total of 90 clusters. A school survey was conducted at the school situated nearest to the first of the selected households.

SUMMARY OF FINDINGS

Growth status

Over half (53%) of the preschool children were low height-for-age (HAZ<-2) with almost a quarter (23%) in the very low category (HAZ <-3). The distribution of height-for-age as compared to the international reference indicates that the entire population of preschool children suffers from stunted growth. Weight-for-age results (<-2) showed that 31% of preschool children were underweight. Only 4.7% of the preschool children had low weight-for-height (WHZ <-2) meaning that there was little wasting at the time of the survey. A majority of non-pregnant women of childbearing age (82%) had a normal body mass index (BMI).

Morbidity

For control of malaria many households reported having heard of mosquito bednets (87%) although only 14% used mosquito bednets in their homes. All of the households with mosquito bednets had treated them with insecticide in the previous 12 months. Malaria parasitemia was highly prevalent in preschool (60%) and school (47%) children. Intestinal parasites in school children were as follows: only 13% had hookworm, 3% had roundworm, and 2.5% had schistosoma mansoni. Knowledge of intestinal worms was not very accurate. Around a quarter (24%) of the school children surveyed were infected with urinary schistosomiasis. Many school children had heard of urinary schistosomiasis (76%) and of

those who heard of the parasites 73% knew the correct symptom of blood in the urine. Symptoms were not accurate indicators of infection for malaria.

Food consumption

The Fortification Rapid Assessment Tool (FRAT), a modified 24-hour recall, was utilized to identify quantities of centrally processed staple foods consumed by specific target groups. The most promising staple food for fortification seems to be sugar, with 46% of preschool children, 37% of women and 44% of men consuming sugar on the previous day from the survey. Oil was the second most prevalent centrally processed potential food for fortification. Hardly anyone consumes centrally processed maize meal in Malawi. Only 7% of preschool children had eaten centrally processed complementary foods on the previous day.

Iodine status

Overall 86% of households had salt on the day of the survey. While 77% of the households had salt with some iodine as measured by titration, only 36% had $\geq$25 parts per million (ppm) of iodine, which is the required amount at household level in Southern Africa. Only 16.1% of school children have heard of iodized salt.

Vitamin A status

Vitamin A deficiency is a widespread problem in Malawi with almost 60% of preschool children, 38% of school children, 57% of women of childbearing age and 38% of men who have serum retinol values <20μg/dL. Almost 70% of preschool children with malaria parasitemia had vitamin A deficiency compared to only 44% who had no malaria parasitemia and were vitamin A deficient. While almost all (98%) of the very young children 6-11 months had received a vitamin A supplement in the previous 6 months, fewer of the preschool children continued to receive a biannual vitamin A supplement as they age. Specifically only 44% of the 24-36 month old children had received a vitamin A supplement in the previous 6 months. Just 34% of women reported having received a vitamin A supplement within two months of delivery. Less than half of school children (43%) had ever heard of vitamin A deficiency compared to 78% of women who had heard of vitamin A.

Anemia, iron status and iron deficiency anemia

The highest prevalence of anemia by hemoglobin (Hb) was found in preschool children (80%), followed by non-pregnant women (27%), school children (22%) and men (17%). The survey assessed contributing factors to anemia. Individuals with malaria are twice as likely to be anemic. Iron deficiency was measured using transferrin receptor (TfR) and zinc protoporphyrin (ZP) for all target groups. In preschool children, iron deficiency was found to be prevalent in 64% by ZP and 61% by TfR. In the other groups, the prevalence estimates by indicator were not similar. In school children, 13.9% were iron deficient by ZP and 23% by TfR. In non-pregnant women, iron deficiency was prevalent in 18% by ZP and 32% by TfR. Iron deficiency in men was around 6% by ZP and only 2% by TfR. Iron deficiency anemia (IDA) was assessed two ways, by combining Hb with ZP and Hb with TfR. Overall, 58% of preschool children had IDA by Hb & ZP and 59% had IDA by Hb & TfR. In school children, IDA was found in 7% by the Hb & ZP indicator and in 10% by the Hb & TfR indicator. In non-pregnant women, IDA was 10% by Hb & ZP and 11% by Hb & TfR. In men, both indicators estimated IDA at around 3%.

Almost half (46%) of the pregnant women in the survey reported taking iron supplements, mostly daily (90%). All women were asked if they had ever received iron supplements during any of their pregnancies and 82% reported taking iron at least during one of their pregnancies. More women (88%) than school children (61%) reported having heard of iron.

CONCLUSION

The study has demonstrated that micronutrient malnutrition is a serious problem in Malawi. More importantly, all indicators point to preschool children as the most vulnerable group.

Vitamin A deficiency is highly prevalent in all target groups, and is of public health concern in preschool children, women of childbearing age and in school aged children. A clear link has been demonstrated between vitamin A deficiency and malaria in preschool children and non-pregnant women. Measures to treat malaria will need to be intensified. In terms of supplementation, the study has demonstrated a very successful program for children less than one year old. In older children and in women of child bearing, the current programs are not very effective. Better ways of reaching these groups will need to be devised.

Of the three intestinal worms assessed (hookworm, roundworm and schistosoma mansoni), hookworm was the most common. Knowledge of intestinal worms in school children was minimal. Awareness campaigns need to be intensified.

The prevalence of anemia, iron deficiency and iron deficiency anemia was observed in preschool children, women groups. Again, it is the preschool children who showed the highest prevalence. This is not surprising as the survey showed that individuals with malaria were twice as likely to be anemic.

The study has helped confirm that only a very small proportion of the Malawi population consumes centrally processed food, and that a very small proportion of children consumes centrally processed complementary food. Of the centrally processed foods, sugar seems to be consumed in the largest amounts, even by the preschool children. Thus, sugar seems to be the most promising vehicle for fortification.

Using the rapid test kits, the majority of the salt tested positive for iodine, although the proportion was lower when the titration method was used. It could be that a lot of non-iodized salt is still coming into the country. However, the results also suggest problems with storage, transportation and the monitoring system used, as a very small proportion of households actually use salt at the recommended levels of iodine.

ACKNOWLEDGMENTS

The Malawi Micronutrient Survey was supported through a cooperative agreement between UNICEF and the Centers for Disease Control and Prevention (CDC). CDC provided technical assistance in planning and training for the survey, and in the analysis of the survey data.

Thanks go to the Malawian children, women and men who participated in this survey; without their willingness, the survey would not have been conducted.

Thanks to the Chief Technical Advisor, Dr. W.O.O. Sangala for the permission to undertake the survey in Malawi. The survey was collaborative, beginning with the members of the National Micronutrient Committee who constituted the local planning team for the survey: Theresa Banda (MOHP), Flywell Chintolo (CHSU), Doris Butao (CHSU), Dorothy Chilima (Bunda College of Agriculture), Alexander Kalimbira (Bunda College of Agriculture), and Kenneth Nkankha (Ministry of Commerce and Industry). Special thanks go to F. Chintolo and D. Butao for directing and supervising all the laboratory components of the survey in Malawi. Thanks also go to the members of the survey field teams for all their hard work and dedication.

Thanks also to the Commissioner of Statistics, Charles Machinjili, the Chief Demographer, Jameson Ndawala, Catherine Chikumba, Richmond Chinula, Rodney Maluwa and Ladislas Mpando, and all of the National Statistical Office in Zomba for handling all the finances and for the expertise they brought to the survey. Their experienced and dedicated enumeration clerks facilitated the household listing exercise, data collection and data entry.

Thanks to the Resident Representative of UNICEF in Malawi, Ms. Catherine Mbengue, and the Programme Coordinator, Mr. Runar Soerensen and to the following staff of UNICEF Malawi: Dr. Juan Ortiz, Augustine Munyimbili, Jean Nyondo, Violet Orchardson for their support in different capacities. Thanks also to Arjan de Wagt, formerly the Nutrition Officer at UNICEF Eastern and Southern Africa Regional Office in Nairobi, Kenya for his valuable technical contributions during the planning phase of the survey.

From the CDC, thanks go to the technical assistance of members of the International Micronutrient Malnutrition Prevention and Control (IMMPaCt) Program: Ibrahim Parvanta, Laurence Grummer-Strawn, Emily Bobrow, Arnold Timmer, Jacky Knowles, Dan Sadler, and Laura Kettel-Khan. Thanks to Diane Thompson who assisted with field training for the survey and with the food focus groups. Thanks also to the Division of Parasitic Disease at CDC for their advice on parasite assessment aspects of the survey.

Thanks to colleagues at the Global Micronutrient Reference Laboratory in the Division of Laboratory Sciences at CDC who assisted greatly in the execution of the survey: Christine Pfeiffer for her participation in planning the laboratory component of the survey, Dan Huff for procuring the needed laboratory supplies, Charles Buxton for training the laboratory technicians in Malawi, and Joanne Mei and Dimitri Fillos for their analysis of the serum iron samples.

Thanks to Emily Bobrow, Henry Mdebwe and Kevin Sullivan for preparing the report.

Table of Contents

EXECUTIVE SUMMARY ..... **II**

ACKNOWLEDGMENTS ..... **V**

LIST OF TABLES ..... **XII**

LIST OF FIGURES ..... **XVI**

LIST OF ABBREVIATIONS ..... **XVII**

CHAPTER 1: INTRODUCTION **1**

1.1 Background **1**
1.2 Micronutrient Malnutrition Situation in Malawi **1**
1.3 Survey Objectives **2**

CHAPTER 2: METHODS **4**

2.1 Components of the Survey **4**
2.2 Scope **4**
2.3 Target populations **4**
2.4 Sample size determination **4**
2.5 Sampling **4**
2.5.1 Sample Frame Stratification 5
2.6 Community Mobilization **5**
2.7 Survey Teams and Training **5**
2.8 Survey Implementation **6**
2.8.1 The Advance Team 7
2.8.2 Sample Selection at the Household 7
2.8.3 Interviews conducted at the household 7
a) General Household Survey 8
Analysis of household characteristics 8
Socioeconomic Status Index 8
Residence (urban and rural) categories 8
b) Knowledge, Attitude, Practice Survey 8
c) Modified Fortification Rapid Assessment Tool (FRAT) 8
2.8.4 Salt Sample Collection at the Household 9
2.8.4 Sample selection at the school 9
2.8.5 Anthropometry 10
a) Length/height 10
b) Body weight 10
2.8.6 Blood Collection 11
2.8.7 Stool and Urine Collection 12
2.9 Biological and Salt Sample Processing and Storage **12**
a) Samples for Determination of Iodine 13
Analysis of Data on Urinary Iodine Levels 13
Analysis of Data on Iodine Levels in Salt 13
b) Samples for Determination of Vitamin A 13
Analysis of Data on Vitamin A Status 14
c) Samples for Determination of Anemia, Iron Status and Iron Deficiency Anemia 14
Analysis of Data on Anemia 14
Analysis of Data on Iron Status 15
Analysis of Data on Iron Deficiency Anemia (IDA) 15

d) Samples for Determination of Infection 15
Malaria 15
Analysis of Data on Malaria 16
Urinary schistosomiasis (urine) 16
Analysis of Data on Urinary schistosomiasis 16
Intestinal parasites (stool) 16
Analysis of Data on Intestinal Parasites 16
2.10 Samples by target group 18
2.11 Data entry and analysis plan 18

CHAPTER 3: DEMOGRAPHICS AND SOCIOECONOMIC CHARACTERISTICS OF THE RESPONDENTS 19

3.1 Residence (Urban/Rural) 19
3.2 Age and Sex 19
3.3 Marital Status 20
3.4 Formal Education Status 21
3.5 Smoking 21
3.6 Reproductive History of Women of Childbearing Age 21
3.7 Tribal Groups 22
3.8 Household Economic Status 22
3.8.1 Housing Conditions 23
3.8.2 Ownership of Household Assets 23
3.8.3 Household Cooking Fuel 23
3.8.4 Water and Sanitation 24
3.8.5 Index of Socioeconomic status 25

CHAPTER 4: ANTHROPOMETRY 26

4.1 Anthropometry of Preschool Children 26
4.1.1 Stunting (Height-for-Age) 26
4.1.2 Underweight (Weight-for age) 27
4.1.3 Wasting (Weight-for-height) 28
4.2 Non-pregnant Women of Childbearing Age 30
4.2.1 Mean weight and height 30
4.2.2 Body Mass Index (BMI) 30
4.3 Comparison of Adult Anthropometry 31

CHAPTER 5: MORBIDITY - PREVALENCE, KNOWLEDGE AND PREVENTION 32

5.1 Household Prevention of Malaria (mosquito bednets) 33
5.2 Malaria Thick Smear Summary Results 35
5.2.1 Malaria in Preschool Children 35
5.2.2 Malaria in School Children 36
5.2.3 Malaria in Women 37
5.2.4 Malaria in Men 38
5.2.5 Malaria Thick Smear Summary Results 39
5.3 Intestinal Parasites in School Children 40
5.3.1 Knowledge of Intestinal Parasites 41
5.4 Urinary schistosomiasis in School Children 42
5.4.1 Knowledge of Urinary Schistosomiasis 43
5.5 Health History 44
5.6 Health history and infection 45
5.6.1 Malaria parasitemia and reported fever 45
5.6.2 Worm infections and reported illness 46

CHAPTER 6: FOOD CONSUMPTION 47

6.1 Fortification Rapid Assessment Tool (FRAT) 47

6.1.1 Standard consumption 47
6.2 Other food-related questions 49
6.2.1 Use of centrally processed foods in household 49
6.2.2 Use of centrally processed complementary foods 51
6.3 Breastfeeding 51
6.3.1 Exclusive breastfeeding 51
6.3.2 Duration of Breastfeeding 52
6.3.3 Comparison of Breastfeeding Practices 52

CHAPTER 7: IODINE STATUS 53

7.1 Urinary Iodine in School Children 53
7.2 Household Iodized Salt Usage 53
7.2.1 Rapid Test Kit Results 53
7.2.2 Salt Titration Results 54
7.2.3 Comparison of Rapid Test Kit and Titration Results 55
7.2.4 Comparison with 2000 MDHS 56
7.3 Knowledge of iodized salt and iodine– Women 56
7.4 Knowledge of iodized salt and iodine– School children 58

CHAPTER 8: VITAMIN A STATUS 59

8.1 Serum retinol levels and vitamin A deficiency 59
8.1.1 Serum retinol levels in preschool children 59
8.1.2 Serum retinol in school children 60
8.1.3 Serum retinol levels in women of childbearing age 61
8.1.4 Serum retinol in men 62
8.2 Comparison of vitamin A deficiency among groups 62
8.3 Vitamin A and Malaria 63
8.4 Self assessed clinical signs of vitamin A deficiency - Women 64
8.5 Vitamin A supplementation 64
8.5.1 Vitamin A supplementation in preschool children 65
8.5.2 Vitamin A supplementation in women of childbearing age 65
8.6 Knowledge of vitamin A deficiency 66
8.6.1 Knowledge of vitamin A deficiency among school children 67
8.6.2 Knowledge of vitamin A deficiency among women 68

CHAPTER 9: ANEMIA, IRON DEFICIENCY AND IRON DEFICIENCY ANEMIA STATUS 71

9.1 Anemia 72
9.1.1 Anemia in Preschool Children 72
9.1.2 Anemia in School Children 72
9.1.3 Anemia in Women of Childbearing Age 73
9.1.4 Anemia in Men 74
9.1.5 Summary of anemia by target group 75
9.2 Iron deficiency 76
9.2.1 Iron Deficiency in Preschool Children 76
9.2.2 Iron Deficiency in School Children 77
9.2.3 Iron Deficiency in Women 78
9.2.4 Iron Deficiency in Men 79
9.2.5 Summary of Iron Deficiency by target group 80
9.3 Iron Deficiency Anemia 81
9.3.1 Iron Deficiency Anemia in Preschool Children 81
9.3.2 Iron Deficiency Anemia in School Children 82
9.3.3 Iron Deficiency Anemia in Women 83
9.3.4 Iron Deficiency Anemia in Men 84
9.3.5 Summary of Iron Deficiency Anemia by target group 85
9.4 Anemia and Infection 86

9.4.1 Anemia, Iron Deficiency Anemia and Infection 86
9.4.2 Anemia and Infection in School Children 87
9.5 Use of iron supplements 87
9.6 Knowledge of anemia and its prevention 88
9.6.1 Knowledge of Iron – School Children 88
9.7 School Environment Questionnaire 91

CHAPTER 10: DISCUSSION 92

10.1 Demographics 92
10.2 Anthropometry 92
10.2.1 Low height-for-age (shortness or stunting) 92
10.2.2 Low weight-for-age (underweight) 93
10.2.3 93
Low weight-for-height (thinness or wasting) 93
10.2.4 Weight and height status for adult women 93
10.3 Morbidity 93
10.3.1 Malaria 93
10.3.2 Intestinal parasites and urinary schistosomiasis 93
10.3.3 Health history 94
10.3.4 Infection and self reported illness 94
10.4 Food consumption 94
10.5 Iodine status 94
10.5 Vitamin A status 94
10.6 Anemia, iron deficiency and iron deficiency anemia 95
10.6.1 Anemia 95
10.6.2 Iron deficiency 95
10.6.3 Iron deficiency anemia 95
10.7 Summary findings 96
10.7.1 Preschool children 96
10.7.2 School Children 96
10.7.3 Women of childbearing age 97
10.7.4 Men 98
10.8 Limitations 98

REFERENCES 99

ANNEX A: MAP OF MALAWI WITH DISTRICTS 101

ANNEX B: DIRECTIONS FOR RANDOM SELECTION OF SCHOOL CHILDREN 102

ANNEX C: JOB DESCRIPTIONS FOR SURVEY TEAM MEMBERS 106

ANNEX D: TRAINING SCHEDULE, MALAWI MICRONUTRIENT SURVEY IN MALAWI (3-11 SEPTEMBER 2001) 111

ANNEX E: LABORATORY METHODS 113

ANNEX F: SURVEY INSTRUMENTS AND LABORATORY FORMS 125

ANNEX G: SOCIOECONOMIC (SES) INDEX 164

ANNEX H: CALIBRATION OF LOCAL HOUSEHOLD MEASURES FOR THE FORTIFICATION RAPID ASSESSMENT TOOL (FRAT) 165

ANNEX I: ALGORITHM FOR BLOOD COLLECTED IN THE MICROTAINER 169

LIST OF TABLES

Table 2.1. Total sample by target group and region, Malawi Micronutrient Survey, Malawi 2001. 5

Table 2.2. Epidemiological criteria for assessing iodine nutrition based on median urinary iodine concentrations in school children (WHO/UNICEF/ICCIDD, 2001). 13

Table 2.3. WHO classification of public health significance of anemia in populations based on the prevalence of hemoglobin (WHO, 2001). 15

Table 2.4. Measures and criteria used to define hematological and biochemical variables for each subgroup 17

of the study population, Malawi Micronutrient Survey, Malawi 2001. 17

Table 2.5. Number of samples by indicator, Malawi Micronutrient Survey, Malawi 2001. 18

Table 3.1. Age distribution by region, Malawi Micronutrient Survey, Malawi 2001. 20

Table 3.2. Sex distribution of preschool children (6-36 months) and school children (6-12 years), Malawi Micronutrient Survey, Malawi 2001. 20

Table 3.3. Marital status of women (15-45 years) and men (20-55 years), Malawi Micronutrient Survey, Malawi 2001. 20

Table 3.4. Formal education of women and men by region, Malawi Micronutrient Survey, Malawi 2001. 21

Table 3.5. Number of pregnancies (gravidity) among women of childbearing age (15-45 years), Malawi Micronutrient Survey, Malawi 2001. 22

Table 3.6. Number of living children (parity) among women of childbearing age (15-45 years), Malawi Micronutrient Survey, Malawi 2001. 22

Table 3.7. Frequency distribution of tribal groups, Malawi Micronutrient Survey, Malawi 2001. 22

Table 3.8. Housing characteristics, Malawi Micronutrient Survey, Malawi 2001. 23

Table 3.9. Ownership of household assets by region, Malawi Micronutrient Survey, Malawi 2001. 23

Table 3.10. Source of household cooking fuel, Malawi Micronutrient Survey, Malawi 2001. .. 24

Table 3.11. Distribution of main source of household drinking water by region, Malawi Micronutrient Survey, Malawi 2001. 24

Table 3.12. Type of sanitary facilities by region, Malawi Micronutrient Survey, Malawi 2001. 24

Table 3.13. Household socioeconomic economic status (SES) by region, Malawi Micronutrient Survey, Malawi 2001. 25

Table 4.1. Height-for-age Z-score (HAZ) summary statistics among preschool children, Malawi Micronutrient Survey, Malawi 2001. 26

Table 4.2. Weight-for-age Z-score (WAZ) summary statistics among preschool children, Malawi Micronutrient Survey, Malawi 2001. 28

Table 4.3. Weight-for-height Z-score (WHZ) summary statistics among preschool children, Malawi Micronutrient Survey, Malawi 2001. 29

Table 4.4. Mean height and weight for non-pregnant women of childbearing age (15-45 years), Malawi Micronutrient Survey, Malawi 2001. 30

Table 4.5. Body mass index (BMI) data for non-pregnant women of childbearing age (15-45 years), Malawi Micronutrient Survey, Malawi 2001. 31

Table 4.6. Comparison of Malawi Micronutrient Survey (2001) and Malawi Demographic and Health Survey (2000) mean height and BMI for non-pregnant women (15-44 years)... 31

Table 5.1. Household mosquito bednet knowledge and use, Malawi Micronutrient Survey, Malawi 2001. 33

Table 5.2. Number of mosquito bednets in households that reported using bednets, Malawi Micronutrient Survey, Malawi 2001. 34

Table 5.3. Soaking practices of mosquito bednets among households that reported using bednets, Malawi Micronutrient Survey, Malawi 2001. 35

Table 5.4. Prevalence of malaria parasitemia among preschool children (6-36 months), Malawi Micronutrient Survey, Malawi 2001. 35

Table 5.5. Malaria parasitemia among preschool children (6-36 months) by severity of infection, Malawi Micronutrient Survey, Malawi 2001. 36

Table 5.6. Prevalence of malaria parasitemia among school children (6-12 years), Malawi Micronutrient Survey, Malawi 2001. 37

Table 5.7. Prevalence of malaria parasitemia among 38

non-pregnant women of childbearing age (15-45 years), ... 38

Malawi Micronutrient Survey, Malawi 2001. 38

Table 5.8. Prevalence of malaria parasitemia in men 39

(20-55 years), Malawi Micronutrient Survey, Malawi 2001. 39

Table 5.9. Prevalence of intestinal parasites among school children (6-12 years), Malawi Micronutrient Survey, Malawi 2001. 41

Table 5.10. Responses to questions concerning intestinal worms by school children, Malawi Micronutrient Survey, Malawi 2001 (n=464). 42

Table 5.11. Prevalence of urinary schistosomiasis among school children (6-12 years), Malawi Micronutrient Survey, Malawi 2001. 43

Table 5.12. Responses to questions concerning urinary schistosomiasis by school children, Malawi Micronutrient Survey, Malawi 2001 (n=537). 44

Table 5.13. Health history reports on day of survey and in previous two weeks by target group, Malawi Micronutrient Survey, Malawi, 2001. 45

Table 5.14. Prevalence of reported fever in those with and without malaria parasitemia, Malawi Micronutrient Survey, Malawi 2001. 45

Table 5.15. Hookworm infection and prevalence of reported blood in stool among school children, Malawi Micronutrient Survey, Malawi 2001. 46

Table 5.16. Urinary schistosomiasis infection and prevalence of reported blood in urine among school children, Malawi Micronutrient Survey, Malawi 2001. 46

Table 6.1. Food consumption pattern of women, preschool children and men, using 24-hour recall consumption data, FRAT, Malawi Micronutrient Survey, Malawi 2001. 47

Table 6.2. Average amounts of centrally processed sugar and oil consumed by women, preschool children and men, national 24-hour recall consumption data, FRAT, Malawi Micronutrient Survey, Malawi 2001. 47

Table 6.3. Average number of days in the past 7 days of centrally processed sugar and oil consumed by women, preschool children and men, national consumption data, FRAT, Malawi Micronutrient Survey, Malawi 2001. 48

Table 6.4. Seasonality of consumption of centrally processed sugar, oil, maize meal and complementary foods by women, preschool children and men, national consumption data, FRAT, Malawi Micronutrient Survey, Malawi 2001. 49

Table 6.5. Brand of centrally processed oil purchased by women 50

who reported using oil, FRAT, Malawi Micronutrient Survey, Malawi 2001. 50

Table 6.6. Brand of centrally processed sugar purchased by women who reported using sugar, FRAT, Malawi Micronutrient Survey, Malawi 2001. 50

Table 6.7. Frequency of purchasing centrally processed oil and sugar by women who reported using oil and sugar, FRAT, Malawi Micronutrient Survey, Malawi 2001. 50

Table 6.8. Type of cooking pots used by women, FRAT, Malawi Micronutrient Survey, Malawi 2001. 51

Table 6.9. Prevalence of exclusive breastfeeding by region, Malawi Micronutrient Survey, Malawi 2001. 51

Table 6.10. Breastfeeding duration of preschool children who had stopped breastfeeding at the time of the survey, Malawi Micronutrient Survey, Malawi 2001. 52

Table 7.1. Prevalence of households (HH) with salt available for testing and with presence of iodine based on a rapid salt iodine test kit, Malawi Micronutrient Survey, Malawi 2001. 53

Table 7.2. Prevalence of households (HH) with various levels of iodine in salt and median iodine levels (ppm) based on salt titration analysis, Malawi Micronutrient Survey, Malawi 2001. 54

Table 7.3. Comparison of rapid test kit and titration results for iodine in salt; based on unweighted analyses, Malawi Micronutrient Survey, Malawi 2001. 55

Table 7.4. Comparison of weighted estimates of the percentage of households with salt containing 15+ ppm iodine, 2000 MDHS (rapid test kit results) and the 2001 Malawi Micronutrient Survey (titration results), Malawi. 56

Table 7.5. Prevalence of women of childbearing age (15-45 years) having heard of iodized salt or reported buying iodized salt, Malawi Micronutrient Survey, Malawi 2001. 57

Table 7.6. Responses to why people use iodized salt, women of childbearing age (15-45 years), Malawi Micronutrient Survey, Malawi 2001 (n=240) 57

Table 7.7. Prevalence of school children having heard of iodized salt, Malawi Micronutrient Survey, Malawi 2001. 58

Table 7.8. Responses to why people use iodized salt, school children, Malawi Micronutrient Survey, Malawi 2001, (n=105) 58

Table 8.1. Prevalence of low serum retinol levels and mean serum retinol levels among preschool children (6-36 months), Malawi Micronutrient Survey, Malawi 2001. 60

Table 8.2. Prevalence of low serum retinol levels and mean serum retinol levels among school children (6-12 years), Malawi Micronutrient Survey, Malawi 2001. 61

Table 8.3. Prevalence of low serum retinol levels and mean serum retinol levels among women of childbearing age (15-45 years), Malawi Micronutrient Survey, Malawi 2001. 62

Table 8.4. Prevalence of vitamin A deficiency in those with and without malaria parasitemia, Malawi Micronutrient Survey, Malawi 2001. 63

Table 8.5. Prevalence of women of childbearing age (15-45 years) with at least one pregnancy reporting difficulty with daytime or night vision during their last pregnancy, Malawi Micronutrient Survey, Malawi 2001. 64

Table 8.6. Prevalence of preschool children (6-36 months) who had ever received a vitamin A supplement and months since last dose, Malawi Micronutrient Survey, Malawi 2001. 65

Table 8.7. Prevalence of women of childbearing age (15-45 years) who received a vitamin A supplement in the first two months after their last delivery, Malawi Micronutrient Survey, Malawi 2001. 66

Table 8.8. Prevalence of school children (6-12 years) having ever heard of vitamin A, Malawi Micronutrient Survey, Malawi 2001. 67

Table 8.9. Responses to questions concerning vitamin A by school children (6-12 years), Malawi Micronutrient Survey, Malawi 2001. 68

Table 8.10. Prevalence of women of childbearing age (15-45 years) having ever heard of vitamin A, Malawi Micronutrient Survey, Malawi 2001. 69

Table 8.11. Responses to questions concerning vitamin A by women of childbearing age (15-45 years), Malawi Micronutrient Survey, Malawi 2001. 70

Table 9.1. Prevalence of low hemoglobin levels and mean hemoglobin levels among preschool children (6-36 months), Malawi Micronutrient Survey, Malawi 2001. 72

Table 9.2. Prevalence of low hemoglobin levels and mean hemoglobin levels among school children (6-12 years), Malawi Micronutrient Survey, Malawi 2001. 73

Table 9.3. Prevalence of low hemoglobin levels and mean hemoglobin levels among non-pregnant women of childbearing age (15-45 years), Malawi Micronutrient Survey, Malawi 2001. 74

Table 9.4. National prevalence of low hemoglobin levels and mean hemoglobin levels among men (20-55 years), Malawi Micronutrient Survey, Malawi 2001. 75

Table 9.5. Prevalence of iron deficiency among preschool children (6-36 months), Malawi Micronutrient Survey, Malawi 2001. 77

Table 9.6. Prevalence of iron deficiency among school children (6-12 years), Malawi Micronutrient Survey, Malawi 2001. 78

Table 9.7. Prevalence of iron deficiency among non-pregnant women of childbearing age (15-45 years), Malawi Micronutrient Survey, Malawi 2001. 79

Table 9.8. Prevalence of iron deficiency among men (20-55 years), Malawi Micronutrient Survey, Malawi 2001. 80

Table 9.9. Prevalence of iron deficiency anemia among preschool children (6-36 months), Malawi Micronutrient Survey, Malawi 2001. 82

Table 9.10. Prevalence of iron deficiency anemia among school children (6-12 years), Malawi Micronutrient Survey, Malawi 2001. 83

Table 9.11. Prevalence of iron deficiency anemia among non-pregnant women of childbearing age (15-45 years), Malawi Micronutrient Survey, Malawi 2001. 84

Table 9.12. National prevalence of iron deficiency anemia among adult men (20-55 years), Malawi Micronutrient Survey, Malawi 2001. 85

Table 9.13. Prevalence of anemia and iron deficiency anemia in those with and without malaria parasitemia, Malawi Micronutrient Survey, Malawi 2001. 87

Table 9.14. Parasitic infection and prevalence of anemia in school children, Malawi Micronutrient Survey, Malawi 2001. 87

Table 9.15. Sources of iron supplements among women reporting iron supplement use, Malawi Micronutrient Survey, Malawi 2001. 88

Table 9.16. Percentage of school children (6-12 years) having ever heard of anemia/shortage of blood, Malawi Micronutrient Survey, Malawi 2001. 88

Table 9.17. Responses to questions concerning anemia, school children (6-12 years), Malawi Micronutrient Survey, Malawi 2001. 89

Table 9.18. Percentage of women of childbearing age (15-45 years) having ever heard of anemia/shortage of blood, Malawi Micronutrient Survey, Malawi 2001. 90

Table 9.19. Responses to questions concerning anemia, women of childbearing age (15-45 years), Malawi Micronutrient Survey, Malawi 2001. 91

Table H.1. Final quantitative measures for each staple food from panel exercise, Malawi Micronutrient Survey, Malawi 2001. 167

LIST OF FIGURES

Figure 4.1. National height-for-age z-score (HAZ) as compared to international reference, Malawi Micronutrient Survey, Malawi 2001. 27

Figure 4.2. National WHZ as compared to international reference, Malawi Micronutrient Survey, Malawi 2001. 29

Figure 7.1. Percentage of households with various levels of iodine (ppm) in salt, Malawi Micronutrient Survey, Malawi 2001. 55

Figure 8.1. National prevalence of vitamin A deficiency by target group, Malawi Micronutrient Survey, Malawi 2001. 63

Figure 9.1. Prevalence of anemia by target group, Malawi Micronutrient Survey, Malawi 2001. 76

Figure 9.3. Prevalence of iron deficiency anemia by target group, Malawi Micronutrient Survey, Malawi 2001. 86

Figure 10.1. Summary of findings among preschool children, Malawi Micronutrient Survey, Malawi 2001. 96

Figure 10.2. Summary of findings among school children, Malawi Micronutrient Survey, Malawi 2001. 97

Figure 10.3. Summary of findings among non-pregnant women of childbearing age, Malawi Micronutrient Survey, Malawi 2001. 97

Figure 10.4. Summary of findings among men, Malawi Micronutrient Survey, Malawi 2001. 98

LIST OF ABBREVIATIONS

BMI	Body Mass Index
CDC	Centers for Disease Control and Prevention
CHSU	Community Health Sciences Unit Laboratory
CPAR	Canadian Physicians Aid and Relief
DBS	Dried Blood Spot
EA	Enumeration Area
EDTA	Ethylenediaminotetraacetate
FRAT	Fortification Rapid Assessment Tool
HAZ	Height-for-Age Z-score
Hb	Hemoglobin
HH	Household
HIS	Health Information System
HPLC	High Performance Liquid Chromatography
ICCIDD	The International Council for Control of Iodine Deficiency Disorders
IDA	Iron Deficiency Anemia
IDD	Iodine Deficiency Disorders
IMMPaCt	International Micronutrient Malnutrition Prevention and Control Program
KAP	Knowledge, Attitudes, and Practices
KNAHP	Karonga Nutrition and Health Program
MDHS	Malawi Demographic and Health Survey
MICAH	Micronutrient and Health
MOHP	Ministry of Health and Population
NCHS	National Center for Health Statistics
NSO	National Statistics Office
PAMM	Program Against Micronutrient Malnutrition
ppm	parts per million
PPS	Probability proportional to size
SES	Socioeconomic status
TfR	Transferrin receptor
UI	Urinary iodine
UNICEF	United Nations Children's Fund
UNU	United Nations University
VAD	Vitamin A Deficiency
WAZ	Weight-for-Age Z-score
WHO	World Health Organization
WHZ	Weight-for-Height Z-score
ZP	Zinc protoporphyrin

CHAPTER 1: INTRODUCTION

At the end of 2000, the Government of Malawi requested assistance from United Nations Children's Fund (UNICEF) and the US Centers for Disease Control and Prevention (CDC), to conduct a Malawi Micronutrient Survey. In order to develop national strategies for the elimination of micronutrient malnutrition, the Government of Malawi and the National Micronutrient Committee decided to obtain a better understanding of the national micronutrient situation. This would then serve as a baseline from which to monitor the impact of specific interventions in the future. As a result, a Malawi Micronutrient Survey was conducted in September-October 2001 in Malawi.

The International Micronutrient Malnutrition Prevention and Control (IMMPaCt) program at the CDC provided funding and technical assistance for the micronutrient survey, under the terms of a cooperative agreement between the CDC and UNICEF, to work towards the elimination of micronutrient deficiencies. UNICEF Malawi also contributed funding and personnel to assist with planning, implementation and follow up to the survey.

A meeting to plan the survey was convened in April 2001 in Lilongwe, Malawi. Participants included officials from the Ministry of Health and Population (MOHP), Bunda College of Agriculture, Community Health Sciences Unit (CHSU) Laboratory, CDC, UNICEF Malawi and UNICEF Eastern and Southern Africa Regional Office. The final plan for the Malawi Micronutrient Survey was developed, through wide consultations with micronutrient stakeholders and experts both in Malawi and at the CDC. Data collection was conducted in September-October, 2001, and this report presents the results of the survey.

1.1 Background

Malawi is a developing country in Southern Africa. With a population of 9.9 million and 118,484 square kilometers of total area, Malawi is one of most densely populated countries in Southern Africa (Census, 1998). The economy is predominantly agricultural. Tobacco, tea and sugar are the major export produce. Maize and cassava are main staple foods produced domestically. Although the country is reputed to be self-sufficient in food, the rapid population growth and persistent droughts have resulted in sporadic persistent food shortages in recent years.

Mortality rates for infants, and children under five, as well as maternal mortality rates, have remained very high in the 1990s. The 2000 Malawi Demographic and Health Survey (MDHS 2000) reported infant and under five mortality rates of 104 and 189 deaths per 1,000 live births, respectively. The maternal mortality rate was reported to be 1,120 deaths per 100,000 live births (MDHS 2000), which was twice the mortality rate reported in the 1992 MDHS. Micronutrient malnutrition is considered to be one of the important risk factors for the high maternal, child and infant morbidity and mortality rates in Malawi.

Malnutrition is a major public health problem and a leading cause of the high infant and child mortality in Malawi. Both the MDHS (1992) and Malawi Social Indicators Survey (1995) showed that almost half of children under-five years old are stunted (48%); about one-third (29%) are underweight and 7% are wasted. Similar results have also been shown in the results of the 2000 DHS (49% stunted, 25% underweight and 5.5% wasted), implying that Malawi's under-nutrition rates have remained high and static over the past 10 years. Malnutrition is also common among women, especially those who are pregnant and breastfeeding.

1.2 Micronutrient Malnutrition Situation in Malawi

Micronutrient malnutrition is a serious public health problem in Malawi. Deficiencies of vitamin A, iron, and iodine contribute to widespread problems of reduced immunity, intellectual development and work capacity, as well as to increased morbidity and mortality, especially among women and children.

A 1989 review of iodine supplementation surveys showed that 56% of the 177,137 women and children examined in some districts in Malawi from 1983 to 1989 had goiter (MOHP, IDD Review Report, 1989). A national plan to eliminate iodine deficiency through Universal Salt Iodization was developed in 1985. Almost all salt in Malawi is imported. The national legislation decreeing that all salt distributed and marketed in Malawi for human and animal consumption must be iodized was passed in 1995. However, large amounts of uniodized salt still come into Malawi through unofficial routes across the borders from neighboring countries, especially in the Southern region. With the introduction of iodized salt, in goiter endemic districts a significant reduction in the prevalence of iodine deficiency in junior primary school pupils showed a total goiter rate to be 27% (MOHP, 1996), and median urinary iodine excretion to be 307 μg/L in Chitipa, 197 μg/L in Rumphi and 239 μg/L in Mzimba (MICAH Survey, 1998).

Evidence from clinical surveys in selected communities suggests that vitamin A deficiency is widespread, affecting most parts of Malawi. In 1983, a survey of children under five in the Lower Shire valley showed that 3.9% of the children had severe vitamin A deficiency (xerophthalmia) (Chirambo et al, 1983). This prevalence was higher than the World Health Organization (WHO) cut off point (< 1% prevalence) which indicates that vitamin A deficiency is a significant public health problem. Studies conducted in Dedza East and Salima districts in 1988 (MOHP, 1988) and in Karonga, Nkhata Bay and Lilongwe districts in 1998 (KNAHP and CPAR reports, 1998) reported similar xerophthalmia rates in children under the age of five years.

Anemia accounts for a large number of hospital admissions and is one of the leading causes of in-patient mortality (MOHP, 1995). The prevalence of anemia, based on numerous localized population surveys and hospital data, ranges from 54-94% in pregnant women, and 70-90% in children under five years of age (MOHP, 1998). Very little information is available on prevalence rates of anemia among school children, adolescent girls, adult men and non-pregnant women of childbearing age.

The etiology of micronutrient deficiencies in Malawi is multifactorial. For example, although the prevalence of breastfeeding is over 90%, exclusive breastfeeding <4 months has been very low in the past: 3% in 1992 (MDHS, 1992) and 11% in 1995 (Malawi Social Indicators Survey, 1995). A remarkable improvement was noted in exclusive breastfeeding of <4 months, 62% as noted in the MDHS, 2000. The MDHS data was reanalyzed for exclusive breastfeeding < 6 months and found to be 45%. Additional causes of micronutrient deficiencies include parasitic disease (malaria, hookworm, urinary schistosomiasis), chronic illness (HIV/AIDS, tuberculosis), hematoglobinopathies (thalassemia, sickle cell) and frequent pregnancies. Furthermore, the Malawian diet is predominantly cereal-based and has a low energy and nutritive value.

The Malawi Government and partners have implemented a number of interventions to eliminate micronutrient malnutrition. The interventions include fortification of some staple foods, micronutrient supplementation of young children and pregnant women, promotion of dietary improvement, public health measures, and nutrition education. The overall impact of these interventions is not well documented.

1.3 Survey Objectives

The objectives of the Malawi Micronutrient Survey were:

- To determine the prevalence of vitamin A deficiency in preschool children aged 6-36 months, in school children 6-12 years, in women of childbearing age 15-45 years and in adult men 20-55 years.
- To determine the prevalence of anemia and iron deficiency in preschool children aged 6-36 months, in school children 6-12 years, in women of childbearing age 15-45 years and

in adult men 20-55 years. In addition, to determine the relationship between anemia and iron deficiency with parasitic infection in 6-12 year old school children.

- To determine the coverage of iodized salt in households and the prevalence of iodine deficiency in school children aged 6-12 years.
- To validate the appropriateness of food vehicles for micronutrient fortification through estimation of the prevalence of use and levels of consumption of centrally processed foods (sugar, oil, maize meal and complementary foods).

CHAPTER 2: METHODS

2.1 Components of the Survey

The Malawi Micronutrient Survey was composed of integrated components that were used to assess the micronutrient status of the population. The various methods employed were anthropometric measurements, hematological and biochemical assessments, salt sample analysis and questionnaires. A general Knowledge, Attitude, and Practice (KAP) survey and a modified Fortification Rapid Assessment Tool (FRAT) were utilized to gather further information.

2.2 Scope

The survey was designed to provide both nationally and regionally representative data for Northern, Central and Southern regions. Randomly selected clusters that were included in the survey covered 26 of the 27 districts in Malawi: twelve districts in Southern region, nine districts in the Central region, and five of the six districts in the Northern region. Annex A includes a map of Malawi with a list of the districts by region. In the Northern Region, the district of Likoma was not included by chance after selecting the sample with probability proportional to size (PPS), due to the very small population that resides on the island of Likoma.

2.3 Target populations

The target populations to assess iron and vitamin A nutrition were children 6 to 36 months as they are the most vulnerable years for deficiencies, and women of childbearing age, 15-45 years. Iodine deficiency was assessed in primary school children 6-12 years old only, so that results could be compared with previous data in Malawi. Data obtained for all these population groups are representative at both national and regional levels.

Micronutrient status was also assessed in adult men aged 20-55 years, except for iodine. Data for adult males are representative at the national level only.

2.4 Sample size determination

After independence, the Population and Housing census reports have been the major sources of demographic data collected starting in 1966. The 1998 Population and Housing Census enumerated a total population of 9.9 million with 1,229,360 (12.5%) residing in the Northern region, 4,041,636 (41.1%) in the Central region and 4,567,490 (46.4%) in the Southern region. These population data were utilized to weight the data during analysis for national prevalence estimates.

Sample sizes were determined using standard statistical procedures through the Epi Table function of Epi Info (EpiInfo 6.04d) using pre-determined values for anticipated prevalence, desired precision, design effect and desired confidence intervals for each target group.

For example, calculation of a regional sample size for women of childbearing age was based on an estimated anemia prevalence of 50%, with required precision of 10%, a design effect of 2 and a 95% confidence interval. The final sample size used was increased to correct for the high percentage of pregnant women in Malawi who were included in some components of the survey. The same parameters were used for school children and children 6-36 months. The sample size for a national sample of men was also calculated using the same factors.

2.5 Sampling

A two-stage cluster sampling design with stratification by region (North, Center, South) was employed in the national household survey. PPS sampling was used to select 30 clusters per

region, making 90 clusters nationally. All households in each cluster were listed through an enumeration exercise conducted by the National Statistics Office two months prior to the field data collection. A cluster was defined as an enumeration area (EA), the designation utilized in data collection for each census conducted in Malawi. Eighteen households were randomly selected per cluster. A household was defined as a group of people who share a common cooking pot. In each household, every preschool child 6-36 months and every other woman of childbearing age 15-45 years was selected for an interview and sample collection. Two adult men (20-55 years) were also sampled per cluster.

A school survey was conducted at the school nearest the first selected household in every cluster to recruit young school children for the survey. If no school was present in the cluster, the closest school outside the cluster to the first selected household was included in the survey. Eight children and two alternate children 6-12 years were selected from each school (Annex B).

2.5.1 Sample Frame Stratification

The target number of households was 540 households per region and 1,620 households nationally. Unfortunately one household survey form in the Northern region went missing so the final count of households visited nationally was 1619, with information from 539 households in the Northern region.

Data were collected from 84% (n=1,942) of the total target of 2,310 respondents. By the methodological design of this household survey, all sampled households that were found vacant during data collection were not replaced. As a result, the household survey failed to reach the targeted sample size per stratum, although no precision was lost. Table 2.1 shows the targeted sample size and the actual sample size reached during the field data collection.

Table 2.1. Total sample by target group and region, Malawi Micronutrient Survey, Malawi 2001.

	Preschool children (6-36 mos)		**School children (6-12 yrs)**		**Women of childbearing age (15-45 yrs)**		**Men (15-45 yrs)**		**Total**	
Region	Target	*Actual*	Target	*Actual*	Target	*Actual*	Target	*Actual*	Target	*Actual*
North	230	*170*	240	*235*	240	*190*			890	*595*
Central	230	*211*	240	*234*	240	*197*			890	*642*
South	230	*167*	240	*232*	240	*145*			890	*544*
National	690	*548*	720	*701*	720	*532*	180	*161*	2,310	*1,942*

2.6 Community Mobilization

The administration structure in the 26 districts, which includes District Commissioners, the Police, District Health Officers, District Education Officers and political leaders were informed of the survey two months prior to the field data collection. Local chiefs and village headmen were also informed during the listing of households. To ensure that people would be available on the day of the survey, a day or two before the data collection, Advance Teams (see section 2.8.1) also served as publicity teams to inform village headmen, school headmasters of the selected schools, and local police of the survey, and the date the survey team would be present in the cluster to collect data.

2.7 Survey Teams and Training

Six field teams conducted the household survey. Each team consisted of one team leader, three interviewers, two laboratory technicians, and one driver. One national supervisor, three regional supervisors and two laboratory regional supervisors administered the field data collection. The survey personnel were experienced enumerators and staff from the NSO and

Ministry of Health and Population (MOHP). Job descriptions of each survey team member are found in Annex C.

All team members received eight days of instruction on the overall survey objectives and procedures at Community Health Science Unit (CHSU) Laboratory. The training schedule is found in Annex D. Interviewers responsible for administering the survey questionnaire participated in role-playing interview exercises to ensure consistency. Interviewers also went through a standardization exercise for anthropometric measurements on women of childbearing age. During the standardization, each interviewer made 2 measurements on 12 subjects.

Laboratory personnel on the teams were trained by the Centers for Disease Control and Prevention (CDC) laboratory personnel on the correct technique for fingerstick and capillary blood collection into microtainers, use of field instruments for analysis of hemoglobin and zinc protoporphyrin, processing and storage of blood for analysis of retinol and transferrin receptor, and storage and transport of urine samples. Detailed training materials for the laboratory staff are included in Annex E. Laboratory technicians were also trained by CHSU staff on creating thick blood smears for malaria assessment, analysis and preparation of stool and urine samples.

The Advance Teams (see section 2.8.1) were trained on the selection of schools and school children during the training. They were trained as interviewers so that they would know the details of the survey and identified as potential advance teams towards the middle of the training. The full survey protocol including sample collection was field-tested by each team twice in urban and rural households and schools near Lilongwe. The sample size for these field tests was smaller than the actual survey design to allow time for further training opportunities in the field.

2.8 Survey Implementation

The flow of the survey was carefully orchestrated. All of the teams began data collection in and around Lilongwe. As they moved farther north and south away from Lilongwe they split into 2 groups of 3 teams each. The 2 groups shared some lab equipment, particularly the Aviv hematofluometer (Aviv Biomedical, Inc.) that measured zinc protoporphyrin, which was carried by the regional lab supervisor. Therefore, the 2 groups met at night to test and process biological samples.

Each team leader received detailed maps of their assigned clusters with the approximate location of the 18 households for the survey as well as the exact location of the public school in the cluster closest to the first household listed. Upon arriving at a cluster, the team leader sent one interviewer and one lab technician to the school. Once the interviewing and sampling at the school was completed, the lab technician and interviewer joined the rest of the team and helped complete the work in the households. The other lab person established a Central Laboratory Site that was most convenient to the 18 households.

In the cluster, each interviewer was assigned to specific households. Once they completed the appropriate interviews within a household, the interviewer either walked the subjects to the Central Laboratory Site, or in some cases due to long distances, the driver provided transport for the selected members of the household to the Central Laboratory Site. Each selected subject was given an Action Card on which there was a list of all the aspects of the survey (interview, anthropometry, sample collection) (Annex F). After each stage was completed, the appropriate person signed the card to ensure that no parts were skipped. The action cards also ensured communication among the team members. Once the interviewer turned the completed forms into the team leader, they went on their next assigned household.

At the Central Laboratory Site, the interviewer took anthropometry measurements on the preschool children and women of childbearing age. After recording these final values, the

team leader was given the form to review. The team leader then transferred the forms to the lab technician, who called each of the subjects one at a time and put an identification sticker on their forms and samples. Once the biological samples were collected from a subject, all the completed questionnaires were given back to the team leader. Once all the forms were organized at the end of the day, the team leaders gave all the forms to the regional supervisor who had them sent to the National Statistics Office (NSO) in Zomba for data entry. All biological samples (blood from all groups and urine and stool from school children) were taken to the district lab for processing in the evening. Job descriptions of each survey team member are in Annex C.

2.8.1 The Advance Team

In order to facilitate the sample selection at the schools, as well as to ensure that fresh stool samples were available for analysis there were two Advance Teams in the survey, one for three teams that went North and one for the three teams that went South.

The Advance Teams alerted the village headmen and local chiefs to the survey. They also visited the selected school of the cluster a day or two before the survey team to prepare them. They left a list of the selected children with the headmaster to give to the interviewer and lab technician when they arrived at the school on the appointed day.

2.8.2 Sample Selection at the Household

Survey subjects were selected at the household level by the interviewers on arrival at a selected cluster. The head of each household was interviewed irrespective of gender. Verbal consent was received from the head of the household after the trained interviewer explained the purpose of the survey.

One designated interviewer on each team selected two men (20-55 years) per cluster from the first two households in which men of the age group were found. To select the women 15-45 years, all women either pregnant or non-pregnant in every household were listed and every other woman was selected as a survey subject. All children 6-36 months found in a selected household qualified for the survey, whether or not their mother was also taking part in the survey. The child's mother or caretaker answered the questionnaires on their behalf.

One designated interviewer on each team selected 2 women of childbearing age (15-45 years) per cluster who were the primary cooks in the first two households selected. These two cooks were asked a separate set of questions on the general food consumption patterns of their household and on their food intake the previous day using the Fortification Rapid Assessment Tool (see section 2.8.3). Two children 6 - 36 months were also selected in a similar fashion, from the first two households by a different designated interviewer on each team and their mother or caretaker was asked to answer on behalf of the child. A FRAT questionnaire for two men 20-55 years in each cluster was also collected. Another interviewer was responsible for identifying and questioning these two men.

When all eligible occupants of a house were not at home, up to three recall visits were made at another time, usually over subsequent days. Selected houses which were either vacant or in which all eligible occupants were away, were not replaced.

2.8.3 Interviews conducted at the household

All of the questionnaires were translated into Chichewa and Chitumbuka and pre-tested to ensure that changes in the meanings of the questions were not lost. The questionnaires were reviewed with all the interviewers during the survey training (see Annex F for all survey instruments and lab forms).

a) General Household Survey

The head of the household was asked a number of questions regarding general characteristics of household, water and sanitation practices and bednet use.

Analysis of household characteristics

In addition to analyzing the individual indicators of household characteristics, a socioeconomic status index was created as a general categorization method. The households were also grouped into urban and rural areas.

Socioeconomic Status Index

In order to categorize the subjects by socioeconomic status (SES) an index was created using responses on the household questionnaire regarding household assets, water source, sanitation, house construction, and type of fuel used by the household. See Annex G for further details on the SES index.

Residence (urban and rural) categories

Enumeration area (EA) numbers for the clusters are assigned in a system that allows for categorization into urban and rural groups. Therefore all clusters were divided into rural and urban categories using their EA number.

b) Knowledge, Attitude, Practice Survey

A Knowledge, Attitude, Practice (KAP) survey was administered as part of the household based survey to women of childbearing age 15-45 years and as part of the school survey to school children 6-12 years. This survey included KAP questions on anemia, vitamin A and use of iodized salt. The KAP was translated into Chichewa and Chitumbuka and finalized after pilot testing in the field.

In addition to specific KAP questions on nutrition, women were asked for demographic information (women's age, reproductive status and history, use of prenatal health services) and socioeconomic status questions (educational level, household socio-cultural background). A short questionnaire was utilized to gather information on preschool children 6-25.9 months. It included details on sex, age, breastfeeding status and history, complementary feeding, caregiver's relationship with the child, birth interval with previous born child, rank order, and health status.

The final section on the questionnaire was a short health history. All subjects (preschool children, school children, women and men) were asked about whether they had a fever, cough or runny nose, diarrhea, blood in their stool or blood in their urine on the day of the survey and/or in the last 2 weeks. Any other illness or conditions were recorded as well.

c) Modified Fortification Rapid Assessment Tool (FRAT)

The Fortification Rapid Assessment Tool (FRAT) is a 24-hour recall tool created by PATH Canada that is specifically designed to gather information to aid in the fortification of the most appropriate staple foods in developing countries. A modified version of the FRAT was utilized in the Malawi survey. The National Fortification Technical Committee had already identified the centrally processed staple foods for fortification (sugar and cooking oil with vitamin A, maize meal and complementary foods (such as Likuni Phala) with iron, folate and other nutrients) hence the FRAT was not utilized for that purpose. The FRAT was used to assess the availability and usual consumption patterns of these centrally-processed staple foods, specifically sugar, oil, maize meal, and complementary foods. To obtain the most accurate quantitative information possible, estimates of usual serving sizes were determined through a cooking exercise to standardize amounts (Annex H).

FRAT information was gathered on a national sample of primary female cooks, preschool children and men. The primary female cook in 2 households in every cluster was asked the FRAT questions. Two men in each cluster were also asked FRAT questions and the caregivers of two preschool children in two households were also questioned. Specific interviewers in each survey team were designated as female, child or male FRAT interviewers, thereby ensuring that FRAT information was gathered from 6 different households per cluster.

The respondents were first asked if their intake the previous day was typical since the FRAT attempts to estimate usual consumption. If yes, then they were asked the consumption questions about that day. If their intake the previous say was not usual then they were asked to think of a typical day.

Then each subject was asked to list the foods of either the day before or the usual day. The list was divided by meal and interviewers were trained to probe for foods by starting in the morning and working towards evening. The listing of foods was not part of the data entry process as it was utilized as a recall exercise only.

Following the brief listing of foods, respondents were asked a series of repeating questions about centrally processed sugar, oil, and maize meal. Caretakers of preschool children were also asked the series of questions on consumption of centrally processed complementary foods.

The repeating sequence of questions started with a question about the consumption of the specific item in any foods or beverages. If none were mentioned, the interviewer skipped to the next section of questions. If the subject had that item then the foods and beverages were listed and the amounts estimated utilizing the set of standard utensils from the training. The subjects were also asked how many days in the past 7 days, not including the previous day, they consumed food or beverages containing the item. The final question in the section asked in which season the subject usually consumes the item.

2.8.4 Salt Sample Collection at the Household

Household salt samples were collected from the head of the household and tested for the presence of iodine using rapid test kits for potassium iodate (MBI). Approximately two tablespoons of salt was collected in plastic bags, sealed, and labeled for transport back to the laboratory from every other household, specifically for those that had even numbers assigned to them. Information on the brand of salt and on the location of salt purchase was also gathered.

2.8.4 Sample selection at the school

The closest primary school to the first household in each cluster was selected as part of the survey. The Advance Teams asked each school headmaster to complete a three question long survey on whether or not their school participated in an iron supplementation program and/or a deworming program. If such programs were in existence then they provided the approximate date of the last round of treatment (see Annex F for survey instruments). The headmaster of the school gave verbal consent for the survey of the school children.

Each Advance Team visited 3 schools each day to randomly select 8 children and 2 alternates from all children 6-12 years to participate in the survey (see Annex B for detailed instructions for sampling). From the school listing of children, all of those 6-12 years were identified and 10 were randomly selected from those who were in attendance that day. The first 8 were the selected children to be included in the survey if they were in attendance at the school on the day of the survey and had brought stool samples. Two alternate children were also asked for stool samples and were utilized if any of the first 8 selected children did not attend school or bring their stool sample on the day of the survey. The list of the selected children was left

with the headmaster to give to the survey team. See Annex B for the sampling directions and listing form.

After selection, the pupils were briefed about the survey, and given a stool collection container in which they were to turn in stool specimen on the day of the survey.

On the day of the survey, a Knowledge, Attitude, Practice (KAP) survey was administered to each subject. Stool and urine samples were collected as well as a blood sample.

2.8.5 Anthropometry

Once participants had completed the interview process, the interviewer escorted them to the Central Laboratory Site in the cluster where height and weight measurements were taken for non-pregnant women of childbearing age (15-45 years) and all infants in the survey (6-36 months of age). The age of the preschool children were calculated based on the difference between the birth date from the interview or from a health card if available, and the date of the measurement. Women's ages were based on self-reported age in years. Anthropometric indicators of length/height-for-age, weight-for-age, weight-for-length/height were determined for the children (see Box 1) using Epi Info (Epi Info 6.04d). Weight, height and body mass index (BMI) was determined for the adult non-pregnant women (see Box 2).

a) Length/height

For children less than 24 months old, recumbent length was measured to the nearest 0.1 cm using a field appropriate Shorr board. The same Shorr stadiometer was used to measure standing height to the nearest 0.l cm for children greater than or equal to 24 months and for adult women. All subjects were measured without shoes.

b) Body weight

UNICEF Seca Uniscales were used to measure body weight of women of childbearing age 15-45 years and preschool children 6-36 months. The weight of the children was assessed using the mother-child function on the scale. Body Mass Index (BMI) was calculated for adult women (see Box 2).

BOX 1. ANTHROPOMETRIC INDICES
Reference: Pediatric anthropometric data presented in this report were interpreted using the international growth reference (NCHS/CDC/WHO reference). This reference is based on growth curves for children in the United States and studies have demonstrated that healthy, well-nourished children from most countries exhibit a pattern of growth that is similar to that of the reference.
Z-scores: The anthropometric indices used for evaluating the nutritional status of children include height-for-age, weight-for-age, and weight-for-height. These indices are interpreted using classifications based on Z-scores (standard deviation units from the reference median). The World Health Organization (WHO) recommends that a Z-score cut-off point of <-2 be used to classify low height-for-age, low weight-for-age, and low weight-for-height for estimating the prevalence of malnutrition. The reference Z-score distribution for each index has a mean of 0.0 and a standard deviation of 1.0. A Z-score cut-off of +2 should be used to classify high weight-for-height for estimating the prevalence of overweight or obesity (also a form of malnutrition). A Z-score of -2 corresponds to the 2.3rd percentile on the reference distribution, while a Z-score of 2 corresponds to the 97.7th percentile on the reference distribution. Thus, with any of the indicators, a prevalence less than or equal to 2.3% is regarded as the surveyed population being free from malnutrition based on that indicator.
Height-for-age: A low height-for-age indicates growth stunting, which reflects a long term deficit of nutritional status and/or a history of illness and disease such as diarrhea and acute respiratory infection. On a population level, a high prevalence of stunting is usually associated

with poor socioeconomic conditions and a greater risk for frequent and/or early exposure to adverse environmental conditions such as illness and inadequate nutrition. A decrease in the prevalence of stunting usually parallels improvements in economic conditions. In developing countries the prevalence of low height-for-age ranges from 10% to 60%. Countries with a <20% prevalence in low height-for-age (Z-score <-2) are classified as countries with low prevalence of stunting by WHO.

Weight-for-age: This index is a composite of height-for-age and weight-for-height. On a cross-sectional basis, weight-for-age is less useful than height-for-age or weight-for-height in defining nutritional status. In most populations where there are few children with low weight-for-height, the weight-for-age status provides essentially the same information as height-for-age.

Weight-for-height: Low weight-for-height, or wasting, is an indicator of acute under-nutrition and is often the result of severe food shortages and/or prolonged severe illness. Unlike the wide variation in stunting rates observed in developing countries, the prevalence of wasting is usually less than 5% in most countries provided there is no severe food shortage. Therefore, a wasting prevalence of more than 5% is of concern; a prevalence of 10% to 14% is considered serious; a prevalence of 15% or higher is considered critical.

Standard Deviation (SD): The S.D. of the Z-score provides information on the spread of the distribution and the quality of the anthropometric measurements done for a survey. In the reference population, the standard deviation (S.D.) of the Z-score distribution for height-for-age and weight-for-height is 1.0. A Z-score S.D. that is lower than 0.9 indicates that the distribution is more homogeneous or one with less variation compared to the reference distribution. A Z-score S.D. >1.0 and <1.2 indicates that the distribution has a wider spread than the reference. A Z-score S.D. <0.80 or >1.3 is suggestive of inaccurate anthropometric measurements and /or inaccurate age information.

Data Quality: During data cleaning, records with potentially erroneous data were excluded from analysis based on the following standard Z-score cutoffs developed by WHO (WHO, 1995):

- height-for-age Z-score (HAZ) <-5.0 or >3.0
- weight-for-age Z-score (WAZ) <-5.0 or >5.0
- weight-for height Z-score (WHZ) <-4.0 or >5.0

Box 2. BODY MASS INDEX

Adult nutritional status is assessed by calculating the Body Mass Index (BMI) from the weight and height of non-pregnant women included in the survey (BMI= Weight (kg)/Height^2 (m)). A BMI below 18.5 indicates underweight or thinness. A BMI greater than 25.0 indicates overweight which can also be categorized by grade as follows (WHO, 1995):

- Underweight <18.5
- Normal weight=18.5-24.9
- Overweight=25-29.9
- Obesity ≥ 30.0

2.8.6 Blood Collection

Trained laboratory personnel were located at the same Central Laboratory Site where the anthropometry was conducted. These laboratory personnel collected capillary blood samples through a finger stick from all subjects using a HemoCue lancet. The first drop of blood collected was used to create a thick smear slide for malaria assessment (Annex E). The finger was then wiped clean and the third drop was drawn into a HemoCue cuvette for evaluation of hemoglobin by the photometric method using the HemoCue Hemoglobin system (HemoCue AB, Angelholm, Sweden).

Additional capillary blood was then collected in a 500 microliter (μL) microtainer with EDTA for processing and stabilization that evening for later analysis. The number and type of these additional tests depended on the blood volume obtained in the microtainer for each target group. An algorithm for the testing procedure can be found in Annex I. Assumptions for the algorithm were that zinc protoporphyrin analysis was conducted first, then a sample taken for vitamin A analysis (serum if sufficient, a dried blood spot (DBS) if not), which was a higher priority than Transferrin Receptor (TfR) analysis (in serum if sufficient, a dried blood spot (DBS) if not). Blood samples of sufficient volume were spun for plasma, which was separated into cryovials, frozen and transported. Until frozen, the blood samples were maintained at refrigerated temperatures (roughly 4°C) until processing by using insulated shipping containers and frozen cold packs.

2.8.7 Stool and Urine Collection

Stool and urine samples were collected from the school children in the survey. From the stool samples, the presence of parasitic infections (hookworm, roundworm and schistosoma mansoni) was assessed through the concentration method (Annex E), since parasitic infections maybe important as indicators of both morbidity and as potential factors associated with anemia and IDA. The urine samples were analyzed for the presence of any blood, both visually and using a dipstick method (Annex E). Additional urine was stored for later analysis of indicators of urinary schistosomiasis (*Schistosoma haematobrium*), by an egg count in 10 ml of urine, and of urinary iodine excretion levels in an additional 2-5 ml of urine.

2.9 Biological and Salt Sample Processing and Storage

The lab technicians performed the malaria analysis, stool sample assessment and urine assessment for urinary schistosomiasis in the field. Urine samples for urinary iodine analysis were transported to the main CHSU lab in Lilongwe. Ten percent of the urine samples were analyzed at CDC. Salt samples from half of the households in the survey were taken to the biochemistry laboratory in CHSU for salt iodine titration. Some of the CHSU staff were trained by the Program Against Micronutrient Malnutrition (PAMM) in analysis of iodine in urine and salt.

All of the TfR dried blood spots are in frozen storage at CDC awaiting the final validation of the new method. The vitamin A serum and the sub-sample of DBS were sent to Craft Technologies for assessment. Following the serum retinol assessment by Craft Technologies, the remaining serum samples were sent back to CDC for serum TfR analysis.

At the household, urine samples were tested for the presence of blood, malaria thick smears were created, salt samples were tested, and hemoglobin was assessed.

At the end of the day, the teams in each region met at a district hospital to run the ZP tests on the hematofluometer, to create the DBS for the TfR, to create vitamin A DBS and to spin the blood samples down to serum which was separated and frozen for serum retinol and serum TfR analysis. The DBS were allowed to dry over night. Smaller volumes of urine samples were transferred into vials for transport to CHSU. Stool samples were placed in formalin for preservation. The concentration method for analysis of intestinal parasites was used to test the stools.

For the HemoCue instrument (HemoCue AB, Angelholm, Sweden), the control cuvette for each specific instrument was used for quality assurance once the lab field station was set up in each cluster. Liquid controls were also utilized on the HemoCue instruments. For the hematofluometer instrument, calibrators and controls were both used.

All of the measures and criteria by target group that were used in the data analysis are listed in Table 2.4. The actual number of specimens analyzed for each indicator is listed in Table 2.5.

a) Samples for Determination of Iodine

Analysis of Data on Urinary Iodine Levels

Urinary iodine values are expressed as micrograms per liter (μg/L). Levels of urinary iodine within an individual vary daily, and even during a given day, and it is also normal to find a few extreme outlying values in any given population, skewing the distribution of values to the left. Consequently, classification of iodine deficiency as a public health problem is done on the basis of median values in population groups (Table 2.2) rather than on individual prevalence as in vitamin A deficiency and anemia. A median urinary iodine value of less than 100 μg/L for school children indicates iodine deficiency in the population (Table 2.4).

The WHO/UNICEF/ICCIDD have established criteria for monitoring progress towards eliminating iodine deficiency disorders (IDD) based on epidemiological data using median urinary iodine levels for school children (Table 2.2) (WHO/ICCIDD/UNICEF, 2001). Duplicates of ten percent of the urine samples were sent to the CDC laboratory for quality control comparative analysis of urinary iodine.

Table 2.2. Epidemiological criteria for assessing iodine nutrition based on median urinary iodine concentrations in school children (WHO/UNICEF/ICCIDD, 2001).

Median urinary iodine (μg/L)	Iodine intake	Iodine nutrition
<20	Insufficient	Severe iodine deficiency
20-49	Insufficient	Moderate iodine deficiency
50-99	Insufficient	Mild iodine deficiency
100-199	Adequate	Optimal
200-299	More than adequate	Risk of iodine-induced hyperthyroidism within 5-10 years following introduction of iodized salt in susceptible groups
>300	Excessive	Risk of adverse health consequences (iodine-induced hyperthyroidism, autoimmune thyroid diseases)

Analysis of Data on Iodine Levels in Salt

Salt samples from every other household in the survey were analyzed by titration to quantify the amount of iodine in the salt. Iodized salt in Southern Africa has been harmonized at 40 parts per million (ppm) $\pm$ 15 with a range from 25 to 55 ppm when assessed at a border of one of the countries in the region. The general agreement is that household salt should therefore have 25 ppm (ICCIDD, 1999).

b) Samples for Determination of Vitamin A

Capillary blood collected in the microtainer was spun using centrifuge machines at district hospitals to separate the serum for retinol determination. As an alternative to collecting serum from samples where there was an insufficient volume of whole blood in the microtainer to obtain enough serum for retinol determination, dried blood spots (DBS) were collected on filter paper. Results of vitamin A measurements from DBS have correlated well with those from serum retinol, when both were determined by high performance liquid

chromatography (HPLC), (Craft et al, 1998). This method is recommended as a viable alternative for assessment of vitamin A status of populations where logistical simplicity is of paramount importance. The DBS for analysis of vitamin A were created using blood from the microtainer at the end of each day, by spotting 50 uL of EDTA blood into a pre-drawn circle on a filterpaper card. Craft Technologies analyzed the serum and DBS samples for retinol.

Analysis of Data on Vitamin A Status

For all target groups estimates of the prevalence of low serum retinol are provided for three different cut-off values (<10 µg/dl, <20 µg/dl, <30 µg/dl) (Table 2.4), and mean retinol by demographic characteristics was reported. Assessment of vitamin A deficiency was also assessed by WHO criteria which states that vitamin A deficiency constitutes a public health problem in countries with a prevalence of >5% of plasma vitamin A of <10 µg/dl (WHO, 1982).

Women of childbearing age who reported at least one pregnancy were asked questions regarding night blindness (difficulty in vision both during the day and night) during their last pregnancy and this data was analyzed in relation to serum/DBS vitamin A levels. Further analysis was done with relation to answers by the women included questions about vitamin A supplement use by themselves (percent of women who reported having received a vitamin A supplement within 2 months of delivery) and by the mothers/caretakers of children 6-26 months (percent who ever received a vitamin A supplement and the median duration since the last dose was given). Information on vitamin A supplements was obtained by questionnaire and by health card where available.

c) Samples for Determination of Anemia, Iron Status and Iron Deficiency Anemia

Assessing the true magnitude of iron deficiency requires the measurement of several biochemical indicators, which are not feasible to include in a field-based survey such as the one in Malawi. Anemia, which is often used a proxy for iron deficiency, was assessed through hemoglobin values. In order to obtain an indication of the prevalence of iron deficiency, zinc protoporphyrin (ZP) was measured using a portable hematofluorometer (Aviv Biomedical, Inc.). Calibrators and controls (Aviv Biochemical, Inc.) were used on a daily basis to quality control results. Log sheets were kept of all quality control measurements (Annex E). The fluorometric test for ZP is low-cost and relatively field friendly. ZP was assessed using capillary blood collected in the microtainer containing EDTA. A minimum of 200μL of capillary blood was collected in the microtainers with ZP being the first priority test from the microtainer blood. A total of 20μL is required for the ZP test. Two ZP tests were conducted toward the end of the day at a central health facility in the field.

Transferrin receptor (TfR) was used as an additional measure of iron deficiency. Following analysis of serum retinol, the remaining serum was sent to CDC for serum TfR assessment. CDC is in the process of validating a dried blood spot (DBS) method for TfR. As the method is still being developed, the Malawi DBS samples have been frozen at CDC for future analysis, therefore it was not possible to include results for DBS TfR in this report. The DBS for TfR were created from the blood in the microtainer at the end of each day, by spotting 100 uL of EDTA blood into a pre-drawn circle on a filter paper card.

Analysis of Data on Anemia

Anemia was assessed using the HemoCue photometric instrument (HemoCue AB, Angelholm, Sweden) on blood from the microtainer. Major advantages of the HemoCue photometer is that it can be battery-operated, is easily portable, displays hemoglobin levels in one minute and avoids complicated handling of blood samples in potentially harsh field conditions.

Quality Control of the HemoCue instrument was ensured by using the control cuvette for each specific instrument before the instrument was used in each cluster. Liquid controls (HemoCue AB, Angelholm, Sweden) were also used at the beginning and end of each day as

further assurance of the quality of HemoCue readings. Log sheets were kept of all quality control measurements (Annex E).

Cut-offs for anemia vary by target group. Anemia is defined as < 11g/dL for preschool children (6-36 months), as <11.5 g/dL for school children (6-12 years), as <12.0 g/dL for non-pregnant women (15-45 years), as <11.0 g/dL for pregnant women (15-45 years) and as <13.0 g/dL for adult men (20-55 years) (Table 2.4).

For prevalence estimates of anemia based on hemoglobin, the hemoglobin values were adjusted based on altitude and smoking status (CDC, Morbidity and Mortality Weekly Report, 1998). Reported means are unadjusted.

WHO classifies anemia as a problem of public health significance based on prevalence estimates from hemoglobin values (WHO, 2001). Table 2.3 presents the classifications of severe, moderate, mild and normal.

Table 2.3. WHO classification of public health significance of anemia in populations based on the prevalence of hemoglobin (WHO, 2001).

Category of public health significance	Prevalence of anemia (%)
Severe	≥ 40
Moderate	20.0 – 39.9
Mild	5.0 – 19.9
Normal	≤ 4.9

The influence of malaria, intestinal parasites and urinary schistosomiasis on anemia was also assessed (Table 2.4).

Analysis of Data on Iron Status

Iron deficiency was defined through two methods. The average of the two measurements of zinc protoporphyrin (ZP) was used as one method of assessing iron deficiency. For preschool children the cut-off of an average ZP greater than 61.0 µmol/mol heme was considered iron deficiency. For all other groups (school children, women of childbearing age, men) the cut-off of >70.0 µmol/mol heme was used to determine iron deficiency (Table 2.4).

The other method for assessing iron status used in the survey was transferrin receptor (TfR). For all target groups, iron deficiency was defined as a TfR value >8.3 µg/mL (Table 2.4).

Analysis of Data on Iron Deficiency Anemia (IDA)

Two composite indicators were created to assess iron deficiency anemia (IDA). One measure was defined as elevated ZP and low hemoglobin indicating anemia. The other measure was based on elevated serum TfR and low hemoglobin indicating anemia. See Table 2.4 for specific values utilized.

d) Samples for Determination of Infection

Malaria

Plasmodium falciparum is the most common cause of malaria infection in Malawi. Of the four species that cause malaria, *P. falciparum* contributes the highest rates of morbidity and mortality (Louis 1984). All subjects in the survey, whether febrile or not, had thick smears made from capillary blood samples. These were analyzed at the end of each day of fieldwork. Presence of *P. falciparum* trophozoites, the asexual erthrocytic development stage of the parasite, and the level of parasitemia, using the 1-plus to 4-plus system, were recorded. Presence of *P. falciparum* gametocytes, the sexual erythrocytic stage and the level of parasitemia were also both recorded.

It is the asexual erythrocytic cycle, with the presence of trophozoites, which cause clinical symptoms of infection such as fever, headaches, nausea, and muscle aches. Malaria parasitemia rates are counts of the asexual parasites, or trophozoites, in the blood.

Analysis of Data on Malaria

Malaria parasitemia, the count of trophozoites or active parasites found circulating the blood, was determined from the thick smear samples. The relationship between malaria parasitemia and anemia was also explored as well as the relationship between reported fever on the day of the survey and malaria parasitemia.

Urinary schistosomiasis (urine)

Urinary schistosomiasis is a common infection in Malawi due to the infestation of water snails particularly in the southern part of Lake Malawi. These snails are the intermediate host of *Schistosoma haematobium* which causes urinary schistosomiasis.

Urinary schistosomiasis causes bleeding inside the bladder and contributes to the anemia status of the child. Such a loss of blood is visible in the urine. Urine samples from school children were assessed with a colorimetric dipstick method for the presence of blood in the urine (Annex E). An aliquot of urine was examined under the microscope for the presence of *Schistosoma haematobium* eggs (Annex E). School children were also asked whether they had urinary schistosomiasis and they were asked whether they had blood in their urine on the day of the survey to see if they recognized and correctly assigned possible meaning to the symptoms of blood in their urine and pain when urinating.

Only school children were asked for urine samples. They serve as a proxy for the rest of the population for both urinary schistosomiasis and for urinary iodine status.

Analysis of Data on Urinary schistosomiasis

Data were reported by dipstick result for presence of blood in the urine and by egg count. The egg count results were also used in combination with the hemoglobin results to assess the impact of infection on anemia. The knowledge data on urinary schistosomiasis was also tabulated in order to see trends.

Intestinal parasites (stool)

Some intestinal parasites cause blood loss and therefore contribute to anemia. These infections also contribute to general morbidity. The presence of parasitic infections such as hookworm, roundworm and schistosoma mansoni were assessed in school children through analysis of stool samples. School children were also asked a set of questions to assess their knowledge of intestinal parasites.

Analysis of Data on Intestinal Parasites

The prevalence of each intestinal parasite (hookworm, round worm and schistosoma mansoni) was reported by age group, standard/grade, sex, residence, region as well as a weighted national figure. The hookworm results were also analyzed with the hemoglobin data to assess the impact of hookworm infection on anemia. The knowledge of intestinal parasites by school children was also reported.

Table 2.4. Measures and criteria used to define hematological and biochemical variables for each subgroup of the study population, Malawi Micronutrient Survey, Malawi 2001.

VARIABLE	INDICATOR	PRESCHOOL CHILDREN (6-36 Months)	SCHOOL CHILDREN (6-12 years)	NON-PREGNANT WOMEN (15-45 years)	PREGNANT WOMEN (15-45 years)	MEN (20-55 years)
Iodine deficiency	Urinary iodine (UI)[1]		Mild deficiency: ≥50 µg/L and <100 µg/L Moderate deficiency: ≥20 µg/L and <50 µg/L Severe deficiency: <20 µg/L			
Vitamin A deficiency	Serum retinol[2]	Three cut-offs used: <10 µg/dL <20 µg/dL<30 µg/dL				
Anemia	Hemoglobin (Hb) [3]	<11.0 g/dL	<11.5 g/dL	<12.0 g/dL	<11.0 g/dL	<13.0 g/dL
	Hb and Malaria	Anemia and malaria parasitemia present				
	Hb and Hookworm		Anemia and hookworm infection			
	Hb and Urinary schistosomiasis		Anemia and eggs present in urine			
Iron deficiency	Zinc protoporphyrin (ZP) [3]	>61.0 µmol/mol heme	>70.0 µmol/mol heme			
Iron deficiency	Serum transferrin receptor (TfR) [4]	>8.3 µg/ml				
Iron deficiency anemia		Elevated ZP (iron deficient) and low Hb (anemic)				
Iron deficiency anemia		Elevated TfR (iron deficient) and low Hb (anemic)				

[1]WHO. Assessment of Iodine Deficiency Disorders and Monitoring their Elimination. 2001.
[2]WHO. Indicators for assessing vitamin A deficiency and their application in monitoring and evaluating intervention programmes. 1996.
[3]WHO, UNICEF, UNU. Iron Deficiency Anemia: Assessment, Prevention, and Control: A guide for programme managers. 2001.
[4]Human Transferrin Receptor: An in vitro enzyme immunoassay. Ramco Laboratories, Inc. kit insert. Catalog Number TF-94.

2.10 Samples by target group

Table 2.5 displays the indicators and activities conducted by target group for the actual samples in the survey.

Table 2.5. Number of samples by indicator, Malawi Micronutrient Survey, Malawi 2001.

Indicators*	Preschool Children 6-36 months	School children 6-12 years	Women of childbearing age 15-45 years	Adult men 20-55 years	Household samples
ANTHROPOMETRY					
Weight and height/length	506		435		
IODINE					
Urinary iodine		686			
Salt samples-test kit					1461
Salt sample-titration					510
VITAMIN A					
DBS Vit A by HPLC	33	31	28	11	
Serum Vit A by HPLC	443	572	441	124	
Total vitamin A data (serum+DBS)	476	603	469	135	
ANEMIA					
Hb by HemoCue	513	693	480	146	
ZP by Hematofluorometer	510	700	496	144	
Serum TfR	367	632	413	51	
Malaria	516	697	488	146	
Urinary Schistosomiasis		695			
Intestinal worms		673			
QUESTIONNAIRES					
KAP survey	548	701	532	161	
FRAT survey**	157		165	161	

*Hb=Hemoglobin, ZP=Zinc Protoporphyrin, TfR=Transferrin Receptor, DBS= Dry Blood Spot, Vit A= vitamin A, HPLC=High Performance Liquid Chromatography, KAP=Knowledge, Attitude, Practice, FRAT = Fortification Rapid Assessment Tool.

**FRAT surveys for preschool children and women may not have been asked of the same subjects as the KAP survey and other indicators.

2.11 Data entry and analysis plan

During the survey, questionnaires were collected, edited, and entered into computer files daily using Epi-Info version 6.04d by National Statistical Office (NSO) staff. The data entry staff remained at NSO during the survey and received the completed surveys as the data was collected. Any errors in completing questionnaires were corrected in the field when possible. To reduce computer data entry error, the entry screen was programmed to accept only codes within a predetermined range. All data were also double entered and verified. The data cleaning, validation and analysis was done in the USA by CDC staff and the National Survey Coordinator.

Once the data were entered and the data sets cleaned, analysis was conducted by the national survey coordinator and CDC staff. Due to the study design, the data were weighted based on population for national prevalence estimates.

CHAPTER 3: DEMOGRAPHICS AND SOCIOECONOMIC CHARACTERISTICS OF THE RESPONDENTS

It is widely known that demographic, social and economic characteristics of a population have profound influence on nutritional status. A better understanding of these characteristics is, therefore, a prerequisite for better understanding of nutrition indicators of a particular population. Data were collected on the demographic, social and economic characteristics of the household survey population. This chapter presents the results of the household survey in the following organization:

- Sample Frame stratification by region
- Demographic characteristics of the respondents
- Household economic characteristics

3.1 Residence (Urban/Rural)

Although stratification was not done based on residence, the residence distribution in the Malawi Micronutrient Survey was very similar to the 1998 Population and Housing Census. The survey included 1,422 rural households (88.3%) and 197 urban households (11.7%). In the Northern region 468 households (86.8%) were rural and 71 households (13.2%) were urban. In the Central region 468 households (86.7%) were rural and 72 households (13.3%) were urban. In the Southern region 486 households (90.0%) were rural and 54 households (10.0%) were urban.

3.2 Age and Sex

Table 3.1 displays the age distribution for all subjects. For preschool children the ranges were 6-11 months (6 month range), 12-23 months (1 year range), and 24-36 months (1 year range). For school children the age ranges used for analysis were 6-8 years (3 year range), and 9-12 years (4 year range). In women the age ranges used were 15-19 years (5 year range), 20-29 years (10 year range), 30-39 years (10 year range), and 40-44 years (5 year range). In men the age ranges used were 20-29 years (10 year range), 30-39 years (10 year range), 40-49 years (10 year range), and 50-54 years (5 year range).

The highest percentage (43.6%) of preschool children were those from 12-23 months. The distribution of school children was skewed with 70% in the range from 9-12 years and 30% in the 6-8 year range. The greatest prevalence of women (40.3%) and men (37.9%) were from 20-29 years old. No regional differences in age ranges were found.

Some of the ages for the respondents were not known or were out of the specified age range in the target group. There were missing age values for 21 preschool children, 2 school children, 8 women and 5 men. For preschool children, the date of birth was recorded on the survey forms. Despite the fact that the forms had instructions regarding date of birth cut-offs on the forms and that all the interviewers received training that included a session on inclusion criteria by age prior to the survey, there were some problems with the ages of some preschool children. In some instances, the calculated age was less than 6 months (sometimes in the negative range) or greater than 36 months.

Table 3.1. Age distribution by region, Malawi Micronutrient Survey, Malawi 2001.

	Northern		Central		Southern		National	
Target Group*	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Preschool children (n=527)								
6-11 months	34	21.4	41	20.3	43	25.9	118	23.0
12-23 months	60	37.7	85	42.1	77	46.4	222	43.6
24-36 months	65	40.9	76	37.6	46	27.7	187	33.4
School children (n=699)								
6-8 years	80	34.2	72	30.9	66	28.4	218	30.0
9-12 years	154	65.8	161	69.1	166	71.6	481	70.0
Women (n=524)								
15-19	35	30.7	49	43.0	30	26.3	114	22.7
20-29	73	25.1	72	34.6	63	30.3	208	40.3
30-39	59	38.6	52	34.0	42	27.5	153	28.5
40-44	21	42.9	18	36.7	10	20.4	49	8.6
Men (n=156)								
20-29	16	28.1	22	40.0	17	38.6	55	37.9
30-39	19	33.3	18	32.7	17	38.6	54	35.4
40-49	15	26.3	10	18.2	7	15.9	32	18.2
50-54	7	12.3	5	9.1	3	6.8	15	8.5

National data is weighted to account for survey design.
*Missing age values for 21 preschool children, 2 school children, 8 women and 5 men.

Table 3.2 shows the sex distribution of the preschool and school children. Almost equal percentages of boys and girls were included in the survey and were comparable to the sex distribution found in the 1998 census (48% male, 52% female).

Table 3.2. Sex distribution of preschool children (6-36 months) and school children (6-12 years), Malawi Micronutrient Survey, Malawi 2001.

	Male		Female		National
	N	%	N	%	N
Preschool children	261	48.4	287	51.6	548
School children	350	49.8	351	50.2	701

National data is weighted to account for survey design.

3.3 Marital Status

The women and men who were interviewed in the household survey were asked whether or not they were married and the results are shown in Table 3.3. Most of the women (76.3%) and men (84.6%) were married. The category of "No Spouse" combines responses of widowed, divorced and separated.

Table 3.3. Marital status of women (15-45 years) and men (20-55 years), Malawi Micronutrient Survey, Malawi 2001.

	Married		No Spouse		Never Married		Total
	N	**%**	**N**	**%**	**N**	**%**	**N**
Women	411	76.3	49	10.5	69	13.2	529
Men	138	84.6	7	3.6	14	11.8	159

National data is weighted to account for survey design.

3.4 Formal Education Status

Attainment of formal education is associated with better understanding that in turn influence decision making on nutrition and health care issues. The respondents were, therefore, asked whether or not they were able to read and write. Out of the 529 women who were interviewed, 54.1% said they were able to read and write whereas 45.9% were not. Of the 161 men interviewed, 69.8% were able to read and write while 30.2% were not. Table 3.4 shows that there are more women and men who are able to read and write and who attained higher formal education than those in the Central and Southern regions. These data are similar to the results from the 1998 census.

Table 3.4. Formal education of women and men by region, Malawi Micronutrient Survey, Malawi 2001.

	Northern		Central		Southern		National	
	N	%	N	%	N	%	N	%
WOMEN								
Self-reported literacy (n=529)								
Able to Read and Write	24	41.1	100	33.1	78	25.8	302	54.1
Unable to Read and Write	65	28.6	95	41.9	67	29.5	227	45.9
Level of Formal Education (n=528)								
No Formal Education	25	13.2	50	25.6	36	25.0	111	23.9
Education up to Std 5	48	25.4	74	37.9	59	41.0	181	37.7
Education up to Std 6-8	86	45.5	40	20.5	34	23.6	160	24.8
Education up to Sec & Above	30	15.9	31	15.9	15	10.4	76	13.6
MEN								
Self-reported literacy (n=161)								
Able to Read and Write	52	88.1	40	71.4	29	63.0	121	69.8
Unable to Read and Write	7	11.9	16	28.6	17	37.0	40	30.2
Level of Formal Education (n=528)								
No Formal Education	2	3.4	9	16.1	4	8.7	15	11.2
Education up to Std 5	9	15.3	21	37.5	21	45.7	51	38.4
Education up to Std 6-8	33	55.9	18	32.1	16	34.8	67	36.2
Education up to Sec & Above	15	25.4	8	14.3	5	10.9	28	14.1

National data is weighted to account for survey design.

3.5 Smoking

The men were asked whether they smoke or not. Of the 161 men in the survey, a total of 41 men (25.5%) smoked.

3.6 Reproductive History of Women of Childbearing Age

The women of childbearing age group were asked whether or not they were pregnant during the time of the household survey. Out of 526 women, 70 (13.0%) said they were pregnant, 450 (85.7%) said they were not and 6 (1.3%) were not sure whether or not they were pregnant. Of those who were pregnant, 21.1% were in the first trimester, 36% in the second trimester and 42.9% in the third trimester.

All women were also asked the number of times they had been pregnant (gravidity). Overall 16.6% had never been pregnant, 53.1% had one to four pregnancies, 28.6% had five to nine pregnancies and 1.7% had ten to twelve pregnancies (Table 3.5).

Table 3.5. Number of pregnancies (gravidity) among women of childbearing age (15-45 years), Malawi Micronutrient Survey, Malawi 2001.

	Number of pregnancies (gravidity)	
	N	**%**
Never pregnant	86	16.6
1-4 pregnancies	276	53.1
5-9 pregnancies	157	28.6
10-12 pregnancies	8	1.7

National data is weighted to account for survey design.

Of the 441 women who had ever been pregnant, 7.9% had no living children, 68.1% had one to four living children and 24.0% had five to nine living children (Table 3.6). All of the eight women who had ten to twelve children lost at least one if not three children.

Table 3.6. Number of living children (parity) among women of childbearing age (15-45 years), Malawi Micronutrient Survey, Malawi 2001.

	Number of living children (parity)	
	N	**%**
No children	34	7.9
1-4 children	302	68.1
5-9 children	105	24.0

National data is weighted to account for survey design.

3.7 Tribal Groups

There are several tribal groups in Malawi with their own distinct languages and cultural practices. However, the predominant tribal groups in the Northern region are Ngoni and Tumbuka, whereas Chewa tribal group is predominant in the Central region, and Yao, Lomwe and Sena are predominant in the Southern region. In the household survey, the respondents were asked about their tribal group. The distribution of tribal groups are listed in Table 3.7.

Table 3.7. Frequency distribution of tribal groups, Malawi Micronutrient Survey, Malawi 2001.

Tribal Groups	**N**	**%**
Chewa	421	33.2
Tumbuka	240	16.2
Lomwe	157	15.4
Ngoni	176	13.3
Yao	173	7.0
Sena	50	5.0
Tonga	73	2.1
Nkhonde	41	1.0
Senga	16	0.8
Lambya	12	0.4
Other	110	5.6
Unknown	1	0.1

National data is weighted to account for survey design.

3.8 Household Economic Status

Household economic status is known to be associated with micronutrient status and morbidity patterns. Food becomes easily available, health care is easily accessible and some basic assets become affordable if the household is economically sound. Thus an understanding of household economic characteristics helps to explain some variations in micronutrient status. In the present survey, data were collected on the housing and sanitary characteristics of the households, water supply, household assets and type of fuel used for cooking.

3.8.1 Housing Conditions

The majority of the roofs on houses in Malawi (76.8%) were thatched and the average number of rooms per household was 2.5 (Table 3.8).

Table 3.8. Housing characteristics, Malawi Micronutrient Survey, Malawi 2001.

Housing characteristics	N	%
Roofing materials (n=1,469)		
Grass thatch	1,125	76.8
Corrugated iron sheets	309	21.5
Tiles	5	0.3
Other	30	1.4
Number of Rooms in Main House (n=1,464)		
1 Room	147	11.4
2 Rooms	526	36.2
3 Rooms	461	32.2
>4 Rooms	330	20.2

National data is weighted to account for survey design.

3.8.2 Ownership of Household Assets

Asset ownership is another of the proxy indicator of economic status. The specific economic determinant asset differs from country to country largely due to the level of socio-economic development. According to the National Economic Council in Malawi, bicycle ownership is a proxy indicator that a household is capable of raising some disposable income to buy a bicycle and is, therefore, rated as socio-economically sound. A list of household assets was read out to the heads of the households in order to assess the ones available in the household. Up to 59.1% (n=863) of the households owned none of the assets on the list shown in Table 3.9.

Table 3.9. Ownership of household assets by region, Malawi Micronutrient Survey, Malawi 2001.

	Northern		Central		Southern		National	
Household Assets	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Selected list of assets (n=1,428)								
Bicycle	152	30.7	215	42.9	166	35.0	533	37.8
Television	17	3.4	23	4.6	5	1.1	45	2.8
Radio	272	54.9	261	52.1	251	53.0	784	52.8
Oxcart	12	2.4	34	6.8	0	0.0	46	3.0
Car	7	1.4	10	2.0	3	0.6	20	1.3
Assets per household (n=1,468)								
0 (no assets owned)	327	66.2	257	51.4	304	64.1	888	59.1
1 Asset Owned	150	30.4	204	40.8	166	35.0	520	36.9
2 Assets Owned	14	2.8	33	6.6	4	0.8	51	3.4
3 Assets Owned	1	0.2	6	1.2	0	0.0	7	0.5
4 Assets Owned	2	0.4	0	0.0	0	0.0	2	0.1

National data is weighted to account for survey design.

3.8.3 Household Cooking Fuel

The heads of the households were asked about the type of fuel they use for meal preparation and other domestic use. About 83% (n=1,221) of the households fetch their own firewood from surrounding woods. Table 3.10 shows the type of cooking fuel used by households in Malawi.

Table 3.10. Source of household cooking fuel, Malawi Micronutrient Survey, Malawi 2001.

Household Cooking Fuel	N	%
Firewood collected from nearby woods	1221	82.8
Firewood bought from nearby market	140	8.7
Charcoal	66	5.6
Electricity	28	1.8
Paraffin	2	0.1
Other	11	1.0

National data is weighted to account for survey design.

3.8.4 Water and Sanitation

Access to clean and safe water and to proper sanitation prevents transmission of infections. The heads of households were asked their current main source of drinking water. Out of 1,468 households, 66.3% had access to clean and safe water supplies comprising boreholes (36.1%), protected shallow wells (4.8%), piped water (5.5%) and public tap water kiosks (19.7%). A total of 34% of the households draw water from unprotected supplies comprising rivers (4.3%) and unprotected shallow wells (29.4%). Table 3.11 shows the regional distribution of household water sources.

Table 3.11. Distribution of main source of household drinking water by region, Malawi Micronutrient Survey, Malawi 2001.

	Northern		Central		Southern		National	
Water source	N	%	N	%	N	%	N	%
Borehole	169	34.1	186	37.1	169	35.7	524	36.1
Public Tap Water Kiosk	93	18.8	45	9.0	138	29.1	276	19.7
Domestic Piped Water	37	7.5	40	8.0	14	3.0	91	5.5
Protected Shallow Well	16	3.2	37	7.4	14	3.0	67	4.8
Unprotected Shallow Well	142	28.7	184	36.7	111	23.4	437	29.4
River	38	7.7	7	1.4	28	5.9	73	4.3
Other	0	0.0	2	0.4	0.0	0.0	2	0.2

National data is weighted to account for survey design.

The heads of the households were asked whether or not they had and use sanitary facilities for disposal of fecal matter. Table 3.12 shows that 86.7% of the households had sanitary facilities where as 13.3% had none. Out of 1,291 households with some sanitary facilities, 80.9% had pit latrines and 3.4% had flush toilets. Better sanitary were found in the Northern region as 9.1% of households has no toilet, whereas 12.4% in the Central region and 15.0% in the Southern region had no toilet at home.

Table 3.12. Type of sanitary facilities by region, Malawi Micronutrient Survey, Malawi 2001.

	Northern		Central		Southern		National	
Sanitary facilities	N	%	N	%	N	%	N	%
Pit latrine	409	82.8	408	81.4	379	80.0	1,196	80.9
Flush toilet	31	6.3	17	3.4	13	2.7	61	3.4
VIP	3	0.6	7	1.4	1	0.2	11	0.7
Other	6	1.2	7	1.4	10	2.1	23	1.7
No toilet	45	9.1	62	12.4	71	15.0	178	13.3

National data is weighted to account for survey design.

3.8.5 Index of Socioeconomic status

An index of socioeconomic status was created as a composite of the data on household type of cooking fuel, water source, type of toilet, material of household roof, material of household floor, number of rooms, and ownership of various household items (Annex G).

Sufficient information on all the variables included in the SES index was available for 1459 households, which is 90% of the sample. The distribution of SES by region is in Table 3.13.

Overall 57.4% of households were in the low SES, 36.0% were in the moderate and 6.6% were in the high SES categories. Significantly more low and moderate SES households were in the Southern region and more high SES households were in the Central region ($p<0.05$).

Table 3.13. Household socioeconomic economic status (SES) by region, Malawi Micronutrient Survey, Malawi 2001.

	Northern		Central		Southern		National	
SES	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Low	282	57.8	275	55.3	280	59.1	837	57.4
Moderate	172	35.2	173	34.8	176	37.1	521	36.0
High	34	7.0	49	9.9	18	3.8	101	6.6

National data is weighted to account for survey design.

CHAPTER 4: ANTHROPOMETRY

This chapter provides results from the anthropometry measurements from preschool children (6-36 months) and non-pregnant women of childbearing age (15-45 years). The organization of this chapter is as follows:

- Preschool children
  - Stunting (Height for age z-score)
  - Underweight (Weight for age z-score)
  - Wasting (Weight for height z-score)
- Non-pregnant women of childbearing age
  - Mean height and weight
  - Body mass index (BMI)
- Comparison of adult anthropometry to MDHS 2000

4.1 Anthropometry of Preschool Children

4.1.1 Stunting (Height-for-Age)

A total of 478 preschool children had valid length or height measurements and age data to calculate height-for-age z-scores (HAZ) (see Box 1). Over half (53.4%) of the preschool children had a low height-for-age (HAZ<-2) with almost a quarter (23.0%) of those were in the very low category (HAZ<-3). The preschool children had an overall HAZ mean of -1.95 ± 1.24, which was lower than the international reference mean of 0.0 (Table 4.1).

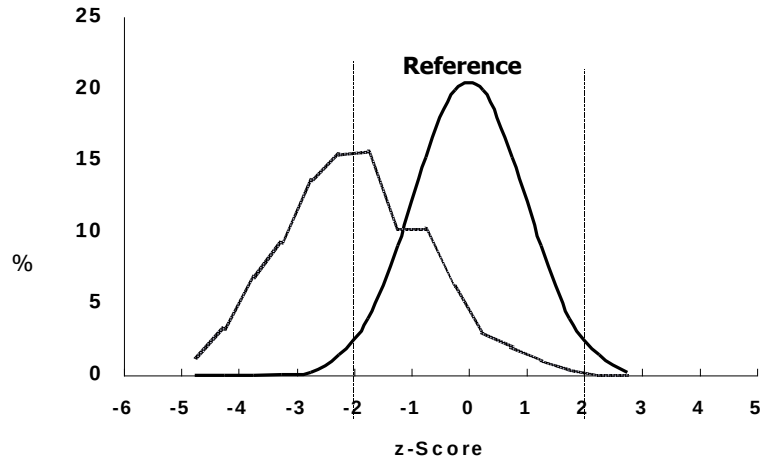
Table 4.1. Height-for-age Z-score (HAZ) summary statistics among preschool children, Malawi Micronutrient Survey, Malawi 2001.

			Prevalence (%)	
Category	**N**	**Mean HAZ ± SD**	**<-3 SD**	**<-2 SD**
Age groups (months)				
6-11	104	-1.48 ± 1.38	15.9	41.4
12-23	205	-2.10 ± 1.18	26.0	57.2
24-36	169	-2.05 ± 1.16	23.6	56.4
Sex				
Male	226	-1.96 ± 1.29	20.8	57.7
Female	252	-1.94 ± 1.20	21.0	49.3
SES				
Low	258	-2.06 ± 1.22	25.2	57.3
Moderate	184	-1.80 ± 1.23	19.2	47.9
High	36	-1.94 ± 1.38	26.0	52.2
Residence				
Urban	39	-1.96 ± 1.25	23.0	43.9
Rural	439	-1.84 ± 1.20	22.9	54.4
Region				
Northern	144	-1.70 ± 1.20*	12.5*	38.9
Central	181	-2.11 ± 1.30	28.7	54.1
Southern	153	-1.99 ± 1.18	19.6	55.6
National	478	-1.95 ± 1.24	23.0	53.4

National data is weighted to account for survey design.
*p<0.05

Figure 4.1 depicts the national distribution curve for HAZ as compared to the international reference. The distribution is clearly shifted to the left, which indicates that the entire population of preschool children in this population suffers from stunted growth.

Figure 4.1. National height-for-age z-score (HAZ) as compared to international reference, Malawi Micronutrient Survey, Malawi 2001.



National data is weighted to account for survey design.

4.1.2 Underweight (Weight-for age)

A total of 506 preschool children had weight and age data sufficient for weight-for-age z-score (WAZ) determinations (Box 1). Around a third (31.1%) of the preschool children were classified as having low underweight (WAZ<-2) with a smaller percentage of those (8.1%) having a very low classification of underweight (WAZ<-3). The overall mean of -1.34 $\pm$ 1.23 was less than the international reference of 0.0 (Table 4.2).

Significant differences in the prevalence of underweight were found by age group with the highest prevalence (33.8%) of 12-23.9 month old children having low underweight (WAZ<-2). The highest prevalence (11.4%) of very low underweight was found in the 6-12 month old children.

In addition, a significantly higher prevalence of low underweight (WAZ<-2) was found in male (35.8%) vs. female (26.7%) preschool children.

Table 4.2. Weight-for-age Z-score (WAZ) summary statistics among preschool children, Malawi Micronutrient Survey, Malawi 2001.

			Prevalence (%)	
Category	**N**	**Mean WAZ ± SD**	**<-3 SD**	**<-2 SD**
Age groups (months)				
6-11	111	-1.09 ± 1.54	11.4*	29.8*
12-23	212	-1.58 ± 1.06	8.9	33.8
24-36	183	-1.22 ± 1.15	4.9	28.6
Sex				
Male	240	-1.37 ± 1.29	10.4	35.8*
Female	266	-1.31 ± 1.16	6.0	26.7
SES**				
Low	275	-1.44 ± 1.25	10.1	34.1
Moderate	193	-1.24 ± 1.19	6.4	29.1
High	37	-1.07 ± 1.22	3.0	18.7
Residence				
Urban	43	-1.12 ± 1.20	0.0	31.3
Rural	463	-1.36 ± 1.23	9.0	29.9
Region				
Northern	155	-1.03 ± 1.27	3.2	21.9
Central	192	-1.41 ± 1.23	7.8	32.8
Southern	159	-1.56 ± 1.13	9.4	31.4
National	506	-1.34 ± 1.23	8.1	31.1

National data is weighted to account for survey design.
*p<0.05
** One missing value for socioeconomic status.

4.1.3 Wasting (Weight-for-height)

A total of 486 preschool children had weight-for-height z-scores (WHZ) calculated for an assessment of wasting (Box 1). Overall only 2 preschool children were below –3 standard deviations (SD) for WHZ. A small prevalence of wasting (WHZ<-2) was also found among preschool children (4.7%) with a mean WHZ of –0.14 ± 1.10 that was slightly less than the international reference of 0.0 (Table 4.3).

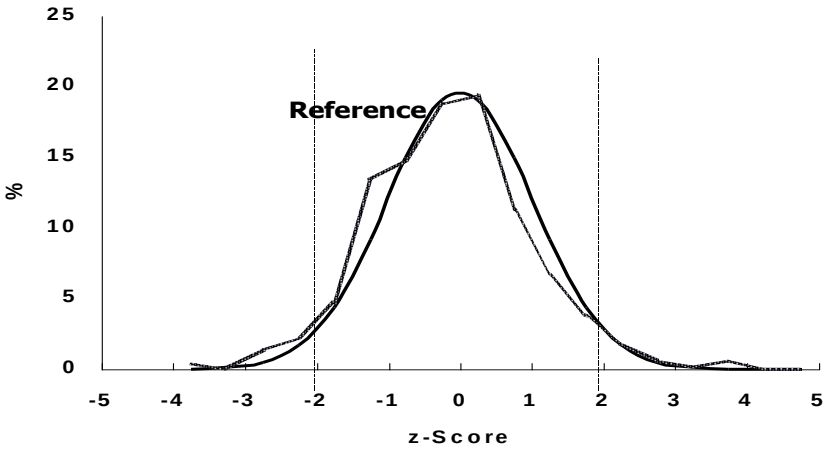
Table 4.3. Weight-for-height Z-score (WHZ) summary statistics among preschool children, Malawi Micronutrient Survey, Malawi 2001.

Category	N	Mean WHZ ± SD	Prevalence (%) <-2 SD
Age groups (months)			
6-11	105	-0.11 ± 1.38	7.3*
12-23	205	-0.39 ± 1.01	5.7
24-36	176	-0.11 ± 0.94	1.8
Sex			
Male	230	-0.13 ± 1.10	5.6
Female	256	-0.16 ± 1.10	3.9
SES**			
Low	262	-0.16 ± 1.16	5.3
Moderate	187	-0.17 ± 1.02	4.9
High	36	0.08 ± 1.06	0
Residence			
Urban	41	-0.13 ± 1.09	6.1
Rural	445	-0.15 ± 1.10	4.5
Region			
Northern	148	-0.04 ± 1.14	3.4*
Central	187	-0.08 ± 1.02	1.1
Southern	151	-0.33 ± 1.14	8.6
National	486	-0.14 ± 1.10	4.7

National data is weighted to account for survey design.
* p<0.05
** One missing value for socioeconomic status.

The distribution of WHZ for preschool children was similar to the reference population (Figure 4.2).

Figure 4.2. National WHZ as compared to international reference, Malawi Micronutrient Survey, Malawi 2001.



National data is weighted to account for survey design.

4.2 Non-pregnant Women of Childbearing Age

4.2.1 Mean weight and height

The mean height was available for 423 women and the mean weight was available for 430 women of childbearing age. Mean values by various characteristics are recorded in Table 4.4. Significant differences were found in the mean weight of women by educational status, SES and residence. Women who had attained a high level of education, in the high SES group and in urban areas tended to be heaviest.

Table 4.4. Mean height and weight for non-pregnant women of childbearing age (15-45 years), Malawi Micronutrient Survey, Malawi 2001.

Characteristics of Women	N	Mean height ± SD	N	Mean weight ± SD
Age Group (years)				
15-19	99	155.5 ± 5.4	99	52.3 ± 12.5
20-29	155	155.1 ± 5.6	156	52.7 ± 7.7
30-39	125	155.7 ± 5.9	125	54.0 ± 11.8
40-45	44	157.2 ± 5.3	45	55.6 ± 10.8
Education*				
None	83	154.8 ± 5.7	87	52.0 ± 6.9***
1-5	144	154.8± 5.8	146	52.3 ± 7.0
6-8	132	155.8 ± 5.1	133	52.4 ± 7.7
>8	63	157.9 ± 5.7	63	59.1 ± 20.6
SES**				
Low	226	155.0 ± 6.0	229	51.3 ± 6.4***
Moderate	153	155.8± 4.9	157	55.3 ± 14.0
High	42	157.8 ± 5.5	42	56.6 ± 11.6
Residence				
Urban	56	156.9 ± 4.7	57	55.9 ± 7.7***
Rural	367	155.4 ± 5.7	373	52.8 ± 10.9
Region				
Northern	151	156.2 ± 5.7	152	53.0 ± 8.1
Central	159	155.6 ± 5.9	163	53.8 ± 11.5
Southern	113	154.8 ± 5.1	115	52.8 ± 12.0
National	423	155.6 ± 5.6	430	53.3 ± 10.6

National data is weighted to account for survey design.
* One unknown response for educational attainment.
** Two missing values for socioeconomic status.
*** $p<0.05$.

4.2.2 Body Mass Index (BMI)

Body mass index (BMI) was calculated on 423 non-pregnant women of childbearing age (15-45 years) (Box 2). The prevalence of underweight women (6.7%) with a BMI of <18.5 was low. A slightly greater prevalence of overweight women (8.1%) with a BMI in the range 25.0-29.9 was found. There is a very small prevalence of obese women (2.4%) with a BMI of >30.0 in Malawi. All BMI calculations by various indicators are displayed in Table 4.5.

Significant differences in the distributions of BMI by educational attainment were noted. A higher proportion of women with secondary school education or greater were obese than women with less education. In addition more women who had only completed standards or grade 6 to 8 were underweight. Almost all (91.7%) of the women with no education were of normal weight by BMI.

Table 4.5. Body mass index (BMI) data for non-pregnant women of childbearing age (15-45 years), Malawi Micronutrient Survey, Malawi 2001.

		Body Mass Index				
Characteristics of Women	**N**	**<18.5**	**18.5-24.9**	**25.0-29.9**	**>30.0**	**Mean ± SD**
Age Group (years)						
15-19	99	9.6	83.8	3.5	3.1	21.5 ± 4.0
20-29	155	5.8	84.2	9.8	0.2	21.8 ± 2.7
30-39	125	6.3	80.5	9.0	4.2	22.2 ± 4.6
40-45	44	3.8	82.4	9.9	3.8	22.6 ± 3.6
Education*						
None	83	3.6	91.7	3.3	1.3	21.7 ± 2.5
1-5	144	5.9	82.4	10.9	0.8	21.8 ± 2.6
6-8	132	11.4	78.9	6.8	2.9	21.5 ± 2.9
>8	63	5.2	76.3	10.6	7.8	23.5 ± 7.2
SES**						
Low	226	8.7	83.2	6.7	1.3	21.4 ± 2.4
Moderate	153	3.5	84.7	8.0	3.8	22.7 ± 5.0
High	42	6.6	73.5	16.1	3.7	22.6 ± 4.0
Residence						
Urban	56	2.6	80.7	14.6	2.1	22.7 ± 3.0
Rural	367	7.3	83.2	7.0	2.5	21.8 ± 3.9
Region						
Northern	151	6.6	82.8	9.3	1.3	21.7 ± 2.8
Central	159	6.3	81.8	9.4	2.5	22.2 ± 4.4
Southern	113	7.1	84.1	6.2	2.7	22.0 ± 3.9
National	423	6.7	82.8	8.1	2.4	21.9 ± 3.8

National data is weighted to account for survey design.
* One unknown response for educational attainment.
** Two missing values for socioeconomic status.

4.3 Comparison of Adult Anthropometry

The mean height and BMI for non-pregnant women from the Malawi Micronutrient Survey was compared to the MDHS from 2000 (Table 4.6). Results were very similar.

Table 4.6. Comparison of Malawi Micronutrient Survey (2001) and Malawi Demographic and Health Survey (2000) mean height and BMI for non-pregnant women (15-44 years).

	Mean Height		Mean BMI	
Years	**2000 MDHS**	**Nat'l MM**	**2000 MDHS**	**Nat'l MM**
15-19	154.5	154.8	20.9	21.3
20-24	155.9	155.3	21.8	21.6
25-29	155.9	155.4	22.1	22.1
30-34	156.6	155.8	22.2	21.9
35-39	156.1	154.9	22.7	22.3
40-44	156.2	156.5	22.6	22.7

National data from the Malawi Micronutrient Survey is weighted to account for survey design.

CHAPTER 5: MORBIDITY - PREVALENCE, KNOWLEDGE AND PREVENTION

This chapter provides results from the malaria assessment of all subjects, from the intestinal parasite data and the urinary schistosomiasis data of preschool children (6-36 months) and from the health history information from all subjects. Household level malaria prevention data was also collected. The organization of this chapter is as follows:

- Household prevention of malaria (mosquito bednets)

- Malaria Thick Smear Results
  - Preschool children
  - School children
  - Women of childbearing age
  - Men

- Intestinal parasites – stool samples
  - School children
- Knowledge of Intestinal Parasites
  - School children

- Urinary schistosomiasis – urine samples
  - School children
- Knowledge of Urinary schistosomiasis
  - School children

- Health History from questionnaire
  - Preschool children
  - School children
  - Women of childbearing age
  - Men
- Health history and infection

5.1 Household Prevention of Malaria (mosquito bednets)

A total of 1471 heads of households answered questions regarding household mosquito bednet knowledge. Nationally 87.4% heads of households had heard of a mosquito bednet. Significant differences were found by socioeconomic status, residence and region. Households classified as having low socioeconomic status had the least knowledge of bednet (83.8%) as compared to both the moderate (91.6%) and high (95.7%) socioeconomic groups. More urban households (93.8%) had heard of mosquito bednets as compared to rural (86.6%) households. More heads of households had heard of mosquito bednets in the Northern (90.3%) and Southern (93.0%) regions as compared to the Central region (80.0%).

When asked, "Is a bednet used by anyone in the family?" only 14.4% heads of households responded positively. Significant differences in household bednet use were found by socioeconomic status, residence and region. Over half of the houses in the high SES group (54.0%) use a bednet in their house in comparison to households in moderate (21.2%) and low (4.6%) SES groups. In rural areas, only 11.1% households use a bednet in contrast to 37.4% in urban areas. The use of household bednets differed by region: 23.2% in the Northern Region, 16.2% in Central Region and 11.1 in Southern Region (Table 5.1).

Table 5.1. Household mosquito bednet knowledge and use, Malawi Micronutrient Survey, Malawi 2001.

	Heard of mosquito bednet		Use mosquito bednet in household	
	N	%	N	%
SES*				
Low	837	83.8	704	4.6
Moderate	521	91.6	477	21.2
High	101	95.7	98	54.0
Residence**				
Urban	176	93.8	165	37.4
Rural	1295	86.6	1125	11.1
Region**				
Northern	496	90.3	448	23.2
Central	501	80.0	401	16.2
Southern	474	93.0	441	11.1
National	1471	87.4	1290	14.4

National data is weighted to account for survey design.
*Missing socioeconomic data from 12 households.
**$p<0.05$

Information on the number of bednets in households where at least one is used was collected. More than half (53.9%) of households with bednets had one net, 33.1% had two nets, 8.8% had three nets and 4.2% had more than 3 nets. Significant differences by socioeconomic status and residence were discovered. The highest prevalence of households with one net was found in the low SES group (77.2%) as compared to the moderate (61.4%) and high (24.7%) SES groups, yet the high SES group had the highest prevalence of two, three and greater than three nets per household. Rural households were more likely to own only one net (58.8%) than their urban counterparts (43.7%), as shown in Table 5.2.

Table 5.2. Number of mosquito bednets in households that reported using bednets, Malawi Micronutrient Survey, Malawi 2001.

		Number of bednets in household			
	N	1	2	3	>3
SES*					
Low	51	77.2	21.8	1.1	0
Moderate	110	61.4	32.1	3.9	2.7
High	55	24.7	41.8	23.6	9.8
Residence**					
Urban	67	43.7	40.4	14.7	1.1
Rural	150	58.8	29.6	5.9	5.6
Region					
Northern	104	41.3	44.2	9.6	4.8
Central	65	47.7	33.8	10.8	7.7
Southern	48	66.7	27.1	6.3	0
National	217	53.9	33.1	8.8	4.2

National data is weighted to account for survey design.
*Missing socioeconomic data from 1 household.
**$p<0.05$

In households where a mosquito bednet was used (n=217), the head of the household was asked who in the household sleeps under the bednet, the father, mother and/or child under 5 years old. Nationally in households that reported using bednets, 68.9% of fathers, 81.2% of mothers and 58.5% of children under 5 years sleep under mosquito bednets. No significant differences between people who sleep under the bednet were found by socioeconomic status, residence or region.

Some of the household heads (n=201) reported how long they had been using a mosquito bednet. Nationally 39.0% had used a bednet less than 1 year, 42.4% had used the bednet from 1-3 years, and 18.6% had used a bednet greater than or equal to 3 years.

Since bednets need to be soaked in insecticide in order to be truly effective, households were asked if they soak their bednet and when the last time they had it soaked. More households in the high SES group (71.5%) had soaked bednets as compared to the moderate (51.8%) and low (41.5%) SES groups. More urban households (65.3%) also had soaked bednets in contrast to rural households (51.0%) (Table 5.3).

Of the 110 households who reported soaking their bednets, 51.7% of them had soaked them in the past 6 months, 31.0% had soaked them between 6-12 months and 17.3% has soaked them greater than 1 year prior to the survey. No significant differences were noted in the frequency of bednet soaking by socioeconomic group, residence or region (Table 5.3).

Table 5.3. Soaking practices of mosquito bednets among households that reported using bednets, Malawi Micronutrient Survey, Malawi 2001.

	Soaking		Frequency of bednet soaking in insecticide			
	N	%	N	< 6 months	6-12 months	> 12 months
***SES**						
Low	51	41.5**	17	44.3	26.8	28.9
Moderate	110	51.8	54	45.9	40.3	13.9
High	55	71.5	39	63.3	18.5	18.2
Residence						
Urban	66	65.3**	40	64.3	24.5	11.2
Rural	151	51.0	70	44.5	34.7	20.8
Region						
Northern	104	35.6	41	43.9	29.3	26.8
Central	65	61.5	38	60.5	23.7	15.8
Southern	48	58.3	31	45.2	38.7	16.1
National	217	55.5	110	51.7	31.0	17.3

National data is weighted to account for survey design.
*Missing socioeconomic data from 1 household.
**p<0.05

5.2 Malaria Thick Smear Summary Results

5.2.1 Malaria in Preschool Children

Preschool children had the highest prevalence of malaria parasitemia, with 60.1% of the subjects having trophozoites present in their blood samples (Table 5.4). Six percent of preschool children had gametocytes detected. Significant differences in parasitemia prevalence were found for preschool children by age group, socioeconomic status and residence.

Table 5.4. Prevalence of malaria parasitemia among preschool children (6-36 months), Malawi Micronutrient Survey, Malawi 2001.

Characteristics of preschool children	N	Malaria parasitemia (%)
Age Group (months)		
6-11	86	50.3*
12-23	187	56.6
24-36	182	68.1
Sex		
Male	247	57.5
Female	269	62.7
SES		
Low	277	64.3*
Moderate	199	59.7
High	39	36.5
Residence		
Urban	40	29.1*
Rural	476	63.2
Region		
Northern	165	56.4
Central	193	56.5
Southern	158	64.6
National	516	60.1

National data is weighted to account for survey design.
*p<0.05

Due to the high prevalence of malaria in preschool children, the data for level of parasitemia is reported in detail in Table 5.5. Most preschool children (60.2%) had parasite levels of +2 and +3.

Table 5.5. Malaria parasitemia among preschool children (6-36 months) by severity of infection, Malawi Micronutrient Survey, Malawi 2001.

		Level of parasitemia (%) in preschool children with malaria parasitemia			
Characteristics of preschool children	N	+1	+2	+3	+4
Age Group (months)					
6-11	43	20.2	22.6	43.8	13.4
12-23	101	21.8	32.5	32.7	12.9
24-36	122	22.7	35.0	25.5	16.8
Sex					
Male	141	23.0	30.4	25.6	21.0
Female	163	23.8	30.0	33.9	12.4
SES*					
Low	174	28.0	29.7	27.6	14.7
Moderate	118	18.6	26.2	34.2	21.0
High	12	7.9	66.7	25.5	0
Residence					
Urban	11	19.5	28.2	34.8	17.4
Rural	293	23.6	30.3	29.8	16.3
Region					
Northern	93	29.0	26.9	25.8	18.3
Central	109	22.0	28.4	29.4	20.2
Southern	102	23.5	32.4	31.4	12.7
National	304	23.4	30.2	30.0	16.4

National data is weighted to account for survey design.
*p<0.05

5.2.2 Malaria in School Children

The prevalence of malaria parasitemia in school children was 47.4% (Table 5.6). Only 1.7% of school children had gametocytes present in their blood. There were no significant differences found in parasite prevalence according to age group, standard, sex, residence or region.

Table 5.6. Prevalence of malaria parasitemia among school children (6-12 years), Malawi Micronutrient Survey, Malawi 2001.

Characteristics of School children	N	Malaria parasitemia (%)
Age Group (years)		
6-7	127	56.9
8-9	171	48.2
10-11	239	42.5
12	160	46.9
Grade/Standard		
1	145	58.4
2	157	51.3
3	177	45.4
4	98	36.1
5	71	38.5
6 and 7	49	44.7
Sex		
Male	349	47.3
Female	348	47.5
Residence		
Urban	83	25.4
Rural	614	50.2
Region		
Northern	235	45.5
Central	230	49.6
Southern	232	46.1
National	697	47.4

National data is weighted to account for survey design.

5.2.3 Malaria in Women

A total of 16.7% of non-pregnant women had malaria parasitemia in their blood. Among the 57 pregnant women sampled, 18.7% had malaria parasitemia present in their blood smears. Rural women were more likely to have malaria parasitemia than their urban counterparts (Table 5.7).

Table 5.7. Prevalence of malaria parasitemia among non-pregnant women of childbearing age (15-45 years), Malawi Micronutrient Survey, Malawi 2001.

Characteristics of Non-pregnant Women	N	Malaria parasitemia (%)
Age Group (years)		
15-19	96	24.0
20-29	152	11.8
30-39	126	18.2
40-45	44	12.6
Education		
None	82	21.2
1-5	147	17.5
6-8	131	14.5
>8	62	12.0
SES		
Low	223	17.4
Moderate	156	18.7
High	42	7.2
Residence		
Urban	55	7.0*
Rural	368	18.3
Region		
Northern	150	18.7
Central	158	16.5
Southern	115	16.5
National	423	16.7

National data is weighted to account for survey design.
*p<0.05

5.2.4 Malaria in Men

A total of 12.2% of the men in the survey had malaria parasitemia. Significantly more men in the high SES group had malaria parasitemia in their blood smears (Table 5.8).

Table 5.8. Prevalence of malaria parasitemia in men (20-55 years), Malawi Micronutrient Survey, Malawi 2001.

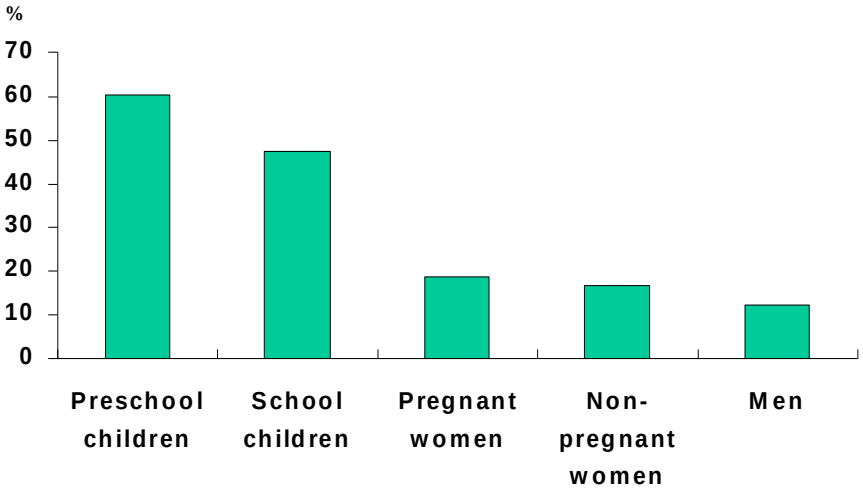
Characteristics of Men	N	Malaria parasitemia (%)
Age Group (years)		
20-29	51	13.7
30-39	46	10.9
40-44	30	13.3
50-55	15	0
Education		
None	13	23.1
1-5	46	8.7
6-8	60	8.3
>8	27	18.5
SES*		
Low	76	6.6
Moderate	58	13.8
High	11	36.4
Residence		
Urban	15	13.3
Rural	131	11.5
Region		
Northern	53	9.4
Central	51	15.7
Southern	42	9.5
National	146	12.2

*p<0.05

5.2.5 Malaria Thick Smear Summary Results

The prevalence of malaria parasitemia (presence of trophozoites), by target group, can be seen visually in Figure 5.1. Preschool children had the highest prevalence at 60.1%, followed by school children (47.4%), pregnant women (18.7%), non-pregnant women (16.7%) and men (12.2). The geometric mean parasite densities for the same groups were 2.3 $\pm$ 1.0 for preschool children, 1.6 $\pm$ 0.7 for school children, 1.6 $\pm$ 1.0 for pregnant women, 1.3 $\pm$ 0.6 for non-pregnant women, and 1.4 $\pm$ 0.6 for men.

Figure 5.1. Prevalence of malaria parasitemia by target group, Malawi Micronutrient Survey, Malawi 2001.



National data is weighted to account for survey design.

5.3 Intestinal Parasites in School Children

From analysis of the stool samples from school children 13.8% had hookworm, 3.7% had roundworm and 2.5% had schistosoma mansoni. Significantly more male children had hookworm and schistosoma mansoni (Table 5.9). Urban children were significantly more likely to have roundworm. School children in the Northern region had significantly more roundworm.

Table 5.9. Prevalence of intestinal parasites among school children (6-12 years), Malawi Micronutrient Survey, Malawi 2001.

Characteristics of School children	N	Hookworm	Roundworm	Schistosoma mansoni
Age Group (years)				
6-7	123	16.1	5.9	4.7
8-9	164	11.3	2.9	2.7
10-11	232	13.4	3.0	1.9
12	154	15.2	4.0	1.6
Grade/Standard				
1	139	18.4	4.3	3.8
2	151	13.1	2.6	3.0
3	171	14.9	4.0	1.0
4	97	11.4	1.5	1.2
5	68	9.9	7.2	4.2
6 and 7	47	9.3	3.7	2.4
Sex				
Male	338	11.0*	3.9	4.2*
Female	335	16.6	3.5	0.8
Residence				
Urban	79	9.9	9.0*	0
Rural	594	14.3	3.1	2.8
Region				
Northern	232	15.9	4.3*	0.9
Central	220	21.4	3.6	2.7
Southern	221	7.2	3.6	2.7
National	673	13.8	3.7	2.5

National data is weighted to account for survey design.
*p<0.05

5.3.1 Knowledge of Intestinal Parasites

Approximately two thirds (65.7%) of school children had ever heard of intestinal worms. Half of them report ever having worms (51.7%) and of those who had worms at one time, (50.9%) received treatment.

School children reported some knowledge of symptoms of intestinal worms, including responses of stomach pain (42.1%) and passing worms in stool (24.0%). A quarter (25.0%) of the school children did not know symptoms of intestinal worm infestation. Knowledge of transmission was very minimal with 71.8% "don't know" responses. Eating soil was repeatedly mentioned as a route of transmission. Knowledge of prevention was also slight with 67.9% "don't know" responses (Table 5.10).

Table 5.10. Responses to questions concerning intestinal worms by school children, Malawi Micronutrient Survey, Malawi 2001 (n=464).

Responses by school children: *	N	%
Symptoms and signs		
Stomach pains	182	42.1
Fever	6	1.8
Pass worms in stools	120	24.0
Weakness	29	7.3
Diarrhea	24	6.5
Other	74	17.0
Don't know	128	25.0
Mode of transmission		
Unwashed food	40	10.2
Untreated water	20	4.9
Walking barefoot	6	1.3
Witchcraft	1	0.3
Other	86	16.4
Don't know	325	71.8
Prevention of intestinal worms		
Eating unbalanced diet	13	3.3
Wearing shoes	6	1.4
Using latrines	10	2.7
Washing hands before eating	25	7.1
Washing food before eating	28	7.0
Other	100	17.6
Don't know	305	67.9

National data is weighted to account for survey design.
*Question asked only of school children who had ever heard about intestinal worms.

5.4 Urinary schistosomiasis in School Children

Testing urine samples for the presence of blood closely approximates yet consistently underestimates the prevalence of urinary schistosomiasis by egg count (Table 5.11). Older age children living in a rural area and living in the Southern region were significantly more likely to have urinary schistosomiasis.

Table 5.11. Prevalence of urinary schistosomiasis among school children (6-12 years), Malawi Micronutrient Survey, Malawi 2001.

Characteristics of School children	N	Blood in urine (dipstick result)	Presence of *Schistosoma haematobium* eggs
Age Group (years)			
6-7	127	17.3*	19.5*
8-9	169	15.3	19.4
10-11	239	23.5	26.3
12	160	27.0	31.1
Grade/Standard			
1	144	17.8	22.0
2	157	27.8	29.9
3	178	21.8	28.1
4	97	16.7	20.9
5	71	14.9	15.3
6 and 7	48	29.7	26.7
Sex			
Male	350	23.4	25.7
Female	345	19.4	23.8
Residence			
Urban	84	7.6*	7.6*
Rural	611	23.2	26.9
Region			
Northern	235	6.8*	6.8*
Central	230	17.0	20.4
Southern	230	28.3	32.2
National	695	21.4	24.7

National data is weighted to account for survey design.
* $p<0.05$

5.4.1 Knowledge of Urinary Schistosomiasis

Of the school children interviewed (n=700), 76.4% had heard of bilharzia or urinary schistosomiasis. In terms of history of infection, 39.1% (n=197) reported having ever had urinary schistosomiasis. Of those children who report ever having urinary schistosomiasis, 48.1% of them had urinary schistosomiasis on the day of the interview. Of the children who had ever reported having urinary schistosomiasis, 38.9% of them had reported being treated at some point.

In terms of responses to questions on symptoms, 73.9% stated that blood in the urine and 34.3% stated that pain when urinating is an indicator of urinary schistosomiasis. Non-coded replies included weight loss and weakness that were mentioned recurrently as symptoms. Around half (51.7%) of the school children stated that contact with contaminated water gave people urinary schistosomiasis, although 32.7% did not know about transmission. Many school children also did not know (44.2%) how to prevent transmission (Table 5.12). Some non-coded responses for methods of prevention included drugs, not jumping over the fire and avoiding urinating in water.

Table 5.12. Responses to questions concerning urinary schistosomiasis by school children, Malawi Micronutrient Survey, Malawi 2001 (n=537).

Responses by school children: *	N	%
Symptoms		
Blood in urine	395	73.9
Pain when urinating	156	34.3
Abdominal pain	24	4.9
Fever	4	1.1
Itching skin	2	0.5
Other	61	11.9
Don't know	85	15.3
Mode of transmission		
Contact with contaminated water (swimming in lake)	261	51.7
Witchcraft	10	2.0
Snails	7	1.8
Other	71	11.6
Don't know	186	32.7
Prevention of urinary schistosomiasis		
Increase access to protected water sources	47	10.1
Stop bathing in a lake/river	132	26.5
Prevent defecating and urinating outside of latrine	103	21.8
Clear vegetation	1	0.1
Other	75	11.8
Don't know	243	44.2

National data is weighted to account for survey design.
*Question asked only of school children who had ever heard about urinary schistosomiasis.

5.5 Health History

The self reported health status of each subject on the day of the survey and in the past 2 weeks is recorded in Table 5.13. All subjects were asked about fever, cough or runny nose, diarrhea, blood in stool, and blood in urine.

Non-pregnant women (27.0%) and men (27.3%) had similar prevalence reports of cough or runny nose that were less than both preschool (49.7%) and school children (40.3%). Preschool children had the highest reported prevalence of fever on the day of the survey (18.9%) and in the previous 2 weeks (50.5%). Preschool children also had the most reported diarrhea on the day of the survey (13.3%) and in the previous 2 weeks (33.5%). The school children had the highest reports of blood in stool (13.3%) and blood in urine (22.5%) on the day of the survey. School children reported the highest cases of other illnesses (32.2%).

Table 5.13. Health history reports on day of survey and in previous two weeks by target group, Malawi Micronutrient Survey, Malawi, 2001.

	Preschool children, 6-36 months (n=547)	School children, 6-12 y (n=697)	Non-pregnant women of childbearing age, 15-45 y (n=449)	Men, 20-55 y (n=161)
Illness on day of survey				
Fever	18.9	12.6	9.3	13.7
Cough or runny nose	49.7	40.3	27.0	27.3
Diarrhea	13.3	9.0	6.1	6.2
Blood in stool	3.7	13.3	3.4	1.9
Blood in urine	1.9	22.5	2.5	3.1
Illness in past 2 weeks				
Fever	50.5	29.8	32.3	36.0
Cough or runny nose	50.0	42.0	33.8	36.6
Diarrhea	33.5	18.7	14.6	14.9
Blood in stool	6.9	11.0	4.0	5.0
Blood in urine	2.0	22.3	3.3	6.2
Other condition/illnesses	15.9	32.2	18.1	26.1

National data is weighted to account for survey design.

5.6 Health history and infection

The relationship between reported symptoms and corresponding infection was examined on all subjects, excluding pregnant women, for malaria parasitemia and reported fever. On school children the relationship between hookworm and reported blood in the stool was examined. Also for school children urinary schistosomiasis and reported blood in urine was assessed. All relationships included reported illness on the day of the survey and in the previous 2 weeks.

5.6.1 Malaria parasitemia and reported fever

Of the preschool children who had malaria parasitemia, 24.2% of them also reported having a fever on the day of the survey which was significantly different from the 10.6% of preschool children who did not have malaria parasitemia yet had a fever on the day of the survey (Table 5.14). No other significant associations were found between malaria parasitemia and reports of fever both on the day of the survey and in the past 2 weeks.

Table 5.14. Prevalence of reported fever in those with and without malaria parasitemia, Malawi Micronutrient Survey, Malawi 2001.

Target group	Malaria parasitemia	N	Prevalence of fever on day of the survey (%)	Prevalence of fever in past 2 weeks (%)
Preschool children	Yes	304	24.2*	52.2
	No	212	10.6	49.6
School children	Yes	328	12.6	29.4
	No	365	12.8	29.9
Non-pregnant women	Yes	73	9.4	31.3
	No	350	9.4	32.3
Men	Yes	17	19.6	37.0
	No	129	12.7	42.3

National data is weighted to account for survey design.
* $p<0.05$

5.6.2 Worm infections and reported illness

No difference was found between school children who had hookworm and their reports of blood in their stool either on the day of the survey or in the previous 2 weeks (Table 5.15).

Table 5.15. Hookworm infection and prevalence of reported blood in stool among school children, Malawi Micronutrient Survey, Malawi 2001.

Parasitic infection		N	Prevalence of blood in stool (%)	
			On day of survey	In past 2 weeks
Hookworm	Yes	100	15.1	11.1
	No	569	12.9	11.5

National data is weighted to account for survey design.

Of the school children who had urinary schistosomiasis 48.2% of them reported having blood in their urine on the day of the survey and 48.6% of them reported having blood in their urine in the previous 2 weeks (Table 5.16), which was significantly different from school children without urinary schistosomiasis.

Table 5.16. Urinary schistosomiasis infection and prevalence of reported blood in urine among school children, Malawi Micronutrient Survey, Malawi 2001.

Parasitic infection		N	Prevalence of blood in urine (%)	
			On day of survey	In past 2 weeks
Urinary schistosomiasis	Yes	137	48.2*	48.6*
	No	555	14.1	13.7

National data is weighted to account for survey design.
* $p<0.05$

CHAPTER 6: FOOD CONSUMPTION

This chapter provides results from the Fortification Rapid Assessment Tool (FRAT) a modified 24-hour recall. The organization of this chapter is as follows:

- FRAT Results
- Breastfeeding Results

FRAT questionnaires can be found in Annex F and the calibration of household utensils for the FRAT estimates can be found in Annex H.

6.1 Fortification Rapid Assessment Tool (FRAT)

Responses to the FRAT questions were obtained from 157 preschool children, 165 women, and 161 men. Specific demographics of the FRAT respondents were not collected.

6.1.1 Standard consumption

Overall, 60% of the women, 51% of the preschool children, and 64% of the men in the survey reported a typical intake the previous day. All other respondents were asked about a usual day.

Sugar was reportedly consumed by 45.9% of preschool children, 37.2% of the women and 44.1% of the men while oil was consumed by 26.8% of preschool children, 36.8% of the women and 45.3% of the men. A very small percentage, 7.1%, of preschool children had consumed centrally processed complementary foods on the previous day (Table 6.1).

Table 6.1. Food consumption pattern of women, preschool children and men, using 24-hour recall consumption data, FRAT, Malawi Micronutrient Survey, Malawi 2001.

	Food consumed (%)		
Centrally Processed Food	Preschool Children (6-36 months)	Women (15-45 years)	Men (20-55 years)
	n=157	n=165	n=161
Sugar	45.9	37.2	44.1
Oil	26.8	36.8	45.3
Maize meal	1.9	2.5	3.7
Complementary foods	7.1		

National data is weighted to account for survey design.

The average amount of each staple food in grams was calculated utilizing the equivalent grams determination from the cooking exercise with the panel women before the survey training (Annex H). Women consumed the greatest amount of sugar, mostly in tea. Preschool children consumed the least amount of sugar. Men consumed the greatest amount of oil (Table 6.2). So few subjects reported consuming centrally processed maize meal or complementary foods on the previous day that consumption estimates were not calculated.

Table 6.2. Average amounts of centrally processed sugar and oil consumed by women, preschool children and men, national 24-hour recall consumption data, FRAT, Malawi Micronutrient Survey, Malawi 2001.

	Average Amount consumed (grams)		
Centrally Processed Food	Preschool Children (6-36 months) n=157	Women (15-45 years) n=165	Men (20-55 years) n=161
Sugar	45	68	54
Oil	3.7	3.8	4.3

National data is weighted to account for survey design.

The average number of days in the past 7 days, not including the previous day, that sugar and oil were consumed did not vary significantly by target group (Table 6.3). The percent of subjects who had sugar or oil more than 2 days before the interview was also analyzed and reported. The percentage of any of the target groups who consumed centrally processed maize meal was so small that the analysis of consumption in the past 7 days was not done.

Table 6.3. Average number of days in the past 7 days of centrally processed sugar and oil consumed by women, preschool children and men, national consumption data, FRAT, Malawi Micronutrient Survey, Malawi 2001.

Centrally Processed Food	Preschool Children (6-36 mos)	Women (15-45 years)	Men (20-55 years)
	n=157	n=165	n=161
SUGAR			
Average number of days consumed in past 7 days	4.1 days	4.8 days	3.9 days
Percent consumed any sugar in last 7 days	60.4%	65%	66.5%
OIL			
Average number of days consumed in past 7 days	3.8 days	3.6 days	3.6 days
Percent consumed any oil in last 7 days	52.4%	56.1%	61.5%

National data is weighted to account for survey design.

Hardly any of the staple foods are solely consumed in the rainy season, although the rainy season may be the time when centrally processed maize is relied on if locally processed maize is not available. A range of 35 to 48% of sugar is purchased in all seasons. A similar range is applicable for oil (Table 6.4). Most of the other category replies for sugar and oil stated that these staple foods are only purchased when there is enough money in the household.

It must be noted that seasonality does vary across the regions of Malawi, but these nationally representative data from the FRAT cannot be divided by region. Thus these seasonal responses are only to obtain a sense of whether buying practices do vary by season.

Table 6.4. Seasonality of consumption of centrally processed sugar, oil, maize meal and complementary foods by women, preschool children and men, national consumption data, FRAT, Malawi Micronutrient Survey, Malawi 2001.

	Preschool Children (6-36 mos) n=157	Women (15-45 yrs) n=165	Men (20-55 yrs) n=161
SUGAR			
All seasons	47.8	41.7	35.4
Harvest seasons	22.9	39.9	36.6
Other*	28.0	12.3	23.0
Rainy season only	1.3	6.1	5.0
OIL			
All seasons	38.9	41.5	35.4
Harvest seasons	21.7	39.6	36.6
Other*	38.9	15.2	26.7
Rainy season only	0.6	3.7	1.2
MAIZE MEAL			
Rainy season only	2.6	6.8	13.8
All seasons	2.6	2.5	2.5
Harvest seasons	1.3	1.2	3.1
COMPLEMENTARY FOODS			
All seasons	9.6		
Harvest seasons	1.9		
Rainy season only	0		

National data is weighted to account for survey design.
*The other responses for sugar and oil included many references to dependence on availability of money rather than season for purchasing.

6.2 Other food-related questions

Some additional questions about the identified staple foods were added to the women and infant FRAT questionnaires.

6.2.1 Use of centrally processed foods in household

The primary female cook of the two households per cluster was asked additional information beyond the standard consumption questions. Information on the usual purchasing habits for cooking oil including brands bought and frequency of purchasing was gathered.

A total of 50.3% of the women reported usually using cooking oil. If they usually used cooking oil, the interviewers asked to see the oil in the house. Of the women who usually use oil, 24.1% did not have oil in the house on the day of the interview. No brand name was available for 36.1% of the household oil. Both Kazinga and Covo oils are both already fortified with vitamin A (Table 6.5). No determination was possible on the amount of oil found in the house.

Table 6.5. Brand of centrally processed oil purchased by women who reported using oil, FRAT, Malawi Micronutrient Survey, Malawi 2001.

Brand of oil	Percent usually using oil (%)
None available	24.1
Repackaged	21.6
Loose from open sack (Oyeza)	14.5
Kazinga (fortified)	14.5
Covo (fortified)	12.1
Homemade	6.0
Sunfoil	6.0
Olivine	1.2

National data is weighted to account for survey design.

Women were also asked about purchasing of centrally processed maize flour and the types of maize flour purchased. Only 1.2% or 2 women reported usually buying centrally processed maize flour. A total of 88.5% of the women reported using local maize mills, called Hammermills.

Women were also asked about the usual availability of household sugar, how often sugar is purchased and the brands acquired. Overall, 61.2% of the women reported usually having sugar in their house. Half of the women with sugar in their house had Illovo sugar. The most common size package of sugar purchased was 1kg bag, which is expected since Illovo primarily markets 1kg bags of sugar (Table 6.6).

Table 6.6. Brand of centrally processed sugar purchased by women who reported using sugar, FRAT, Malawi Micronutrient Survey, Malawi 2001.

Brand of sugar	Percent usually using sugar*	Amount usually purchased (%)			
		0.25 kg	0.5 kg	1.0 kg	2.0 kg
Illovo	49.7			85.3	
None available	24.8				
Loose from open sack (Oyeza)	11.4	12.5	56.3	25.0	6.3
Repackaged/No brand name	2.7				
Other	2.7				

National data is weighted to account for survey design.
*Not all questionnaires had a response for brand of sugar found in the house on the day of the interview.

Oil and sugar are most frequently bought once a month. The other responses for oil state time periods one month or more. The other replies for sugar are more dependent on the availability of money (Table 6.7).

Table 6.7. Frequency of purchasing centrally processed oil and sugar by women who reported using oil and sugar, FRAT, Malawi Micronutrient Survey, Malawi 2001.

	Oil (%)	Sugar (%)
Once a month	33.8	30.6
Once a week	12.1	26.9
Every two weeks	17.2	11.9
Every other day	8.3	6.9
Every day	3.8	1.3
Other*	21.0	20.6
Don't Know	3.8	1.9

National data is weighted to account for survey design.
*The other responses included many references to "less than a month" and "dependent on money."

The type of pots used for cooking household food was also ascertained. The most common type of pot used for cooking was a clay pot. The second most common was an aluminum pot (Table 6.8).

Table 6.8. Type of cooking pots used by women, FRAT, Malawi Micronutrient Survey, Malawi 2001.

Type of pot	Percent of households using specific type of cooking pot (%)
Clay pot	69.7
Aluminum	52.7
Stainless Steel	23.0
Enamel	16.4
Iron	4.8
Don't know	4.8

National data is weighted to account for survey design.

6.2.2 Use of centrally processed complementary foods

In addition to the standard consumption questions, the caregivers of preschool children in 2 households per cluster were asked if the child was given centrally processed complementary foods yesterday. Only 12.7% preschool children usually consume centrally processed complementary foods. They ate Likuni Phala, Cerelac, Baby Best and infant formula.

6.3 Breastfeeding

Of the 450 non-pregnant women who were interviewed, 43.3% (n=195) affirmed that they were currently breastfeeding.

6.3.1 Exclusive breastfeeding

The caretakers of the preschool children in the survey were asked about their breastfeeding practices or their knowledge of the breastfeeding practices that were used with the child. The caretaker was asked the age of the children when they introduced solid foods or drink to complement breast milk as a way to gain an estimate of exclusive breastfeeding practices.

Of the 419 preschool children less than 12 months old, 52.3% were fed other foods or drink besides breast milk at less than six months and 47.7% had neither been fed any solid food nor drink through six months of age. Table 6.9 shows some significant regional variation, with a higher prevalence of exclusively breastfed children for less than 6 months in the Central Region and more exclusively breastfed children in the Southern region.

Table 6.9. Prevalence of exclusive breastfeeding by region, Malawi Micronutrient Survey, Malawi 2001.

				Range of months of exclusive breastfeeding (%)				
	N	Percent <6 mos	Percent >=6 mos	0-3 mos	4-6 mos	7-9 mos	10-12 mos	>12 mos
Region								
Northern	127	52.8	47.2*	21.3	66.9	10.2	0.8	0.8
Central	159	61.0	39.0	25.8	64.2	8.2	1.3	0.6
Southern	119	42.9	57.1	12.6	68.9	17.6	0.8	0.0
National	405	53.1	46.9	20.5	66.4	11.6	1.0	0.5

National data is weighted to account for survey design.
*p<0.05

6.3.2 Duration of Breastfeeding

Overall 60.2% of all the preschool children in the survey were still being breastfed at the time of the survey. Of the ones who had stopped breastfeeding and were over 12 months of age, 7.0% (n=18) stopped breast-feeding at the age of less than 12 months whereas 93.0% (n=192) were breastfed for 12 months and over (Table 6.10). Results are similar across the three regions.

Table 6.10. Breastfeeding duration of preschool children who had stopped breastfeeding at the time of the survey, Malawi Micronutrient Survey, Malawi 2001.

	N	Percent <12 months	Percent >= 12 months
Region			
Northern	77	11.7	88.3
Central	84	9.5	90.5
Southern	49	2.0	98.0
National	210	7.0	93.0

National data is weighted to account for survey design.

6.3.3 Comparison of Breastfeeding Practices

The Malawi Demographic and Health Surveys (MDHS) of 1992 and 2000 revealed that over 90% of children in Malawi were breastfed up to 18 months of age. The 2000 MDHS found 63% prevalence of exclusive breast-feeding under the age of 4 months, whereas solid food, drink and water were given to 37% of the infants besides breast milk. The 2000 Micronutrient and Health (MICAH) Project of the World Vision found exclusive breast-feeding rate of 72% in children under the age of 4 months.

CHAPTER 7: IODINE STATUS

This chapter provides estimates for the coverage of iodized salt, and knowledge of iodine deficiency disorders (IDD) and iodized salt. The organization of this chapter is as follows. Results are presented for:

- Household iodized salt usage
  - Rapid test kit results
  - Salt titration results
  - Comparison of rapid test kit and titration results
  - Comparison of titration results with 2000 MDHS rapid test kit
- Knowledge of iodized salt and iodine deficiency
  - Among women of childbearing age
  - Among school children

7.1 Urinary Iodine in School Children

The measure of the iodine nutrition status of school children is based on urinary iodine in children aged 6-12 years. Quality assurance results indicate that the data are not reliable and therefore not to be included in this report.

7.2 Household Iodized Salt Usage

The iodine content of salt was measured two ways. First, at the household, a rapid test kit was used (MBI, India) and, for a sub-sample of households, salt samples were collected and sent to a laboratory for iodine titration.

7.2.1 Rapid Test Kit Results

While the MBI kit has a number of semi-quantitative cutoff values based on the intensity of the reaction using a color scheme, for this survey it was decided to categorize the results as **no color change** (no reaction and therefore unlikely to contain iodine) vs. **any color change** (the salt is likely to contain at least some iodine).

Of the 1461 households surveyed, 86.1% had salt available for testing (Table 7.1). In general, lower SES households and households in Southern Malawi were least likely to have salt available for testing. Of the households with salt, 91.7% had some iodine according to the rapid test kit. There was no significant difference in the proportion of households with at least some iodine by the various household characteristics (residence, region, or SES).

Table 7.1. Prevalence of households (HH) with salt available for testing and with presence of iodine based on a rapid salt iodine test kit, Malawi Micronutrient Survey, Malawi 2001.

Household Characteristic	N	HH with salt (%)	Results with color change* (%)**
SES			
Low	831	80.5	92.2
Moderate	517	92.6	91.9
High	101	99.3	87.4
Residence			
Urban	175	92.4	91.8
Rural	1286	85.3	91.7
Region			
Northern	490	87.1	94.1
Central	497	89.5	89.9
Southern	474	82.9	92.9
National	1461	86.1	91.7***

National data is weighted to account for survey design.
Note: there were 10 completed household interviews where the rapid salt iodine test results were not provided.
*A change in color is an estimate of the presence of iodine in the salt using the MBI kit.
**Based on households that had salt available for testing.

***95% CI: 89.5, 94.0, DEFF = 2.245

7.2.2 Salt Titration Results

Salt titration was performed on a sub-sample of household salt (n=510). Overall, 77.6% of salt samples contained some iodine (>0 ppm) (95%CI: 72.2, 82.9, DEFF=2.126). The percentage of households with various iodine levels in salt, as determined by titration, is also presented in Table 7.2. For international comparisons, the indicator used to assess the coverage of the salt iodization intervention, is the percentage of households using salt with at least 15 ppm iodine (WHO/UNICEF/ICCIDD 2001). Target coverage rates for the elimination of iodine deficiency are that 90% of households should be using food grade salt with an iodine content of at least 15ppm. In Malawi, 47.1% (95% CI: 40.5, 53.8; DEFF = 2.338) of the households are estimated to have salt with at least 15 ppm. Consistent with the harmonization regulations for iodized salt in Southern Africa the target at the household is for 100% of households to be using salt that contains at least 25 ppm iodine (ICCIDD, 1999). Only 36.7% (95% CI: 30.4, 43.0, DEFF=2.260) of the households in this survey met this target. Figure 7.1 displays the prevalence of households with varying levels of iodized salt.

Of the salt that contained some iodine (> 0 ppm), the median iodine level was 23.3 ppm, and a distribution of the iodine content is presented in Figure 7.1. From the figure, the most frequent categories were where the salt iodine content was <15 ppm.

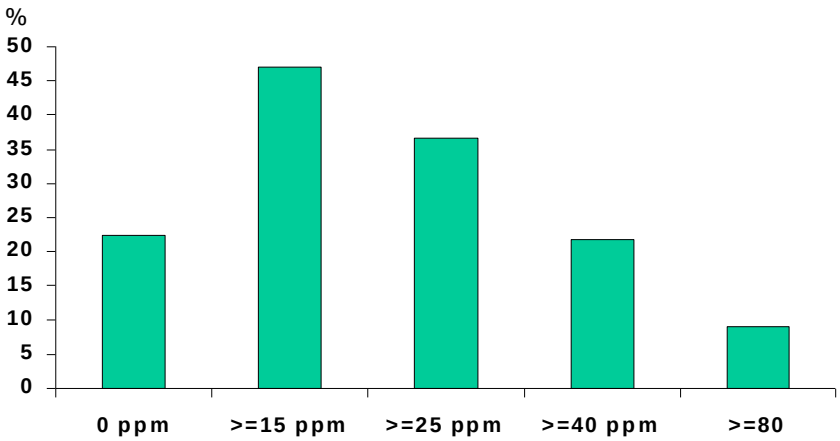
There were no significant differences in iodine levels by residence or by SES. There were significant differences by Region. The Southern region had the lowest coverage of iodized salt (70.0%) compared to the Northern region where 93.1% of the household salt had some iodine. While the Southern region had the lowest coverage of salt with some iodine, the iodine content of salt with iodine in the Southern region was the highest of the three regions, with a median value of 34.9 ppm. The iodine content of salt in the Central region was the lowest with a median value of 16.9 ppm.

Table 7.2. Prevalence of households (HH) with various levels of iodine in salt and median iodine levels (ppm) based on salt titration analysis, Malawi Micronutrient Survey, Malawi 2001.

Household characteristic	N	Percentage of HH with various levels of iodine (ppm) in salt							Median Iodine (ppm)*
		0 ppm **no** iodine	>0 ppm **some** iodine	≥15 ppm	≥25 ppm	≥30 ppm	≥40 ppm	≥80 ppm	
SES									
Low	269	24.0	76.0	42.3	34.3	28.4	19.2	6.5	20.1
Moderate	202	20.9	79.1	52.0	40.0	36.5	25.7	11.1	25.4
High	34	22.1	77.9	55.7	35.2	30.2	19.3	15.8	24.3
Residence									
Urban	59	22.2	77.8	44.0	32.2	28.9	21.0	9.6	19.0
Rural	451	22.4	77.6	47.5	37.3	32.1	21.9	8.9	24.3
Region									
Northern	202	6.9	93.1	62.9	44.6	33.7	20.8	5.9	23.3
Central	158	17.1	82.9	44.3	29.7	20.9	12.7	4.4	16.9
Southern	150	30.0	70.0	46.0	40.7	40.0	29.3	13.3	34.9
National	510	22.4	77.6	47.1	36.7	31.7	21.8	9.0	23.3

National data is weighted to account for survey design.
Note: salt iodine titration performed on a subset of households (approximately 1/3 of households surveyed). For 5 households, SES level could not be determined.
*The median iodine content of salt (in ppm) was based on salt with some measurable level of iodine (i.e., calculation excludes salt samples with no iodine).

Figure 7.1. Percentage of households with various levels of iodine (ppm) in salt, Malawi Micronutrient Survey, Malawi 2001.



National data is weighted to account for survey design.

7.2.3 Comparison of Rapid Test Kit and Titration Results

Weighted analyses of rapid test kit results estimated 91.7% of households with salt available for testing had salt that contained at least some iodine (some color change), compared to 77.6% based on titration (Table 7.3). Assuming that titration is the "gold standard", this discrepancy between the two coverage estimates is due to the rapid test kit's false positive test results; of the 463 rapid test kit results indicating the presence of iodine, 67 (14.5%) did not contain iodine according to titration results. Therefore the rapid test kit overestimates the proportion of households having salt with some iodine.

In Table 7.2, there was no significant difference in iodized salt coverage, based on the rapid test kit, between the three Regions. However, the titration results identified the Southern region as having only 70% of households using iodized salt and also identified the problem of inadequate iodine levels in iodized salt in the Central region.

Table 7.3. Comparison of rapid test kit and titration results for iodine in salt; based on unweighted analyses, Malawi Micronutrient Survey, Malawi 2001.

		Titration Results (ppm)			
		> 0 some iodine	**= 0 no iodine**		
Rapid Test	**Yes (+)**	396	67	463	PV+ = 85.5%
Kit Results*	**No (-)**	21	18	39	PV- = 46.2%
		417	85	502	
		Sensitivity = 95.0%	Specificity = 21.2%		

*If there was a color change using the rapid test kit, this is classified as **Yes (+)**; if there was no color change, the classification was **No (-)**.
Sensitivity calculated as 396/417; specificity 18/85; PV+ 396/463; PV- 18/39

7.2.4 Comparison with 2000 MDHS

In 2000, and Malawi Demographic and Health Survey (MDHS) was performed in Malawi that assessed approximately 14,000 households. A rapid test kit was used to estimate the proportion of households using iodized salt. In the MDHS, the iodine content of the salt was recorded into the four categories on the survey instrument: 0-14 ppm, 15-20 ppm, 20-74 ppm, and 75+ ppm. In the MDHS report, the proportion of households with salt containing 15+ ppm iodine was presented. The 2001 Malawi Micronutrient Survey recorded for rapid test kit results "no iodine" vs. "some iodine," therefore the rapid test kit results cannot be directly compared between the two surveys. However, the 2000 MDHS rapid test kit results can be compared with the 2001 Malawi Micronutrient Survey titration results as shown in Table 7.4. Overall, both surveys estimate similar coverage levels of the proportion of households with salt containing 15+ ppm. The MDHS reported the coverage higher in urban area, whereas the 2001 Malawi Micronutrient Survey found no important urban/rural differences. The two surveys had similar coverage estimates by region.

Table 7.4. Comparison of weighted estimates of the percentage of households with salt containing 15+ ppm iodine, 2000 MDHS (rapid test kit results) and the 2001 Malawi Micronutrient Survey (titration results), Malawi.

Household Characteristic	2000 MDHS, rapid test kit results, 15+ ppm	2001 Malawi Micronutrient Survey, titration results, 15+ ppm
Residence		
Urban	66.3	44.0
Rural	46.2	47.5
Region		
Northern	59.2	62.9
Central	46.8	44.3
Southern	48.4	46.0
National	48.9	47.7

National data from the Malawi Micronutrient Survey 2001 is weighted to account for survey design.
MDHS percentage based on percentage of children under five living in households using adequately iodized salt; Malawi Micronutrient Survey estimates based on households with salt available for testing.

7.3 Knowledge of iodized salt and iodine– Women

A total of 524 women of childbearing age (15 years up to 45 years) were interviewed during the survey. Of these women, 48.4% reported having heard of iodized salt (Table 7.5). Women of higher education, higher SES, and from urban areas were significantly more likely to report having heard of iodized salt; no significant differences were found by age or region.

Women reporting having heard of iodized salt were asked additional questions related to iodized salt. Of this subset of women (n=242), 46.5% reported that when they shop they buy iodized salt (see Table 7.5). Women of higher education, higher SES, and from urban areas were significantly more likely to report buying iodized salt. Responses to the reasons why people use iodized salt are presented in Table 7.6. Around half (50.1%) responded that people buy salt to prevent goiter, 25.7% mentioned the prevention of growth failure, 6.0% mentioned factors related to still births, spontaneous abortion, and infant deaths, and 15.6% reported other reasons; 23.7% reported that they did not know why people use iodized salt. Multiple answers were recorded for knowledge questions.

Table 7.5. Prevalence of women of childbearing age (15-45 years) having heard of iodized salt or reported buying iodized salt, Malawi Micronutrient Survey, Malawi 2001.

Characteristics of Women	Total No. of women surveyed	Women reporting having heard of iodized salt		Percent reporting buying iodized salt*
		N	%	
Age Group (years)				
15-19	114	52	46.6	49.9
20-29	208	93	47.9	48.8
30-39	153	75	50.5	43.0
40-45	49	22	48.5	38.3
Education				
None	108	28	25.2	40.9
1-5	180	63	44.2	30.9
6-8	158	90	62.6	56.6
>8	76	61	76.8	60.2
SES				
Low	280	90	34.4	35.2
Moderate	193	107	59.2	47.0
High	48	43	86.6	69.6
Residence				
Urban	71	53	74.9	60.9
Rural	453	189	44.2	42.5
Region				
Northern	188	82	44.1	52.4
Central	191	83	43.7	54.2
Southern	145	77	53.1	40.3
National	524	242	48.4	46.5

National data is weighted to account for survey design.
Note: Education was unknown for two women and SES unknown for three women.
*Percent based on women who had reported having heard of iodized salt.

To summarize, just below half (48.4%) of the women had heard of iodized salt, and of those who had heard of iodized salt, close to half (46.5%) report buying iodized salt and around three-quarters (76.3%) provided one or more reasons why people use iodized salt (Table 7.6).

Table 7.6. Responses to why people use iodized salt, women of childbearing age (15-45 years), Malawi Micronutrient Survey, Malawi 2001 (n=240)

Listed responses by women of childbearing age to: Why do people use iodized salt? *	%
Prevent goiter development	50.1
Prevent stillbirths, spontaneous abortions, and infant deaths	6.0
Prevent growth failure	25.7
Other	15.6
Don't know	23.7

National data is weighted to account for survey design.
Note: survey participants could provide multiple responses to why people use iodized salt
*Question asked only of women who had heard of iodized salt

7.4 Knowledge of iodized salt and iodine– School children

A total of 701 schoolchildren were surveyed and asked "Have you heard of iodized salt?" Only 16.3% responded "yes" (Table 7.7). In general, older school children and schoolchildren in the higher grade/standard were more likely to respond that they had heard of iodized salt; there were no significant differences by sex, residence, or region.

Table 7.7. Prevalence of school children having heard of iodized salt, Malawi Micronutrient Survey, Malawi 2001.

Characteristics of School Children	N	Percent reporting having heard of iodized salt
Age Group (in years)		
6-7	127	12.2
8-9	171	8.8
10-11	242	19.2
12	161	21.9
Grade/Standard		
1	145	9.9
2	160	7.0
3	178	14.7
4	98	20.0
5	71	28.6
6 and 7	49	43.5
Sex		
Male	350	17.1
Female	351	15.4
Residence		
Urban	84	20.8
Rural	617	15.7
Region		
Northern	235	11.9
Central	234	14.5
Southern	232	18.6
National	701	16.3

National data is weighted to account for survey design.

Among school children that answered yes to having heard of iodized salt, the schoolchildren were asked: "Why do people use iodized salt?" Of school children that had heard of iodized salt, most (57.1%) did not know why people use it (Table 7.8). In general, it appears that knowledge of iodized salt and the reasons for its use were not widely known by school children at the time of the survey.

Table 7.8. Responses to why people use iodized salt, school children, Malawi Micronutrient Survey, Malawi 2001, (n=105)

Listed responses by school children to: Why do people use iodized salt? *	%
Prevent goiter development	13.4
Prevent stillbirths, spontaneous abortions, and infant deaths	0.0
Prevent growth failure	1.9
Other**	30.5
Don't know	57.1

National data is weighted to account for survey design.
*Question asked only of children who had heard of iodized salt
** Responses for other included "to be healthy" and "it tastes good."

CHAPTER 8: VITAMIN A STATUS

A number of different indicators related to vitamin A were collected in this survey. The organization of this chapter is as follows:

- Serum retinol levels and prevalence of vitamin A deficiency
  - Preschool children
  - School children
  - Women of childbearing age
  - Men
- Comparison of vitamin A deficiency among groups
- Vitamin A and Malaria
- Self-assessed clinical sign of vitamin A deficiency, poor eye sight
  - Women of childbearing age
- Vitamin A supplementation
  - Preschool children
  - Women of childbearing age
- Knowledge of vitamin A deficiency and its prevention
  - Preschool children
  - Women of childbearing age

8.1 Serum retinol levels and vitamin A deficiency

8.1.1 Serum retinol levels in preschool children

Of the 547 preschool children (6-36 months) in the survey, serum retinol values were available for 476 (87.0%). The prevalence of low serum retinol and mean retinol by demographic characteristic is presented in Table 8.1. The weighted prevalence of vitamin A deficiency (defined as a serum retinol <20 µg/dl) was 59.2% (95% CI: 52.9, 65.4; DEFF = 2.001). The overall weighted mean serum retinol was 19.6 (95% CI: 18.6, 20.7). Children from high SES households were significantly less likely to be vitamin A deficient and to have, on average, a higher mean serum retinol. The Northern region was significantly less likely to be vitamin A deficient and had, on average, a higher mean serum retinol. There were no differences in these vitamin A indicators by age, sex, or residence.

Table 8.1. Prevalence of low serum retinol levels and mean serum retinol levels among preschool children (6-36 months), Malawi Micronutrient Survey, Malawi 2001.

Characteristics of Preschool children	N	Prevalence (%) of serum retinol:			Mean serum retinol (µg/dl)
		<10 µg/dl	<20 µg/dl	<30 µg/dl	
Age Group (months)*					
6-11	97	4.8	59.7	94.6	19.1
12-23	191	6.8	58.8	87.7	20.1
24-36	170	9.7	61.1	94.4	19.1
Sex					
Male	228	9.3	62.6	92.6	19.3
Female	248	5.6	55.9	89.9	19.9
SES					
Low	258	6.6	60.4**	92.5**	19.4**
Moderate	181	9.5	63.6	93.7	18.8
High	36	3.0	30.3	72.2	24.8
Residence					
Urban	38	12.1	58.0	90.2	20.2
Rural	438	6.9	59.3	91.3	19.6
Region					
Northern	149	3.4**	40.3**	79.2**	24.2**
Central	175	4.6	63.4	90.9	19.5
Southern	152	10.5	59.9	94.1	18.7
National	476	7.4	59.2	91.2	19.6

National data is weighted to account for survey design.
*For 18 children the exact age was unknown
**p<0.05

8.1.2 Serum retinol in school children

Out of the 701 school children in the survey, serum retinol results were available for 603 (86.0%). Estimates of the prevalence of low serum retinol are provided for three different cutoff values (Table 8.2). The prevalence of vitamin A deficiency (VAD) in school children (serum retinol <20 µg/dl) was 38.3% (95% CI: 32.1, 44.6, DEFF = 2.582) and the mean serum retinol was 24.1 µg/dl (95% CI: 22.8, 25.5). The most significant difference in the prevalence of VAD (defined as a serum retinol <20 µg/dl) was by Region, with the Central region having the highest prevalence (65.7%; 95% CI: 55.4, 76.1, DEFF = 2.6), the Southern region intermediate (22.3%; 95% CI: 13.7, 30.8, DEFF = 1.9) and the Northern region the lowest prevalence (10.2%; 95% CI: 5.9, 14.5, DEFF = 1.1). The only other significant difference in VAD was by grade, with children in higher grades having a lower prevalence.

Table 8.2. Prevalence of low serum retinol levels and mean serum retinol levels among school children (6-12 years), Malawi Micronutrient Survey, Malawi 2001.

Characteristics of School Children	N	Prevalence (%) of low serum retinol:			Mean serum retinol (µg/dl)
		<10 µg/dl	<20 µg/dl	<30 µg/dl	
Age Group (years)					
6-7	107	9.3	42.5	82.9	21.6
8-9	155	5.6	44.8	81.0	21.8
10-11	208	6.6	35.8	68.9	24.8
12	133	3.2	31.9	59.2	27.4
Grade/Standard					
1	123	9.1	48.6	85.6	20.8
2	144	5.0	37.7	73.4	23.9
3	157	9.0	38.6	70.6	23.5
4	83	2.1	27.2	74.9	25.8
5	58	1.8	37.8	52.7	27.9
6 and 7	38	3.1	28.5	50.2	29.5
Sex					
Male	295	7.6	35.3	70.4	24.6
Female	308	4.5	41.1	73.6	23.7
Residence					
Urban	67	12.9	47.0	66.7	24.3
Rural	536	5.2	37.3	72.7	24.1
Region					
Northern	215	0.0	10.2	53.5	30.5
Central	213	10.8	65.7	89.2	18.5
Southern	175	3.4	22.3	62.3	27.3
National	603	6.0	38.3	72.1	24.1

National data is weighted to account for survey design.

8.1.3 Serum retinol levels in women of childbearing age

Serum retinol values were available for 464 women ages 15–45 years of age (Table 8.3). The overall prevalence of vitamin A deficiency, defined as a serum retinol <30 µg/dl in this group, was 89.9% (95% CI: 85.2, 94.5; DEFF = 2.86). No statistically significant differences were found by demographic categories for a prevalence of serum retinol <30 µg/dl or for mean serum retinol levels. The mean serum retinol was 20.0 (95% CI: 18.8, 21.3). The prevalence for various cutoffs of serum retinol and mean retinol values are presented in Table 8.3 by various demographic factors.

For a prevalence of serum retinol <10 µg/dl, there were significant differences by age group and education. Older women were more likely to have a serum retinol <10 µg/dl (compared to younger women) as were women of lower education (compared to higher educated women).

Table 8.3. Prevalence of low serum retinol levels and mean serum retinol levels among women of childbearing age (15-45 years), Malawi Micronutrient Survey, Malawi 2001.

Characteristics of Women	N	Prevalence (%) of serum retinol:			Mean serum retinol (µg/dl)
		<10 µg/dl	<20 µg/dl	<30 µg/dl	
Age Group (years)					
15-19	100	0.0*	55.7	91.4	19.9
20-29	184	3.3	61.3	88.5	19.8
30-39	135	7.2	51.9	93.2	20.4
40-45	45	18.3	58.6	81.9	20.3
Education					
None	92	12.5*	55.5	89.2	20.0
1-5	163	5.0	60.4	89.8	19.4
6-8	143	1.2	56.4	91.6	20.3
>8	65	0.0	53.9	87.7	21.5
SES					
Low	250	6.4	55.3	87.8	20.4
Moderate	170	4.4	60.6	93.1	19.4
High	42	0.0	57.3	92.6	20.2
Residence					
Urban	56	2.4	69.2	94.4	18.3
Rural	408	5.5	55.4	89.2	20.3
Region					
Northern	167	1.8	37.7	89.2	22.3
Central	168	3.6	58.3	92.9	19.8
Southern	129	7.0	60.5	87.6	19.7
National	464	5.1	57.4	89.9	20.0

National data is weighted to account for survey design.
*p<0.05

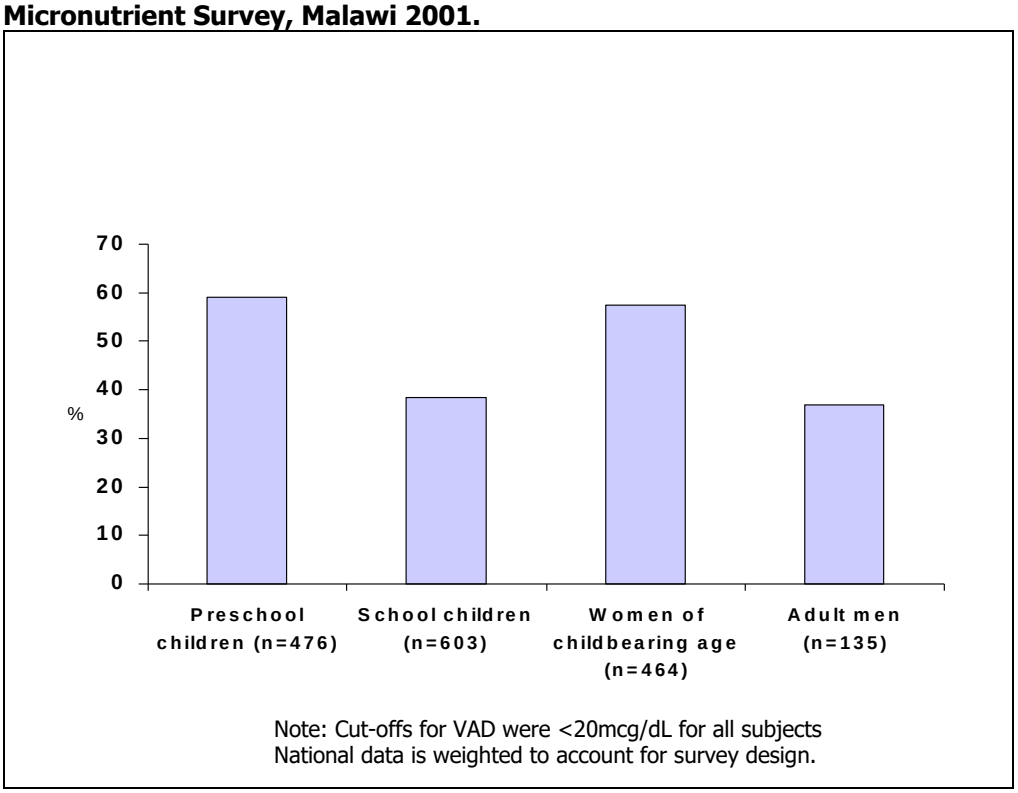
8.1.4 Serum retinol in men

Of the 135 men for which there were serum retinol assessments, the mean was 23.5 µg/dl (95% CI: 21.1, 25.8). Only 1.4% (95% CI: 0, 3.7; DEFF=1.38) of the men had serum retinol values <10 µg/dl, yet 36.9% (95% CI: 27.2, 46.6; DEFF=1.422) had values <20 µg/dl and 81.2% (95% CI: 73.2, 89.2; DEFF=1.469) had values <30 µg/dl.

8.2 Comparison of vitamin A deficiency among groups

In all target groups the prevalence of vitamin A deficiency assessed at the cut-off of <10 µg/dl exceeded the WHO 5% distinction of vitamin A deficiency as a public health problem. The prevalence of vitamin A deficiency as assessed by serum retinol was similar for women and preschool children with a spike in prevalence at a retinol level of around 20µg/dl. The prevalence for school children did not spike at a certain level, indicating that the vitamin A intake of school-age children increases (Figure 8.1).

Figure 8.1. National prevalence of vitamin A deficiency by target group, Malawi Micronutrient Survey, Malawi 2001.



Note: Cut-offs for VAD were <20mcg/dL for all subjects
National data is weighted to account for survey design.

8.3 Vitamin A and Malaria

The relationship between malaria parasitemia and vitamin A deficiency was examined (Table 8.4). Vitamin A deficiency was categorized as serum retinol <20 µg/dl for all target groups and malaria parasitemia was defined as presence of any parasites. Preschool children had the greatest prevalence (69.5%) of malaria parasitemia and vitamin A deficiency, which was significantly different from preschool children without malaria parasitemia who had vitamin A deficiency (44.1%). A similar significant difference was found in non-pregnant women, as 67.4% of them had malaria parasitemia and vitamin A deficiency whereas 53.2% of them without malaria parasitemia and vitamin A deficiency.

Table 8.4. Prevalence of vitamin A deficiency in those with and without malaria parasitemia, Malawi Micronutrient Survey, Malawi 2001.

Target group	Malaria parasitemia	N	Prevalence of vitamin A deficiency (%)
Preschool children	Yes	283	69.5*
	No	193	44.1
School children	Yes	286	42.8
	No	316	36.8
Non-pregnant women	Yes	71	67.4*
	No	335	53.2
Pregnant women	Yes	9	81.4
	No	45	61.9
Men	Yes	16	38.4
	No	118	36.8

National data is weighted to account for survey design.
* $p<0.05$

8.4 Self assessed clinical signs of vitamin A deficiency - Women

Questions concerning difficulty in vision during the last pregnancy were restricted to women of childbearing age who had reported at least one pregnancy. There were a total of 429 women who met the above criteria and for whom a response to the question is available. Overall 14.5% (95% CI: 10.5, 18.6; DEFF=1.482) of the women reported difficulty during their last pregnancy in their vision during the daytime and 7.7% (95% CI: 5.2, 10.2; DEFF=0.985) during the night (Table 8.5). The only statistically significant association was the frequency of difficulty with vision during the day by education level, with those of higher education level less likely to report vision difficulties.

The responses to this question should be interpreted cautiously because the timing of the last pregnancy was not noted; therefore, in some women the last pregnancy may have been recent while in others it could have been 20 years or more prior to the survey.

Table 8.5. Prevalence of women of childbearing age (15-45 years) with at least one pregnancy reporting difficulty with daytime or night vision during their last pregnancy, Malawi Micronutrient Survey, Malawi 2001.

Characteristics of women	N	Percent of women reporting difficulty with vision during daylight	Percent of women reporting difficulty with vision during night
Age Group (years)			
15-19	39	18.0	3.7
20-29	194	12.1	6.5
30-39	149	12.8	8.0
40-45	47	28.0	16.5
Education			
None	103	22.0*	12.4
1-5	154	15.0	6.9
6-8	127	8.1	5.4
>8	45	5.7	3.9
SES			
Low	243	16.5	9.2
Moderate	152	12.4	5.0
High	32	8.9	5.1
Residence			
Urban	44	6.2	9.8
Rural	385	15.5	7.5
Region			
Northern	159	13.2	7.5
Central	141	18.4	7.8
Southern	129	11.6	7.8
National	429	14.5	7.7

National data is weighted to account for survey design.
*p<0.05

8.5 Vitamin A supplementation

A history of vitamin A supplementation was taken for each preschool children included in the survey.

8.5.1 Vitamin A supplementation in preschool children

A total of 86.3% of preschool children had ever received a vitamin A supplement. The caretakers of the preschool children reported that 55.6% who ever had a vitamin A supplement had one in the last six months, with a high capture rate for the very young children. It seems that beyond the completion of the childhood immunizations, the preschool children do not continue to visit the health centers for vitamin A supplements every 6 months (Table 8.6).

Table 8.6. Prevalence of preschool children (6-36 months) who had ever received a vitamin A supplement and months since last dose, Malawi Micronutrient Survey, Malawi 2001.

Characteristics of Preschool Children	N	**Percent children who ever received vitamin A supplement**	Months since last dose**		
			Median	≤6 mos	≤12 mos
Age Group (months)*					
6-11	116	70.6***	3	69.2***	-
12-23	219	91.3	4	60.7	83.4
24-36	184	90.9	9	40.4	64.1
Sex					
Male	256	85.8	5	54.5	72.9
Female	284	86.7	4	56.6	74.4
SES					
Low	290	85.3	4	56.6***	72.7
Moderate	208	88.9	5	59.2	76.1
High	40	79.1	9	30.2	70.2
Residence					
Urban	42	100.0***	9	42.3***	72.7***
Rural	498	85.0	4	57.0	73.9
Region					
Northern	167	90.4	6	54.0	79.5
Central	207	82.6	5	50.2	70.5
Southern	166	88.6	4	60.7	75.2
National	540	86.3	5	55.6	73.7

National data is weighted to account for survey design.
*For 21 children the exact age was unknown; SES was unknown for 2 children
**Based on children who reportedly had ever received a vitamin A supplement; the number of months was unknown for 3 children.
***p<0.05

The majority of the children (91.0%) received their last vitamin A dose during a routine visit to a health clinic, 5.0% during a sick visit to a health clinic, and the rest were at another site or unknown.

8.5.2 Vitamin A supplementation in women of childbearing age

Women reporting having one or more previous pregnancies were asked: "After your last pregnancy, in the first two months after delivery, did you receive a vitamin A supplement like this one" and a vitamin A supplement was shown to the women. Out of the 524 women of childbearing age (15-45 years), 95 (18.1%) reported to have **never** been pregnant or previous pregnancy information was unknown. This left 429 potentially eligible women for this question, of which for two women use of vitamin A was unknown, leaving a total of 427 women.

Of the 427 women, 34.9% (95% CI: 30.0, 39.8; DEFF=1.196) reported having received a vitamin A supplement within 2 months of their last delivery (Table 8.7). The only significant association was with education, with higher educated women more likely to report having received a vitamin A supplement.

Similar to the previous section, the responses to this question should be interpreted cautiously because the timing of the last pregnancy was not noted; therefore, in some women the last pregnancy may have been recent while in others it could have been 20 years or more prior to the survey.

Table 8.7. Prevalence of women of childbearing age (15-45 years) who received a vitamin A supplement in the first two months after their last delivery, Malawi Micronutrient Survey, Malawi 2001.

Characteristics of women	N	Percent reporting having received vitamin A supplement within 2 mos. of delivery
Age Group (years)		
15-19	38	17.4
20-29	193	37.9
30-39	149	35.6
40-45	47	34.9
Education		
None	103	24.7*
1-5	153	37.3
6-8	127	35.7
>8	44	52.8
SES		
Low	243	31.0
Moderate	150	40.3
High	32	42.1
Residence		
Urban	44	43.1
Rural	383	33.9
Region		
Northern	159	49.7
Central	140	33.6
Southern	128	32.8
National	427	34.9

National data is weighted to account for survey design.
*p<0.05.

8.6 Knowledge of vitamin A deficiency

As part of the KAP survey for school children and women a series of questions on vitamin A were asked. The series of questions began with a self-assessment of whether the respondent had ever heard of vitamin A. If the school child or woman had heard of vitamin A then a number of specific questions on use of vitamin A, consequences of deficiency, prevention of deficiency and sources of vitamin A were also asked.

8.6.1 Knowledge of vitamin A deficiency among school children

School children were asked a number of questions concerning their knowledge of vitamin A and VAD. Of 701 students asked if they had ever heard of vitamin A, 43.5% reported they had (Table 8.8). Older students were more likely to report having heard of vitamin A than younger students, and a similar finding by grade. Urban students were significantly more likely to report having heard of vitamin A; there were no significant differences by sex or region.

Table 8.8. Prevalence of school children (6-12 years) having ever heard of vitamin A, Malawi Micronutrient Survey, Malawi 2001.

Characteristics of School Children	N	Percent reporting having ever heard of vitamin A
Age Group (in years)		
6-7	127	13.8*
8-9	171	35.4
10-11	242	50.4
12	161	61.9
Grade/Standard		
1	145	13.4*
2	160	33.8
3	178	49.4
4	98	59.6
5	71	73.3
6 and 7	48	68.5
Sex		
Male	350	46.0
Female	351	41.0
Residence		
Urban	84	61.3*
Rural	617	41.2
Region		
Northern	235	35.7
Central	234	42.3
Southern	232	46.1
National	701	43.5

National data is weighted to account for survey design.
$p<0.05$.

Of the 290 children reporting they had heard of vitamin A, they were asked a number of questions concerning vitamin A and VAD. Multiple answers were recorded for these questions.

Just one school child knew that vitamin A helps a person to see. The highest response for what vitamin A does in the body was good growth (29.6%). A similar percentage of children (24.3%) stated that vitamin A makes a person strong and 20.8% knew that vitamin A protects a person from disease. This correlates with the 42.1% of school children who stated that always being sick is a consequence of vitamin A deficiency. Knowledge of prevention was not very widespread as only 29.1% said that eating a balanced diet prevents against vitamin A deficiency and 24.0% said that yellow fruits and vegetables were a source of vitamin A (Table 8.9).

Table 8.9. Responses to questions concerning vitamin A by school children (6-12 years), Malawi Micronutrient Survey, Malawi 2001.

Listed responses by school children to: *	N	%
Use of vitamin A in the body (n=289)		
Good growth	81	29.6
Makes a person strong	72	24.3
Protects from disease	53	20.8
Other reasons	48	16.1
Keeps the body satisfied	6	2.7
Helps a person see	1	0.4
Prevents edema	1	0.4
Don't know	81	26.3
Consequences of vitamin A deficiency (n=290)		
Always sick	116	42.1
Weakness	58	20.7
Anemia	38	13.3
Other	35	10.8
Bad skin	7	2.9
Loss of appetite	3	1.1
Night blindness	4	1.0
Don't know	88	28.8
Prevention of vitamin A deficiency (n=290)		
Eat balanced diet	83	29.1
Eat enough food	32	11.3
Other ways mentioned	34	10.9
Eat fruit rich in vitamin A	25	9.1
Vitamins from hospital	25	8.9
Nothing	2	0.5
Avoid contaminated food	1	0.4
Sunbathe	0	0.0
Don't know	121	42.0
Sources of vitamin A (n=290)		
Dark leafy vegetables	105	35.8
Other sources mentioned	79	26.2
Yellow fruits/vegetables	64	24.0
Meat	46	14.0
Pills/syrup	15	6.4
Eggs	17	5.3
Groundnuts	13	4.3
Don't know	90	30.6

National data is weighted to account for survey design.
*Question asked only of children who had ever heard about vitamin A

8.6.2 Knowledge of vitamin A deficiency among women

Overall, 78.1% of the women reported having heard of vitamin A (Table 8.10). Significantly more women 20-39 years with a higher education attainment had heard of vitamin A.

Table 8.10. Prevalence of women of childbearing age (15-45 years) having ever heard of vitamin A, Malawi Micronutrient Survey, Malawi 2001.

Characteristics of women	N	Percent reporting having ever heard of vitamin A
Age Group (years)		
15-19	114	67.0*
20-29	207	82.4
30-39	152	82.2
40-45	48	73.4
Education		
None	108	66.7*
1-5	180	77.1
6-8	156	88.1
>8	76	82.7
SES		
Low	279	76.1
Moderate	193	80.3
High	47	80.5
Residence		
Urban	69	86.8
Rural	452	76.8
Region		
Northern	188	86.7
Central	188	80.3
Southern	145	74.5
National	521	78.1

National data is weighted to account for survey design.
*p<0.05

Women who had heard about vitamin A previously, were asked an additional four questions concerning vitamin A. Multiple answers were recorded for the questions. Women of childbearing age (15-45 years) had a greater knowledge than the school children of vitamin A in general. Around a third of women knew that vitamin A makes a person strong (40.5%), helps with good growth (32.1%) and protects from disease (30.4%). Only 12.0% knew that vitamin A helps a person to see. Always being sick was known by 38.7% of the women as a consequence of vitamin A deficiency. More than half of the women (53.5%) replied that eating a balanced diet was the best way of preventing of vitamin A deficiency. Overall 38.6% of the women stated that yellow fruits and vegetables were sources of vitamin A (Table 8.11).

Table 8.11. Responses to questions concerning vitamin A by women of childbearing age (15-45 years), Malawi Micronutrient Survey, Malawi 2001.

Listed responses by women to: *	N	%
Use of vitamin A in the body (n=420)		
Makes a person strong	149	40.5
Good growth	121	32.1
Protects from disease	115	30.4
Helps a person see	44	12.0
Other reasons	17	4.8
Keeps the body satisfied	21	4.3
Prevents edema	3	1.7
Don't know	138	26.8
Consequences of vitamin A deficiency (n=422)		
Weakness	156	42.9
Always sick	156	38.7
Night blindness	66	16.6
Anemia	55	10.2
Bad skin	36	10.1
Other	25	6.2
Loss of appetite	21	5.7
Don't know	115	24.0
Prevention of vitamin A deficiency (n=422)		
Eat balanced diet	204	53.5
Vitamins from hospital	87	27.2
Eat fruit rich in vitamin A	97	23.2
Eat enough food	77	15.5
Other ways mentioned	22	5.1
Avoid contaminated food	2	1.8
Nothing	2	0.1
Sunbathe	0	0.0
Don't know	112	21.8
Sources of vitamin A (n=422)		
Dark leafy vegetables	175	47.3
Yellow fruits/vegetables	159	38.6
Meat	107	27.3
Eggs	92	19.5
Other sources mentioned	66	17.3
Groundnuts	37	10.2
Pills/syrup	23	4.9
Don't know	100	20.2

National data is weighted to account for survey design.
*Question asked only of women who had ever heard about vitamin A

CHAPTER 9: ANEMIA, IRON DEFICIENCY AND IRON DEFICIENCY ANEMIA STATUS

A number of different indicators related to anemia, iron deficiency and iron deficiency anemia were collected in this survey. The organization of this chapter is as follows:

Anemia

- Hemoglobin
  - Preschool children
  - School children
  - Women of childbearing age
  - Men
- Comparison of anemia among groups

Iron Deficiency

- TfR and ZP
  - Preschool children
  - School children
  - Women of childbearing age
  - Men

Iron Deficiency Anemia

- TfR and Hb
- ZP and Hb
  - Preschool children
  - School children
  - Women of childbearing age
  - Men

Anemia, iron deficiency anemia and infection

- Malaria parasitemia and Anemia and Iron Deficiency Anemia
  - Preschool children
  - School children
  - Women of childbearing age
  - Men
- Intestinal Parasites and Anemia
  - School children
- Urinary Schistosomiasis and Anemia
  - School children

Use of iron supplements

- Women of childbearing age

Knowledge of anemia and its prevention

- School children
- Women of childbearing age

9.1 Anemia

The prevalence of anemia is based on hemoglobin data from capillary blood samples analyzed using the HemoCue instrument (HemoCue AB, Angelholm, Sweden). All hemoglobin data were adjusted for altitude (CDC, Morbidity and Mortality Weekly Report, 1998).

9.1.1 Anemia in Preschool Children

Almost 80.0% of preschool children were anemic. Significant differences were found in preschool children by age group, residence and region (Table 9.1). More young children and rural children were anemic. Anemia was most prevalent in the Southern Region and the least in the Northern Region.

Table 9.1. Prevalence of low hemoglobin levels and mean hemoglobin levels among preschool children (6-36 months), Malawi Micronutrient Survey, Malawi 2001.

Characteristics of preschool children	N	Percent anemic*	Mean hemoglobin (g/dl ± SD)
Age Group (months)**			
6-11	86	92.2***	8.9 ± 1.6***
12-23	185	80.9	9.6 ± 1.6
24-36	181	73.5	10.2 ± 1.4
Sex			
Male	244	82.5	9.6 ± 1.6
Female	269	77.0	9.7 ± 1.6
SES			
Low	275	81.3	9.5 ± 1.6
Moderate	198	80.3	9.7 ± 1.6
High	39	68.1	10.3 ± 1.6
Residence			
Urban	39	55.1***	10.5 ± 1.6***
Rural	474	82.1	9.6 ± 1.6
Region			
Northern	164	65.2***	10.4 ± 1.8***
Central	192	74.0	10.3 ± 1.5
Southern	157	88.5	9.2 ± 1.5
National	513	79.7	9.7 ± 1.6

National data is weighted to account for survey design. Percent anemic was adjusted for altitude.
*Preschool children: anemia (<11.0 g/dL).
**For 18 children the exact age was unknown.
*** p<0.05

9.1.2 Anemia in School Children

Overall school children were much less likely to be anemic (22.3%) than the preschool children (79.7%). The prevalence of anemia significantly decreased in the 8-11 year range and in the third and fourth standard (Table 9.2). Rural school children were more anemic.

Table 9.2. Prevalence of low hemoglobin levels and mean hemoglobin levels among school children (6-12 years, Malawi Micronutrient Survey, Malawi 2001.

.

Characteristics of School Children	N	Percent anemic*	Mean hemoglobin (g/dl ± SD)
Age Group (years)			
6-7	127	34.7**	11.9 ± 1.3**
8-9	170	18.9	12.4 ± 1.2
10-11	237	17.7	12.6 ± 1.2
12	159	23.0	12.6 ± 1.5
Grade/Standard			
1	145	33.4**	12.0 ± 1.3**
2	157	24.1	12.3 ± 1.4
3	175	17.5	12.5 ± 1.1
4	96	12.1	12.7 ± 1.1
5	71	23.5	12.6 ± 1.7
6 and 7	49	16.2	13.0 ± 1.3
Sex			
Male	347	24.1	12.5 ± 1.3
Female	346	20.5	12.4 ± 1.3
Residence			
Urban	83	11.1**	12.4 ± 1.2
Rural	610	23.7	12.9 ± 1.3
Region			
Northern	234	18.8	12.6 ± 1.3
Central	228	20.2	12.6 ± 1.4
Southern	231	24.7	12.2 ± 1.2
National	693	22.3	12.4 ± 1.3

National data is weighted to account for survey design. Percent anemic was adjusted for altitude.
*School children: anemia (<11.5 g/dL).
** p<0.05

9.1.3 Anemia in Women of Childbearing Age

Overall 27.0% of non-pregnant women were anemic (Table 9.3). Younger non-pregnant women had a significantly lower prevalence of anemia than the older non-pregnant women. In non-pregnant women no difference was found in either the mean Hb by current menstruation status.

A total of 57 pregnant women had their hemoglobin values recorded and 22.1% were anemic (mean 11.9 ± 1.5).

Table 9.3. Prevalence of low hemoglobin levels and mean hemoglobin levels among non-pregnant women of childbearing age (15-45 year Malawi Micronutrient Survey, Malawi 2001.

Characteristics of Non-pregnant Women	N	Percent anemic*	Mean hemoglobin (g/dl ± SD)
Age Group (years)			
15-19	96	25.0**	12.8 ± 1.3
20-29	152	26.7	12.7 ± 1.5
30-39	126	21.9	12.7 ±1.4
40-45	44	47.9	12.0 ±1.9
Education			
None	82	32.3	12.5 ± 1.6
1-5	147	27.7	12.6 ± 1.5
6-8	131	24.2	12.9 ± 1.2
>8	62	22.0	12.6 ± 1.6
SES			
Low	223	25.4	12.7 ± 1.5
Moderate	156	31.8	12.6 ± 1.4
High	42	19.5	12.8 ± 1.5
Residence			
Urban	55	17.5	13.0 ± 1.2
Rural	368	28.4	12.6 ± 1.5
Region			
Northern	158	26.0	12.8 ± 1.4
Central	169	24.1	12.8 ± 1.5
Southern	123	30.4	12.5 ± 1.5
National	423	27.0	12.7 ± 1.5

National data is weighted to account for survey design. Percent anemic was adjusted for altitude.
*Non-pregnant women: anemia (<12.0 g/dL).
**p<0.05

9.1.4 Anemia in Men

Around a quarter of the men in the survey smoked (25.5%). If they smoked, their hemoglobin was adjusted accordingly (CDC, Morbidity and Mortality Weekly Report, 1998). A total of 17.4% of the men in the national sample were anemic. The only significant difference found in anemic men was by region (Table 9.4).

Table 9.4. National prevalence of low hemoglobin levels and mean hemoglobin levels among men (20-55 years), Malawi Micronutrient Survey, Malawi 2001.

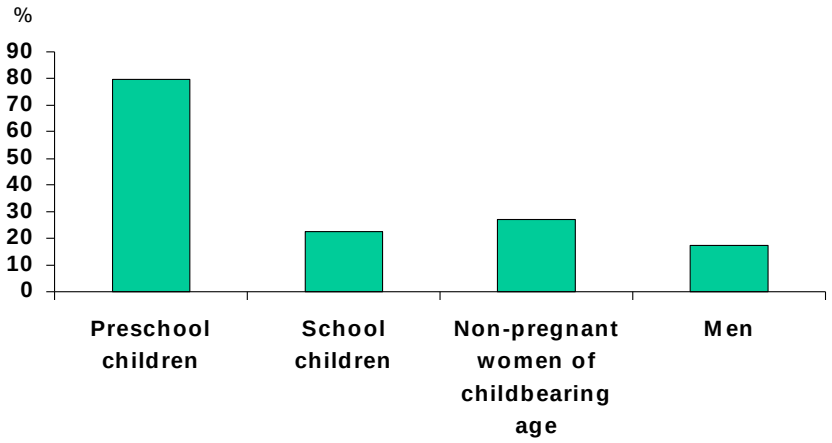
Characteristics of Men	N	Total anemic*	Mean hemoglobin (g/dl ± SD)
Age Group (years)			
20-29	51	14.9	15.1 ± 2.2
30-39	46	24.9	14.6 ± 1.6
40-49	30	16.2	14.8 ± 2.0
50-55	15	9.4	14.9 ± 1.7
Education			
None	13	8.2	14.4 ± 2.6
1-5	46	22.3	14.6 ± 2.1
6-8	60	16.5	15.1 ± 1.7
>8	27	13.2	15.2 ± 1.7
SES			
Low	76	21.2	14.5 ± 2.0
Moderate	58	15.5	15.0 ± 1.8
High	11	0	16.0 ± 1.2
Residence			
Urban	15	12.0	14.8 ± 1.9
Rural	131	17.9	15.2 ± 1.6
Region			
Northern	53	1.9**	15.4 ± 1.3
Central	51	17.6	14.8 ± 2.0
Southern	42	21.4	14.3 ± 2.3
National	146	17.4	14.9 ± 1.9

National data is weighted to account for survey design. Percent anemic was adjusted for altitude and cigarette smoking.
*Adult men: anemia (<13.0 g/dL).
** p<0.05

9.1.5 Summary of anemia by target group

Figure 9.1 displays the prevalence of anemia by target group. The highest prevalence of anemia was found in preschool children (79.7%) followed by non-pregnant women (27.0%), school children (22.3%) and men (17.4%). The WHO classifications of anemia as a public health problem as applied to Malawi show that there is a severe anemia problem (≥40%) in preschool children, a moderate problem (20.0 - 39.9%) in women and school children and a mild problem (5.0 – 19.9%) in men (Table 2.3).

Figure 9.1. Prevalence of anemia by target group, Malawi Micronutrient Survey, Malawi 2001.



National data is weighted to account for survey design.

9.2 Iron deficiency

Iron deficiency was assessed through two methods. Most subjects had sufficient quantities of capillary blood samples taken for zinc protoporphyrin (ZP) analysis. The ZP was analyzed each evening following the completion of the field work that day. Two consecutive ZP values were taken and recorded. In the data analysis, an average for two separate readings was calculated. Serum transferrin receptor (TfR) was the second indicator of iron deficiency and was performed only in some cases when there was an adequate amount of serum left after serum retinol analysis.

9.2.1 Iron Deficiency in Preschool Children

For preschool children, iron deficiency by ZP was prevalent in 64.6% (mean 89.5 $\pm$ 51.4) and in 61.5% by TfR (mean 11.0 $\pm$ 5.7). Both indicators found significant differences in iron deficiency by age group, residence and region (Table 9.5).

In preschool children the prevalence of iron deficiency as measured by TfR was consistently less than when using ZP as the indicator (Table 9.5). The trend of having prevalence estimates being lower in TfR than ZP is only true for preschool children and may have to do with the fact that the cut-off for ZP is lower in preschool children than in the other target groups.

Table 9.5. Prevalence of iron deficiency among preschool children (6-36 months), Malawi Micronutrient Survey, Malawi 2001.

		Zinc protoporphyrin (ZP)*			Serum transferring receptor (TfR)**	
Characteristics of Preschool children	N	Percent iron deficient	Mean (μmol/mol)	N	Percent iron deficient	Mean (μg/ml)
Age Group (months)						
6-11	82	80.8***	113.2 ± 59.5***	60	72.2	13.0 ± 6.9***
12-23	179	62.9	91.2 ± 49.6	132	61.2	11.2 ± 5.8
24-36	178	58.8	77.5 ± 46.7	132	53.9	9.5 ± 4.7
Sex						
Male	235	67.8	92.0 ± 52.7	175	63.1	11.0 ± 5.5
Female	263	61.8	87.3 ± 50.1	190	59.8	10.9 ± 6.0
SES						
Low	270	67.8	90.3 ± 46.4	196	66.7	11.3 ± 6.2
Moderate	190	62.0	89.7 ± 52.6	138	54.8	10.6 ± 5.2
High	37	57.4	84.8 ± 74.7	30	55.6	10.3 ± 5.5
Residence						
Urban	36	48.1***	68.1 ± 45.2 ***	27	27.3***	7.9 ± 4.2***
Rural	462	66.1	91.5 ± 51.5	338	64.8	11.3 ± 5.8
Region						
Northern	159	47.2***	67.0 ± 39.4***	133	48.9***	9.6 ± 4.9***
Central	188	59.0	81.1 ± 43.9	126	60.3	11.1 ± 6.2
Southern	151	74.2	103.2 ± 57.0	106	66.0	11.2 ± 5.5
National	**489**	**64.6**	**89.5 ± 51.4**	**365**	**61.5**	**11.0 ± 5.7**

National data is weighted to account for survey design.
*Iron deficiency is ZP>61 μmol/mol heme.
** Iron deficiency is TfR >8.3 μg/ml.
**** p<0.05

9.2.2 Iron Deficiency in School Children

School children had a prevalence of iron deficiency of 13.9% by ZP (mean 49.9 ± 32.6) and 23.0% by TfR (mean 6.6 ± 3.2). Analysis of the data for school children found significant differences in iron deficiency by standard, residence and region (Table 9.6).

Table 9.6. Prevalence of iron deficiency among school children (6-12 years), Malawi Micronutrient Survey, Malawi 2001.

		Zinc protoporphyrin (ZP)*			Serum transferring receptor (TfR)**	
Characteristics of School children	N	Percent iron deficient	Mean (μmol/mol)	N	Percent iron deficient	Mean (μg/ml)
Age Group (years)						
6-7	126	19.1	52.0 ± 28.7	112	32.0	7.2 ± 3.0
8-9	170	13.2	47.9 ± 23.9	157	20.9	6.5 ± 2.5
10-11	233	11.2	46.6 ± 20.8	216	21.8	6.4 ± 2.9
12	155	14.7	55.0 ± 50.5	145	20.2	6.7 ± 4.2
Grade/Standard						
1	144	16.8	50.3 ± 21.9	126	29.2***	7.0 ± 2.5***
2	157	18.2	52.5 ± 29.0	145	27.6	7.0 ± 3.3
3	173	12.8	50.2 ± 24.6	160	23.4	6.4 ± 3.1
4	94	14.7	52.7 ± 49.5	90	20.6	6.5 ± 2.7
5	68	7.5	46.8 ± 50.5	63	13.8	6.8 ± 5.2
6 and 7	49	3.5	39.4 ± 15.2	47	7.4	5.7 ± 2.2
Sex						
Male	342	14.3	48.9 ± 26.8	319	20.5	6.6 ± 2.9
Female	343	13.5	50.9 ± 37.5	312	25.4	6.7 ± 3.5
Residence						
Urban	82	5.1***	39.9 ± 16.5***	70	12.6***	6.2 ± 2.0
Rural	603	15.0	51.2 ± 33.9	561	24.2	6.7 ± 3.3
Region						
Northern	230	6.5***	42.1 ± 25.4***	216	23.1	6.9 ± 3.1
Central	226	11.5	50.2 ± 32.9	199	25.1	6.7 ± 3.8
Southern	229	17.5	51.4 ± 33.6	216	21.3	6.5 ± 2.7
National	685	13.9	49.9 ± 32.6	631	23.0	6.6 ± 3.2

National data is weighted to account for survey design.
*Iron deficiency is ZP>70 μmol/mol heme.
** Iron deficiency is TfR >8.3 μg/ml.
*** p<0.05

9.2.3 Iron Deficiency in Women

For non-pregnant women 15-45 years of age, the overall prevalence of iron deficiency was 17.9% by ZP (mean 53.6 ± 43.8) and 32.4% by TfR (mean 7.7 ± 4.0). The TfR prevalence estimates were consistently almost double the ZP percentages (Table 9.7). There were significant differences noted in iron deficiency by ZP by age groups, residence and region and by TfR in residence. A higher prevalence of iron deficiency was found in rural areas, in the Southern Region and in the oldest and youngest age groups.

Of the 56 pregnant women who had assessment using the ZP method, 8.3% were iron deficient with a mean of 46.4 ± 24.7. In addition, 49 pregnant women in the survey also had serum TfR analysis resulting in a 26.7% prevalence of iron deficiency with a mean of 7.9 ± 3.8.

Table 9.7. Prevalence of iron deficiency among non-pregnant women of childbearing age (15-45 years), Malawi Micronutrient Survey, Malawi 2001.

	Zinc protoporphyrin (ZP)*			Serum transferring receptor (TfR)**		
Characteristics of Women	N	Percent iron deficient	Mean (μmol/mol)	N	Percent iron deficient	Mean (μg/ml)
Age Group (years)						
15-19	96	21.8***	53.3 ± 25.2	80	36.3	7.6 ± 3.6
20-29	150	14.0	49.1 ± 23.8	131	30.3	7.5 ± 3.7
30-39	124	14.9	54.1 ± 61.8	101	30.3	7.5 ± 3.6
40-45	43	31.2	69.7 ± 66.1	32	41.4	9.4 ± 7.2
Education						
None	80	19.9	56.8 ± 31.0	64	42.6	8.3 ± 3.4
1-5	146	18.3	54.7 ± 55.4	113	25.3	7.2 ± 4.3
6-8	130	15.3	47.6 ± 22.8	114	33.2	7.4 ± 3.8
>8	60	16.2	55.6 ± 53.7	55	33.0	8.2 ± 4.6
SES						
Low	220	18.8	52.0 ± 26.1	171	38.2	7.7 ± 3.3
Moderate	154	18.0	56.9 ± 58.2	134	28.1	7.7 ± 4.6
High	41	13.3	51.0 ± 58.9	40	23.3	7.5 ± 5.0
Residence						
Urban	52	8.0***	40.0 ± 25.0***	45	16.7***	6.3 ± 2.4***
Rural	365	19.4	55.6 ± 45.6	301	34.9	7.9 ± 4.2
Region						
Northern	147	9.5***	43.4 ± 23.3***	143	30.1	7.6 ± 4.2
Central	157	17.8	54.2 ± 36.3	124	30.6	7.8 ± 4.1
Southern	113	20.4	55.8 ± 54.5	79	35.4	7.5 ± 4.0
National	417	17.9	53.6 ± 43.8	346	32.4	7.7 ± 4.0

National data is weighted to account for survey design.
**Iron deficiency is ZP>70 μmol/mol heme.
**Iron deficiency is TfR >8.3 μg/ml.
***p<0.05

9.2.4 Iron Deficiency in Men

The national prevalence of iron deficiency in adult men was 5.5% by ZP (mean 37.0 ± 17.0). Significant different mean values were found by education and region (Table 9.8). Only 50 serum samples from adult men were assessed for TfR and 2.4% of them were iron deficient by TfR assessment.

Table 9.8. Prevalence of iron deficiency among men (20-55 years), Malawi Micronutrient Survey, Malawi 2001.

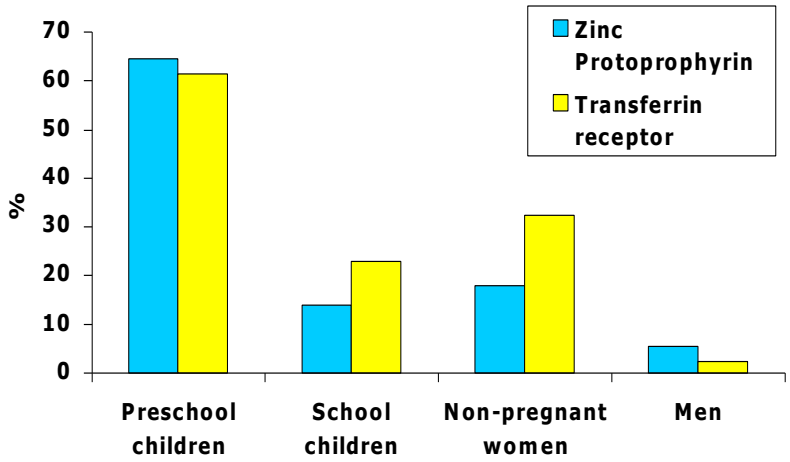
	Zinc protoporphyrin (ZP)*			Serum transferring receptor (TfR)**		
Characteristics of Men	N	Percent iron deficient	Mean (μmol/mol)	N	Percent iron deficient (>8.3 μg/ml)	Mean (μg/ml)
Age Group (years)						
20-29	51	6.9	37.9 ± 19.5	17	0	3.5 ± 1.8
30-39	46	3.3	35.9 ± 14.4	11	0	3.3 ± 0.9
40-49	30	10.4	39.9 ± 17.7	12	12.0	3.5 ± 2.7
50-55	15	0	34.5 ± 15.3	9	0	2.4 ± 1.2
Education						
None	13	0	46.0 ± 17.3***	5	23.4	5.6 ± 3.3***
1-5	46	9.3	40.5 ± 16.1	13	0	3.4 ± 1.5
6-8	60	5.4	35.4 ± 18.9	22	0	2.6 ± 1.2
>8	27	0	30.2 ± 10.3	10	0	3.0 ± 1.8
SES						
Low	76	8.5	39.2 ± 19.1	26	0	3.1 ± 1.4
Moderate	58	2.7	36.3 ± 14.8	18	7.2	3.5 ± 2.4
High	11	0	26.9 ± 7.0	6	0	2.9 ± 2.0
Residence						
Urban	15	0	29.8 ± 8.6	7	0	1.9 ± 1.2
Rural	131	6.1	37.8 ± 17.6	43	2.8	3.4 ± 1.9
Region						
Northern	53	1.9	30.5 ± 13.0***	15	0	2.8 ± 1.6
Central	51	9.8	41.2 ± 20.4	26	3.8	3.3 ± 2.1
Southern	42	2.4	40.0 ± 14.8	9	0	3.5 ± 1.4
National	146	5.5	37.0 ± 17.0	50	2.4	3.2 ± 1.8

National data is weighted to account for survey design.
*Iron deficiency is ZP>70 μmol/mol heme.
** Iron deficiency is TfR >8.3 μg/ml.
***p<0.05

9.2.5 Summary of Iron Deficiency by target group

Figure 9.2 displays the prevalence of iron deficiency by target group. The highest prevalence of iron deficiency was found in preschool children (64.6% by ZP and 61.5% by TfR) followed by non-pregnant women (17.9% by ZP and 32.4% by TfR), school children (13.9% by ZP and 23.0% by TfR) and men (5.5% by ZP and 2.4% by TfR).

Figure 9.2. Prevalence of iron deficiency by target group, Malawi Micronutrient Survey, Malawi 2001.



9.3 Iron Deficiency Anemia

Two combination indicators were utilized to assess iron deficiency anemia. One was the combination of elevated ZP (iron deficiency) and low hemoglobin (anemia). The other was elevated TfR (iron deficiency) and low hemoglobin (anemia). Both indicators are reported for each target group.

9.3.1 Iron Deficiency Anemia in Preschool Children

The values for iron deficiency anemia (IDA) with both combination indicators were very similar in preschool children. The overall prevalence of IDA using ZP and Hb was 58.9% and 59.3% for TfR and Hb (Table 9.9). Significant differences were found by age group, SES, residence and region. The younger children were more likely to suffer from IDA, as were those in the low SES, rural areas and in the Southern region. Only the TfR and Hb indicator found the significant difference by SES.

Table 9.9. Prevalence of iron deficiency anemia among preschool children (6-36 months), Malawi Micronutrient Survey, Malawi 2001.

	Zinc protoporphyrin (ZP) and Hemoglobin (Hb)*		Serum transferring receptor (TfR) and Hemoglobin (Hb)**	
Characteristics of Preschool children	N	Percent with iron deficiency anemia	N	Percent with iron deficiency anemia
Age Group (months)				
6-11	86	74.4***	60	72.2***
12-23	185	60.0	132	59.6
24-36	181	49.8	132	50.7
Sex				
Male	244	60.2	175	61.6
Female	269	57.7	190	57.0
SES				
Low	275	62.6	196	65.6***
Moderate	198	55.2	138	52.8
High	39	53.7	30	49.7
Residence				
Urban	39	35.0***	27	22.3***
Rural	474	61.2	338	62.8
Region				
Northern	164	40.9***	133	39.8***
Central	192	53.6	126	58.7
Southern	157	68.2	106	65.1
National	513	58.9	365	59.3

National data is weighted to account for survey design. Percent anemic was adjusted for altitude.
*Iron deficiency anemia is ZP>61 μmol/mol heme and Hb<11.0 g/dl.
**Iron deficiency anemia is TfR >8.3 μg/ml and Hb<11.0 g/dl
*** p<0.05

9.3.2 Iron Deficiency Anemia in School Children

For school children, the combination IDA indicators are also very similar, with an estimate prevalence of 7.6% using the ZP and Hb determination and 10.2% for the TfR and Hb indicator (Table 9.10). The younger children had a significantly higher prevalence of IDA as did those school children in the rural areas. It is interesting to note that the significance by age was only found in the TfR and Hb determination.

Table 9.10. Prevalence of iron deficiency anemia among school children (6-12 years), Malawi Micronutrient Survey, Malawi 2001.

	Zinc protoporphyrin (ZP) and Hemoglobin (Hb)*		Serum transferring receptor (TfR) and Hemoglobin (Hb)**	
Characteristics of School children	N	Percent with iron deficiency anemia	N	Percent with iron deficiency anemia
Age Group (years)				
6-7	127	11.5	112	18.1***
8-9	171	6.0	156	6.8
10-11	237	4.9	215	7.1
12	158	10.1	144	12.1
Grade/Standard				
1	145	9.4	126	15.9
2	158	8.5	144	12.0
3	176	7.7	159	9.0
4	96	5.9	89	3.8
5	71	7.2	63	9.2
6 and 7	49	2.9	47	5.5
Sex				
Male	348	9.1	318	9.1
Female	347	6.1	310	11.3
Residence				
Urban	83	1.9***	69	0.5***
Rural	612	8.3	559	11.3
Region				
Northern	235	3.8	215	8.4
Central	229	7.9	197	10.7
Southern	231	8.2	216	10.2
National	695	7.6	628	10.2

National data is weighted to account for survey design. Percent anemic was adjusted for altitude.
*Iron deficiency anemia is ZP>70 μmol/mol heme and Hb<11.5.
**Iron deficiency anemia is TfR >8.3 μg/ml and Hb<11.5.
*** p<0.05

9.3.3 Iron Deficiency Anemia in Women

The non–pregnant women had a 10.3% prevalence of iron deficiency anemia by ZP and Hb and a 11.4% prevalence of iron deficiency anemia by TfR and Hb (Table 9.11). No significant differences were noted.

Of the 58 pregnant women for whom there is data on ZP and Hb, 7.7% of them had iron deficiency anemia. Of the 48 women for whom data was available on TfR and Hb, 5.5% of them had iron deficiency anemia.

Table 9.11. Prevalence of iron deficiency anemia among non-pregnant women of childbearing age (15-45 years), Malawi Micronutrient Survey, Malawi 2001.

	Zinc protoporphyrin (ZP) and Hemoglobin (Hb)*		Serum transferring receptor (TfR) and Hemoglobin (Hb)**	
Characteristics of Women	N	Percent with iron deficiency anemia	N	Percent with iron deficiency anemia
Age Group (years)				
15-19	96	8.6	80	15.6
20-29	152	9.3	131	8.0
30-39	126	8.2	101	10.3
40-45	44	22.0	32	20.1
Education				
None	82	14.6	64	14.5
1-5	147	9.7	113	11.9
6-8	131	7.3	114	7.5
>8	62	10.3	55	12.4
SES				
Low	223	9.0	171	10.3
Moderate	156	13.6	134	14.4
High	42	5.7	40	6.7
Residence				
Urban	55	7.0	45	6.2
Rural	368	10.8	301	12.2
Region				
Northern	150	4.7	143	9.1
Central	158	10.8	124	12.1
Southern	115	11.3	79	11.4
National	423	10.3	346	11.4

National data is weighted to account for survey design. Percent anemic was adjusted for altitude.
*Iron deficiency anemia is ZP>70 μmol/mol heme and Hb<12.0 g/dl.
**Iron deficiency anemia is TfR >8.3 μg/ml and Hb<12.0 g/dl.

9.3.4 Iron Deficiency Anemia in Men

Yet again the combination indicators for IDA are similar. A very small percentage of men suffer from IDA, specifically 3.4% using the ZP and Hb value and 2.4% using the TfR and Hb value (Table 9.12). The two indicators found differing significance. The TfR and Hb noted that more IDA was in men with no education, which may not be valid since the numbers in each cell are very small. The same is true for the significance found by the ZP and Hb indicator by region. Due to the fact that the sample of men was one national sample and very small, it is hard to make distinctions when breaking the data into many cells.

Table 9.12. National prevalence of iron deficiency anemia among adult men (20-55 years), Malawi Micronutrient Survey, Malawi 2001.

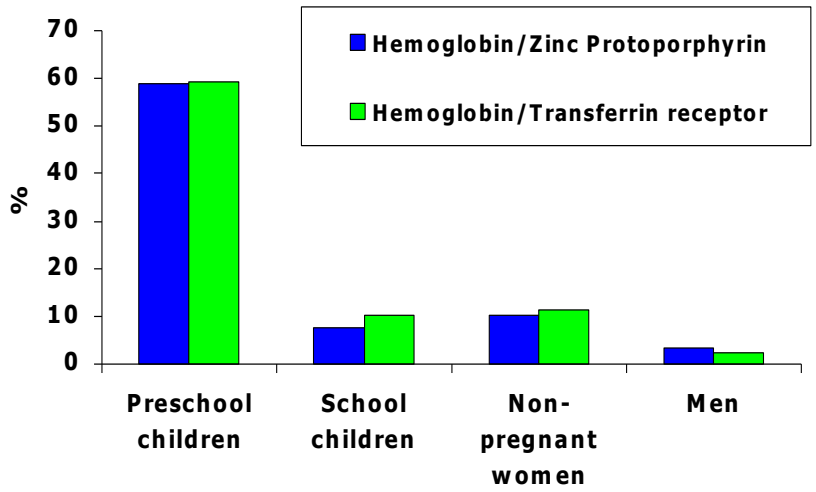
	Zinc protoporphyrin (ZP) and Hemoglobin (Hb)*		Serum transferring receptor (TfR) and Hemoglobin (Hb)**	
Characteristics of Men	N	Percent with iron deficiency anemia	N	Percent with iron deficiency anemia
Age Group (years)				
20-29	51	6.9	17	0
30-39	46	2.6	11	0
40-49	30	0	12	12.0
50-55	15	0	9	0
Education				
None	13	0	5	23.4
1-5	46	6.6	13	0
6-8	60	2.4	22	0
>8	27	0	10	0
SES				
Low	76	6.4	26	0
Moderate	58	0	18	7.2
High	11	0	6	0
Residence				
Urban	15	0	7	0
Rural	131	3.7	43	2.8
Region				
Northern	53	0	15	0
Central	51	7.9	26	3.8
Southern	42	0	9	0
National	146	3.4	50	2.4

National data is weighted to account for survey design. Percent anemic was adjusted for altitude and cigarette smoking.
*Iron deficiency anemia is ZP>70 μmol/mol heme and Hb<13.0 g/dl.
**Iron deficiency anemia is TfR >8.3 μg/ml and Hb<13.0 g/dl.

9.3.5 Summary of Iron Deficiency Anemia by target group

Figure 9.3 displays the prevalence of iron deficiency by target group. The highest prevalence of iron deficiency was found in preschool children (58.9% by Hb & ZP and 59.3% by Hb & TfR). Non-pregnant women and school children had similar levels of iron deficiency anemia. Men had the lowest amount of iron deficiency anemia of all the target groups.

Figure 9.3. Prevalence of iron deficiency anemia by target group, Malawi Micronutrient Survey, Malawi 2001.



9.4 Anemia and Infection

Anemia has many contributing factors. Various types of infection that cause cellular lysis or suppression of hematopoesis (these are the ways that malaria causes anemia) or blood loss increase the prevalence of anemia. Therefore, data on infection were combined with hemoglobin values to determine the percentage in each target group who were anemic and losing blood. For all target groups, malaria as a contributing factor was assessed.

9.4.1 Anemia, Iron Deficiency Anemia and Infection

For preschool children, school children and non-pregnant women, there were significant differences found between those with and without malaria parasitemia and the prevalence of anemia confirming that in the survey sample malaria has a major effect on anemia status (Table 9.13).

Analysis was also done to examine the relationship between malaria parasitemia and iron deficiency anemia. Using both the Hb & ZP and Hb & TfR indicators, there was a significant difference found among preschool children for those with and without malaria parasitemia (Table 9.13).

Table 9.13. Prevalence of anemia and iron deficiency anemia in those with and without malaria parasitemia, Malawi Micronutrient Survey, Malawi 2001.

Target group	Malaria parasitemia	N	Prevalence of anemia (%)	N	Prevalence of iron deficiency anemia (Hb & ZP) (%)	N	Prevalence of iron deficiency anemia (Hb & TfR) (%)
Preschool children	Yes	302	91.0*	207	69.1*	207	74.8*
	No	211	62.5	158	38.0	158	37.9
School children	Yes	326	27.2*	327	8.4	296	12.6
	No	366	17.9	367	6.9	331	8.0
Non-pregnant women	Yes	73	40.1*	73	18.4*	60	15.7
	No	350	24.3	350	8.6	286	10.5
Pregnant women	Yes	10	41.5	10	11.7	8	27.5
	No	47	17.6	47	3.4	40	0
Men	Yes	17	21.0	17	14.0*	4	30.6
	No	129	16.9	129	1.9	46	0

National data is weighted to account for survey design.
* $p<0.05$

9.4.2 Anemia and Infection in School Children

In school children, the relationship between hookworm infection and anemia and urinary schistosomiasis and anemia were examined and no significant difference were noted (Table 9.14).

Table 9.14. Parasitic infection and prevalence of anemia in school children, Malawi Micronutrient Survey, Malawi 2001.

Parasitic infection		N	Prevalence of anemia (%)
Hookworm	Yes	99	26.9
	No	568	21.5
Urinary schistosomiasis	Yes	136	26.6
	No	553	20.8

National data is weighted to account for survey design.

9.5 Use of iron supplements

Women of childbearing age were asked about their current and previous use of iron supplements. Of the pregnant women interviewed, 46.3% were taking iron and 7.0% of the non-pregnant were taking iron supplements.

Almost all of the women taking iron supplements did so daily, 90.2%, with 2.8% reporting not taking the iron regularly and only 1.5% taking iron weekly.

Most women, 81.9%, obtained their iron supplements from a clinic, hospital or health center (Table 9.15).

Table 9.15. Sources of iron supplements among women reporting iron supplement use, Malawi Micronutrient Survey, Malawi 2001.

Place where iron supplements are obtained	Percent of women who obtained iron supplements
Village health volunteer	5.9
Traditional birth attendants	3.9
Grocery/market	3.9
Clinic/hospital/health center	81.5
Mobile clinic services	4.8

National data is weighted to account for survey design.

All women (n=524) were asked if they had received iron supplements during any of their pregnancies. A total of 82.3% had iron at least during one pregnancy.

9.6 Knowledge of anemia and its prevention

Both women of childbearing age and school children were asked a number of knowledge questions about anemia. In Chichewa and Chitumbuka, the most predominant languages of Malawi and the languages used in the surveys, anemia is translated as "shortage of blood." Overall, 88.7% of women and 61.6% of the school children interviewed had heard of anemia/shortage of blood. Only those who said that they had heard of anemia/shortage of blood were asked further questions.

9.6.1 Knowledge of Iron – School Children

Of all the school children, the youngest children and those in the lowest grades/standards were not as familiar with the term anemia as the older children. A significantly greater number of urban school children had heard of anemia (Table 9.16).

Table 9.16. Percentage of school children (6-12 years) having ever heard of anemia/shortage of blood, Malawi Micronutrient Survey, Malawi 2001.

Characteristics of School Children	N	Percent reporting having ever heard of anemia/shortage of blood
Age Group (years)		
6-7	127	38.5*
8-9	170	53.7
10-11	242	66.3
12	161	80.0
Grade/Standard		
1	145	37.7*
2	159	58.2
3	178	72.9
4	98	60.8
5	71	76.5
6 and 7	49	90.7
Sex		
Male	350	64.0
Female	350	60.0
Residence		
Urban	84	77.2*
Rural	616	60.0
Region		
Northern	235	60.0
Central	233	63.5
Southern	232	61.2
National	**431**	**61.6**

National data is weighted to account for survey design.
*p<0.05

School children who had heard of anemia or shortage of blood were asked two additional knowledge questions about anemia. Multiple answers were recorded for both questions. More school children than women did not have an answer to the anemia questions asked. The order of most frequent answers was almost the same for the school children and women when asked how a person becomes anemic. The top foods mentioned that prevent anemia were vegetables, other, fruit and dark green leafy vegetables (Table 9.17).

Table 9.17. Responses to questions concerning anemia, school children (6-12 years), Malawi Micronutrient Survey, Malawi 2001.

Listed responses by school children: *	N	%
Causes of shortage of blood/anemia (n=429)		
Lack of food	137	31.8
Illness/disease	128	29.7
Bleeding	11	2.6
Heavy work	0	0
Genetics	0	0
Other	55	12.8
Don't know	159	36.9
Foods to prevent shortage of blood/anemia (n=429)		
Vegetables	180	42.0
Fruit	95	22.1
Dark green leafy vegetables	83	19.3
Nsima	77	17.9
Meat	68	15.9
Beans	55	12.8
Eggs	29	6.8
Milk	27	6.3
Rice	20	4.7
Chicken	13	3.0
Vitamin C rich food	7	1.6
Maize	6	1.4
Other	120	28.0
Don't know	70	16.3

National data is weighted to account for survey design.
*Question asked only of school children who had ever heard about anemia/shortage of blood.

9.6.2 Knowledge of Iron - Women

In the women, significant differences in having heard of anemia were found by age group and educational attainment (Table 9.18). The youngest women still in their teens and the women with no education had the least knowledge of anemia.

Table 9.18. Percentage of women of childbearing age (15-45 years) having ever heard of anemia/shortage of blood, Malawi Micronutrient Survey, Malawi 2001.

Characteristics of Women	N	Percent reporting having ever heard of anemia/shortage of blood
Age Group (years)		
15-19	114	80.8*
20-29	207	93.1
30-39	153	89.5
40-45	49	96.5
Education		
None	111	90.4*
1-5	181	82.6
6-8	160	92.9
>8	76	98.3
SES		
Low	282	88.2
Moderate	196	89.9
High	48	91.5
Residence		
Urban	72	95.8
Rural	457	88.1
Region		
Northern	189	87.8
Central	195	87.2
Southern	145	91.7
National	529	88.7

National data is weighted to account for survey design.
*p<0.05

Women who had heard of anemia or shortage of blood were asked two further knowledge questions about anemia. Multiple answers were recorded for both questions. Many women stated that anemia is a consequence of lack of food (68%). Others replied that illness or disease were the cause of anemia (47.1%). Few women named bleeding (10.7%) and some stated frequent pregnancies or births (10.4%). When asked about foods that prevent anemia, the most common answers were fruit, vegetables and dark green leafy vegetables (Table 9.19).

Table 9.19. Responses to questions concerning anemia, women of childbearing age (15-45 years), Malawi Micronutrient Survey, Malawi 2001.

Listed responses by women of childbearing age: *	N	%
Causes of shortage of blood/anemia (n=469)		
Lack of food	319	68.0
Illness/disease	221	47.1
Bleeding	50	10.7
Other	49	10.4
Heavy work	17	3.6
Genetics	8	1.7
Don't know	81	17.3
Foods to prevent shortage of blood/anemia (n=469)		
Fruit	236	50.3
Vegetables	223	47.5
Dark green leafy vegetables	191	40.7
Meat	131	27.9
Beans	92	19.6
Eggs	78	16.6
Other	50	10.7
Milk	38	8.1
Vitamin C rich food	34	7.2
Nsima	27	5.8
Rice	8	1.7
Maize	5	1.1
Chicken	4	0.9
Don't know	47	10.0

National data is weighted to account for survey design.
*Question asked only of women who had ever heard of anemia/shortage of blood.

9.7 School Environment Questionnaire

There were a total of 90 primary schools visited for the survey. The Advance Team had each school Headmaster complete a brief questionnaire concerning deworming and iron supplementation program in their schools.

Complete forms were collected from all but one school. The form from the school in cluster 254 in the Central Region was lost and the data never entered. Therefore compiled results are from 89 schools.

Four schools have a mass deworming program. Three of them are in the Northern Region and the other school is in the Central Region. Two of the school in the Northern Region had the last round of deworming in August 2001 and the other Northern Region school had their last round of deworming in September 2001. The Central Region school had their last deworming round in April 2001.

The same school with the deworming program also had an iron supplementation program.

CHAPTER 10: DISCUSSION

The Malawi Micronutrient Survey in Malawi has confirmed that the micronutrient status of Malawian preschool children, school children, women of childbearing age and men is far from being ideal. Precise estimates of the prevalence of different deficiencies serve as a national baseline from which to measure progress in the future. The data also establishes a basis for advocacy and resource mobilization for micronutrient interventions and to establish priorities for action.

10.1 Demographics

The actual sample size was less than expected. Possible reasons for only reaching 84% of the target sample can be explained from reports from the survey teams. In many cases the households had migrated to tea and coffee estates during the time of the survey. There were also many reports of households who had left their homes to attend funerals.

The sampling based on demographic information was very similar with results from the 1998 Population and Housing Census in Malawi. The residence distribution was similar with rural (88.3%) and urban (11.7%) households included in the survey. The age and sex distribution was also similar.

Age estimates were not reliable, particularly for preschool children. Caregivers were asked the birth date of the child 6-36 months and even though they were aided by the interviewers with a calendar of events, there were still 21 preschool children with age data beyond the designated age range. In addition there were missing ages from 2 school children, 8 women and 5 men.

A greater proportion of older school children (70% were 9-12 years) participated in the survey even though the children were randomly selected by age. This age distribution may reflect the fact that there are a greater number of older children in primary school since only recently was primary school education free of charge in Malawi.

The ability to read and write is differed between men and women, with almost 70% of men as compared to around 55% of women who report being able to read and write. Few people are highly educated with only 13.6% women and 14.1% men have completed secondary school and beyond. These data are also similar to the 1998 Population and Housing Census in Malawi.

Almost 85% of the women in the survey had been pregnant at least once. Women tend to have many pregnancies, resulting in many children per woman.

Overall, Malawi has a large low SES group (57%), few highly educated people, few have access to good housing, safe water supplies, sound sanitary facilities, and own assets.

10.2 Anthropometry

10.2.1 Low height-for-age (shortness or stunting)

Low height-for-age is also referred to as shortness or stunting (WHO, 1996). At a community level, a high prevalence of low height-for-age among young children implies long-term malnutrition and/or poor health of the population, and is a reliable indicator of overall socioeconomic conditions. In a generally healthy and well-nourished population, the statistically expected prevalence of low height-for-age is about 2.3%.

Stunting is very prevalent in Malawi with over half of the preschool children (53%) who are in the <-2 SD group. As the prevalence of low height-for-age in Malawi is over 50% the WHO classifies Malawi as a country having a "very high" prevalence of stunting. The survey results are consistent with the 2000 MDHS for stunting as being more severe in boys (57%) than in

girls (49%). There is more stunting in the Southern regions than in the Central and Northern regions.

10.2.2 Low weight-for-age (underweight)

As weight-for age or underweight is a composite indicator for both height-for-age and weight-for-height, there is not as much to conclude from underweight results. It is sufficient to report that there was high prevalence of preschool children in Malawi who were found to be underweight (31%). Malawi would be classified by WHO as having a "very high" prevalence of low weight-for-age.

10.2.3 Low weight-for-height (thinness or wasting)

The prevalence of low weight-for-height is a measure used to assess acute or recent malnutrition at the population level (WHO, 1996). The prevalence of wasting was low which suggests no acute nutritional problems. It can also be stated that at the time of the survey there was no severe food shortage, particularly since the survey was conducted close to harvest season. Based on WHO criteria, the prevalence of low weight-for-height would be considered "acceptable."

10.2.4 Weight and height status for adult women

Body mass index (BMI) results indicate that the majority of women (83%) fall within the normal range of 18-25. It will be important to utilize BMI over time to monitor adult nutritional status particularly as more women become educated and possibly shift the SES distribution.

In terms of the mean height values, older women have a greater average height than the younger women which may indicate that 40 years ago when women were children their nutritional status was better than current young women having children.

10.3 Morbidity

Various areas were considered in the morbidity chapter. These include malaria, intestinal parasites, urinary schistosomiasis, health history results and infection with symptoms.

10.3.1 Malaria

Mosquito bednets have the potential to decrease the prevalence of malaria. From the results a majority of households (87%) have heard of bednet although only 14% had a mosquito bednet in their home. Of the households with mosquito bednets they are utilizing them correctly and treating them within a year of receiving them.

The malaria parasitemia results indicate that the higher prevalence of malaria in preschool and school children possibly relates to issues of immunity. It may be worth exploring that the preschool children may benefit from intermittent presumptive treatment for malaria at immunization visits, which is an action that is being considered by WHO.

10.3.2 Intestinal parasites and urinary schistosomiasis

Not many school children were infected with intestinal parasites. In addition to children not having worms, they did not have distinct knowledge of intestinal parasites that would be needed to prevent transmission if there were many worms in the environment.

From the urinary schistosomiasis results, it can be concluded that the dipstick test in urine for the presence of blood serves as an accurate proxy for the presence of *Schistosoma haematobrium* eggs. Such an easy and economical test would help track the prevalence of the parasites, particularly as almost a quarter of the school children (24%) were infected.

The knowledge of urinary schistosomiasis is not clear enough for children to prevent transmission of the parasites. Communities must be engaged to rid the environment of the worms and habitat for the snails.

10.3.3 Health history

The prevalence of self reported illness in preschool children and school children was higher than in the adult which is consistent with the biochemical indicators for morbidity as well as with the micronutrient malnutrition results as well. It therefore makes the most sense to target interventions to younger children who are more at risk.

10.3.4 Infection and self reported illness

Symptoms were not found to be good indicators of disease. Specifically a fever in the past 2 weeks was only accurate for half the cases of malaria in preschool children and in even fewer school children, non-pregnant women and men. Visible blood in the urine predicts urinary schistosomiasis about 50% of the time. Prevention must be the priority for malaria, intestinal parasites and urinary schistosomiasis as well as for micronutrient malnutrition in general.

10.4 Food consumption

The Fortification Rapid Assessment Tool (FRAT) was utilized to identify in what quantities groups in Malawi consume certain centrally processed staple foods. The most promising staple food for fortification seems to be sugar, with 46% of preschool children, 37% of women and 44% of men consuming sugar on the previous day from the survey. Oil was the second most prevalent centrally processed potential food for fortification.

10.5 Iodine status

While 77% of the households had salt with some iodine as measured by titration, only 36% had $\geq$25 ppm of iodine, which is the required amount at household level in Southern Africa.

Efforts are needed to improve the proportion of households using iodized salt in the Southern and Central regions, and efforts are needed to improve the median iodine content of the iodized salt used in households in the Central region and perhaps the Northern region. There may still be problems with salt from Mozambique that is uniodized and comes across the border.

It is interesting to note that salt may be a measure of SES (Table 7.5) as almost 70% of women in the high SES category report buying iodized salt as compared to 35% in the low and 47% in the moderate SES groups. The results also show that rural areas are not receiving information about iodized salt.

A surprising result was that only 16.1% of school children have heard of iodized salt. And of the school children who have heard of iodized salt, 57.1% did not know why people use iodized salt.

10.5 Vitamin A status

Vitamin A deficiency can result in night blindness, and if severe enough, in complete loss of eye sight due to disruption in the surface integrity of the conjunctiva and cornea. In addition vitamin A deficiency can result in delayed growth and development, and is associated with impairments in immune status. Vitamin A deficiency is a major public health problem in Malawi according to the WHO (WHO, 1982). Almost 60% of preschool children, 38% of school children, 57% of women and 38% of men have serum retinol values $<20\mu g/dL$. A high prevalence of malaria and vitamin A deficiency was also found. Treating the malaria may therefore have a positive effect on the vitamin A deficiency.

Almost all of the very young children from 6-11 months received a vitamin A supplement in the previous 6 months, but fewer and fewer of the older children continued to receive their bi-annual vitamin A supplement. Better coverage over time needs to be addressed in the older children after they have received their immunizations in the first year of life. Vitamin A needs to be seen as an ongoing immunization that is required every 6 months until the child is 5 years old. Postpartum vitamin A supplements must also be given within 2 months of delivery on a more consistent basis.

Women have been targeted by vitamin A information campaigns since 78% of the women in the survey had heard of vitamin A as compared to only 43% of school children. Obviously campaigns can work to spread news to women.

10.6 Anemia, iron deficiency and iron deficiency anemia

Anemia is defined as a low hemoglobin concentration, while iron deficiency is a low level of storage or functional iron in the body. Severe iron deficiency results in anemia, and is referred to as iron deficiency anemia (IDA). In infants and preschool children, iron deficiency can result in developmental delays and behavioral disturbances. The developmental delays may persist past school age if the iron deficiency is not corrected. Iron deficiency anemia is also associated with poor birth outcomes including pre-term delivery and low birth weight. Among adolescents and adults, iron deficiency could contribute to fatigue and reduced work capacity. Unfortunately the sample size of pregnant women in the survey (n=57) was insufficient to make conclusions about this important group.

10.6.1 Anemia

Anemia is commonly used as a proxy indicator to screen for iron deficiency because it is relatively easy to assess, and because iron deficiency is often the most common cause of anemia. Other known causes of anemia include malaria, intestinal parasites, chronic illness, and other nutrient deficiencies (e.g. folic acid deficiency).

While it is necessary to examine each of the indicators that relate to anemia separately it is also important to note that the hemoglobin indicator for anemia is very informative. The highest prevalence of anemia by hemoglobin (Hb) was found in preschool children (80%) followed by non-pregnant women (27%), school children (22%) and men (13%). It is not surprising due to the large prevalence of anemia in preschool children that over half of all anemia preschool children (55%) also had malaria parasitemia. All the factors that cause anemia are particularly prevalent in the preschool children.

10.6.2 Iron deficiency

Iron deficiency was measured using transferrin receptor (TfR) and zinc protoporphyrin (ZP) for all target groups. In preschool children, iron deficiency was found to be prevalent in 64% by ZP and 61% by TfR. In the other groups, the prevalence estimates by these indicators were not as similar nor as prevalent. In school children, 13.9% were iron deficient by ZP and 23% by TfR. In non-pregnant women, iron deficiency was prevalent in 18% by ZP and 32% by TfR. Iron deficiency in men was around 5% by ZP and only 2% by TfR. More research would aid in assessing which of the iron indicators is the most helpful for monitoring of iron interventions in the future.

10.6.3 Iron deficiency anemia

Iron deficiency anemia (IDA) was assessed in two ways, by combining Hb with ZP and Hb with TfR. Overall, 58% of preschool children had IDA by Hb & ZP and 59% had IDA by Hb & TfR. In school children, IDA was found in 7% by the Hb & ZP indicator and in 10% by the Hb & TfR indicator. In non-pregnant women, IDA was 10% by Hb & ZP and 11% by Hb & TfR. In men, both indicators estimated IDA at around 2%. Again more research is necessary to determine which combination of indicators really gives the accurate picture of IDA.

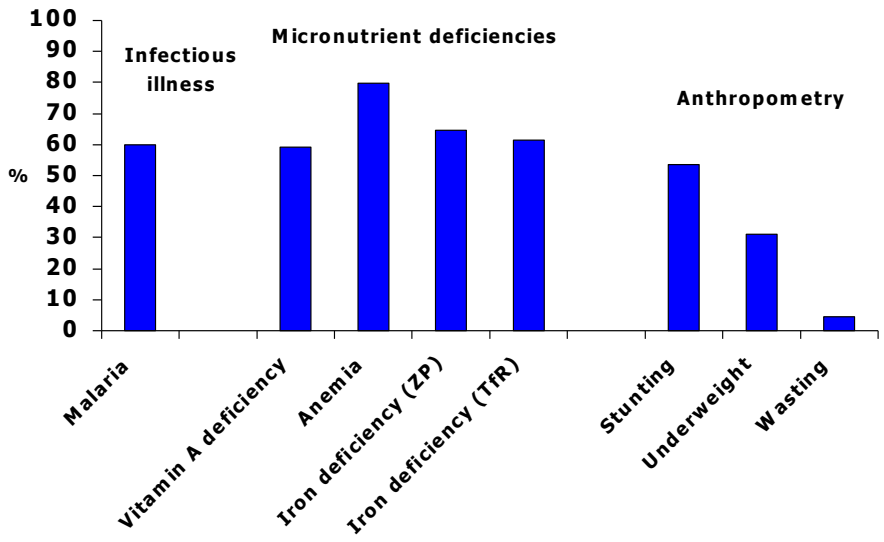
10.7 Summary findings

It is often helpful to visually compare the main findings from a large survey in order to determine what areas need to be targeted for interventions.

10.7.1 Preschool children

Preschool children are most at risk for all infectious diseases and micronutrient deficiencies assessed in the survey. No acute nutritional problems were noted in the preschool children as there was a low prevalence of wasting found. The high prevalence of stunting and underweight are most indicative of general low SES. The high prevalence of anemia stands out in Figure 10.1. There is also a correspondingly high prevalence of malaria and iron deficiency, which both need to be addressed in preschool children as well as in women of childbearing age (Figure 10.3).

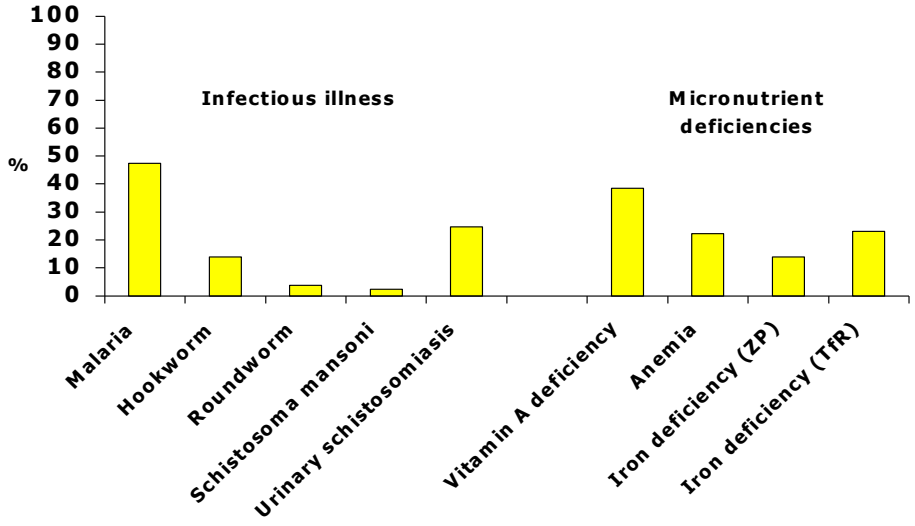
Figure 10.1. Summary of findings among preschool children, Malawi Micronutrient Survey, Malawi 2001.



10.7.2 School Children

The priorities for school children should malaria prevention and increased vitamin A consumption as these have the highest prevalence of infection and deficiency (Figure 10.2). Prevention of malaria plus an additional focus on increased iron consumption would most likely address the anemia. School children could be taught to link their accurate self-assessment of blood in their urine as a sign of infection with urinary schistosomiasis. In areas near natural water sources it might be possible to use this method of self-assessment as the basis for treatment. With such a low prevalence of intestinal parasites, deworming of school children is not a priority.

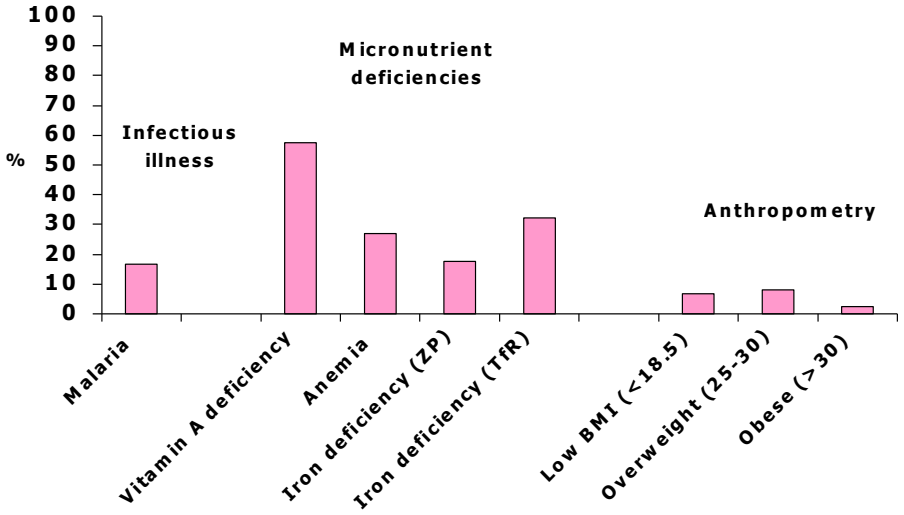
Figure 10.2. Summary of findings among school children, Malawi Micronutrient Survey, Malawi 2001.



10.7.3 Women of childbearing age

As the sample of pregnant was too small for conclusions, the findings in Figure 10.3 are for non-pregnant women of childbearing age. Vitamin A deficiency stands out with the highest prevalence. Iron deficiency is also a major problem among women. As women have such a profound effect on the nutritional status of their children it is understandable for the preschool children to also be micronutrient deficient. Interventions to address both vitamin A and iron deficiency in women are essential.

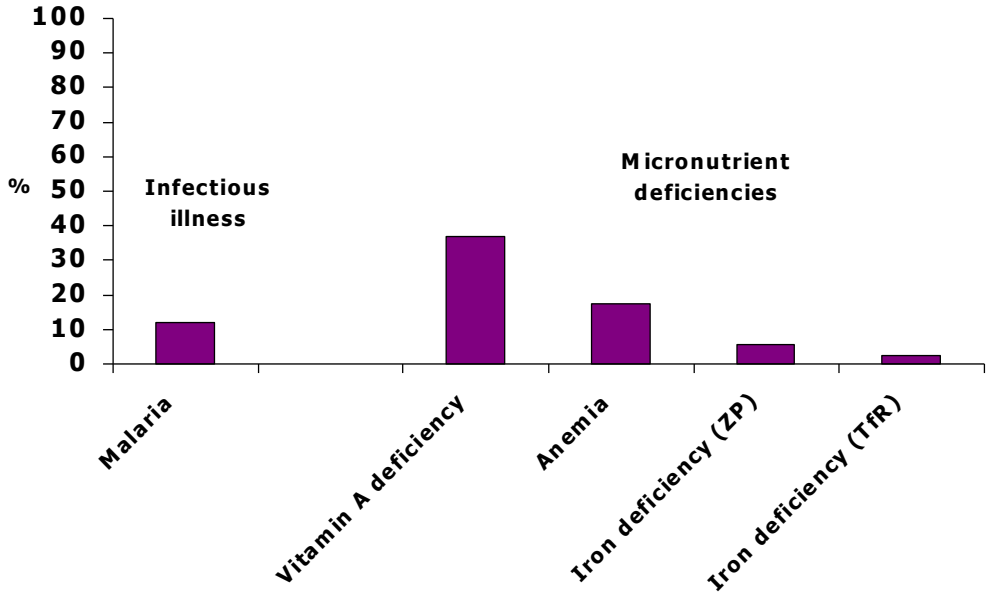
Figure 10.3. Summary of findings among non-pregnant women of childbearing age, Malawi Micronutrient Survey, Malawi 2001.



10.7.4 Men

The most striking finding in the men is the high prevalence of vitamin A deficiency (Figure 10.4). As men are not usually included in Malawi Micronutrient Surveys there is no international data to use for comparison. As the findings also showed that men consume sugar vitamin A fortification of centrally processed sugar is a promising intervention. With vitamin A deficiency found in the men, there is the possibility of directing communication messages to the men for themselves and their families.

Figure 10.4. Summary of findings among men, Malawi Micronutrient Survey, Malawi 2001.



10.8 Limitations

There were a number of limitations to the survey. In particular, the sample size for the anthropometry was small, yet the prevalence estimates were consistent with the recent 2000 MDHS. There were problems with the reported age, especially with the preschool children. The data quality was compromised due to short training for data entry. The data cleaning therefore took an exceptionally long time to sort through due to the training being abbreviated. The survey design was very complex with many of laboratory specimens analyzed in the field. There was some trouble with the ZP instruments as they were not designed to be field friendly tools. There was no biochemical measure of infection to use to adjust the serum retinol values.

REFERENCES

1. Centers for Disease Control and Prevention. Recommendations to prevent and control iron deficiency in the United States. Morbidity and Mortality Weekly Report (MMWR) 1998: 47 (1-29).

2. Chirambo, M. et al 1983

3. Cook JD, Skikne BS, Baynes RD. Serum transferring receptor. Annu Rev Med 1993; 44:63-74.

4. Craft, et. al., 1998 (Vitamin A DBS reference)

5. Epi Info, Version 6.04d. Centers for Disease Control and Prevention, USA and WHO, Geneva, Switzerland. 1999.

6. HemoCue AB, Angelholm, Sweden.

7. Human Transferrin Receptor: An in vitro enzyme immunoassay. Ramco Laboratories, Inc. kit insert. Catalog Number TF-94.

8. ICCIDD, MI, UNICEF, WHO, Botswana Government. Report on the ICCIDD Inter-Country Workshop on Harmonization of Iodated Salt Regulations for Southern Africa. Francistown, Botswana, July 1999.

9. Labbé RF, Vreman HJ and Stevenson DK. Zinc protoporphyrin: a metabolite with a mission. Clinical Chemistry (1999) 45:12, 2060-72.

10. Malawi Demographic and Health Survey. 1992

11. Malawi Demographic and Health Survey. 2000.

12. Malawi Social Indicators Survey, 1995

13. MBI. Rapid test kits for the presence of iodine in salt. 85 GN Chetty Road, iii Floor, T Nagar, Madras 600 017, India.

14. MICAH. Survey report. World Vision Malawi, 1998.

15. Miller, LH. Malaria Chapter 27 in Tropical and Geographical Medicine. Warren KS and Mahmoud AAF (eds). McGraw-Hill, p223-239. 1984.

16. Ministry of Health and Population. Health Information System. 1995.

17. Ministry of Health and Population. IDD Review Report. Malawi, 1989.

18. Ministry of Health and Population. Survey report. Malawi, 1996.

19. Ministry of Health and Population. Survey report. Malawi, 1988.

20. Training Modules on Weaning, MOHP 1992 with assistance from the Royal Tropical Institute, Amsterdam and the World Food Programme.

21. United Nations. How to weigh and measure children: Assessing the nutritional status of young children in household surveys. New York, 1989.

22. World Health Organization. Physical status: The use and interpretation of anthropometry: Report of a WHO expert committee. WHO Technical Report Series 854, 1995.

23. World Health Organization. Control of vitamin A deficiency and xerophthalimia. WHO Technical Report Series No. 672. Geneva, Switzerland. 1982.

24. WHO, UNICEF, UNU. Iron Deficiency Anemia: Assessment, Prevention, and Control: A guide for programme managers. 2001. – red book, anemia

25. WHO/UNICEF/ICCIDD. Assessment of Iodine Deficiency Disorders and Monitoring their Eliminationa: A Guide for Program Managers. 2001

26. World Health Organization. Assessment of Iodine Deficiency Disorders and Monitoring their Elimination. 2001. (Document WHO/NHD/01.1). – purple book

27. World Health Organization. Indicators for assessing vitamin A deficiency and their application in monitoring and evaluating intervention programmes. 1996. (Document WHO/NUT/96.10). – green and yellow

28. World Health Organization. Iron deficiency anemia: assessment, prevention, and control. A guide for programme managers. 2001. (Document WHO/NHD/01.3).

29. ZP Hematofluorometer – Instruction Manual. Aviv Biomedical, Inc. 1999.

ANNEX A: MAP OF MALAWI WITH DISTRICTS

ANNEX B: DIRECTIONS FOR RANDOM SELECTION OF SCHOOL CHILDREN

There will be TWO Advance Teams, one to follow the Northern Group and one for the Southern Group.

Each Advance Team will visit 3 schools each day to randomly select **8 children and 2 alternates** from 6-12 years to participate in the survey. The schools will be selected by being the closest public school to the first randomly chosen house in each cluster.

1. Find the headmaster of the school.

2. Describe that the school was selected to be part of the Malawi Micronutrient Survey and that you would like to randomly select 8 children and 2 alternates from the school to participate.

3. Make sure to tell the headmaster when the team will be arriving to collect the samples and conduct the interviews. In some cases, this will be on a Saturday.

4. From the school listing of children identify those who are 6-12 years. Do not pay attention to the standard level of the children. We are only interested in the age.

5. Somehow mark those children who are 6-12 years. Count the **total** number of children in the correct age range.

6. Calculate the **total divided by 10** (we want 8 children and 2 alternates in the school). Always round down to the nearest whole integer.

7. Randomly select a number between **1 and the total divided by 10. This is the sampling interval = X.**

8. Select the child who is equal to X and then choose every child who is X spaces from the previous child. If one of the selected children is not in school that day then choose the next child on the list. Follow the interval from the originally chosen children. There should be a minimum of 8 children and 2 alternates selected from each school.

9. For example, there are 321 children in the school who are from 6-12 years. So, 321/10 = 32.1. Round down to the nearest whole integer, so 32 which equals X. Then choose a random number between 1 and 32, say 10. Select child number 10 from the school list. The next selected child is 10+X or 10+32, so select child 42 from the school list. The next selected child is 42+X or 42+32, so select number 74. Continue selecting children until you have 10 children total.

   If one of the selected children is not in school on the day the Advance Team is present, select the next child on the list that is below the missing child. Then continue with the next selected child.

10. Make one list of the selected children and the alternates, and have the headmaster keep it to give to the lab tech who will visit the school as part of the survey team.

11. Explain that the first 8 children chosen are the selected children, who will participate in the whole survey. We want 8 children to complete the entire survey from each school. The alternates are chosen in case one of the selected children is not present on the day of the survey. Make sure the headmaster and the children understand the difference between the selected children and the alternates.

12. Give the headmaster a stool container for each of the selected children and the alternates. Explain how the children should put a small sample of stool in the cup. The

samples should be as fresh as possible, from the previous day or from the morning that the survey team arrives (12 hours or less before).

13. Explain to the headmaster that the survey team will be in the area and a lab tech will visit the school on the designated day. The selected children and the alternates should be ready with their stool sample from the previous day (12 hours or less before). The children who complete the survey will be given urine containers, have their sample of blood taken from their finger, and be asked a questionnaire on the day the lab tech visits the school.

14. Ask the headmaster the questions on the School Environment Survey.

15. Thank the headmaster.

Stool sample procedure
Small sample needed. The child should be told to defecate to the side of the latrine. Once they finish they should use something other than their hand to scoop a small sample into the cup. Then tell them to close the lid tightly and bring the sample to school on the designated day. The samples need to be very recent, within 12 hours or less from the time they are collected.

Urine sample procedure
The children will be given a cup for a urine sample on the day the survey team is in the cluster. The urine sample must be collected between 11am and 2pm.

Finger stick
The children will have a sample of their blood taken through a finger stick method. This will test for malaria and anemia. Children with hemoglobin less than 9.0 g/dL will be given a referral form to go to the nearest health clinic for treatment.

National Micronutrient Survey in Malawi 2001
Random selection of school age children (6-12 years)

School name: _____ Cluster #: |_|_|_|

Date of visit: |_|_| - |_|_| - |_|_| ID No. Of Sampler: |_|_|

Total # of children (6-12 years) = ____ / 10 = _____ (Sampling interval =X)
(Round down to the nearest whole integer)

Start by selecting a random number between 1 and X. Select the child who is at the random number. Then select the next child who is X from the first selected child. Continue selecting children using the X interval until you have 10 children selected total in each school. The last two children will be the alternates. Record the child's name and age below. The label will be added to the form on the day of the survey.

For example, there are 321 children in the school who are from 6-12 years. So, 321/10 = 32.1 Round down to the nearest whole integer, so 32 that equals X. Then choose a random number between 1 and 32, say 10. Select child number 10 from the school list. The next selected child is 10+X or 10+32, so select child 42 from the school list. The next selected child is 42+X or 42+32, so select number 74. Continue selecting children until you have 10 children total.

If one of the selected children is not in school on the day the Advance Team is present, select the next child on the list that is below the missing child. Then continue with the next selected child.

Number	Child's name	Age (years)	1=Selected 2=Alternate	LABEL
1.	_____	|_|_|	1	
2.	_____	|_|_|	1	
3.	_____	|_|_|	1	

4.	_____	|_|_|	1	
5.	_____	|_|_|	1	
6.	_____	|_|_|	1	
7.	_____	|_|_|	1	
8.	_____	|_|_|	1	
9.	_____	|_|_|	2	
10.	_____	|_|_|	2	

If one of the selected children is not present on the day of the survey, use one of the alternates. We always want 8 children to complete all parts of the survey.

ANNEX C: JOB DESCRIPTIONS FOR SURVEY TEAM MEMBERS

Team Leader Job Description

The overall responsibilities of the supervisor include:

- oversee the members of the team
- correct sampling methodology including the identification of houses and subjects
- placement of interviewers throughout the cluster
- keep track of the household numbers for each day
- designating the central place for lab team and ensuring everyone knows the location of the central place
- checking surveys once they are complete
- organizing the surveys to give to the data entry personnel
- directing the driver especially if there is a need for transporting interviewers and/or subjects to the lab
- assessing the supplies (copies of surveys, etc.)
- serve as a back-up for the lab and the interviewers
- coordinate with the regional supervisors to have the lab techs work to process the samples and to transport the samples to Lilongwe

The following is a suggested sequence of events:

1. Review the schedule for the team. Make sure everyone knows what cluster number is correct and the household numbers that each interviewer should use for that day. The interviewers should fill out as much of the first page of the household survey as possible. Each interviewer should know the name of the head of the houses that they will visit that day as they need to confirm that they are in the correct house. The household numbers should already be assigned and recorded on the enumeration listing.

2. Before entering the cluster, review the listing and the map from the enumeration exercise. Make a rough plan for where to put the central lab and how to arrange the interviewers.

3. Enter the selected cluster and find the area of the randomly chosen starting household.

4. Find the chief or authority figure in the area to confirm that they know about the survey and have given their permission.

5. Find a central place for the lab tech and make sure everyone knows where that central point will be.

6. Send the other lab tech to the designated school. Double check that the lab techs have the necessary supplies.

7. Determine which households each interviewer will visit that day and give them a plan. Each interviewer should have the name of the head of the household and a household number already determined. Make sure each interviewer knows which surveys they will conduct that day (for example, the Man's Survey, the Women's FRAT or the Infant's FRAT).

8. Send the interviewers to their starting household. Periodically check on each of them, especially if the distances are not too far.

9. When an interviewer brings selected subjects to the central lab site, then help with the anthropometric measurements (length/height).

10. Before you leave the cluster, collect all the questionnaires and look through them for skipped questions, any other errors, and illegible marks. Ensure that all "other" responses are written in English!

11. At the end of the sample collection, collect all the questionnaires from the day and organize them to give them to the data entry personnel. As the teams move farther from Lilongwe, the regional supervisors may help in collecting the surveys and having them taken to Lilongwe for data entry.

Interviewer Job Description

Each interviewer will be told where to start and given a plan for the day by the team supervisor. Each interviewer must know where the central lab is located in order to direct people to the correct place.

Every interviewer should have the following items with them:
- Salt test kit
- Household questionnaires
- Listing of women
- Women's questionnaires
- Infant's questionnaires
- Action cards
- Clipboard
- Bag
- Pencil and eraser

One interviewer on the team will be responsible for the MAN'S SURVEY and will interviewer the FIRST TWO MEN they encounter in their households that day.

Another interviewer will be responsible for the WOMEN'S FRAT and will conduct the FRAT on the FIRST TWO PRIMARY COOKS in the FIRST TWO HOUSEHOLDS of the day.

Another interviewer will be responsible for the INFANT'S FRAT and will ask questions to the caretaker of the FIRST TWO INFANTS they interview that day.

1. Follow the directions of the team supervisor who will have given each interviewer a plan for the day. The supervisor will give each interviewer the name of the heads of each household they will visit.

2. Fill out as much of the top of the household form before entering the household.

3. Identify the first household of the day and confirm that the head of the household corresponds with the name on the enumerator's list. If no one is home or there is no competent person to talk to, mark this on the household survey form. Find out from a neighbor the household has been or will be absent for a long time. Follow the codes on the household survey form.

4. Determine if the household needs to be visited again and attempt to set a time when an interviewer will return.

5. Follow the tips to good interviewing. Find a person of authority, most likely a mother in the household, to interview. Begin reading the introduction at the start of the household questionnaire and obtain consent for the survey.

   If the household refuses the interview, mark this on the household survey, thank the person and move on to the next designated household. Follow the codes on the household survey form.

6. Once consent is obtained, begin the survey. Before asking about the household salt, determine the people who live in the household. Remember that a household is defined as having a common cooking pot.

7. On the separate Listing of Women (15-45 years), record all the women in the age range in the household from OLDEST to YOUNGEST. **Select every other woman on the gray lines.**

8. **The salt testing should be done only in the households where you also interview a woman.**

9. If a woman or multiple women in that household have been selected, then proceed with the WOMEN'S QUESIONNAIRE. If you are an interviewer who needs to also conduct the WOMEN'S FRAT **and** you are in your first or second household of the day, then determine the woman who is the main cook for the household and ask her the FRAT questions as well.

10. Also ask if there are any children age 6-36 months in the household. Use the even calendar developed in the training to determine the age of the children. **Select and interview every child 6-36 months.** If you are an interviewer who need to also conduct the INFANT'S FRAT **and** you are in your first or second household of the day, then determine the caretaker for the infant and ask her the FRAT questions as well. If there is more than one infant in the house, ask which caretaker does more of the cooking and select that caretaker for the Infant FRAT.

11. If you are an interviewer who need to also conduct the MAN'S SURVEY **and** you are in your first or second household of the day, then find a man 20-54 years to question.

12. Following all the interviews for the household, fill out the bottom of the first page of the household survey where it asks how many women, infants and men were interviewed in the household. Record any notes in the space provided at the bottom of the household survey. Make sure to keep the completed questionnaires clean and organized by household.

13. Fill out an Action Card for that person and take all of the selected subjects to the central lab.

14. For women and preschool children conduct anthropometric measurements. Have the team leader or some other trained person (another interviewer) help with the measurements for length/height.

15. Hand in completed surveys to the team leader who will review them and then give them to the lab tech to label.

16. Explain to the subjects that they must hold onto their Action Card (not handing it to another person) and give it to the lab tech when they are called.

17. Once you have completed the appropriate surveys in a household move on to the next designated household and repeat the process.

Lab Technologist Job Description – School

The laboratory technologist who goes to the school will be responsible for:

1. Arriving at the school with all necessary equipment and supplies (HemoCue, cuvettes, Rapid Assessment Tool (FRAT) questionnaire for two children, QC record sheets for the HemoCue, ink pens, sharpie markers, result recording sheets for the HemoCue results, labels for samples, microtainers, and a cooler with cold packs for the urine specimens, alcohol wipes, gauze and bandages).

2. Performing quality control for the HemoCue instrument (Calibration slide, low and normal controls) and recording results. Ensuring that instrument is operating in the correct range before beginning any testing.

3. Correctly identifying the pre-selected children with the help of the headmaster and ensuring that all specimens from the children are correctly labeled.

4. Conducting a proper fingerstick on each of the pre-selected children.

5. Preparing a malaria thick smear for each of the pre-selected children.

6. Collecting 500 μL of blood in a microtainer on each of the pre-selected children (mix well). **Do not overfill or under fill.**

7. Performing hemoglobin assessment on each of the pre-selected children and recording results. Children with a hemoglobin of < 9 g/dL will be given a referral slip.

8. Gathering urine samples and stool samples from the pre-selected children (each one will have been provided the collection materials and containers by the advanced team).

9. Conducting the interview process for each of the pre-selected children.

10. Performing the FRAT on the identified sub-sample of children.

11. Once this is complete, gather up all materials, specimens, and forms and move to the centrally located collection point to assist the other laboratory technologist with the remaining specimen collections for the cluster.

Technologist Job Description - Central Laboratory Site

The laboratory technologist who goes to the central collection point will be responsible for:

1. Arriving at the collection point with all necessary equipment and supplies (HemoCue, cuvettes, spare batteries for the HemoCue, slides for the malaria smears, the Modified Fortification Rapid Assessment Tool (FRAT), QC record sheets for the HemoCue, ink pens, result recording sheets for the HemoCue results, labels for samples, microtainers, and a cooler with cold packs for the urine specimens, alcohol wipes, gauze and bandages).

2. Performing quality control for the HemoCue instrument (Calibration slide, low and normal controls) and recording results. Ensuring that instrument is operating in the correct range before beginning any testing.

3. Correctly identifying the individuals presenting for testing and ensuring that all specimens are correctly labeled.

4. Conducting a proper fingerstick on each of the individuals.

5. Preparing a malaria thick smear for each person.

6. Collecting 500 μL of blood in a microtainer on each person (mix well).
Do not overfill or under fill.

7. Performing hemoglobin assessment on each person and recording results.

Both Laboratory Technologists Job Descriptions

After, the last hemoglobin assessment of the day is performed; test the low and normal quality control standards for HemoCue instruments used that day.

Once all of the patients are completed, gather up all materials, specimens, and forms and move with the other laboratory technologist to the testing facility identified by the team supervisor.

Perform quality control testing for the ZP instrument and record the results.

Conduct ZP testing, prepare dried blood spots for TfR and vitamin A. Spin EDTA tubes down and pull off remaining serum for vitamin A determination.

Stain malaria smear slides.

Perform parasitological examination of stool for fecal parasites.

Perform urine dipstick to detect protein and red cells.

Examine urine samples for *Schistosoma haematobium* eggs.

Replenish supplies in box for the next testing day (as per the checklist).

Re-freeze cold packs.

Regional Supervisor Job Description

- General trouble shooting of problems
- Act as the sampling authority
- As the teams move farther from Lilongwe, help with collecting the surveys and having them taken to Lilongwe for data entry.

Regional Lab Supervisor Job Description

- Find a central location for the three teams to set up the ZP machine and work on processing the samples from the day.
- Calibrate the ZP machine each day.

Data entry personnel Job Description

Use EpiInfo 6.04d to enter all the questionnaires and lab forms. Every file must be double entered.

ANNEX D: TRAINING SCHEDULE, NATIONAL MICRONUTRIENT SURVEY IN MALAWI (3-11 SEPTEMBER 2001)

Date	Time	Lab techs	Interviewers	Supervisors	Advance Team	Data Entry
Day 1: Monday Sept 3	Morning	Introduction, Background of Survey, Logistics, Sampling				
	Afternoon	Intro to interviewing and Intro to Anthropometry				
Day 2: Tuesday Sept 4	Morning	General overview Fingerstick Procedure & Practice Malaria Thick Smear Microtainer Malaria Stain Labeling Result Forms	Questionnaire review and practice: Household, listing of women, salt testing, women's questionnaire, infant questionnaire			
	Afternoon				Review sampling and logistics	
Day 3: Wednesday Sept 5	All day	HemoCue QC (including control slide) Referral forms ZP (QC & Operation) Dried blood spots (50 µL & 100 µL) Centrifuging & Plasma Separation	Anthropometry: Standardization	Review sampling and logistics		
	Evening	ZP calibration with Regional Lab Supervisors				
Day 4: Thursday Sept 6	Morning	Urine & Stools Reagent preparation	FRAT training		Go to schools (2) to select children	
	Afternoon	School children's questionnaire				Go over data entry files

Day 5: **Friday Sept 7**	All day	**Field testing - North and South Teams - visit 2 villages and schools**			Go to schools (2) to select children	
	Evening	Process samples collected				
Day 6: **Saturday Sept 8**	Morning	Discuss field work from previous day Making changes to questionnaires and sending them to Zomba for printing Make some copies of the revised questionnaires for field test on Monday				Double enter data from field
	Afternoon	Prepare for next day when survey begins				
	Evening			Final questions		
Day 7: **Monday Sept 10**	All day	**Field testing - North and South Teams - visit 2 villages and schools**			Begin regular schedule for survey	
	Evening	Process samples collected				
Day 8: **Tuesday Sept 11**	Morning	Prepare reagents	Review	Review		
	Afternoon	Gather supplies for survey				
Wed Sept 12	**Begin Malawi Micronutrient Survey**					

ANNEX E: LABORATORY METHODS

The Finger Puncture Procedure

National Micronutrient Survey in Malawi 2001

A finger puncture procedure will be conducted for all survey participants older than 6 months of age. Those survey participants that are 6 months of age and have small fingers will undergo the heelstick procedure, since the bones of the distal phalanx (located in the thickest part of the finger) may be injured by a lancet puncture.

1. Identify the survey participant. For this study there are two distinct groups, **group a** which is located at the school closest to the first house identified in each cluster, and **group b**, which represents the occupants of each house selected to participate in the survey.

    a. School participants will be pre-selected by the advance team and will be brought to the testing area in the school by the headmaster. Survey team lab personnel will carry labels for the students.

    b. Those individuals who are sent to the central collection site from the houses selected to participate in the survey will arrive to the testing site with their health card with labels attached.

2. Organize your collection equipment. (Lancet, alcohol pad, gauze, band-aid, HemoCue cuvette, microscope slide, labels, Microtainer, and cryovial).

3. Cut the barcode from the tube label and discard the barcode. Wrap the tube label around the Microtainer tube (this allows blood volume to be seen). Only the section from the patient ID number down to the date and initials must remain on the tube.

4. Label the cryovial with the appropriate label. Ensure that barcode is placed "ladder" style (sideways) on the vial (barcode placed vertical rather than horizontal). **Do not cut this label.**

5. Select the skin puncture site on the side of the finger (not too close to the nail bed). You may use either hand, but the less dominant hand is usually not as calloused. Use the middle or ring finger (3rd or 4th finger). Do not use the last finger (5th finger) or the thumb.

6. Thoroughly clean the puncture site with a 70% isopropyl alcohol pad (continue to clean the site until no dirt appears on the alcohol pad). Wipe the site dry with gauze. (Residual alcohol may dilute sample).

7. Puncture the site with a disposable lancet. Hold the finger firmly to immobilize the finger, as some patient's response is to pull away as you perform the skin puncture. Use moderate pressure and depress the plunger completely, then release the plunger and remove the lancet. Discard the lancet in the puncture-resistant sharps container. **A good deep stick will give you a good flow of blood, which will allow you to rapidly fill the Microtainer to the 500 μL level – this will prevent the blood from clotting during the collection.**

8. Using the first drop of blood, prepare the thick malaria smear slide. Make sure to put the blood on the same side of the slide that has the rough frosted end. Put the label over the frosted end of the slide. Place the slide in the sun to dry.

9. Collect the blood in the Microtainer tube by applying light pressure opposite the puncture site until a drop appears. Use the scoop on the microtainer tube to guide the drop into the tube. **Do not scrape the side of the finger to collect the blood. Continue to squeeze the finger and the whole hand to help blood flow. You may use the gauze to wipe away some of the blood that covers the finger before applying more pressure.** Continue to collect blood droplets until you reach the 500 μL fill line (a minimum of 250μL is required to obtain accurate results). Do not overfill.

10. Remove the scoop from the Microtainer and discard into the sharps container. Replace the microtainer cap and gently invert the tube 8 to 10 times to ensure adequate mixing of the blood with the EDTA in the tubes.

11. Using gauze, place gentle pressure on the site to stop bleeding. Apply a band-aid.

Helpful suggestions:

When applying pressure to stimulate flow it is helpful to apply pressure and then relax pressure momentarily to allow blood to flow into the capillary bed.

Perform puncture at heart level or below.

Hold survey participant's hand in a downward fashion to allow gravity to assist with blood droplet formation.

The Heelstick Procedure

National Micronutrient Survey in Malawi 2001

A skin puncture procedure performed on the heel will be conducted for survey participants 6 months of age who have very small fingers. The heelstick is preferred for this age group because the bones of the distal phalanx (located in the thickest part of the finger) may be injured by a lancet puncture. The heelstick is performed on the lateral or medial portions of the foot (left and right), never the central area of the foot, the arch, or the back of the heel.

12. Identify the survey participant. Those individuals who are sent to the central collection site from the houses selected to participate in the survey will arrive to the testing site with their health card with labels attached. Children in this age group can be identified by the individual bringing them to the collection site.

13. Organize your equipment. (Lancet, alcohol pad, gauze, band-aid, hemocue cuvette, microscope slide, labels, Microtainer, and cryovial).

14. Cut the barcode from the tube label and discard the barcode. Wrap the tube label around the Microtainer tube (this allows blood volume to be seen). Only the section from the patient ID number down to the date and initials must remain on the tube.

15. Label the cryovial with the appropriate label. Ensure that barcode is placed "ladder" style (sideways) on the vial (barcode placed vertical rather than horizontal). **Do not cut this label.**

16. Select the skin puncture site. Either foot can be used.

17. Thoroughly clean the puncture site with a 70% isopropyl alcohol pad (continue to clean the site until no dirt appears on the alcohol pad). Wipe the site dry with gauze. (Residual alcohol may dilute sample).

18. Puncture the site with a disposable lancet. Firmly hold the heel, place the lancet perpendicular to the heel and perform the puncture. Discard the lancet in the puncture-resistant sharps container.

19. Using the first drop of blood, prepare the thick malaria smear slide. Make sure to put the blood on the same side of the slide that has the rough frosted end. Put the label over the frosted end of the slide. Place the slide in the sun to dry.

20. Collect the specimen in the microtainer tube by applying light pressure opposite the puncture site until a drop appears. Use the scoop on the microtainer tube to guide the drop into the tube. **Do not scrape the side of the foot to collect the blood. You may use the gauze to wipe away some of the blood that covers the heel before applying more pressure.** Collect as much blood as you can, attempt to collect 500 μL (250 μL is the minimum for accurate results). (It is understood that infants may not bleed from a heelstick as readily as an adult would from a fingerstick). Do not overfill.

21. Remove the scoop from the microtainer and discard into the sharps container. Replace the microtainer cap and gently invert the tube 8 to 10 times to ensure adequate mixing of the blood with the EDTA in the tubes.

22. Using gauze, place gentle pressure on the site to stop bleeding. Apply a band-aid.

Helpful suggestions:

When applying pressure to stimulate flow it is helpful to apply pressure and then relax pressure momentarily to allow blood to flow into the capillary bed.

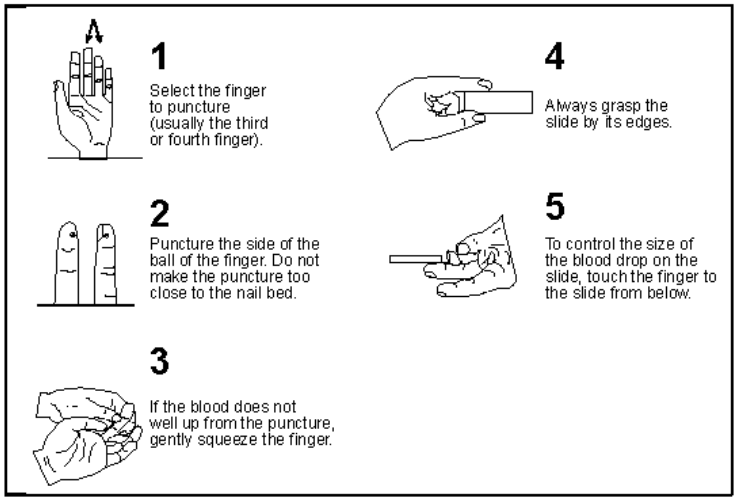
Perform puncture at heart level or below.

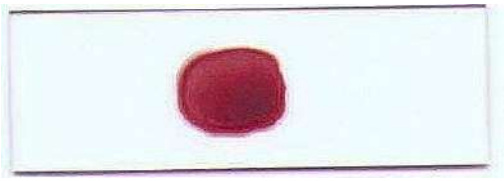
Hold survey participant's foot in a downward fashion to allow gravity to assist with blood droplet formation.

The Malaria Thick Smear
Slide Preparation Procedure

National Micronutrient Survey in Malawi 2001

1. Place the correct label on the rough frosted end of the slide.
2. Conduct the fingerstick according to the finger puncture procedure.
3. Using the first drop of blood, touch the clean, labeled microscope slide near one end to the formed blood drop. (**Make sure that blood drop is placed on same side of the slide that the label is on**).
4. Spread the drop of blood with the corner of another slide to make an area about 1 cm in diameter.
5. Correct thickness is attained when newsprint is barely legible through the smear.





Hemocue Procedure

National Micronutrient Survey in Malawi 2001

Upon reaching the school site or the central collection point, check the instrument accuracy using the calibration cuvette (specific for the instrument). If the cuvette reads within the specified range listed on its container, perform daily quality control (QC) on the instrument. **If the calibration cuvette provides a reading that is not within the range specified on its container, clean the cuvette holder and the cuvette with a dry kim wipe.**

Perform daily QC by measuring and recording the results for each of the low, normal and high range control vials (**see form).**

For each use:

1. Assemble all of the materials needed prior to collecting and testing each survey participant. Reseal the cuvette container **immediately** after taking out a cuvette for use.

2. Conduct the fingerstick according to the finger puncture procedure.

3. Prepare the malaria thick smear slide according to the procedure.

4. Fill the Microtainer (no less than 250 µL and no more than 500 µL).

5. Recap the Microtainer and invert the tube (gently) 8-10 times.

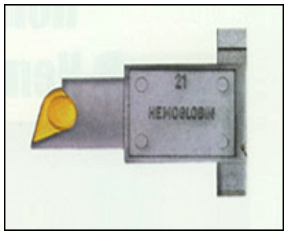
6. Bandage the survey participant's finger.

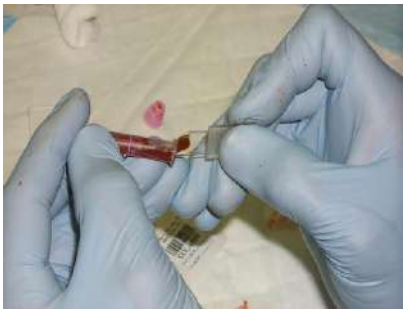
7. Remove the cap from the well-mixed Microtainer tube.

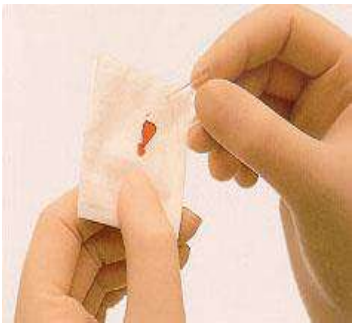
8. Fill the Hemocue cuvette by holding the Microtainer tube in a horizontal position and tapping the blood forward to the edge of the Microtainer. Place the pointed tip (with the cuvette's groove facing upward) of the Hemocue cuvette into the blood drop. The cuvette will fill automatically by capillary action. **Never try to "top off" the cuvette after the initial filling**. If the cuvette is not filled with the attempt, discard it in the biohazard container and use a second cuvette.

9. Wipe off any excess blood from the cuvette. Ensure that no blood is "sucked out" of the cuvette when wiping it.

10. Place the cuvette in its holder and **gently** push the holder into the photometer. The cuvette should be read **within 10 minutes** of being filled. It normally takes 15-45 seconds for a reading. Discard the cuvette into a biohazard container immediately after recording the Hgb value.


21
HEMOGLOBIN






B-Hemoglobin
129.

National Micronutrient Survey in Malawi 2001
Hemocue Hemoglobin Quality Control Form

Hemocue Serial Number _____ CDC Number_____ Control cuvette number_____

Low control lot number_____ Normal control lot number_____
High control lot number_____

Quality control for blood hemoglobin results (grams per deciliter - g/dL)

Morning						Evening				
Date **2001**	**Control Slide Specific for the Instrument**	**Low Target: 8.0 ± 0.4 (7.6 - 8.4)**	**Normal Target: 11.9 ± 0.6 (11.3-12.5)**	**High Target: 15.9 ± 0.8 (15.1 - 16.7)**	**Initials**	**Control Slide Specific for the Instrument**	**Low Target: 8.0 ± 0.4 (7.6 - 8.4)**	**Normal Target: 11.9 ± 0.6 (11.3 - 12.5)**	**High Target: 15.9 ± 0.8 (15.1 - 16.7)**	**Initials**

Operating Procedures for Aviv ZP Hematofluorometer
National Micronutrient Survey in Malawi 2001

1. Plug electrical cord into proper outlet.

   1a. Depress the "ON" button (it should illuminate) and the sample slide will extend out of the instrument.

2. Place a blank cover glass in the sample slide holder. **Only touch the edges of the cover glass – fingerprints may affect reading.**

3. Depress the "MEASURE" button. (Readout should be less than 15)

4. Place at least 20 µL of EDTA anticoagulated whole blood in the center of the cover glass.

5. Spread the sample over the hole, using a plastic pipette tip with sufficient blood to cover the aperture of the sample slide. DO NOT use anything that will scratch the cover glass. No additional preparation is needed and no other volume measurement is required.

6. Depress the "MEASURE" button located on the front of the instrument. The instrument will pause for a second to calibrate itself, automatically draw the sample slide with the whole blood sample into the measuring compartment, analyze the sample, displaying the results and return the sample. Record the results on the "ZP and Dried Blood Spot Form." **Perform the sample measurement two times for each sample**. *If the second reading is significantly higher than the first, discard the cover slip and pipette tip into the red sharps container and re-cap the sample and mix well. Start over at direction # 1.*

7. Discard the used cover glass and pipette tip into the red sharps container.

Hematofluometer Quality Control Form
National Micronutrient Survey in Malawi 2001

Controls for Daily Quality Control

Instrument number: (Circle one) 1 2 3

Date	Time	Temp	Low (blue top) 22 ± 4 *	Middle (white top) 59 ± 7*	High (red top) 120 ± 12*	Comments	Initials

* u mol ZP/mole of heme

Method for the parasitological examination of stool for fecal parasites
Formol ether Concentration technique
National Micronutrient Survey in Malawi 2001

Requirements:

1. Formol water, 10% (prepared by mixing 50ml of strong formaldehyde solution with 450 mls of distilled or filtered water.)

2. Diethyl ether

3. Sieve (strainers) with small holes preferably 400-450um in size.

Method

1. Using a rod or stick, emulsify an estimated 1 gram of faces in about 4mls of 10% formol water contained in a screw cap tube.

2. Add further 3-4ml 10% v/v formol water; cap the bottle, mix, by shaking for 20 seconds.

3. Sieve the emulsified faces, collecting the sieved suspension in the beaker.

4. Transfer the suspension to a conical tube made of strong glass or polypropylene. Add an equal volume of ether, i.e. 3-4ml.

5. Stopper the tube and mix for 1 minute. If using a vortex mixer, leave the tube unstopped for and mix for about 15 seconds.

6. With a tissue or piece of cloth wrapped round the top of the tube, loosen the stopper (considerable pressure will have built inside the tube). Centrifuge immediately at 750-100g (approximately 3000rpm) for 1 minute.
   After centrifuging, the parasites will have sedimented to the bottom of the tube and the fecal debris will have collected in a layer between the ether and formol water.

7. Using a stick or the stem of a plastic bulb pipette, loosen the layer of fecal debris from the side of the tube and rapidly invert the tube to discard the ether, fecal debris, and formol water. The sediment will remain.

8. Return the tube to its upright position and allow the fluid from the side of the tube to drain to the bottom of the tube.

9. Using a plastic bulb pipette or Pasteur pipette, mix the sediment. Transfer all the sediment to a slide, and cover with a cover glass.

10. Examine microscopically the entire preparation using the 10x objective with the condenser iris closed sufficiently to give good contrast. Use the 40x objective to identify the small cysts and eggs. If cysts are present, run a small drop of iodine under the cover glass to confirm their identity.

11. Count the number of each type of parasite in the entire preparation. This will give the approximate number of each parasite per gram of faces.

Laboratory method for the examination of urine
for Schistosoma haematobium eggs
National Micronutrient Survey in Malawi 2001

Sedimentation technique

1. Collect a specimen of urine, report its appearance and test for protein and red cells.

2. Mix the urine well and transfer 10ml to a conical test tube. Centrifuge at slow to medium speed (1500-2000 rpm) for 5 minutes to sediment the eggs. Do not extend this limit to avoid hatching.

3. Using Pasteur pipettes, remove and discard all the supernatant fluid. Transfer the entire sediment to a slide and cover it with cover glass.

4. Using the 10x objective with the condenser iris closed sufficiently to give good contrast examine the preparation microscopically for Schistosoma haematobium eggs and count the number of eggs per 10 ml of urine.

5. Report the number of eggs as eggs/10ml of urine.

Cluster #: | | | | Household number: | | | | |

ANNEX F: SURVEY INSTRUMENTS AND LABORATORY FORMS

NATIONAL MICRONUTRIENT SURVEY IN MALAWI 2001
MOH&P/UNICEF/CDC
HOUSEHOLD QUESTIONNAIRE

We are from the Ministry of Health and UNICEF. We are working on a project concerned with nutrition and health. I would like to talk to you about this. The interview will take about 15 minutes. All the information we obtain will remain strictly confidential and your answers will never be identified. After these questions to you, I may like to speak with some of the women in your household and the women who take care of the children 6-36 months.
May I start now? *IF PERMISSION IS GIVEN, BEGIN THE INTERVIEW.*

HOUSEHOLD INFORMATION PANEL	
1. Cluster number: |_|_|_|	**2. Household number: |_|_|_|_|**
3. Interviewer number: |_|_|	**4. Team number: |_|**
5. Name of head of household: _____	

6. Region: (circle) North ..... 1 Central ..... 2 South 3	7. (circle) Urban .....1 Rural 2
8. District: _____	9. Village/Place_____

Interview Visits:	1st attempt	2nd attempt	Last attempt	**Date of interview**
Date	__ __/__ __/__	__ __/__ __/__	__ __/__ __/__	|_|_| - |_|_|- |_|_|
Result	__	__	__	**Final Result** |_|
Next visit (date & time)	__ __/__ __/__ __ __ : __ __	__ __/__ __/__ __ __ : __ __		**Total # of visits** |_|

Result Codes:	10. Language of interview:
Completed ..... 1 Refused ..... 2 Not at home/no competent person ..... 3 Postponed..... 4 Entire household absent for long time.... 5	Chichewa .....1 Tumbuka .....2 English 3
Other (*specify*) _____ 8	
11. Team leader: _____	12. Data entry clerk: |_|_|

Interviewer/supervisor notes*: Use this space to record notes about the interview with this household, such as call-back times, incomplete individual interview forms, number of attempts to re-visit, etc.*

Number of interviews completed in the household (record by interviewer):

# Women	**Women's Frat**	# Children 6-36 months	Infant Frat	# Men	TOTAL

Cluster #: | | | | Household number: | | | | |

13. What is your tribe or ethnicity? |_|_|

01=Chewa
02=Tumbuka
03=Yao
04=Sena
05=Lomwe
06=Senga
07=Ngoni
08=Tonga
09=Nkhonde
10=Lambya
88=Other (specify) _____
99=Unknown

14. What type of fuel does your household mainly use for cooking? |_|

1=Wood collected
2=Wood purchased
3=Cow dung
4=Paraffin
5=Charcoal
6=Electricity
7=Gas/propane
8=Other (specify) _____
9=Don't know

15. What is your current main source of drinking water? |_|

1=Piped water in dwelling
2=Public tap
3=Borehole
4=Well/spring (protected)
5=Well/spring (unprotected)
6=Lake/river/small pond
8=Other[Specify] _____

16. What kind of toilet facility does your household use? |_|

1=Flush toilet
2=Pit latrine
3=Ventilated improved pit (VIP) latrine/Sanplat
4=Bush/river/lake
8=Other (specify) _____

17. What is the material of roof?|_|

1=Reeds/grass
2=Tin/metal
3=Tile
4=Wood planks
8=Other (specify) _____

18. What is the material of the floor? |_|

1=Earth smeared
2=Earth natural, not smeared
3=Bricks
4=Cement
5=Wood
8=Other (specify) _____

19. Number of rooms in the main house |_|_|

Do you have any of the following items: (circle response)

Item	Yes	No	Don't Know
20. Radio	**1**	**2**	**3**
21. Television	**1**	**2**	**3**
22. Bicycle	**1**	**2**	**3**
23. Motorcycle	**1**	**2**	**3**
24. Ox Cart	**1**	**2**	**3**
25. Car or truck	**1**	**2**	**3**

Cluster #: | | | | Household number: | | | | |

MALARIA

26. Have you ever heard of a mosquito bednet? |_|

1=Yes 2=No *If No then skip to Q33.*

27. Is a bednet used by anyone in the family? |_|

1=Yes 2=No *If No then skip to Q33.*

28. How many bednets do you have in your household? |_|_|

29. Who sleeps under the bednets in your household?
(Circle answers. Multiple responses possible)
1=Father
2= Mother
3=Child under 5 years
8=Other (specify) _____
9=Don't know

30. How long have the bednets been used in your household?

|_|_| (enter months, 99=don't know)

31.Since you got the bednets, have they been soaked in a liquid to make it repel mosquitoes better?

|_| 1=Yes 2=No 9=Don't know

32. How long ago did you last dip the net?

|_|_| (enter months, 99=don't know)

SALT TESTING

We would like to check whether the salt used in your household is iodized.

33. May I see a sample of the salt used to cook the main meal eaten by members of your household last night? |_|
1=Iodized with Potassium Iodate (color change)
2= Not iodized (no color)
3=No salt in home *(end the survey)*

Brand name	**Tick if type of salt in household**
Tambala	
Cerebos	
Cresta	
Loose from open Sack (Oyeza)	
Repackaged/No brand name	
Other (specify)	

Take a sample of salt from the **EVEN** number households. You will need **1.5 tablespoons** of salt for a sample to assess the amount of iodine in the salt. Make sure to place the sample of salt in a plastic bag and seal it. Write the household number on the outside of the bag with a permanent marker.

34. Was a salt sample taken from this household (is it an EVEN numbered household)?

|_| 1=Yes 2=No

Thank you.

Cluster #: | | | | Household number: | | | | |

National Micronutrient Survey in Malawi 2001
MOH&P/UNICEF/CDC
MAN'S QUESTIONNAIRE (20-54 years)

Put bar code label here

Name _____

Birth date (dd/mm/yy) __ __ /__ __ / __ __

(Use event calendar for age. Enter 01 for the day if not known. Enter 01 for the month if not known. Must enter a year.)

Age (record in completed years) |_|_|

DEMOGRAPHIC INFORMATION

1. What is your martial status? |_|
   1=Currently married
   2=Widowed
   3=Divorced
   4=Separated
   5=Never married
   6=Polygomous

2. Are you able to read and write? |_| 1=Yes 2=No

3. What is the highest level of education you attended? |_|_|
   01=Standard 1-2
   02=Standard 3-5
   03=Standard 6-8
   04=Junior secondary school
   05=Senior secondary school
   06=Above secondary school
   08=No education
   09=Don't know
   10=Adult literacy
   11=Religious education only

HEALTH HISTORY

4. Do you currently smoke cigarettes? |_| 1=Yes 2=No

5. Do you have a fever today? |_| 1=Yes 2=No 9=Don't know

6. Did you have a fever in the past 2 weeks?

   |_| 1=Yes 2=No 9=Don't know

7. Do you have a cough or runny nose today?

   |_| 1=Yes 2=No 9=Don't know

8. Did you have a cough or runny nose in the past 2 weeks?

   |_| 1=Yes 2=No 9=Don't know

9. Do you have diarrhea today?

   |_| 1=Yes 2=No 9=Don't know

10. Did you have diarrhea in the past 2 weeks?

|_| 1=Yes 2=No 9=Don't know

11.Do you currently have any blood in your stool?

|_| 1=Yes 2=No 9=Don't know

12. In the past 2 weeks, have you noticed any blood in your stool?

|_| 1=Yes 2=No 9=Don't know

13. Do you currently have any blood in your urine?

|_| 1=Yes 2=No 9=Don't know

14. In the past 2 weeks have you noticed any blood in your urine?

|_| 1=Yes 2=No 9=Don't know

15. In the past two weeks, have you had any other condition/illnesses?

|_| 1=Yes 2=No

If yes, please specify below.

_____

Cluster #: | | | | Household number: | | | | |

FRAT - 24 hour recall on foods to fortify

Food 1: Sugar
Food 2: Centrally processed oil
Food 3: Centrally processed maize flour

16. We would like to know what foods you ate yesterday. Was your intake unusual in any way yesterday?

|_| 1=Yes 2=No

If yes, then ask the following questions about a usual day.
If no, then ask the following questions about yesterday.

Begin by asking what foods were eaten the previous day or on a usual day. List them below:

LISTED FOODS

Breakfast Lunch Supper/Dinner Snacks

SUGAR

Refer to LISTED FOODS.

17. Did you consume any foods or beverages with sugar?

|_| 1=Yes 2=No *If no, then skip to Q18.*

If yes, what foods or beverages contain **sugar**? **List the foods and amount consumed below in the chart.**

Foods consumed yesterday containing **SUGAR**	Amount consumed (Teaspoon or Tablespoon)

18. How many days, in the last 7 days, did you eat foods/beverages prepared with **sugar**? |_|

19. In which season(s) do you eat **sugar**? |_|
1=All seasons
2=Rainy season only
3=Harvest seasons
8=Other (specify) _____

Cluster #: | | | | Household number: | | | | |

CENTRALLY PROCESSED OIL

Refer to LISTED FOODS.

20. Did you consume any foods with **centrally processed oil**?

|_| 1=Yes 2=No *If no, then skip to Q21.*

If yes, what foods contain **centrally processed oil**?

List the foods and amount consumed or used in a recipe below in the chart.

Foods consumed yesterday containing **CENTRALLY PROCESSED OIL**	Amount used in recipe (Tablespoon)	Number of people served

21. How many days, in the last 7 days, did you eat foods prepared with **centrally processed oil**? |_|

22. In which season(s) do you eat **centrally processed oil**? |_|
1=All seasons
2=Rainy season only
3=Harvest seasons
8=Other (specify) _____

Cluster #: | | | | Household number: | | | | |

CENTRALLY PROCESSED MAIZE FLOUR

Refer to LISTED FOODS.

23. Did you consume any foods with **centrally processed maize flour**?

|_| 1=Yes 2=No *If no, then skip to Q24.*

If yes, what foods contain **centrally processed maize flour**?

List the foods and amount consumed below in the chart.

Foods consumed yesterday containing **centrally processed maize flour**	Amount consumed (Bowl; S,M, or L Chipande)

24. How many days, in the last 7 days, did you eat foods/beverages prepared with **centrally processed maize flour**? |_|

25. In which season(s) do you eat **centrally processed maize flour**? |_|
1=All seasons
2=Rainy season only
3=Harvest seasons
8=Other (specify) _____

Thank you.

National Micronutrient Survey in Malawi 2001
MOH&P/UNICEF/CDC
Listing of WOMEN 15-45 years

Cluster #: |_|_|_| **Date** __ __ / __ __ / __ __ **Interview Number:** |_|_|

List every woman aged 15-45 years in the selected households starting with the oldest to the youngest woman. Select and interview every other woman (on the gray or even numbered lines).

Line no.	**Household #**	**Name of Woman**	**Age** (record in completed years)
1.	|_|_|_|_|		
2.	|_|_|_|_|		
3.	|_|_|_|_|		
4.	|_|_|_|_|		
5.	|_|_|_|_|		
6.	|_|_|_|_|		
7.	|_|_|_|_|		
8.	|_|_|_|_|		
9.	|_|_|_|_|		
10.	|_|_|_|_|		
11.	|_|_|_|_|		
12.	|_|_|_|_|		
13.	|_|_|_|_|		
14.	|_|_|_|_|		
15.	|_|_|_|_|		
16.	|_|_|_|_|		
17.	|_|_|_|_|		
18.	|_|_|_|_|		

Cluster #: | | | | Household number: | | | | |

NATIONAL MICRONUTRIENT SURVEY IN MALAWI 2001
MOH&P/UNICEF/CDC
WOMAN'S QUESTIONNAIRE

Put bar code label here

Name of Woman_____

Birth date (dd/mm/yy) __ __ /__ __ / __ __

(Use event calendar for age. Enter 01 for the day if not known. Enter 01 for the month if not known. Must enter a year.)

Age (record in completed years) |_|_|

DEMOGRAPHIC INFORMATION

1. What is your marital status? |_|
   1=Currently married
   2=Widowed
   3=Divorced
   4=Separated
   5=Never married

2. Are you able to read and write? |_| 1=Yes 2=No

3. What is the highest level of education you attended? |_|_|
   01=Standard 1-2
   02=Standard 3-5
   03=Standard 6-8
   04=Junior secondary school
   05=Senior secondary school
   06=Above secondary school
   08=No education
   09=Don't know
   10=Adult literacy
   11=Religious education only

4. Are you currently breastfeeding? |_| 1=Yes 2=No

5. Are you currently pregnant? |_| 1=Yes 2=No 9=Don't know
   If No or Don't know then skip to Q7.

6. How many months have you been pregnant? |_|_|

7. How many times have you been pregnant? (Include current pregnancy) |_|_|

   If never been pregnant, skip to Q9.

8. How many biological children do you have? |_|_|

9. Do you currently have your menstrual period? |_|

   1=Yes 2=No 9=Not applicable, woman is currently pregnant

IODINE

10. Have you heard of iodized salt? |_|

    1=Yes 2=No *If no, then skip to Q13.*

11. When you shop do you buy iodized salt? |_|

    1=Yes 2=No 9=Don't Shop

12. Why do people use iodized salt? (Circle answers. Multiple answers possible.)

1=Prevent goiter development
2=Prevent still births, spontaneous abortions and infant deaths
3=Prevent growth failure
8=Other (specify)_____
9=Don't know

ANAEMIA

13. Have you ever heard of anemia/shortage of blood? |_|

1=Yes 2=No *If no, then skip to Q16.*

14. Can you tell me how you get a shortage of blood (Multiple answers possible)?
1=Lack of food 4=Heavy work
2=Illness/disease 5=Genetics
3=Bleeding
8=Other (specify)_____
9=Don't know

15. Can you tell me any foods that are good to eat to prevent a shortage of blood/anemia? (Circle answers. Multiple answers possible.)
01=Eggs 07=Maize
02=Milk 08=Nsima
03=Beans 09=Meat
04=Vegetables 10=Chicken
05=Fruit 11=Dark green leafy vegetables
06=Rice 12=Vitamin C rich food
88=Other [Specify] _____
99=Don't know

16. Are you currently taking iron tablets (show common iron tablet in Malawi)?

|_| 1=Yes 2=No If No, then skip to Q19.

17. How often do you take these tablets? |_|
1=Daily 2=Weekly 3=Not often
8=Other (specify) _____

18. Who provides these tablets? |_|
1=Village health volunteer
2=Health Surveillance Assistants (HSAs)
3=Traditional birth attendants (TBAs)
4=Purchase in grocery/market
5=Clinic/Hospital/Health Center
8=Other (specify) _____
9=Don't know

19. Did you receive these tablets during any of your pregnancies? |_|

1=Yes 2=No 9=Not applicable, never been pregnant

VITAMIN A
If the woman has never been pregnant, then skip to Q23.

20. During your last pregnancy did you have difficulty with your vision during daylight?
|_| 1=Yes 2=No

21. During your last pregnancy did you have difficulty with your vision at night?

|_| 1=Yes 2=No

22. After your last pregnancy, in the first two months after delivery, did you receive a vitamin A capsule/supplement like this one (show vitamin A capsule)?

|_| 1=Yes 2=No

23. Have you ever heard about vitamin A? |_|

1=Yes 2=No *If No then skip to Q28.*

24. What does vitamin A do for the body? (Circle answers. Multiple answers possible.)
1=Good growth
2=Keeps the body satisfied
3=Makes a person strong
4=Helps a person see
5=Prevents oedema
6=Protects from disease
8=Other (specify) _____
9=Don't know

25. What problems does a person with vitamin A deficiency have?
(Circle answers. Multiple answers possible.)
1=Night blindness
2=Bad skin
3=Weakness
4=Always sick
5=Loss of appetite
6=Anemia
8=Other (specify) _____
9=Don't know

26. What can a person do to prevent vitamin A deficiency?
(Circle answers. Multiple answers possible.)
1=Vitamins from hospital
2=Eat balanced diet
3=Eat enough food
4=Eat fruit rich in vitamin A
5=Sunbathe
6=Avoid contaminated food
7=Nothing
8=Other (specify) _____
9=Don't know

27. What are the main sources of vitamin A?
(Circle answers. Multiple answers possible.)
1=Dark leafy vegetables
2=Yellow fruits/vegetables
3=Groundnuts
4=Meat
5=Eggs
6=Pills/syrup
8=Other (specify) _____
9=Don't know

Cluster #: | | | | Household number: | | | | |

HEALTH HISTORY

28. Do you have a fever today?

|_| 1=Yes 2=No 9=Don't know

29. Did you have a fever in the past 2 weeks?

|_| 1=Yes 2=No 9=Don't know

30. Do you have a cough or runny nose today?

|_| 1=Yes 2=No

31. Did you have a cough or runny nose in the past 2 weeks?

|_| 1=Yes 2=No

32. Do you have diarrhea today?

|_| 1=Yes 2=No

33. Did you have diarrhea in the past 2 weeks?

|_| 1=Yes 2=No

34. Do you currently have any blood in your stool?

|_| 1=Yes 2=No

35. In the past 2 weeks have you noticed any blood in your stool?

|_| 1=Yes 2=No 9=Don't know

36. Do you currently have blood, other than menstrual blood, in your urine?

|_| 1=Yes 2=No 9=Don't know

37. In the past 2 weeks have you noticed any blood, other than menstrual blood, in your urine?

|_| 1=Yes 2=No 9=Don't know

38. In the past two weeks, have you had any other condition/illnesses?

|_| 1=Yes 2=No 9=Don't know

If yes, please specify.

_____

ANTHROPOMETRY

If the woman is pregnant do not weigh or measure height. Then enter 999.9

39. Height (cm) __ __ __ .__

40. Weight (kg) __ __ __ .__

Thank you.

Cluster #: | | | | Household number: | | | | |

National Micronutrient Survey in Malawi 2001
MOH&P/UNICEF/CDC
School Child's QUESTIONNAIRE

Put bar code label here

Name _____

Sex of child (1=Male; 2=Female) |_|

Age (**record in completed years from the Advance Team form)** |_|_|

Current Grade/Standard |_|

IODINE

1. Have you heard of iodized salt? |_| 1=Yes 2=No *If no, then skip to Q3.*

2. Why do people use iodized salt?
(Circle answers. Multiple answers possible.)
1=Prevent goiter development
2=Prevent still births, spontaneous abortions and infant deaths
3=Prevent growth failure
8=Other (specify)_____
9=Don't know

ANAEMIA

3. Have you ever heard of shortage/shortage of blood? |_| 1=Yes 2=No *If no, skip to Q6.*

4. Can you tell me how you get a shortage of blood?
(Circle answers. Multiple answers possible.)
1=Lack of food 4=Heavy work
2=Illness/disease 5=Genetics
3=Bleeding
8=Other (specify)_____
9=Don't know

5. Can you tell me any foods that are good to eat to prevent a shortage of blood/anemia? (Circle answers. Multiple answers possible.)
01=Eggs 07=Maize
02=Milk 08=Nsima
03=Beans 09=Meat
04=Vegetables 10=Chicken
05=Fruit 11=Dark green leafy vegetables
06=Rice 12=Vitamin C rich food 88=Other
[Specify] _____
99=Don't know

VITAMIN A

6. Have you ever heard about vitamin A?

|_| 1=Yes 2=No *If No then skip to Q11.*

7. What does vitamin A do for the body? (Circle answers. Multiple answers possible.)
   1=Good growth
   2=Keeps the body satisfied
   3=Makes a person strong
   4=Helps a person see
   5=Prevents oedema
   6=Protects from disease
   8=Other (specify) _____
   9=Don't know

8. What problems does a person with vitamin A deficiency have?
   (Circle answers. Multiple answers possible.)
   1=Night blindness
   2=Bad skin
   3=Weakness
   4=Always sick
   5=Loss of appetite
   6=Anemia
   8=Other (specify) _____
   9=Don't know

9. What can a person do to prevent vitamin A deficiency?
   (Circle answers. Multiple answers possible.)
   1=Vitamins from hospital
   2=Eat balanced diet
   3=Eat enough food
   4=Eat fruit rich in vitamin A
   5=Sunbathe
   6=Avoid contaminated food
   7=Nothing
   8=Other (specify) _____
   9=Don't know

10. What are the main sources of vitamin A?
    (Circle answers. Multiple answers possible.)
    1=Dark leafy vegetables
    2=Yellow fruits/vegetables
    3=Groundnuts
    4=Meat
    5=Eggs
    6=Pills/syrup
    8=Other (specify) _____
    9=Don't know

Cluster #: | | | | Household number: | | | | |

BILHARZIA/URINARY SCHISTOSOMIASIS

11. Have you ever heard of bilharzia?

|_| 1=Yes 2=No *If no, then skip to Q18.*

12. What are the symptoms of bilharzia?
(Circle answers. Multiple answers possible.)
1=Blood in urine
2=Pain when urinating
3=Abdominal pain
4=Fever
5=Itching skin
8=Other (specify) _____
9=Don't know

13. Have you ever had bilharzia?

|_| 1=Yes 2=No 9=Don't know
If no or don't know, then skip to Q16.

14. Do you have bilharzia now?

|_| 1=Yes 2=No 9=Don't know

15. Have you ever been treated for bilharzia?

|_| 1=Yes 2=No 9=Don't know

16. How do people get bilharzia? |_|
1=Contact with contaminated water (i.e. swimming in lake)
2=Witchcraft; 3=Snails
8=Other (specify) _____
9=Don't know

17. How can bilharzia be prevented in the community?
(Circle answers. Multiple answers possible.)
1= Increase access to protected water sources
2= Stop bathing in a lake/river
3= Prevent defecating and urinating outside of latrine
4= Clear vegetation
8=Other (specify) _____
9=Don't know

Cluster #: | | | | Household number: | | | | |

INTESTINAL WORMS

18. Have you ever heard of intestinal worms?

|_| 1=Yes 2=No *If No then skip to Q24.*

19. What are the symptoms and signs of intestinal worms?
(Circle answers. Multiple answers possible.)
1=Stomach pains
2=Fever
3=Pass worms in stools
4=Weakness
5=Diarrhoea
8=Other (specify) _____
9=Don't know

20. Have you ever had intestinal worms? |_|

1=Yes 2=No; 9=Don't know *If no or don't know, then skip to Q22.*

21. Have you ever been treated for intestinal worms?

|_| 1=Yes 2=No 9=Don't know

22. How did you/do people get intestinal worms?
(Circle answers. Multiple answers possible.)
1=Unwashed food
2=Untreated water
3=Walking barefoot
4=Witchcraft
8=Other (specify) _____
9=Don't know

23. How can you avoid getting intestinal worms?
(Circle answers. Multiple answers possible.)
1=Eating balanced diet
2=Wearing shoes
3=Using latrines
4=Washing hands before eating
5=Washing food before eating
8=Other (specify) _____
9=Don't know

Cluster #: | | | | Household number: | | | | |

HEALTH HISTORY

24. Do you have a fever today? |_| 1=Yes 2=No 9=Don't know

25. Did you have a fever in the past 2 weeks? |_| 1=Yes 2=No 9=Don't know

26. Do you have a cough or runny nose today?

|_| 1=Yes 2=No 9=Don't know

27. Did you have a cough or runny nose in the past 2 weeks?

|_| 1=Yes 2=No 9=Don't know

28. Do you have diarrhea today?

|_| 1=Yes 2=No 9=Don't know

29. Did you have diarrhea in the past 2 weeks?

|_| 1=Yes 2=No 9=Don't know

30.Do you currently have any blood in your stool?

|_| 1=Yes 2=No 9=Don't know

31. In the past 2 weeks, have you noticed any blood in your stool?

|_| 1=Yes 2=No 9=Don't know

32. Do you currently have any blood in your urine?

|_| 1=Yes 2=No 9=Don't know

33. In the past 2 weeks have you noticed any blood in your urine?

|_| 1=Yes 2=No 9=Don't know

34. In the past two weeks, have you had any other condition/illnesses?

|_| 1=Yes 2=No

If yes, please specify below.

_____.

Thank you.

Cluster #: |_|_|_| Household number: |_|_|_|_|

NATIONAL MICRONUTRIENT SURVEY IN MALAWI 2001
MOH&P/UNICEF/CDC
Infant/Child (6-36 months) QUESTIONNAIRE
Interview with mother of child or primary caretaker

Put bar code label here

Child's name_____

Sex of child (1=Male; 2=Female) |_|

Birth date of child (dd/mm/yy) __ __ /__ __ / __ __

(Record the month and year. If the day of birth is not known, enter 15 for the middle of the month)

Cut-Offs for Age:

6-36 months include in survey
Length measurement on children less than 24 months
Height measurement on children 24 months and older

Child 6 months or older was born before 15 March 2001 – include in survey
Child younger than 3 years was born after 15 September 1998 – include in survey

FEEDING INFORMATION

1. How old was this child when you stopped breastfeeding?

|_|_| (in months; 88=still breastfed; 99=Don't know)

2. How old was this child when s/he was first fed something other than breastmilk?
(include water, formula, juice, solid foods)

|_|_| (in months; 88=still exclusively breastfed; 99=Don't know)

VITAMIN A

3. Has this child ever received a vitamin A capsule/supplement like this one (show vitamin A capsule)? (Check Child Health Card)
|_| 1=Yes 2=No 9=Don't know
If no or don't know, then skip to Q6.

4. How many months ago did the child take the last dose?

|_|_| (months; enter 00 for current month)

5. Where did the child get this last dose? |_|
1=Routine visit to health clinic
2=Sick visit to health clinic
3=Campaign
8=Other (specify) _____
9=Don't know

ANAEMIA

6. Is this child currently taking iron tablets/supplements (show iron tablets)?
(Check Child Health Card or booklet)
|_| 1=Yes 2=No 9=Don't know

Cluster #: ☐☐☐ Household number: ☐☐☐☐

HEALTH HISTORY

7. Does the child have a fever today?

|_| 1=Yes 2=No 9=Don't know

8. Did the child have a fever in the past 2 weeks?

|_| 1=Yes 2=No 9=Don't know

9. Does the child have a cough or runny nose today?

|_| 1=Yes 2=No 9=Don't know

10. Did the child have a cough or runny nose in the past 2 weeks?

|_| 1=Yes 2=No 9=Don't know

11. Does the child have diarrhea today?

|_| 1=Yes 2=No 9=Don't know

12. Did the child have diarrhea in the past 2 weeks?

|_| 1=Yes 2=No 9=Don't know

13. Have you currently noticed any blood in the child's stool?

|_| 1=Yes 2=No 9=Don't know

14. In the past 2 weeks, have you noticed any blood in the child's stool?

|_| 1=Yes 2=No 9=Don't know

15. Have you currently noticed any blood in the child's urine?

|_| 1=Yes 2=No 9=Don't know

16. In the past 2 weeks, have you noticed any blood in the child's urine?

|_| 1=Yes 2=No 9=Don't know

17. In the past 2 weeks, has your child had any other condition/illnesses?

|_| 1=Yes 2=No 9=Don't know

If yes, please specify:

_____

ANTHROPOMETRY

18. Length/Height (cm) __ __ __ .__
(circle type of measurement taken)

19. Weight (kg) __ __ .__

Thank you.

Cluster #: | | | | Household number: | | | | |

NATIONAL MICRONUTRIENT SURVEY IN MALAWI 2001
MOH&P/UNICEF/CDC
WOMEN'S Fortification Rapid Assessment Tool (FRAT) QUESTIONNAIRE

Interviewer number: |_|_|

SUBSAMPLE OF Women of Reproductive Age
(FRAT is to be done on the THIRD AND FOURTH household visited by one identified interviewer. Two women per cluster should be asked the FRAT questions. The main cook should be asked the following questions.)

COOKING OIL

1. Do you usually use cooking oil? |_| 1=Yes 2=No *If no, skip to Q3.*

Ask to see the household cooking oil:

Type of oil	Tick if found in household	Amount purchased
Covo (fortified)		
Kazinga (fortified)		
Family Favorite		
Superstar		
Sunfoil		
Olivine		
Homemade		
Loose from open sack (Oyeza)		
Repackaged/No brand name		
Other (specify)		
None available		

2. How often do you buy cooking oil? |_|
1=Every day
2=Every other day
3=Once a week
4=Every two weeks
5=Once a month
8=Other (specify) _____
9=Don't know

MAIZE FLOUR

3. Is most of your household maize flour bought pre-processed or do you process it yourself?

|_| 1=Centrally processed 2=Locally processed – ***If 2 then Skip to Q5.***

4. How often do you buy **centrally processed maize flour**? |_|
1=Every day
2=Every other day
3=Once a week
4=Every two weeks
5=Once a month
8=Other (specify) _____
9=Don't know

Cluster #: | | | | Household number: | | | | |

Ask to see the package for the maize flour:

Type of maize flour	**Tick if found in household**
Grain and Milling: whole grain	
Grain and Milling: Super cream	
Grain and Milling: Cream of maize	
Rab processors: Ufa Woyera	
Rab's Sunshine Cream of Maize	
Loose from open sack (Oyeza)	
Repackaged/No brand name	
Other (specify)	
None available	

5. Do you use a maize mill (Hammermill)? |_| 1=Yes 2=No

SUGAR

6. Do you usually have sugar available in your house?

|_| 1=Yes 2=No

7. How often do you buy sugar? |_|
1=Every day
2=Every other day
3=Once a week
4=Every two weeks
5=Once a month
8=Other (specify) _____
9=Don't know

Ask to see the household sugar:

Type of sugar	**Tick if found in household**	**Amount purchased**
Illovo		
Loose from open sack (Oyeza)		
Repackaged/No brand name		
Other (specify)		
None available		

8. What kind of pot do you use to cook the food for your household?
(Circle answers. Multiple answers possible)
1=Iron
2=Aluminum
3=Stainless Steel
4=Clay pot
5=Enamel
8=Other (specify) _____
9=Don't know

Cluster #: |_|_|_| Household number: |_|_|_|_|

FRAT - 24 hour recall on foods to fortify

Food 1: Sugar
Food 2: Centrally processed oil
Food 3: Centrally processed maize flour

9. We would like to know what foods you ate yesterday. Was your intake unusual in any way yesterday?

|_| 1=Yes 2=No

If yes, then ask the following questions about a usual day.
If no, then ask the following questions about yesterday.

Begin by asking what foods were eaten the previous day or on a usual day. List them below:

LISTED FOODS

Breakfast **Lunch** **Supper/Dinner** **Snacks**

SUGAR

Refer to LISTED FOODS.

10. Did you consume any foods or beverages with sugar?

|_| 1=Yes 2=No *If no, then skip to Q11.*

If yes, what foods or beverages contain **sugar**?

List the foods and amount consumed below in the chart.

Foods consumed yesterday containing **SUGAR**	Amount consumed (Teaspoon or Tablespoon)

11. How many days, in the last 7 days, did you eat foods/beverages prepared with **sugar**? |_|

12. In which season(s) do you eat **sugar**? |_|

1=All seasons
2=Rainy season only
3=Harvest seasons
8=Other (specify) _____

Cluster #: |_|_|_| Household number: |_|_|_|_|

CENTRALLY PROCESSED OIL

Refer to LISTED FOODS.

13. Did you consume any foods with **centrally processed oil**?

|_| 1=Yes 2=No *If no, then skip to Q14.*

If yes, what foods contain **centrally processed oil**?

List the foods and amount consumed or used in a recipe below in the chart.

Foods consumed yesterday containing **CENTRALLY PROCESSED OIL**	Amount used in recipe (Tablespoon)	Number of people served

14. How many days, in the last 7 days, did you eat foods prepared with **centrally processed oil**?
|_|

15. In which season(s) do you eat **centrally processed oil**? |_|
1=All seasons
2=Rainy season only
3=Harvest seasons
8=Other (specify) _____

Cluster #: |_|_|_| Household number: |_|_|_|_|

CENTRALLY PROCESSED MAIZE FLOUR

Refer to LISTED FOODS.

16. Did you consume any foods with **centrally processed maize flour**?

|_| 1=Yes 2=No *If no, then skip to Q17.*

If yes, what foods contain **centrally processed maize flour**? List the foods and amount consumed below in the chart.

Foods consumed yesterday containing **centrally processed maize flour**	Amount consumed (Bowl; S, M, or L Chipande)

17. How many days, in the last 7 days, did you eat foods/beverages prepared with **centrally processed maize flour**? |_|

18. In which season(s) do you eat **centrally processed maize flour**? |_|
    1=All seasons
    2=Rainy season only
    3=Harvest seasons
    8=Other (specify) _____

Thank you.

Cluster #: | | | | Household number: | | | | |

NATIONAL MICRONUTRIENT SURVEY IN MALAWI 2001
MOH&P/UNICEF/CDC
Infant Fortification Rapid Assessment Tool (FRAT) QUESTIONNAIRE

Interviewer number: |_|_|

SUBSAMPLE OF Infants (6-36 months)

(FRAT is to be done on the first 2 infants 6-36 months visited in separate households by one identified interviewer. The mother or primary caretaker of the child should be asked the following questions. Two infants 6-36 months per cluster should be asked the FRAT questions.)

COMPLEMENTARY FOODS

1. Did you give him/her **centrally processed complementary foods** yesterday**?**

|_| 1=Yes 2=No

If yes, ask to see any processed purchased complementary foods in the house:

Type of food	**Tick if foods are in house**
Likuni Phala	
Breakfast Cereal	
Cerelac	
Baby Best	
Infant formula	
Other (specify)	

Cluster #: | | | | Household number: | | | | |

FRAT - 24 hour recall on foods to fortify
Food 1: Sugar
Food 2: Centrally processed oil
Food 3: Centrally processed maize flour
Food 4: Centrally processed complementary foods

2. I would like to know what foods the child ate yesterday. Was the intake unusual in any way yesterday?

|_| 1=Yes 2=No

If yes, then ask the following questions about a usual day.
If no, then ask the following questions about yesterday.

Begin by asking what foods were eaten the previous day or on a usual day. List them below:

LISTED FOODS

Breakfast **Lunch** **Supper/Dinner** **Snacks**

SUGAR

Refer to LISTED FOODS.

3. Did he/she consume any foods or beverages with sugar?

|_| 1=Yes 2=No *If no, then skip to Q4.*

If yes, what foods or beverages contain **sugar**?

List the foods and amount consumed below in the chart.

Foods consumed yesterday containing **SUGAR**	Amount consumed (Teaspoon or Tablespoon)

4. How many days, in the last 7 days, did you eat foods/beverages prepared with **sugar**? |_|

5. In which season(s) does he/she eat **sugar**? |_|
1=All seasons
2=Rainy season only
3=Harvest seasons
8=Other (specify) _____

Cluster #: | | | | Household number: | | | | |

CENTRALLY PROCESSED OIL

Refer to LISTED FOODS.

6. Did he/she consume any foods with centrally processed oil?

|_| 1=Yes 2=No *If no, then skip to Q7.*

If yes, what foods contained **centrally processed oil**?

List the foods and amount consumed or used in a recipe below in the chart.

Foods consumed yesterday containing **CENTRALLY PROCESSED OIL**	Amount used in recipe (Tablespoon)	Number of people served

7. How many days, in the last 7 days, did he/she eat foods prepared with **centrally processed oil**? |_|

8. In which season(s) does this child eat **centrally processed oil**? |_|
   1=All seasons
   2=Rainy season only
   3=Harvest seasons
   8=Other (specify) _____

Cluster #: | | | | Household number: | | | | |

CENTRALLY PROCESSED MAIZE FLOUR

Refer to LISTED FOODS.

9. Did this child consume any foods with **centrally processed maize flour**?

|_| 1=Yes 2=No *If no, then skip to Q10.*

If yes, what foods contained **centrally processed maize flour**?

List the foods and amount consumed below in the chart.

Foods consumed yesterday containing **centrally processed maize flour**	Amount consumed (Bowl; S, M, or L Chipande)

10. How many days, in the last 7 days, did this child eat foods/beverages prepared with **centrally processed maize flour**? |_|

11. In which season(s) do this child eat **centrally processed maize flour**? |_|
    1=All seasons
    2=Rainy season only
    3=Harvest seasons
    8=Other (specify) _____

Cluster #: | | | | Household number: | | | | |

CENTRALLY PROCESSED COMPLEMENTARY FOODS

Refer to LISTED FOODS.

12. Did this child consume any foods with **centrally processed complementary foods**?

|_| 1=Yes 2=No *If no, then skip to Q13.*

If yes, what foods contained **centrally processed complementary foods**?

List the foods and amount consumed below in the chart.

Foods consumed yesterday containing **Centrally Processed Complementary Foods**	Amount consumed (Bowl)

13. How many days, in the last 7 days, did he/she eat foods prepared with **centrally processed complementary foods**? |_|

14. In which season(s) does he/she eat **centrally processed complementary foods**? |_|
    1=All seasons
    2=Rainy season only
    3=Harvest seasons
    8=Other (specify) _____

Thank you.

Put bar code label here

ACTION CARD
National Micronutrient Survey in Malawi 2001
MOH&P/UNICEF/CDC

Cluster number: |_|_|_| Household number: |_|_|_|_|

Name of Subject _____

(circle one)

Infant/Child Woman Man

Put bar code label here

ACTION CARD
National Micronutrient Survey in Malawi 2001
MOH&P/UNICEF/CDC

Cluster number: |_|_|_| Household number: |_|_|_|_|

Name _____

(circle one)

Infant/Child Woman Man

NATIONAL MICRONUTRIENT SURVEY IN MALAWI 2001
MOH&P/UNICEF/CDC
School Environment QUESTIONNAIRE

Name of School _____

Cluster Number: |_|_|_|

Ask each school headmaster:

1. Is there a mass deworming program in this school?

|_| 1=Yes 2=No *If no, then skip to Q3.*

2. If yes, when was the last round of deworming this year (2001) (mm/yy)?

__ __ / __ __

3. Is there an iron supplementation program in this school?

|_| 1=Yes 2=No

Thank you.

NATIONAL MICRONUTRIENT SURVEY IN MALAWI 2001

Hemoglobin & Malaria Testing Form

Region: North Central South Team #: _ Cluster #: _ _ _ Date of visit: _ _ / _ _ / _ _

ID No. of Lab Tech: _ _ Hemocue #: N- __ __ Control Cuvette ___ ___• ___

Number	Label	Malaria slide made (√)	Hemoglobin value (g/dL)	Trophozoites present? 1 = yes 2 = no If yes, enter 1+, 2+, 3+ or 4+	Gametocytes present? 1 = yes 2 = no If yes, indicate number seen
1.			___ ___• ___		
2.			___ ___• ___		

National Micronutrient Survey in Malawi 2001
ZP and Dried Blood Spot Form

Name of the school
Region N C S
Cluster number Team number

Date of visit to cluster (dd/mm/yy)
Date of analysis (dd/mm/yy)
Id # of lab tech

√ if DBS was done and if sample was separated

#	Label	Volume of blood in microtainer -uL	First ZP	Second ZP	DBS TfR (100uL)	DBS Vitamin A (50uL)	Spin for serum/plasma
1		— — —	— — —	— — —			
2		— — —	— — —	— — —			
3		— — —	— — —	— — —			

National Micronutrient Survey in Malawi 2001
URINE TEST

Name of the school ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐ Date of visit to school (dd/mm/yy) ☐☐- ☐☐- ☐☐

Region N C S

Cluster number ☐☐☐ Team number ☐ Id # of microscopist ☐☐

#	Label	1=Selected or 2=Reserved	Visible blood? 1=Yes 2=No	Hemastix results 0=None 1=Trace, non-hemolysed 2=Trace, hemolysed 3=+ 4=++ 5=+++	Urine saved for urinary iodine analysis (mL)	Volume of urine filtered (mL)	*Schistosoma haematobium* Enter 00000-99999
1		|_|	|_|	|_|	__ __ . __	__ __ . __	|_|_|_|_|_|
2		|_|	|_|	|_|	__ __ . __	__ __ . __	|_|_|_|_|_|

National Micronutrient Survey in Malawi 2001
STOOL MICROSCOPY

Name of the school
Region N C S
Cluster number Team number

Date of visit to school (dd/mm/yy)
Date of analysis (dd/mm/yy)
Id # of microscopist

#	Label	1=Selected or 2=Reserved	Visible blood? 1=Yes 2=No	Hookworm Enter 00000-99999	Roundworm Enter 00000-99999	Schistosoma mansoni Enter 00000-99999
1		|_|	|_|	|_|_|_|_|_|	|_|_|_|_|_|	|_|_|_|_|_|
2		|_|	|_|	|_|_|_|_|_|	|_|_|_|_|_|	|_|_|_|_|_|
3		|_|	|_|	|_|_|_|_|_|	|_|_|_|_|_|	|_|_|_|_|_|

National Micronutrient Survey in Malawi 2001
Shipping List

Blood Spot TfR Samples

Sent to CDC

Cluster #: _ _ _ Team #: _ Date of Collection (dd/mm/yy): _ _ / _ _ / _ _
Bag #: _ _ of _ _ (Please place a set of controls (3 levels) in every other bag prepared)

Label	**100 μL blood spot (√ if made)**	**Lab Tech ID Number**

National Micronutrient Survey in Malawi 2001
Shipping List

Blood Spot Retinol (vitamin A) Samples

Sent to Craft Technologies

Cluster #: _ _ _ Team #: _ Date of Collection (dd/mm/yy): _ _ / _ _ / _ _

Bag #: _ _ of _ _

Label	**50 μL blood spot (√ if made)**	**Lab Tech ID Number**

National Micronutrient Survey in Malawi 2001
Shipping List

Plasma Retinol (vitamin A) Samples

Sent to Craft Technologies

Cluster #: _ _ _ Team #: _ Date of Collection (dd/mm/yy): _ _ / _ _ / _ _

Bag #: _ _ of _ _

Label	**Plasma Retinol (√ if separated)**	**Lab Tech ID Number**

ANNEX G: SOCIOECONOMIC (SES) INDEX

A socioeconomic status index was created in order to categorize households. Table SES1 shows the items and scores used in the index. The range of index values was from 0 to 12. Low SES was designed as 0-2, moderate SES as 3-5 and high SES as 6-12.

Table SES1. Socioeconomic (SES) index categories and scores, Malawi Micronutrient Survey, Malawi 2001.

Category	Response	Score
Type of fuel	Wood collected	0
	Wood purchased	0
	Cow dung	0
	Paraffin	1
	Charcoal	0
	Electricity	1
	Gas/Propane	1
	Other	0
	Don't Know	0
Water supply	Piped water in dwelling	1
	Public tap	0
	Borehole	1
	Well/spring (protected)	1
	Well/spring (unprotected)	0
	Lake/river/small pond	0
	Other	0
Toilet facility	Flush toilet	1
	Pit latrine	0
	Ventilated improved pit (VIP) latrine/Sanplat	1
	Bush/river/lake	0
	Other	0
Roof	Reeds/grass	0
	Tin/metal	1
	Tile	1
	Wood planks	0
	Other	0
Floor	Earth smeared	0
	Earth natural, not smeared	0
	Bricks	0
	Cement	1
	Wood	1
	Other	0
Number of rooms*	Two rooms or less	0
	Three rooms or more	1
Radio	In household	1
	Not in household	0
Television	In household	1
	Not in household	0
Bicycle	In household	1
	Not in household	0
Motorcycle	In household	1
	Not in household	0
Oxcart	In household	1
	Not in household	0
Car	In household	1
	Not in household	0

*Mean number of rooms was 2.5, therefore the cut-point of 3 was chosen.

ANNEX H: CALIBRATION OF LOCAL HOUSEHOLD MEASURES FOR THE FORTIFICATION RAPID ASSESSMENT TOOL (FRAT)

The FRAT is designed to give an approximate measure of the amount of each food consumed. Therefore prior to the survey training in August 2001 a panel of women was gathered at a clinic in Lilongwe. Usual foods made with the raw staple ingredients were ascertained and standard recipes were also determined. Household measurements and portion sizes were standardized through an exercise with the panel of women.

Standard household utensils, such as chipande (serving spoons for the staple foods), bowls, cups, teaspoons and tablespoons, were shown to the women and found to be consistent throughout Malawi. During the survey, sets of the standard household utensils were utilized as aids by the interviewers. Table H.1 summarizes the standard household measures for each of the foods containing the target foods and the gram equivalent measures for the raw ingredient from the household measures.

The women from the panel demonstrated their usual cooking and food preparation methods with each of the identified centrally processed staple foods: sugar, oil, maize meal and complementary foods.

CENTRALLY PROCESSED SUGAR:
Malawians add sugar to drinks and some foods specifically to tea, phala (porridge), and thobwa (fermented maize drink). Sugar is not normally used in cooking, except for some cakes and fried donuts. Based on discussions with Malawians, chikondamoyo (corn bread) and donuts are food consumed that contain sugar. The recipes for these foods are listed below:

Chikondamoyo is bread made from whole maize meal mixed with some sugar and bicarbonate of soda and baked in a hot oven. It is often eaten as a snack. About 2 tablespoons per 1 cup maize flour usually serves 2 people so average of 1 tablespoon per serving.

The recipe for donuts is usually 2 Tablespoons sugar, 1 cup flour, and 1 teaspoon of baking powder and it serves 3 people (2T =3 teaspoons per tablespoon X 2 = 6 teaspoons). Six teaspoons divide by the number of servings or 3 = 2 teaspoons per serving. One serving of donuts contains 2 teaspoons of sugar. Sometimes bananas are used to enrich so less sugar is used.

The standard measuring utensil for sugar consumption is a teaspoon. For standardization of sugar measurements, empty cups were weighed and the women put a usual serving of sugar into an empty cup. This procedure was repeated ten times. Each woman then had a cup with ten equivalents of the usual teaspoon of sugar. Then the cups with ten serving of sugar were weighed and the average amount for one teaspoon was determined for each woman to obtain the gram equivalent of one teaspoon of sugar. Averaging the calculations of the women made a final determination. The same procedure was followed for standardizing a tablespoon of sugar. The calculations and final measurements are in Table H.1.

CENTRALLY PROCESSED OIL:
Oil is usually used for cooking relish and other meat dishes for the household. Oil is also added to rice. Oil is also used for frying of donuts and chips. Standard recipes do not exist for these foods. Therefore estimates of oil used may range widely.

The tablespoon was determined to be the standard measure for cooking oil. The average gram weight of a tablespoon of oil was determined in a similar method as the one employed for sugar. It was determined to be 10 grams. The panel of women determined that the best way to gather information on cooking oil consumption was to estimate the amount of oil in tablespoons in the cooking pot and then report the number of people served. Although this estimate is of the amount of oil used in cooking not the amount consumed, it was decided that such an estimate would be sufficient for this survey. Therefore in the FRAT survey, the respondents were asked to report the amount of oil in tablespoons and then divide by number of people served to obtain a general approximation of the amount of oil consumed. Total oil sales was estimated to be the most for the chips sold on the streets, then for the donuts and finally for the home consumption (information from Theresa Banda). More data could be gathered from street chip and donut purveyors.

The calculations and final measurements are in Table H.1.

CENTRALLY PROCESSED MAIZE FLOUR:
Maize flour is used in two main forms, phala (porridge) and nsima (staple food of Malawi which is a thick maize meal porridge). There are two main ways of processing the maize flour. One processing method is to keep the husk intact which yields a coarser form of flour called mgaiwa. The other method of processing is much more refined and produces maize flour called ufa woyera.

Standard recipes for phala and nsima were found in Training Modules on Weaning, MOHP 1992 with assistance from the Royal Tropical Institute, Amsterdam and the World Food Programme. It was determined that in 100g of phala made with mgaiwa there are 9g of maize flour. In 100g of phala made with ufa woyera there is 7g of maize flour. In 100g of nsima there are 25g of maize flour. The recipe for making two servings of nsima is 1 cup ufa to 2 ¾ to 3 cup of water according to Malawi cookbooks, however most Malawians do not use a recipe. They boil water in a pot then add handfuls of ufa (maize flour) until the phala or nsima reaches the right consistency.

In order to verify and standardize a recipe for phala and nsima with both type of flour, mgaiwa and ufa woyera, the panel of women went through a cooking exercise.

The assumption was that the recipe for the phala is 9 parts water to 1 part maize flour for both the mgaiwa and the ufa woyera. One woman cooked phala with ufa woyera and one cooked phala with mgaiwa. The amount of water and maize flour used was weighed and calculated in grams (quantitative). The results were compared to the standard recipe. The other women in the panel commented on the cooking method and assessed the consistency of the phala to verify the recipe and portions used (qualitative).

The assumption for nsima was that the recipe is 3 parts water to 1 part maize flour. Different women cooked nsima, one using ufa woyera and another using mgaiwa. The same commenting procedure was followed as described above for quantitative and qualitative results.

The women in the panel identified the common serving utensils for the phala and the nsima as a small chipande, a medium chipande and a large chipande. Nsima and phala are usually served into a bowl or cup.

Each utensil was filled with food and weighed 5 times, thereby yielding an average weight for each portion size. The calculations and final measurements are in Table FRAT2.

CENTRALLY PROCESSED COMPLEMENTARY FOOD:
The most common centrally processed complementary food in Malawi is Likuni Phala. It is a porridge made with soy products. The Training Modules on Weaning, MOHP 1992 with assistance from the Royal Tropical Institute, Amsterdam and the World Food Programme determined in 100g of Likuni Phala there are 11g of flour.

The same panel of women also cooked Likuni Phala to verify and standardize the recipe. The assumption was that the recipe for the Likuni Phala is 9 parts water to 1 part maize flour. One woman cooked Likuni Phala. The amount of water and maize flour used was weighed and calculated in grams (quantitative). The results were compared to the standard recipe. The other women in the panel commented on the cooking method and assessed the consistency of the phala to verify the recipe and portions used (qualitative).

The same utensils used for other phala and nsima are used for Likuni Phala and other complementary foods. These are a small chipande, a medium chipande and a large chipande. Likuni phala is usually served into a bowl or cup.

Each utensil was filled with food and weighed 5 times, thereby yielding an average weight for each portion size. The calculations and final measurements are in Table H.1.

The following measurement equivalents were utilized for calculations:
- 1 cup liquid = 250ml = 240 grams
- 1 ounce =30 grams
- 1 tablespoon = 20 ml = ½ ounce = 15 grams
- 1 teaspoon = 5 ml

Quantitative measurements from the cooking exercise with the panel of women are summarized in Table H.1.

Table H.1. Final quantitative measures for each staple food from panel exercise, National Micronutrient Survey in Malawi 2001.

Food	**Household Measure**	**Recipe of raw food X**	**Usual Portion (grams)**	**Weight of raw food X in usual portion (grams)**
Centrally Processed Sugar				
Sugar added to foods and beverages (phala, tea)	Teaspoon	-	Field test-6.6g	
	Tablespoon	-	Field test-16.8g	
Chikondamoyo (bread)	1 Piece	2 tsp	10g	
Donuts	1 donut	1tsp	5g	

Thobwa (fermented maize drink)	Cup	2 tsp	10g	
Centrally Processed Oil				
Oil	Tablespoon	-	10g	
Relish	Tablespoons used in making relish and number of people served	-	To be estimated per recipe in Tablespoons and divided by the number of people served	
Centrally Processed Maize Flour				
Phala (porridge) made with Ufa Woyera	¼ bowl	**Ufa Woyera** Field test-6g per 100g	200g	12g
	½ bowl		400g	24g
	¾ bowl		600g	36g
	1 bowl		800g	48g
Phala (porridge) made with Mgaiwa	¼ bowl	**Mgaiwa** Field test -12g per 100g	200g	24g
	½ bowl		400g	48g
	¾ bowl		600g	72g
	1 bowl		800g	96g
Nsima staple food made with Ufa Woyera	Small chipande	**Ufa Woyera** Field test-17g per 100g	190g	32g
	Medium chipande		235g	40g
	Large chipande		395g	65g
Nsima staple food made with Mgaiwa	Small chipande	**Mgaiwa** Field test-20g per 100g	190g	38g
	Medium chipande		235g	47g
	Large chipande		395g	76g
Centrally Processed Complementary Food				
Phala (porridge) made with Likuni Phala	¼ bowl	**Likuni Phala** Field test -16g per 100g	200g	32g
	½ bowl		400g	64g
	¾ bowl		600g	96g
	1 bowl		800g	128g
Baby Best	¼ bowl = 200g or teacup serving for infant	-	200g	12g*
Kreemy Meel			200g	20g*
Rab's sunshine			200g	36g*
Nestle Cerelac			200g	50g*

*From packaging on each of these brand name complementary foods found in the market.

ANNEX I: ALGORITHM FOR BLOOD COLLECTED IN THE MICROTAINER

Note: In all target groups TfR was done on serum samples that remained after serum retinol analysis was complete.

Assumptions:
Assumptions for the algorithm were that vitamin A analysis (either serum or DBS) was a higher priority than TfR analysis and vitamin A analysis in serum was a higher priority than DBS. It was also assumed that it would be most difficult to obtain a sufficient volume of from all subjects, particularly from young children, for all tests.

Preschool children:
- Hb (1), Malaria (2) and ZP (3) are done on everybody
- If you have **>200 uL** of blood left, spin down and separate serum into clean vial for **serum vit. A**.
- If **<200 uL** of blood left, spot 50 uL of blood for **DBS vit. A**

School Children:
- Hb (1), Malaria (2) and ZP (3) are done on everybody
- If **>300 uL** of blood left
    - spot 100 uL of blood for **DBS TfR** for a 1/3 subset
    - then spin down and separate serum into clean vial for **serum vit. A**
- If **>200 but <300 uL** of blood left, spin down and separate serum into clean vial for **serum vit. A**.
- If **<200 uL** of blood left, spot 50 uL of blood for **DBS vit. A**

Women and men:
- If **>400 uL** of blood left
    - spot 100 uL of blood for **DBS TfR** for a 1/3 subset
    - spot 50 uL of blood for **DBS vit. A**
    - then spin down and separate serum into clean vial for **serum vit. A**
- If **>300 but <400 uL** of blood left
    - spot 100 uL of blood for **DBS TfR** for a 1/3 subset
    - then spin down and separate serum into clean vial for **serum vit. A**
- If **>200 but <300 uL** of blood left, spin down and separate serum into clean vial for **serum vit. A**.
- If **<200 uL** of blood left, spot 50 uL of blood for **DBS vit. A**