National Micronutrient and Anthropometric Nutrition Survey

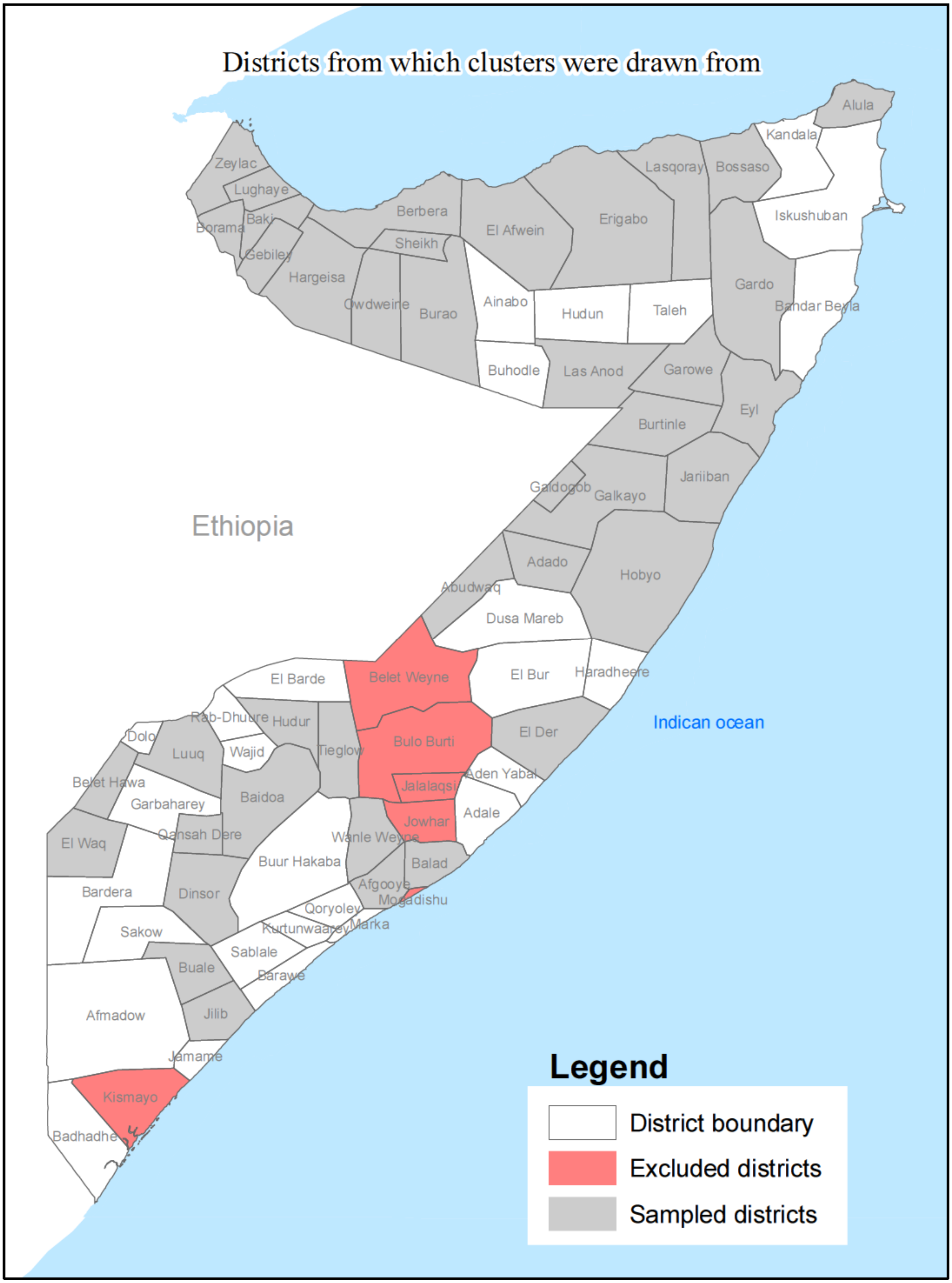
Somalia 2009

Funded by

Sida

Financially and technically supported by

World Health Organization
unicef
United Nations World Food Programme


Districts from which clusters were drawn from
Alula
Kandala
Zeylac
Lasqoray
Bossaso
Lughaye
Berbera
Erigabo
Iskushuban
Borama
Baki
El Afwein
Sheikh
Gebiley
Gardo
Hargeisa
Ainabo
Bandar Beyla
Owdweine
Burao
Hudun
Taleh
Buhodle
Las Anod
Garowe
Eyl
Burtinle
Jariiban
Galdogob
Galkayo
Ethiopia
Adado
Hobyo
Abudwaq
Dusa Mareb
El Barde
Belet Weyne
El Bur
Haradheere
Rab-Dhuure
Hudur
Indican ocean
Dolo
El Der
Luuq
Wajid
Tieglow
Bulo Burti
Aden Yabal
Belet Hawa
Jalalaqsi
Garbaharey
Baidoa
Adale
Jowhar
Qansah Dere
El Waq
Wanle Weyne
Buur Hakaba
Balad
Bardera
Dinsor
Afgooye
Mogadishu
Qoryoley
Kurtunwaarey
Marka
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World Health Organization (WHO) Regional Office for Europe
World Food Programme (WFP)
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Survey funded by: Swedish International Development Agency (SIDA), UNICEF, WFP and WHO

Acknowledgements

Our special thanks goes to all staff of UNICEF, WFP, WHO and the Ministries of Health authorities who took part in the survey, both in Nairobi and in the regional offices in Somalia. We are also grateful to everyone who took time to comment on the various drafts of the report. In particular, we would like to sincerely thank the following for their contributions to the survey:

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Abbreviations and Acronyms

AGP	:	Alpha-1-Glycoprotein
APP	:	Acute Phase Protein
ARI	:	Acute Respiratory Infection
BMI	:	Body Mass Index
CDC	:	Center for Disease Control and Prevention
CIHD	:	Centre for International Health and Development, Institute of Child Health
CRP	:	C-Reactive Protein
DBS	:	Dried Blood Spot
ELISA	:	Enzyme-Linked Immunosorbent Assay
EPI	:	Expanded Programme on Immunisation
FAO	:	Food and Agriculture Organization
FFQ	:	Food Frequency Questionnaire
FSAU		Food Security Analysis Unit
FSNAU	:	Food Security & Nutrition Analysis Unit (formerly FSAU)
GAM	:	Global Acute Malnutrition
HAZ	:	Height-for- Age Z scores
HB	:	Haemoglobin
HRP	:	Horse Radish Peroxidase
IDP	:	Internally Displaced Persons
IYCF	:	Infant and Young Child Feeding
MICS	:	Multiple Indicator Cluster Survey
MOH	:	Ministry of Health, Puntland
MOHL	:	Ministry of Health & Labour, Somaliland
MUAC	:	Middle Upper Arm Circumference
NCHS	:	National Center for Health Statistics, United States
NEZ	:	North East Zone
NIPHORN	:	Nutrition Information Project, Horn of Africa team
NWZ	:	North West Zone
QC	:	Quality Control
RBP	:	Retinol Binding Protein
RDT	:	Rapid Diagnostic Test
SAM	:	Severe Acute Malnutrition
SCZ	:	South Central Zone
SD	:	Standard Deviation
SFC	:	Supplementary Feeding Centre
SMART	:	Standardized Monitoring and Assessment of Relief and Transition
SPSS	:	Statistical Package for the Social Sciences
SSS	:	Somalia Secretariat Support
sTfR	:	Soluble Tranferrin Receptor
TFC	:	Therapeutic Feeding Centre
TFG	:	Transitional Federal Government
UIC	:	Urinary Iodine Concentration
UNDP	:	United Nations Development Programme
UNHCR	:	United Nations High Commissioner for Refugees
UNICEF	:	United Nations Children's Fund
WAZ	:	Weight-for-Age Z Scores
WFP	:	World Food Programme
WHO	:	World Health Organization
WHZ	:	Weight-for-Height Z Scores

SUMMARY

Introduction

- Somalia is situated in the horn of Africa and borders Kenya, Ethiopia and Djibouti on the Southwest, West and Northwest respectively, with the Gulf of Aden and Yemen on the North. The country has been without a functional central government for almost two decades since the overthrow of Siad Bare in 1991. Health indicators in Somalia remain among the worst in the world. The country is in a chronic nutrition crisis with rates of acute and chronic malnutrition consistently exceeding emergency thresholds.
- The only available information on micronutrient malnutrition is on anaemia in children 6-59 months from Somaliland in 2001, where a cluster survey conducted by UNICEF and the Ministry of Health and Labour (MOHL) identified 59.5% of children as anaemic. In the 2006 MICS, UNICEF ascertained that nationally, only 1.2% of households were using iodised salt. In addition, there was only 24% coverage of Vitamin A capsule distribution in children under-five years.
- Given the lack of both national and regionally representative data on micronutrient status in Somalia, the FSNAU (Food Security and Nutrition Analysis Unit), in collaboration with other partners initiated, a national micronutrient survey. The survey was conducted between March and August 2009.

Survey Purpose

- The overall purpose of the survey was to assess the nutritional status of the population of Somalia. This involved an assessment of household characteristics, dietary intake, micronutrient status, anthropometry, infant feeding practices, and malaria prevalence.

Methods

- A national, two-stage, stratified, household cluster survey was carried out in Somalia between March-August 2009. The survey was carried out in four phases; North East, North West, Central and South respectively.
- A total of 31, 32 and 33 clusters were assessed in the 3 survey strata, which comprised the North East, North West and South Central zones of Somalia.
- The study covered a total of 2872 households and included 3231 pre-school children (0-59 months), 868 school aged children (6-11 years) and 2801 women of reproductive age (15-49 years).
- The survey involved: administration of household questionnaires; anthropometric measurements of pre-school children and women of reproductive age (weight, height, sitting height, MUAC);

biochemical assessment of blood samples from children 6-59 months, school age children and women (haemoglobin, iron status, malaria, vitamin A, and C-reactive protein); and urinary iodine measurement and goitre observation in school age children and women of reproductive age.

Results

Indicator	Sample	North West	North East	South Central	Combined
Household Characteristics					
Access to improved water source	All household members	31.9%	47.1%	28.0%	32.4%
Household iodised salt utilisation	All household members	0.4% (0.1-1.8)	0.1% (0.0-0.9)	6.7% (2.1-19.3)	3.9% (1.3-11.3)
Most prevalent main income source	All household members	Casual labour (41.9%)	Casual labour (53.0%)	Animal Products (43.8%)	-
Proportions of households usually eating three meals/day	All household members	64.8% (56.8-72.1)	41.4% (33.5-49.8)	19.3% (15.7-23.4)	35.2% (31.9-38.5)
Proportions of households usually eating two meals/day	All household members	31.9% (24.8-39.9)	45.2% (38.3-52.2)	73.7% (68.1-78.6)	57.6% (53.8-61.4)
Mean number of food types eaten	All household members	5.32 (5.21-5.43)	5.95 (5.83-6.06)	5.32 (5.20-5.45)	5.52 (5.46-5.59)
Children 0-59 months					
Prevalence global acute malnutrition	6-59 months	13.9% (11.6-16.5)	10.7% (8.6-12.7)	16.5% (13.0-20.6)	13.9% (11.9-16.0)
Prevalence severe acute malnutrition	6-59 months	4.1% (3.0-5.6)	1.3% (0.5- 2.0)	5.9% (3.9- 8.7)	4.0% (3.1- 4.9)
Prevalence of stunting (HA)	6-59 months	19.5% (16.3-23.2)	16.5% (12.6-21.3)	31.6% (27.2-36.2)	23.2% (21.0-25.4)
Prevalence of underweight (WA)	6-59 months	18.5% (15.4-22.1)	12.8% (9.8-16.5)	25.4% (19.9-31.8)	19.5% (17.1-22.0)
Prevalence of total malnutrition based on MUAC	6-59 months	7.3% (5.2-10.1)	4.8% (3.0-7.5)	9.8% (7.0-13.5)	8.4% (6.6-10.7)
Prevalence global acute malnutrition	0-5 months	-	-	-	17.1 % (12.6 - 22.9)
Prevalence severe acute malnutrition	0-5 months	-	-	-	8.1 % (5.2 - 12.5)

Prevalence of underweight (WA)	*0-5 months*	-	-	-	*27.1 % (21.7 - 33.3)*
Prevalence of stunting (HA)	*0-5 months*	-	-	-	*15.2 % (10.6 - 21.2)*
Prevalence of anaemia	*6-59 months*	*45.2% (38.0-52.6)*	*56.4% (47.7-64.2)*	*68.7% (61.6-75.0)*	*59.3% (54.8-63.6)*
Prevalence of iron deficiency	*6-59 months*	*59.6% (51.5-67.2)*	*59.6% (49.3-69.2)*	*58.3% (49.8-66.3)*	*58.9% (53.5-64.1)*
Prevalence of vitamin A deficiency	*6-59 months*	*25.6% (18.3-34.5)*	*24.1% (16.4-33.8)*	*40.7% (31.2-51.1)*	*33.3% (27.5-39.6)*
Prevalence of exclusive breastfeeding	*<6 months*	*12.7% (6.7-22.7)*	*6.3% (1.6-21.6)*	*2.8% (0.9-8.2)*	*5.3% (3.1-9.2)*
Continued breastfeeding at 12 months	*12-15 months*	*60.3% (45.7-73.3)*	*45.0% (32.9-57.8)*	*64.4% (49.4-77.1)*	*60.8% (50.6-70.1)*
Continued breastfeeding at 24 months	*20-23 months*	*6.4% (1.6-21.8)*	*8.3% (2.5-24.4)*	*34.9% (24.0-47.7)*	*26.8% (17.1-34.6)*
Introduction of solids, semi solids or soft food	*6-8 months*	*38.3% (28.5-49.2)*	*11.6% (4.8-25.6)*	*12.5% (5.6-25.8)*	*17.1% (11.5-24.5)*
Prevalence of diarrhoea[1]	*0-23 months*	*21.6% (17.1-27.0)*	*20.4% (13.9-28.8)*	*18.8% (13.6-25.3)*	*19.7% (16.0-23.9)*
Prevalence of ARI[1]	*6-23 months*	*25.4% (19.7-32.0)*	*31.6% (24.4-39.8)*	*16.3% (11.1-23.4)*	*20.7% (16.8-25.3)*
Prevalence of suspected fever[1]	*6-23 months*	*13.0% (8.9-18.6)*	*24.0% (19.0-29.9)*	*26.2% (20.8-32.4)*	*22.8% (19.2-26.9)*
Women of Reproductive Age (15-49 years)					
Prevalence of under weight (BMI <18.5 kg/m²)	*Women*	*25.2% (21.8-29.0)*	*18.8% (15.5-22.5)*	*28.6% (23.0-35.0)*	*26.2% (22.6-30.1)*
Prevalence of over weight (BMI >30.0 kg/m²)	*Women*	*9.5% (6.7-13.5)*	*14.3% (10.9-18.5)*	*3.8% (2.1-6.8)*	*6.9% (5.3-8.8)*
Tetanus vaccination Coverage	*Women*	*55.3% (46.1-64.2)*	*33.9% (26.3-42.5)*	*40.8% (32.0-50.4)*	*43.3% (37.2-49.5)*
Vitamin A coverage	*Women*	*22.8% (17.1-29.8)*	*20.2% (14.3-27.8)*	*22.8% (15.2-32.6)*	*22.4% (17.4-28.3)*
Visible goitre prevalence	*Women*	*3.3% (2.2-4.9)*	-	*1.4% (0.8-2.6)*	*2.0% (1.4-2.9)*
Prevalence of total anaemia	*Non pregnant Women*	*38.3% (26.3-51.9)*	*52.8% (38.5-66.7)*	*53.8% (40.9-66.3)*	*49.1% (40.8-57.4)*

Iron deficiency	*Non pregnant Women*	*39.0% (33.3-45.1)*	*40.8% (34.1-47.9)*	*43.4% (34.4-52.8)*	*41.5% (36.5-46.7)*
Vitamin A deficiency	*Women*	*49.5% (43.5-55.6)*	*48.8% (41.0-56.5)*	*58.9% (48.1-68.9)*	*54.4% (48.3-60.4)*
Median urinary iodine concentration	*Non pregnant women*	*224.4 µg/L*	*397.7 µg/L*	*312.8 µg/L*	*325.1 µg/L*
		School Aged Children			
Prevalence of visible goitre	*6-11yrs*	*1.3% (0.4-4.3)*	*-*	*0.3% (0.0-2.4)*	*0.7% (0.2-1.8)*
Prevalence of anaemia	*6-11yrs*	*15.4% (10.8-21.3)*	*33.0% (25.1-42.0)*	*36.5% (28.5-45.3)*	*29.8% (24.9-35.2)*
Prevalence of iron deficiency	*6-11yrs*	*17.8% (13.0-24.0)*	*20.4% (13.9-28.9)*	*22.9% (16.6-30.7)*	*20.8% (16.9-25.4)*
Prevalence of vitamin A deficiency	*6-11yrs*	*21.3% (14.8-29.8)*	*26.1% (19.8-33.5)*	*40.3% (29.6-52.0)*	*31.9% (25.8-38.6)*
Median urinary iodine concentration	*6-11yrs*	*295.5 µg/L*	*619.4 µg/L*	*397.4 µg/L*	*417.1 µg/L*
		Malaria			
Malaria prevalence	*All subjects*	*1.3% (0.5-3.1)*	*2.1% (1.1-3.8)*	*0.5% (0.1-1.8)*	*1.0% (0.6-1.7)*
Proportion of people who slept under a mosquito net	*All subjects*	*12.7% (7.1-21.5)*	*28.8% (18.6-41.7)*	*12.4% (6.6-21.9)*	*15.3% (10.9-21.0)*

[1] Two week period prevalence

Recommendations

In order to address the problems of malnutrition identified by the survey, a one day consultative meeting was convened by FSNAU for all stake holders and conducted on March 30th 2010 at the Somalia Secretariat Support (SSS) Baobab Conference Room. The following recommendations are informed by the results of this consultation.

1. **Iodine Intake**

i) Exploring the Results Further

a) Given the high iodine intakes reported for both children and adults there is need for further research on the sources of iodine. FSNAU will contact SWALIM to discuss the possibility of investigating the iodine content of water sources in Somalia..

b) Further investigations could be conducted on the levels of dehydration of individuals from the sampled populations; this may provide insight on the high iodine concentration reported, as high levels of dehydration in an individual may increase the iodine content in urine. This will be discussed further with ICH.

c) Comparative studies that assess the level of iodine among similar populations in the region for example populations from Dadaab refugee camp and Ethiopia should be reviewed in order to compare the results and assess for any similarities among the groups that can explain the high iodine levels observed.

d) There is need to consult and discuss the results with international experts that conduct research on iodine, this would assist greatly in further understanding the possible causes of the high iodine results reported. A core group of experts should be called together to identify further research needs.

ii) Policy Restriction on Provision of iodized Salt

a) It was suggested that the promotion of iodized salt and or efforts to promote the internal production of iodised salt in the country are minimized, until the source of excessive iodine intake is clarified.

b) The Health Sector should also be advised to restrict any promotion of the consumption of iodized salt until further research is conducted on the source of ingested iodine. However, it is stressed that there is currently *no evidence* of any ill effects from iodine intake in Somalia and it would be inappropriate to raise unnecessary alarm.

c) Aid agencies should be advised not to distribute relief food that contains iodised salt until further research on the source of ingested iodine. Where possible, distributed food aid products should not be fortified with iodine.

iii) Goitre Clinical Case Detection

a) Further analysis may be required on to understand the clinical implications that high iodine intake has on the Somali population. The reporting of high iodine intakes alone does not indicate whether unfavourable physiological consequences are occurring. Thyroid function tests are required to investigate the effects..

2. Anthropometric Findings (Focus on Women and Children)

i) Further Research

a) FSNAU should conduct further research and disseminate the BMI values findings for the women collected during the study after adjustment using the Cormic index. This will assist in interpretation of the results on women's nutritional status and provide fuller information for appropriate response planning.

b) Additional analysis should also be conducted by FSNAU to compare these results with MUAC data collected from women in other studies conducted at a similar time.

c) Further research is also required to understand the cultural issues affecting women's household food access, perceptions of women's weight and eating habits, and how this could be affecting the high level of acute malnutrition. Studies should include the issues of intra household sharing of food and restriction of certain food types.

ii) Campaigns and Programmes Promoting Appropriate Practices

a) Breastfeeding support and counselling programmes are essential for women and infants/children and should be strengthened. These programmes can also be used as an entry point for vitamin A and iron supplementation. These programs are particularly useful for vulnerable groups such as internally displaced populations.

b) Professional communication campaigns that promote appropriate infant and young child feeding practices should be conducted with relevant and helpful information on food preparation, appropriate complementary feeding and weaning and hygienic practices. These should be simple, focused, and regionally specific.

c) A child friendly environment should be provided within IDP camps and in all MCH facilities to support breastfeeding.

d) Positive deviance studies should be shared and used to promote good practices. For example, in Somaliland the rates of exclusive breastfeeding are higher compared to other regions, this can help in informing and encouraging best practices in other regions.

e) A detailed action plan on the IYCF recommendations should be developed from the recommendations of the KAP study carried out in Somalia in 2007.

f) Weight monitoring of women during pregnancy, should be undertaken and used to promote healthy weight gain. Healthy eating habits should be encouraged to prevent both underweight and overweight conditions in women.

g) Women's workloads should be considered when designing programmes to ensure that women are not spending too much time and resources participating in these programmes and therefore compromising the quality and time they spend on other activities.

h) Appropriate food consumption habits should be promoted, including the consumption of foods of adequate quality and quantity and reducing the consumption of tea at meal times, as this affects the absorption of iron and is a risk factor for anaemia.

3. Vitamin A and Iron Findings

i) Supplementary/Therapeutic Approaches

a) Given the different levels of vitamin A and iron deficiency in the country, when designing the interventions, a regional specific approach should be used to ensure that the interventions are relevant to the population in the region.

b) Improve optimal immunization coverage and vitamin A supplementation for children and women through e.g. Routine EPI (fixed and outreach) activities and Child health Days. With enhanced logistical support to ensure supplies meet demand etc .

c) Vitamin A and iron supplementation and vaccinations for children and women should be provided at MCH facilities and nutrition centres. In addition, these services should also be provided at birth in skilled delivery points.

d) De-worming programmes for women (including pregnant) and children should be promoted and conducted in various fora such as health centres, schools etc.

e) The nature of pastoralist populations need to be considered when designing outreach programmes to improve health service access. Strategies such as combining child and animal vaccination campaigns at water points or on market days should be considered

f) Teachers in schools should be trained to identify basic signs of micronutrient deficiencies e.g. pallor and fatigue, and thereafter refer the affected children to the relevant treatment centres in the area.

g) Fortification of school meals with iron and micronutrients, especially those provided in school feeding programmes including the fortification of cereals distributed in food distributions.

h) A national protocol on the use of iron supplements in malaria endemic areas should be developed.

i) Improvement in the efficiency of supplementation and vaccination service delivery is required. This includes ensuring that there is adequate and timely supply at all times. Forging of partnerships between the main stakeholders in order to scale up programmes in neglected areas should also be considered.

ii) Improving Dietary Diversity

a) Communication campaigns should be initiated to promote diet diversity and improve the consumption of Vitamin A and Iron rich foods in the diet of the population. Close monitoring of consumption should be undertaken in conjunction.

b) Ways need to found to link with relevant sectors to improve the nutrient quality of foods. For example, by linking with the livestock sector and conducting further research on understanding issues surrounding milk quality (e.g. effect of boiling on vitamin levels) or production of higher quality crops such as yellow fleshed cassava.

c) Including nutrition education in the curriculum in schools to promote appropriate feeding and health practices and promote peer-to-peer education in the home.

d) The use of home based fortification programmes using food supplementation products, such as micronutrient powders and lipid nutrient supplements, could be explored but would require careful monitoring to ensure appropriate and safe usage.

e) The possibility of fortifying cereals consumed by the population should be explored in detail. As part of this work a survey should be conducted to determine the specific types of local and imported fortified and un-fortified cereals consumed by the population. This would provide insight on the feasibility of cereal fortification in the regions.

f) Purchasing of food has been identified as the main source of food in the households, therefore response agencies may consider cash transfers for micronutrient rich foods as a means of providing support when designing programmes aimed at improving the food security at household level.

Overall Recommendations

1. A Micronutrient Task force for Somalia should be developed to provide guidance and co-ordination on implementation of the suggested guidelines.

2. All the recommendations discussed should be linked with the overall nutrition strategy being developed for Somalia.

3. Partnerships with global micronutrient initiatives and other relevant global institutions need to be encouraged for exposure to experiences in other similar contexts and to support the mobilization of appropriate resources for Somalia.

1.0 Introduction

Somalia is situated in the horn of Africa and borders Kenya, Ethiopia and Djibouti on the southwest, west and northwest respectively with the Gulf of Aden and Yemen on the north. The country has been without a functional central government for almost two decades since the overthrow of Siad Bare in 1991. Moreover, the state collapse, lawlessness and conflict, coupled with the natural disasters, have led to the disruption to the normal livelihoods of much of the population. There has been consequent large scale internal displacement as well as migration of refugees to neighbouring countries.

The collapse of the central government led to the formation of the relatively stable entities of Puntland and Somaliland in the north-east and north-west, respectively, while the south and central regions continue to be plagued by complex emergencies. This differential development has created disparities in terms of access to basic needs as well as the extent and severity of humanitarian emergencies. These disparities make it difficult to generalize about the situation in Somalia as a whole and analysis by zone is desirable.

Livelihood patterns in Somalia have partly been determined by harsh climatic conditions and the presence of two perennial rivers in south and central Somalia. The climate is arid, semi-arid and equatorial, characterized by a bimodal but intermittent pattern of rainfall which subsequently constrains the basic livelihood sources of livestock and agriculture[1].

Health indicators in Somalia remain among the worst in the world. Life expectancy stands at 45 years for men and 47 for women.[2] One in every seven Somali children dies before the age of five years.[3] Approximately 43% of Somalis live below the extreme poverty line. Polio, which re-emerged in Somalia in 2005 after three polio-free years, seems to have been brought under control, with no new cases since March 2007.[4] However, malaria, tuberculosis, diarrhoeal diseases and other preventable or easily

1 JNA (Somali Joint Needs Assessment) (2006). Cluster report: Livelihood and Solutions for the displaced.

2 UNDP Somalia. http://www.so.undp.org/index.php/About.html

3 UNICEF Somalia http://www.unicef.org/infobycountry/somalia_statistics.html (viewed on 10th February 2010)

4 WHO (2008)Somalia is again polio.freehttp://www.who.int/mediacentre/news/releases/2008/pr09/en/index.html (accessed on 18th February 2010)

treated diseases continue to kill thousands each year. Acute respiratory illness is common, especially among children, and may be associated with the near universal use of solid fuels for cooking and the lack of adequate household ventilation. Health care facilities are scarce, with an estimated one physician per 25,000 people. More than half of health care staff are unskilled, with little opportunity to receive quality training. In some areas, security is one of the main impediments to accessing health care, as staff are sometimes unable to reach their workplace, or potential beneficiaries are unwilling to take risks in order to reach a health centre which offers inadequate services.

Throughout southern and central Somalia, typical levels of acute malnutrition in children below the age of five years, outside of times of crisis, remain at appallingly high levels, over 15% in most areas. [5, 6] In the north of Somalia, in areas enjoying greater peace, stability and development, malnutrition rates have been consistently lower, with median rates over the past seven years of about 10% in Somaliland and 14% reported in Puntland. Substantial pockets of high vulnerability are also seen in the urban centres, displaced people's camps and areas experiencing extreme environmental degradation. High levels of severe[7] acute malnutrition (up to 5% in some recent assessments); indicate the high proportion of children under five years of age that face a high risk of death. A generally high incidence of diarrhoea, outbreaks of Acute Watery Diarrhoea (AWD) and other communicable diseases coupled with low[8] immunization coverage for measles further increase this risk. Throughout the country, levels of malnutrition are consistently and significantly beyond acceptable levels. Out of 24 nutrition assessments conducted in south and central Somalia, 19 have reported levels of acute malnutrition above the emergency threshold of 15%. The causes of the chronic acute nutrition crisis are multiple, including high rates of morbidity, limited access to safe water and sanitation facilities, which are exacerbated by periods of food insecurity caused by drought, floods and conflict, all recurrently experienced by large proportions of the population in south-central Somalia. Median rates of chronic malnutrition for the past seven years also remain unacceptably high at 25% in south-central, 21% in Puntland and 16% in Somaliland.

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5 Global Acute Malnutrition. Below -2 SD from median weight for height of reference population.

6 FSNAU . Analytical approach . http://www.fsausomali.org/200506095641_nutrition.php (accessed on 18th February 2010.

7 Severe malnutrition; below -3 SD from median weight for height of NCHS 1978 reference population.

8 Average vaccination coverage for measles in the 13 assessments performed in 2007 was 38%.

1.1 Micronutrient Status

Somalia is in a chronic nutrition crisis with rates of acute and chronic malnutrition consistently exceeding emergency thresholds in some areas over prolonged periods. High rates of morbidity are thought to be the major driving force behind these persistently high rates of malnutrition. The situation is facilitated by low immunization coverage rates and exacerbated by periods of food shortage, and limited basic social services. Anecdotal evidence has identified cases of anaemia, vitamin A deficiency and iodine deficiency at community level however the availability of prevalence data to determine the public health significance of the main micronutrient deficiency disorders in Somalia is sadly lacking.

The only available information on micronutrient deficiencies is on anaemia in children 6-59 months from Somaliland in 2001, where a study conducted by UNICEF and the Ministry of Health and Labour (MoHL) identified 59.5% of children as anaemic, from a sample of 784 children drawn from 30 clusters and tested using the HemoCue (18.3% mild anaemia, 33.2% moderate anaemia and 8% severe anaemia)[9].

In the 2006 MICS, UNICEF identified that only 1.2% of households were using iodised salt nationally, and there was only 24% coverage of Vitamin A capsule distribution in children under-five years.[10] This information, though limited, highlights the elevated risks of vitamin A, iodine and iron deficiency in Somalia.

With such an adverse nutrition situation, an understanding of the public health significance of micronutrient malnutrition was essential to explore the potential contributions of these deficiencies to the overall crisis. Unfortunately, in spite of a significant amount of nutrition information available, there was a lack of representative data available on micronutrient deficiencies both regionally and nationally. Providing this information was considered essential to enabling a detailed understanding of the underlying causes and the development of an appropriate response to tackle the health, nutrition and food security crisis.

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9 WHO (2005) Somalia: Vitamin and Mineral Nutrition Information System (VMNIS) WHO Global Database on Anaemia

10 UNICEF (2006) Somalia Multiple Indicator Cluster Survey

In response to this situation, the FSNAU (Food Security and Nutrition Analysis Unit) in collaboration with UNICEF, WFP (World Food Program), WHO (World Health Organisation), Ministry of Heath authorities and CIHD (Centre for International Heath and Development) initiated a national micronutrient survey in 2009.

The selection of the micronutrients to be included in the study was based on the likelihood of finding deficiency, the public health significance, and the practical issues involved in collecting and measuring biological samples. The study focussed on *iron*, *vitamin A* and *iodine* for the reasons outlined briefly below.

Iron is important for both the physical and cognitive development of children and low iron levels may impair child development as well as adult productivity. Within Somalia it is generally assumed that poor diet quality, as well as dependence on long term food aid coupled with cultural food consumption practices is likely to result in poor intake of iron and low bio-availability. In addition to iron deficiency, prevalent infections in Somalia, including malaria, may be major causes of anaemia.

Vitamin A is required for vision and immunity and a deficiency is associated with xerophthalmia and elevated child mortality. The limited availability and consumption of fruits in larger parts of Somalia is thought to be one factor that contributes to a low absorption of pro-vitamin A carotenoids and places the population at risk of deficiency.

Iodine deficiency results in insufficient thyroid hormone production which is important for the regulation of body metabolism and normal brain development. Deficiency can have disastrous impacts on child development and adolescent and adult health. Due to the low coverage of salt iodisation it was assumed that the population of Somalia would be at risk of iodine deficiency.

This report describes the findings of the National Micronutrient Malnutrition Survey conducted in Somalia between the months of March to August 2009. It discusses the public health significance of the data on the micronutrient status of the population and provides recommendations for the development of an appropriate and evidence-based response strategy to help manage the ongoing nutrition crisis.

2.0 Survey Purpose and Objectives

2.1 Study Purpose

The purposes of this study were two fold:

1. Assess the nutritional status of vulnerable population groups within Somalia.
2. Provide baseline data on the prevalence of selected micronutrient deficiencies to enable future monitoring.

2.2 Survey Objectives

- To determine the prevalence of Iron deficiency and anaemia in children 6-59 months, school aged children (6-11 years) and women of reproductive age (15-49 years) using biological indicators
- To determine the prevalence of Vitamin A deficiency in children 6-59 months, school aged children (6-11 years) and women of reproductive age (15-49 years) using biochemical indicators
- To determine the prevalence of iodine deficiency in school aged children (6-11 years) and women (15-49 years) using biological indicators.
- To assess the anthropometric status of children 6-59 months and women of reproductive age (15-49 years).
- To assess the immunization status of children for Measles, Vitamin A, Polio, DPT3 and the status of maternal tetanus and Vitamin A supplementation coverage.
- To assess the prevalence of acute respiratory infections (ARI), diarrhoea and fever in children 6-59 months of age.
- To determine the prevalence of *Plasmodium falciparum* infection in all household members using a rapid diagnostic test.
- To determine the coverage of Insecticide Treated bed Nets (ITN).
- To assess the proportion of households using iodised salt.
- To assess infant and young child feeding practices.
- To assess the diversity and frequency of consumption of locally available micronutrient rich foods through household dietary diversity assessment and individual dietary diversity assessment of women of reproductive age.

3.0 Methods

3.1 Sampling

The study was a national, stratified, cross sectional multi-stage cluster survey with the three zones of Somalia treated as separate strata. This allowed estimates at both the zonal and national level. Probability proportional to size (PPS) was used for the first stage of sampling at the regional level and the second stage sampling used a combination of mapping, segmentation and modified EPI sampling depending on the areas being surveyed and the availability of maps, as shown in Annex 7.

To enable the use of PPS to allocate clusters, lists were compiled in Microsoft Excel of all the settlements and villages and their associated populations within each zone. Data was obtained mainly from lists drawn up by WHO and it's implementing partners as part of National Immunisation Day campaigns.[11] Data on internally displaced persons (IDP) was obtained from lists maintained by the United Nations High Commissioner on Refugees (UNHCR). The available data identified the districts in which displaced persons were located but did not allow identification of the settlements within districts. For the purposes of constructing the cluster selection lists the IDP population for each district was therefore equally distributed between settlements within each district where IDPs were located.

The cumulative population in each zone (resident plus IDP) was obtained and then divided by the number of clusters to be surveyed in each zone to get the cluster interval. A random number between one and the cluster interval was randomly generated using ENA for SMART software.[12] The section (geographical area) with the cumulative population that contained the random number was allocated the first cluster and subsequent clusters were allocated to sections by adding of the cluster interval. A total of 35 clusters were allocated in North West and North East and 40 clusters in South Central Somalia so as to remove the need for cluster replacement in case some clusters become inaccessible during the survey due to insecurity.

11 Data available from UNDP did not provide population estimates below district level.

12 ENA for SMART October 2007, http://www.nutrisurvey.de/ena/ena.html

The second stage sampling involved a combination of mapping and segmentation to identify the specific start point for the clusters within each section. Selection of the second stage sampling procedure depended on the size of the settlement and its urban or rural nature. Clusters were defined generically as Urban, Rural and IDP although this did not have an influence in the cluster selection. Urban was defined using the UNDP definition of a settlement with a population over 50,000.

Urban Settlements

Maps were kindly provided by FAO Somalia Water and Land Information Management, (SWALIM) and included coverage of the main urban areas at a scale of 1:10,000. The maps had been compiled using satellite imagery and at this scale it was possible to identify individual houses and other structures.

Where maps were available random numbers were drawn from the X and Y axis of the map to identify the 1 km grid square from where the cluster is to be selected. This same square was further subdivided into equal squares using a smaller overlay grid of squared paper. Random numbers were again selected to identify values for the X and Y axis of the grid and where these intersected the square was selected. The mid point of the selected small square was then estimated by using major landmarks like roads, junctions to identify the centre house in the selected area. The use of local staff was important in the identification of the actual area on the map. After the first house had been surveyed the team then stood with their back to the doorway and selected the next house to their left to survey and moved in this direction until the required number of households were captured.

Small Rural Settlements

In areas where there was no map available and the geographic areas was not too large the EPI method was used. The team moved to the centre of the settlement and then spun a pen to select a random direction. The team walked in the direction shown by the pen along a straight line to the edge of the segment and counted all the houses. Upon reaching the end of the settlement a random number between one and the number of houses that were counted on the line was selected. The team then walked back towards the centre of the cluster counting the houses and stopped at the house indicated by the random number. This house represented the first house to be sampled in the cluster.

The selection of the subsequent houses then followed the same procedure as described above.

Large Rural Settlements

Where there was no map available and the geographic area was too large to sample using the EPI system, the area was segmented before the first household was sampled. The team asked the community about the approximate number of households in the settlement. Depending on the number of households, the settlement was divided in to equal portions of about 30-90 houses and sketch maps were drawn in some cases. The subdivision was mainly along major land marks like roads, river, foot path etc. The subdivided portions were then numbered. Using random number tables the team chose one portion. The selection of the household then followed as for the smaller settlements above.

Absent members of the family were revisited at least twice before the end of the survey in the cluster and were not replaced if not available. In cases of the absence of a whole household, information was sought on the whereabouts of the family and only if the household was not within reach were they replaced with the next household on the left otherwise the household was revisited twice like absentee individuals. Households that refused were replaced with the next available household and individuals for biological sample collection were replaced, however subjects for anthropometry and other non biological measurement were not replaced.

3.2 Target Population

The sampling units for this survey were households continuing residents or internally displaced people within the three zones of Somalia. Urban and rural settlements were not independently sampled but were considered separately in the analysis during the comparison of some key variables. Within the sampled households, children under five years, school aged children (6-11 years), and women of reproductive age (15-49 years) were the main target groups. Table 1 below shows the population groups and the key measurement variables.

Table 1 Summary of data to be collected for each age group

Age Group	HH Questio-nnaire	Anthro-pometry	Immun-isation Status	FFQ	Infant feeding	Urinary Iodine	Retinol Binding Protein	Haemo-globin	sTfR	CRP	Malaria
Infants 0-5 months	√	√		√	√						
Children 6-23 months	√	√	√	√	√		√	√	√	√	√
Children 24-59 months	√	√		√			√	√	√	√	√
Children 6-11 years	√					√	√	√	√	√	√
Women 15-49 years	√	√	√	√		√	√	√	√	√	√

3.3 Sample Size

The sample size required for each survey zone (strata) was based on the assumed prevalence given in Table 2 and the desired precision for each indicator. The calculation of sample size used a population of 999 000[13] children, a confidence interval of 95%, an assumed design effect of 1.0 for infant feeding indicators, 1.5 for micronutrient parameters and 2.0 for other measures, and a non-response of 10%. Calculations were performed using Epi Info 6.04.

Results of the sample size calculations are given in Table 2. This shows the sample size required for measuring different indicators in each population group, e.g. children 6-59

13 A higher sample size per strata was assumed in the initial planning of the survey.

months, each zone, and the three zones combined. To determine how many people were to be sampled in each cluster, the sample size was divided into the number of clusters (35) and rounded up to a whole number. For example, 241 children aged 6-59 months are required for the measurement of retinol binding protein (RBP). This is equivalent to seven subjects per cluster. As both RBP and soluble transferrin receptor (sTfR) were derived from dried blood spots (DBS) the larger sample size (241) was used for this and the haemoglobin analysis. In this case, the first seven subjects of the target group were enrolled for the biological sample collection. A cluster control sheet (Annex 10) was used by the tam leader to monitor whether the required number of samples had been achieved. In the event that the team found more people of a particular target group than they needed in the last house, all of the individuals in that target group were sampled in order to avoid selection bias.

Table 2 Sample size required for different indicators

Indicator	Estimated Prevalence (%)	Reference	Required Precision (%)	Sample size		
				Target Group	Strata	Total
Global Acute Malnutrition[14]	18.7	FSAU survey database	4.0	811	811	2433
Vaccination status[15]	35	MICS (2006)	5.0	777	1554	4662
Exclusive Breastfeeding	13	MICS (2006)	7.0	99	99	297
Anaemia	50	Somaliland anaemia study (2002)	8.5	222	666	1998
Iron deficiency	50	African refugee populations[16]	8.5	222	666	1998
Vitamin A deficiency	40	African refugee populations[6]	8.0	241	723	2169

14 Median estimates of global acute malnutrition for Somalia from data collected over the last 7 years are approximately 16% in South Central, 15% in Puntland and 12% in Somaliland.

15 For immunization status, prevalence estimates from the UNICEF MICS 2006 study for children under five years approximated 35% for Polio, 12% for DPT and 19% for Measles. Vitamin A capsule distribution coverage was 24%.

16 Seal, A. J., Creeke, P. I., Mirghani, Z., Abdalla, F., McBurney, R. P., Pratt, L. S., Brookes, D., Ruth, L. J., & Marchand, E. (2005) Iron and vitamin A deficiency in long-term African refugees. J.Nutr. 135: 808-813.

Iodine deficiency[17]	n/a	n/a	-	300	600	1800

3.4 Data Collection

The survey was conducted in four phases starting in the North East, then North West, Central and South. The seven clusters that were part of the South Central strata were surveyed in a separate phase because of logistical reasons. The data collection was done by six teams in the North West and North East and by three teams in Central regions while eight teams were recruited to conduct the fieldwork in South Somalia. The number of teams deployed was dependent on the proximity of the clusters, security and clan balancing, especially in the South and Central areas.

Each team was composed of eight people: 2 enumerators, 2 biological sample collectors, 2 measurers and one team leader. A FSNAU Nutrition Field Analyst was allocated to each team to supervise the fieldwork. Most of the survey teams, except for the biological sample collectors, were people with experience conducting surveys in Somalia and therefore already had thorough training and understanding of survey methods. A number of the survey team members belonged to the Nutrition Information Project Horn of Africa team (NIPHORN). The biological sample collectors were mainly laboratory staff who were taken from hospitals within the respective zones. The strict sample storage and drying procedure employed for the processing of the dried blood spots and other biological samples made the involvement of laboratory trained personnel very desirable. In some situations, where laboratory staff were unavailable experienced nurses were selected instead for this task.

A seven day intensive training was initially planned in all the three zones however the number of days was increased to 9 and 8 in North East and North West respectively. This was mainly due to challenges experienced during the piloting which necessitated an extra one to two days. Due to insecurity it was only possible to provide minimal field level

17 Iodine deficiency was measured by determining the median urinary iodine concentration. A minimum sample of 300 children and women per strata was planned.
n/a - not available

supervision in South Central Somalia. Here, great attention was given to both the training and pilot testing and the latter was repeated in case of a team's unsatisfactory performance until satisfactory sample collection and questionnaire quality was acheived.

The training covered in-depth the survey methodology, anthropometric techniques, haemoglobin measurement, care and cleaning of the HemoCue photometer, use fo rapid diagnostic tests for malaria, rapid salt testing for iodine, questionnaire administration, household selection procedure, and recording of results and biological sample collection techniques (a sample of the time table is given in Annex 11). Practical sessions, role plays, video shows and lectures were used during the training. All the teams were at first trained on all of the aspects of the survey. Later in the training team members were selected, based on their performance during the initial training days, and allocated to the specific tasks they were to perform. After the teams were formed each group undertook a further in-depth review, role play and teaching sessions on their assigned task.

Pilot testing was done in an area that was not in the sampled area. About 3-4 households were sampled by the each team and the quality of the sample collection; questionnaire and other aspects of the survey were examined. Each team was allowed to make a presentation on the challenges and obstacles faced during the pilot on the following morning. Feedback on the team's performance was given by the study coordinator in the presence of all the survey teams and thereafter individual teams were grouped together and any short comings discussed. Major errors like incorrect labelling, poorly filled questionnaires, missing records etc were not accepted and the concerned teams were asked to repeat the pilot test.

During survey implementation teams in the North East and North West were able to work in close proximity to each other and move systematically with in each zone. Each team was allocated a pre-decided list of specific clusters which eased both logistics and team supervision. All biological samples and questionnaire were compiled by the team supervisors upon finishing a cluster and reviewed by the Laboratory Coordinators and the Study Coordinator respectively. Continuous monitoring of errors and discussion of concerns helped improved subsequent data collection in each cluster for the teams. However, this type of practice was not possible in the South and Central Somalia. Here, teams were allocated to areas based on clan settlement patterns and each team was sent to clusters around their home area. Due to security restrictions, team supervision was not possible in all the clusters and, where possible, teams were supervised at the start of their first cluster. In South and Central Somalia it proved impossible to provide any field-level senior supervision of the team surveying the three clusters in Middle Juba.

3.5 Questionnaires

Six module questionnaires were designed to provide information on the relevant indicators of the target population as indicated in the study objectives. Since most of the staff in Somalia were comfortable reading the questionnaires in English, translation of the questionnaires was not necessary. However, the specific meanings of some questions were clarified during the training and interviewers carried copies of the questionnaires with hand written translations as required.

The five module questionnaires covered the following areas:
Module 1: This included questions relating to household size, socioeconomic status, gender of head of household etc.

Module 2: This included questions and measures on infant (0-5 months) nutritional status, infant feeding practices and morbidity.

Module 3: This included questions and measures of nutritional status for children 6-59 months. Information on child health and infant feeding, morbidity and nutritional habit during diarrhoea were some of the information asked.

Module 4 This included questions on children 6-11 years. These groups were mainly included for the urine sample as well as the dried blood spot for vitamin A and iron as well as haemoglobin analysis.

Module 5: This included questions and measure on women aged 15 – 49 years. Information on women's health status: family status, mother's education, pregnancy status, immunization status etc were gathered together with the biological and anthropometric measurements.

Module 6: The RDT results on malaria together with ownership and use of insecticide treated nets, type of net and cost of net were included in this module

3.6 Anthropometry

Weight and length were measured for all children aged 0-23 months while the weight and height were measured for all children aged 24-59 months. Weight, height and sitting height were also measured in all the sampled women. No anthropometric measurements were taken on school aged children.

The weight was taken using a digital scale from Seca Gmbh and Co. (Model 88102165g). Children under six months were weighed using an infant digital scale (Model BD-590). The amount of clothing worn while weighing was minimized and in the cases where the mother insisted on covering the baby with a piece of cloth, the cloth was pre-weighed and zeroed before measuring infants. Older children and women were weighed using the adult digital scale. In children who could not stand alone on the scale the mother's weight was taken first and subsequently zeroed and thereafter the child was given to the mother while she was standing on the scale and the weight of the child was recorded.

Height and length were taken using a Shorr Infant-Child-Adult Height Board[18] to the nearest mm. Children less than 24 months old were measured lying down while children from 24-59 months and all women were measured standing.

Sitting height was also measured for all the women by placing the height board on a low plastic table. The height board was placed on the table and the mother was asked to sit on the table with the height board. The mother was asked to sit upright and stretch her hands with her thighs parallel and the legs resting on the ground. The measurement was taken to the nearest 0.1cm after three deep breaths by the subject.

18 Shorr Productions, USA

Oedema in children was assessed by placing thumb pressure on both feet of the child for a period of 3 seconds and observing the presence or absence of an indent on both feet. Oedema cases reported by the survey team were verified by the team supervisors in North West and North East, however, this was not possible in many clusters in the South Central Somalia due to security restrictions.

The acute malnutrition prevalence was calculated from the weight for height (WH) index values combined with the presence of oedema. The WH indices were derived using the WHO 2006 Growth Standards and the NCHS 1978 Growth Reference[19 20]. Data was cleaned by excluding values that lay outside of the range +4 and -4 Z-scores from the sample mean and Z-scores were calculated using ENA for Smart software (Version October 2007). The table below gives the classification of the WH indices expressed in Z-scores.

Table 3 Definitions of Acute Malnutrition Using WH and/or Oedema in Children Aged 6–59 Months[21]

Category of malnutrition	Z-scores	Oedema
Severe malnutrition	< -3 SD	Yes/No
	> -3 SD	Yes
Moderate malnutrition	< -2 SD and ≥ -3 SD	No
Global acute malnutrition	< -2 SD	Yes/No

3.7 Mid Upper Arm Circumference (MUAC)

MUAC was measured on the left arm, at the middle point between the elbow and the shoulder, while the arm was relaxed and hanging by the body's side. The measurement was done using TALC MUAC tapes to the nearest mm. Table 4 below provides details of the classification of different MUAC measurements.

Table 4 Guidelines for Classification of Malnutrition based on MUAC[22]

19 http://www.who.int/childgrowth/en/

20 NCHS: National Center for Health Statistics (1977) NCHS growth curves for children birth-18 years. United States. Vital Health Statistics. 165, 11-74.

21 SMART METHODOLOGY. 2006. Measuring Mortality, Nutritional Status, and Food Security in Crisis Situations

MUAC reading	Categories of Malnutrition
MUAC < 11.5cm	Severe malnutrition and high risk of mortality
MUAC ≥ 11.5cm and <12.5cm	Moderate malnutrition and moderate risk of mortality
MUAC ≥ 12.5 cm <13.5 cm	At risk of malnutrition
MUAC ≥ 13.5 cm	Adequate nutritional status

22 WHO and UNICEF. (2009) WHO Child Growth Standards and the identification of severe acute malnutrition in infants and children. A joint statement by the WHO and UNICEF.

3.8 Clinical assessment

In all women and school age children surveyed in the North West and South Central strata, assessment for the presence or absence of visible goitre was observed. Palpation of goitre was not done due to the challenge of ensuring the correct identification of an enlarged thyroid. The subjects were asked to raise their head and the presence or absence of an enlarge thyroid was observed by a team member. Women were asked to remove the veil around the neck and in some cases they were examined by fellow female staff from the team in private in case of resistance to the removal of neck coverings. In most cases team supervisors cross checked goitre cases and took a photograph of the case for cross-checking. Goitre assessment was not performed in North East Somalia due to initial concerns about cultural acceptability.

3.9 Biological Sample collection

3.9.1 Sample labelling

Sheets of pre-printed identification number labels were used for labelling of all biological samples. Each row of 7 stickers contained a unique sample number that was used for each individual's DBS, urine samples and questionnaires. This enabled the robust linking of the laboratory results with questionnaire data.

Unique survey identification numbers were used for each household and individual in the study. The combination of zone number, cluster number, household number and individual number generated the unique numbers used for identification of households and individuals in the study. North West, North East and South Central were designated as zones 1, 2 and 3 respectively.

3.9.2 Blood Collection

In children 6-59 months, school age children and women of reproductive age, finger prick blood samples were collected for the measurement of haemoglobin, malaria infection, soluble transferrin receptor, C-Reactive Protein, Alpha-1 Glycoprotein and Retinol Binding Protein. The subjects were asked to sit and relax with the fingers not bent to allow maximum blood flow. Either the middle finger or the ring finger was used for sample collection. A safety lancet was used to prick the site of the finger after cleaning. The first drop of blood was wiped off and the second drop was used for Haemoglobin estimation. The remaining blood on the finger was again wiped off and a drop of blood was allowed to accumulate at the tip of the finger. The DBS filter paper was then touched gently into the pool of blood until the circle was completely filled and an equal size blood drop could be seen on the reverse of the filter paper. The last drop was then used for malaria testing. A total of 70 paired venous blood samples were also collected in the North West and North East strata in order to use them for calibration purposes.

3.9.3 Dried Blood Spot Processing

Filter paper number 903 from Whatman and Schleicher & Schuell (S&S) were used for dry blood spot (DBS) collection during the survey in North East and North West respectively, while a combination of both was used in South and Central Somalia. The Schleicher & Schuell filter papers were provided by CDC Atlanta and were printed with five circles for blood spot collection, while the Whatman filter papers were supplied by DBS-Tech in Germany and were cut to the size of a microscope slide. These smaller papers could only take up to 3 blood spots. The mix of both supplies in South and Central Somalia was because of logistical problems encountered during the initial shipment of supplies from Germany. However, no

significant differences in values between the DBS collected from the different filter papers were noted.

Duplicate sets of 3 drops on each filter paper were collected when using the Whatman paper while one paper with five drops was used for the S&S paper. The filter papers were placed horizontally over a slide box with a desiccant underneath overnight and transferred to zip lock bags with desiccant and humidity indicator after 24 hours. All filter papers were then put in a deep freezer at about -5 to -10^{o}C.

3.9.4 Serum Samples

Parallel serum samples were also collected so as to calibrate the values of the DBS. Approximately 3mL of blood sample per subject was collected from two clusters in the North West and North East. These clusters were selected due to the proximity of the cluster to a cold chain facility. The venous blood was collected into a Vacutainer® tube with serum separating gel. The whole blood sample was then returned to base and serum separation done after standing the tubes to allow separation. About 1-2mL serum sample aliquots were transferred into 2ml screw capped cryovials tubes and frozen in a deep freezer at about -10^{o}c. All serum samples were separated from whole blood and frozen within 6-8 hours of collection.

3.9.5 Urine Samples

A 10 ml urine sample was collected from a sample of women (15-49 years old) and school age children (6-11 years) for urinary iodine measurements. The subjects were provided with a pre-labelled 30ml urine collection tube and asked to provide a urine sample. Upon receiving the urine sample the team ensured the screw cap was fastened and the tube was dry and the urine tube was then placed into a cool box and transported back to the base at the end

of the day. Upon arrival at the base, the laboratory coordinator counterchecked the sample label with the questionnaire labels. The urine samples were then transferred into two same label 5ml cryovials tubes and each set of urine samples were placed into a separate cryovial box and frozen at -10^{o}c until shipment. A one time thawing of the urine samples during transport from Somalia to Kenya occurred, however dry ice was used for the subsequent shipment to the point of analysis.

3.9.6 Salt sample collection

Salt samples for iodine testing were collected from a sub sample of households across all clusters. The first nine households in each cluster had their salt samples tested using a rapid iodine test kit and the remaining sample was stored for future titration to confirm the amount of iodine in the salt. About 1-2 spoonfuls of salt were transferred into a zip lock bag and labelled with the household unique identification number using a permanent marker pen. The salt sample from each cluster were then packed in one bigger zip lock bag and stored at room temperature.

3.10 Biochemical Measurements

3.10.1 Haemoglobin

Measurement of haemoglobin was performed directly in the household using a portable photometer HemoCue Hb 201[23]. Haemoglobin measurement was done on the first seven children 6-59 months, school age children 6-11 year and women of reproductive age. In cases where there was more than the required number of subjects from a target group within a household, the team sampled all the target subjects in order to avoid a bias in selection.

The principle of the HemoCue Hb 201 measurement is based on the conversion of blood haemoglobin to methemoglobin by sodium nitrite and production of azidemethemoglobin after reaction with sodium azide. The absorption of azidemethemoglobin is then measured at wavelength using the HemoCue photometer which displays haemoglobin levels in grams per decilitre (g/dL). The HemoCue cuvette therefore serves both as the

[23] HemoCue AB, Box 1204, SE-262 23 Angelholm, Sweden.

blood collection device as well as the reaction site where the liquid blood sample mixes with the dried reagents[24].

Hemocue controls of high, medium and low values were used for quality control of the HemoCue machine on a daily basis. In far distance clusters, teams were provided with two HemoCue machines in case of breakdown. HemoCue control tests were mainly performed by the laboratory coordinator in North East and North West, however surveys teams were provided with controls so that they could test the machine daily before use. All the control readings were within an acceptable range of variation and none were out of the expected range throughout the entire survey.

The second drop of blood from the finger prick was transferred into a HemoCue cuvette for the measurement of haemoglobin. The cuvette was filled from one drop using a continuous action and blood was wiped away from the faces of the cuvette with lint free tissue before immediate insertion into the photometer. The table below shows the cut off values used to define anaemia in this study based on cut-offs recommended by WHO[25].

Table 5 Cut-off Points for Defining Anaemia in different age groups[26]

Age/Sex groups	Categories of Anaemia (g/dL)			
	Total	Mild	Moderate	Severe
Children 6 - 59 months	<11.0	10.9 - 10.0	9.9 - 7.0	< 7.0
Children 6-11 years	<11.5	11.5 - 11.0	10.9 - 8.0	< 8.0
Adult females >15 years	<12.0	11.9 - 11.0	10.9 - 8.0	< 8.0
Pregnant Women	<11.0	10.9 - 10.0	9.9 - 7.0	< 7.0

In population surveys of anaemia a classification of prevalence can be used determine the public health significance of the problem in the population. The table below gives the classification recommended by WHO and used in this survey.

24 Sharman, Almaz. 2000. Anemia Testing in Population-Based Surveys: General Information and Guidelines for Country Monitors and Program Managers. ORC Macro Calverton, Maryland, USA

25 The management of nutrition in Major Emergencies, WHO, 2000

26 Sharman, Almaz. 2000. Anemia Testing in Population-Based Surveys: General Information and Guidelines for Country Monitors and Program Managers. ORC Macro Calverton, Maryland, USA

Table 6 Classification of the Public Health Significance of Anaemia[27]

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

3.10.2 ELISA (Enzyme-Linked Immunosorbent Assays)

Upon arrival of the DBS in the DBS-Tech laboratory in Germany, 3 mm duplicate punches were taken from the dried blood spot. This was then soaked overnight with 1 ml phosphate buffered saline at 4^{o}C in a 96 deep well plate. The extract was then used in the same way as a similar diluted serum sample in an in-house sandwich ELISA method. A sandwich ELISA was used in estimation of retinol binding protein (RBP), C-reactive protein, and soluble transferrin receptor.

The anti-sTfR, anti-RBP, and anti-CRP antibody dilutions were coated on 96 well plates and incubated overnight in a refrigerator. The wells were then washed with a buffer three times and the plates inverted after the last wash to drain off the remaining buffer. A 100 ml aliquot of diluted serum and standard samples were then added to the wells. In order to ensure accuracy, the measurements were carried in duplicate and replicate samples were placed in different positions. A diagram of the plate wells with the respective well information is placed underneath the plate in order to guide the dispensing of the samples. The serum samples were then diluted using a wash buffer and 100 μl of diluted horseradish peroxidase (HRP) coupled antibodies were subsequently added and incubated at room temperature. A colour reagent (1 mg tetra methyl benzidine (TMB)) was then added to the plate wells. The reaction was stopped after 5-10 min with

27 World Health Organization. 2001. Iron Deficiency Anaemia: Assessment, Prevention, and Control. A guide for programme managers.WHO/NHD/01.3

phosphoric acid and measurement was done at 450 nm with a reference wavelength set at 650 nm[28].

A commercially available control sample from Bio-Rad (Liquichek Immunology Control) was serially diluted and used to obtain a calibration curve on each plate. However, no values were available for sTfR from this kit and another commercially available kit (Ramco Laboratories) was used to obtain the concentration of sTfR.

Serum retinol has been widely used for the determination of vitamin A deficiency in populations. However, the measurement of RBP has been found to provide an alternative that is inexpensive, simple and studies have shown a high correlation between serum retinol and RBP. As with some other measures of nutritional status, the blood concentration of RBP (an acute phase protein) can be affected by inflammation caused by infections and febrile illness. It also has a short half-life and synthesis may be impaired in the presence of protein energy malnutrition, which in turn can affect the mobilization of retinol from body stores.

There are various RBP cut-off points proposed for the classification of vitamin A deficiency. Studies have suggested different values depending on their sensitivity and specificity (ROC curves) for detecting low serum retinol. Gorstein et al[29] and Baingana et al[30] have suggested and used, respectively, an RBP cut-off of <0.825 μmol/L while other studies have used 0.77μmol/L[31] and 0.73 μmol/L. Therefore, there is still a lack of international agreement on the most appropriate RBP cut-off to use for the classification

28 Juergen G. Erhardt, John E. Estes, Christine M. Pfeiffer, Hans K. Biesalski, and Neal E. Craft (2004). Combined Measurement of Ferritin, Soluble Transferrin Receptor, Retinol Binding Protein, and C-Reactive Protein by an Inexpensive, Sensitive, and Simple Sandwich Enzyme-Linked Immunosorbent Assay Technique. American Society for Nutritional Sciences.

29 Gorstein, J. L., Dary, O., Pongtorn, Shell-Duncan, B., Quick, T., & Wasanwisut, E. (2007) Feasibility of using retinol-binding protein from capillary blood specimens to estimate serum retinol concentrations and the prevalence of vitamin A deficiency in low-resource settings. Public Health Nutrition 11: 513-520.

30 Baingana, R. K., Matovu, D. K., & Garrett, D. (2008) Application of retinol-binding protein enzyme immunoassay to dried blood spots to assess vitamin A deficiency in a population-based survey: The Uganda Demographic and Health Survey 2006. Food and Nutrition Bulletin 29: 297-305.

31 Mary V Gamble, Rajasekhar Ramakrishnan, Neal A Palafox, Kennar Briand, Lars Berglund, and William S Blaner (2001).Retinol binding protein as a surrogate measure for serum retinol: studies in vitamin A–deficient children from the Republic of the Marshall Islands. The American Society for Clinical Nutrition 73:594–601

of vitamin A deficiency. In this survey we used a cut-off of <0.825 μmol/L to classify vitamin A deficiency in children and a cut-off of <1.24 μmol/L in women.

The public health significance of vitamin A deficiency (serum retinol <0.70 μmol/L) has been categorized as mild, moderate and severe prevalence if in between 2-10%, >10-<20% and >20% respectively[32]. In this report we use the same cut-offs to classify the significance of vitamin A deficiency determined using RBP concentrations.

Soluble transferrin receptors (sTfR) are found on cell membranes and enhance the entry of transferrin bound iron into the cell. Therefore, there is an up regulation of sTfR to compete for more iron when the iron supply is inadequate. An increase in sTfR is seen in iron deficiency anaemia and iron deficient erythropoesis. The amount of sTfR correlates well with the cell iron needs.

The sTfR cut-off is usually specified by the kit manufacturer. In this case, a sTfR concentration above 8.3 μg/ml was regarded as iron deficient with the normal range being 3.0 - 8.3 μg/ml.

Infection and trauma is followed by an acute phase response that includes the production of proteins to promote inflammation, activate complement and stimulate phagocytic cells to arrest the tissue damage[33]. The measurement of the acute phase protein CRP can therefore help to control for the potential confounding effect of different levels of infection and febrile illness in different populations groups. A cut-off of 5mg/L was used to classify individuals with a current acute phase reaction.

Malaria testing was done on the first 50 people per cluster using rapid diagnostic test (RDT) kits from Orchid Biomedical System 88/89, India. The RDT test is based on the principle of detection of histidine-rich protein II antigen (HRP-II) that is produced by trophozoites of *Plasmodium Falciparum* and young but not mature gametocytes. The imunochoromatographic detection of the antigen is based on the capture of the antigen

32 WHO (1996). Indicators for assessing Vitamin A Deficiency and their application in monitoring and evaluating intervention programmes pg 1-59

33 CDC and Micronutrient Initiative (2007). Indicators and Methods for Cross-Sectional Surveys of Vitamin and Mineral Status of Populations.

from peripheral blood using antibodies. The antibodies are paired with a dye and produce a coloured reaction on the test card in case of positive results.[34].

3.10.3 Urinary iodine

Iodine concentration in urine is the main indicator used to monitor current iodine intake[35]. Urinary iodine concentration varies significantly with high inter-subject and intra-subject variation[36]. Thus, urinary iodine estimation can only be used to make population estimates and not an individual assessment. Both spot urine samples and 24 hours sample have been previously used in urinary iodine assessment. Spot urine samples provide an adequate assessment of a population iodine status and are routinely used as 24 hours urine sample has been found to be unnecessary and difficult to obtain. However, Andersen et al[37] has shown large variations between the spot urine samples as compared to 24 hours samples and suggests that ensuring a sample size of between 100 to 500 will provide an assessment of population iodine status with a precision between ± 10 and ± 5% respectively.

The analysis of urinary iodine was done in South Africa at the Nutritional Intervention Research Unit (NIRU) laboratory. This laboratory is part of the International Resource Laboratory for Iodine (IRLI) network that participates in CDC's (Centers for Disease Control and Prevention) Ensuring the Quality of Iodine Procedures (EQUIP) Program, which evaluates the accuracy of results[38].

The principle of the urinary iodine tests is based on the Sandel Kolthoff reaction method which utilises the catalytic effect of iodide on the oxidation reduction of ceric ions (Ce^{4+}) and arsenite (As^{3+}). Iodine in urine occurs in the form of iodide. Urine samples, digested

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34 New Perspectives Malaria Diagnosis, Report of a Joint WHO/USAID Informal Consultation. WHO/CDS/RBM/2000.14 WHO/MAL/2000.1091

35 WHO. (2004). Iodine status Worldwide: WHO Global Database on Iodine Deficiency. World Health Organization. Geneva, Switzerland.

36 Haddow JE, McClain MR, Palomaki GE, Hollowell BS & Hollowell JG. (2007). Urine iodine measurements, creatinine adjustment and thyroid deficiency in an adult United States population. J Clin Endocrinol Metab; 92 pp 1019–1022.

37 Andersen, S., Karmisholt, J., Pedersen, K. M., & Laurberg, P. (2007). Reliability of studies of iodine intake and recommendations for number of samples in groups and in individuals. Br.J.Nutr. pp. 1-6.

38 Iodine network. http://www.iodinenetwork.net/Resources_Lab.htm

in strong acid and ashed at high temperature to remove other substances interfering with the reaction, are analysed by observing the catalytic action of iodide on the reduction of Ce^{4+} coupled with the oxidation of As^{3+}. Ceric ion has a yellow colour while the cerous ion is colourless. The speed of the colour disappearance is proportional to the concentration of iodide catalysing the reaction[39].

The urine samples were analysed using a slightly modified quantitative method based on the Sandell-Kolthoff reaction. About 0.25ml of urine sample was digested in 1.0ml *ammonium persulfate* at temperatures between 91-95oc for 60 minutes to remove interfering substances. An aliquot of 0.050ml of the digested urine sample was then put into a 96 microplate and 0.1 ml *arsenic acid* followed by 0.05ml *ceric ammonium sulphate* solution. The reaction was then determined spectrophometrically with a plate reader at 405nm after 25 minutes incubation at 30^{o}c. Each of the plates had a unique standard curve (ranging from 0-320 µg/L) and internal controls (ranging from 80-600 µg/L). Urine sample with values above the standard curve and acceptable control range were diluted 1 in 5 at first, which were normally followed by 1 in 10 and 1 in 20 dilutions if needed. Samples were diluted till an absolute value was reached within the acceptable criteria.

Population median urinary iodine concentration (UIC) are categorised as deficient, adequate, more than adequate or excessive. The table below shows the different cut offs based on median UIC.

Table 7 Criteria for Assessing Iodine Status of School Aged Children and Adults using Median Urinary Iodine Concentration (UIC)[40]

Median UIC (µg/l)	Iodine intake
<20	Insufficient
20-49	Insufficient
50-99	Insufficient
100-199	Adequate
200-299	More than adequate
>300	Excessive

39 Belling, G.B. (1982).Determination of iodine. S.Australia. CSIRO Division Of Human Nutrition. p 1-9

40 WHO. (2004). Iodine status Worldwide: WHO Global Database on Iodine Deficiency. World Health Organization. Geneva, Switzerland.

3.10.4 Rapid salt iodine testing

Household salt iodine testing was done using an improved iodized salt field test kit from MBI International-India[41]. Salt samples are oxidized with an acidic solution to liberate free iodine which then turns starch blue. The intensity of the colour is proportional to the amount of iodine in the salt sample. The test provides semi-quantitative results with categories given as 0 ppm, less than 15 ppm and more than 15 ppm. A small amount of salt was put into the kit's cup, two drops of the test solution was added, and the results were observed after one minute. If no colour change occurred, a separate sample of salt was taken and five drops of the re-check solution was added plus two drops of the test solution and a change in colour was observed for one minute. The salt was only regarded as not containing iodine when both tests were negative. This reagent however would not detect the presence of iodide in salt samples fortified with potassium iodide.

3.11 Data Analysis

Data entry was done by three people with every strata entered as soon as the survey in that phase was finished. The data entry was done using EpiData software version 3.0.[42] This software enables easy data entry and validation. Data cleaning was done by running frequency tables and distributions in order to check for outliers and repeated entries. Three days data cleaning was done after the end of every data entry period and the data entry person together with the study coordinator reverted to the hard copies of the data collection forms in order to resolve any anomalies that were discovered.

Data analysis was carried out using SPSS version 16.0 using the Complex Samples module. Cross tabulation of categorical variables was performed and risk ratios calculated when appropriate. For continuous variables (e.g. haemoglobin, sTfR, urinary iodine, weight-for-height, height-for-age, weight-for-age, birth weight, and BMI) means and standard deviations, or medians and the inter quartile ranges were calculate. In order to calculate nationally representative results from the individual strata, population

41 Rapid salt iodine testing kits from MBI Kits International T-nagar Chennai-600 017 INDIA

42 Lauritsen JM & Bruus M. EpiData (version 3). A comprehensive tool for validated entry and documentation of data. The EpiData Association, Odense Denmark, 2003-2004.

weights were calculated as described below and used to adjust combined prevalence estimates. 95% confidence intervals were calculated allowing for the complex survey design. Graphs were generated in Excel 2003 or SPSS 16.0.

Anthropometric data from children 6-59 months of age was entered in ENA for SMART (Version October 2007) software for anthropometric analysis and determination of the prevalence of anthropometrically defined malnutrition.

3.12 Calculation of Population Weights

A weighting factor was used in order to generate the combined results of prevalence figures. This population weight was obtained by dividing the total strata population obtained from WHO village population data and UNHCR IDP data with the actual number of people surveyed. The figure given as the population weight therefore represents the number of people it represents for every record from that stratum. The sum of the entire weights corresponds to the size of the population from which the sample was drawn from. Table 8 shows the population weights.

Table 8 Calculation of Population Weights

Strata	Total Population	Under Five Population	Actual Sampled Surveyed	POPW[1]
North West	1,655,825	331,165	1048	316.0
North East	1,079,188	215,838	995	216.9
South Central	4,092,947	818,589	1261	649.2

[1] POPW = Total Population/Studied Sample

3.13 Ethical approval

The study protocol was reviewed and approved by Ministry of Health officials from the separate authorities in the three zones of Somalia. Ethical approval for the study was also provided by the University College London Research Ethics Committees (application number 1822/001). Somaliland provided their ethical approval via their letter dated 28th October 2008, while those of the Puntland was approved vide MOH/PL/210/08 of 7th September 2009 and the South Central provided approval through the Ministry of Health of the TFG via their letter MOH/SOM/MOG/DG/60/08 dated 12th September 2008.

A participant information sheet was prepared and read to the subjects before starting the interview and data collection process. Verbal consent was obtained from subjects and from guardians in the case of children. Due to high anticipated illiteracy rate signed consent was found not appropriate for this population.

Subjects were informed of their right to freely decide whether to participate in the study and that their refusal or participation will not affect their access to health, food relief or any other services. They were informed of their right to withdraw from the study at any point if they desired to do so and that nothing adverse would result from their decision.

4.0 Results

4.1 Household characteristics

The tables below show the number of households and clusters sampled in each zone (strata). The number of clusters covered ranged from 31 clusters in North East, 32 in North West to 33 in South Central Somalia. The initial higher number of clusters that were planned for inclusion could not be achieved due to security problems that prevented access. However, as shown in table 11 the attainment of the required target sample sizes ranged from 92.9% - 121.9%, showing a good attainment of the planned sample. It is also important to note that apart from micronutrient indicators, other variables were included that required a larger sample size. Table 10 shows the actual number of subjects interviewed per target group.

In table 12 the distribution of settlement type is shown for each strata. Households were separated into urban, rural and those households within Internally Displaced Persons (IDP) settlements. A higher number of urban households were sampled in North East, while a higher number of rural settlements were captured in South Central. The proportion of IDP households was overall quite low but exceeded 12% in the South Central strata. This was not unexpected given the higher levels of conflict experienced in this area of Somalia.

Table 13 shows the mean number of people and children under-five years per household in all three strata. The average household size was similar across all strata. A mean of about five people in South Central and six in North West and North East were noted. There was a mean of about one child under the age of five years per household across the strata. South Central Somalia had the least members per household as well as slightly more children less than five years of age. Figure 1 shows the age and sex distribution of children 0-59 months, with a smaller proportion of both sexes in the 0-5 months and 54-59 months which is mainly due to the narrow age ranges in both groups.

Table 9 Cluster and Household Coverage in Each Stratum

Strata	Number of clusters and households visited			
	Planned number of clusters per strata	Actual number of clusters sampled per strata	Number of households	Percent of households per strata
North West	35	32 (91%)	954	33.2
North East	35	31 (89%)	927	32.3
South Central	40	33 (83%)	991	34.5
Combined	110	96 (87%)	2872	100

Table 10 Number of subjects interviewed per target group and strata

Strata	0-5 months	6-59 months	School children	Women (15-49 years)
North West	71	959	300	856
North East	96	873	267	941
South Central	109	1124	301	1004
Combined	276	2955	868	2801

Table 11 Target sample size and actual number captured during the study

Indicator	**Target national sample size**	**Subjects measured during the study**	**% of the target**
Global Acute Malnutrition	2433	2966	121.9
Vaccination status	4662	4290	92.1
Exclusive Breastfeeding	297	276	92.9
Anaemia	1998	2198	110.0
Iron deficiency	1998	2106	105.4
Vitamin A deficiency	2169	2106	97.1
Iodine deficiency	1800	1760	97.8

Table 12 Type of Settlements per Strata

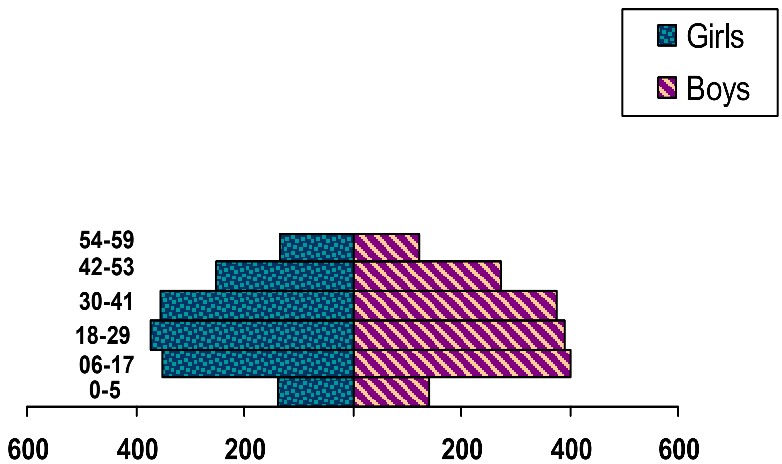
Settlement	Strata: North West Households	North East Households	South Central Households	Combined
Urban	329 (34.5%)	509 (54.1%)	60 (6.1%)	898 (31.3%)
Rural	564 (59.1%)	418 (45.1%)	811(81.8%)	1793 (62.4%)
IDP Settlements	61 (6.4%)	0 (0%)	120 (12.1%)	181(6.3%)
Combined	954 (100%)	927(100%)	991(100%)	2872 (100%)

Table 13 Household Composition by Strata[1]

Zones	People per Household					Under Five Children per Household				
	N	Mean	Min	Max	Std. Dev	N	Mean	Min	Max	Std. Dev
North West	954	5.9 (5.72-6.08)	1	15	2.8	954	1.22 (1.15-1.29)	0	5	1.09
North East	927	5.8 (5.75-5.93)	1	15	2.8	927	1.12 (1.05-1.19)	0	5	1.05
South Central	991	5.3 (5.12-5.39)	1	15	2.2	991	1.30 (1.24-1.35)	0	4	0.87
Combined	2872	5.6 (5.53-5.73)	1	15	2.6	2872	1.21 (1.18-1.25)	0	5	1.01

[1]Figures in brackets are 95% confidence intervals

Figure 1 Sex and Age Distribution of Children 0-59 months



4.1.1 Household Characteristics

As shown in the figure below the sex of the household head was predominantly male. However, there was a significantly higher proportion of female headed households in the north-east (P = 0.026) with about 43% headed by women.

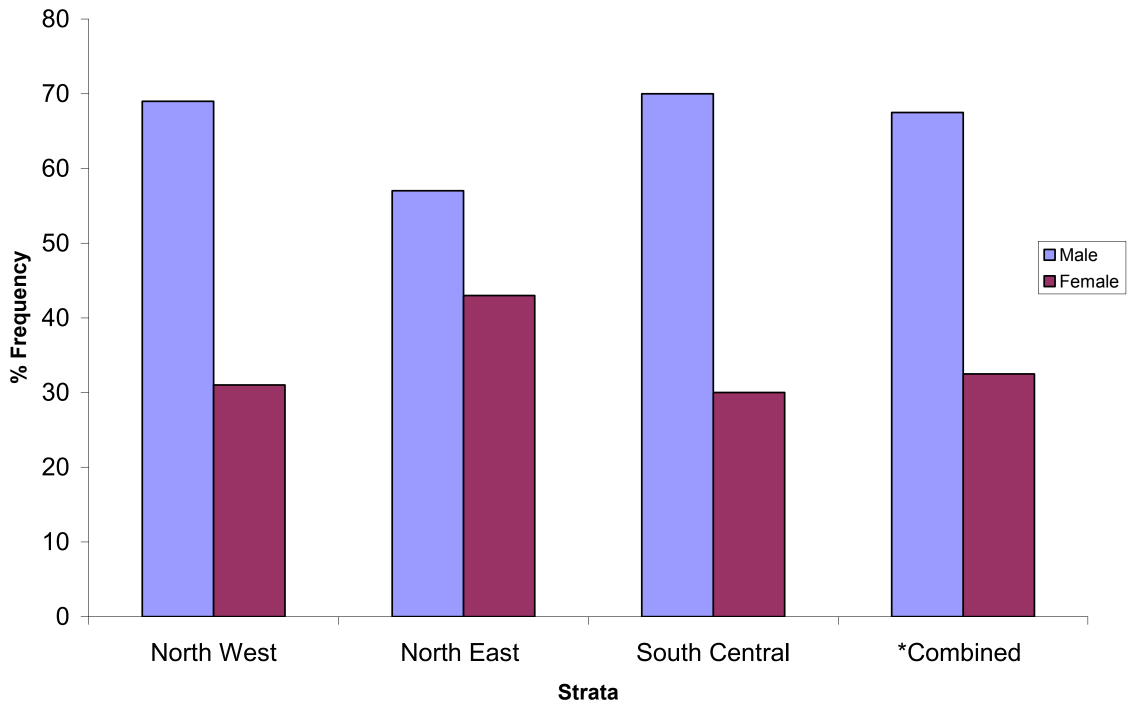
Table 14 describes the type of dwelling the household members lived in. Interestingly, the type of dwelling in the north-west and south central was similar with a high number of makeshift dwellings (38.3% and 46.2%). The number of makeshift dwellings was minimal in the north-east, representing only 8.3% of the households. Moreover, the number of permanent houses was quite high in the north-east and north-west, representing 39.5% and 25.9% of the households, respectively, but they comprised only 2% of dwellings in South Central.

As shown in Table 15, most of the household inhabitants were residents[43] in all strata. There was no significant difference in the duration of stay of the household in the area

[43] Someone who lives at a particular place for a prolonged period or who was born there.

across the strata (P = 0.660). The number of households hosting refugees six months prior to the survey was significantly different ($p < 0.001$) with the north-east and south central hosting a higher number of refugees, representing 19.0% and 15.5% of the total households, respectively. There were very low numbers of refugees hosted in the north-west with only 4% of households hosting refugees as shown in Figure 3 below.

Figure 2 Sex of Household Head



* Weighted proportion

Table 14 Type of Dwelling

	Makeshift	Temporary (mud houses or sticks)	Semi permanent (mud/stone with iron sheets)	Permanent houses	Others	Total
North West	365	200	139	247	2	953
*Row %	38.3%	21.0%	14.6%	25.9%	0.2%	100
*95% CI	28.8-48.7	15.3-28.1	10.2-20.4	17.9-36.0	0-1.5	
North East	77	83	390	366	11	927
*Row %	8.3	9.0	42.1	39.5	1.2	100
*95% CI	3.6-18.0	5.2-15.0	31.7-53.2	29.5-50.4	0.4-3.2	
South Central	457	281	229	20	2	989
*Row %	46.2	28.4	23.2	2.0	0.2	100
*95% CI	34.0-58.9	19.3-39.7	13.5-36.8	0.6-7.0	0.1-0.8	
Combined	899	564	758	633	15	2869
*Row %	37.5	23.0	24.2	14.9	0.4	100
*95% CI	30.1-45.4	17.5-29.7	17.9-31.9	11.9-18.6	0.2-0.8	

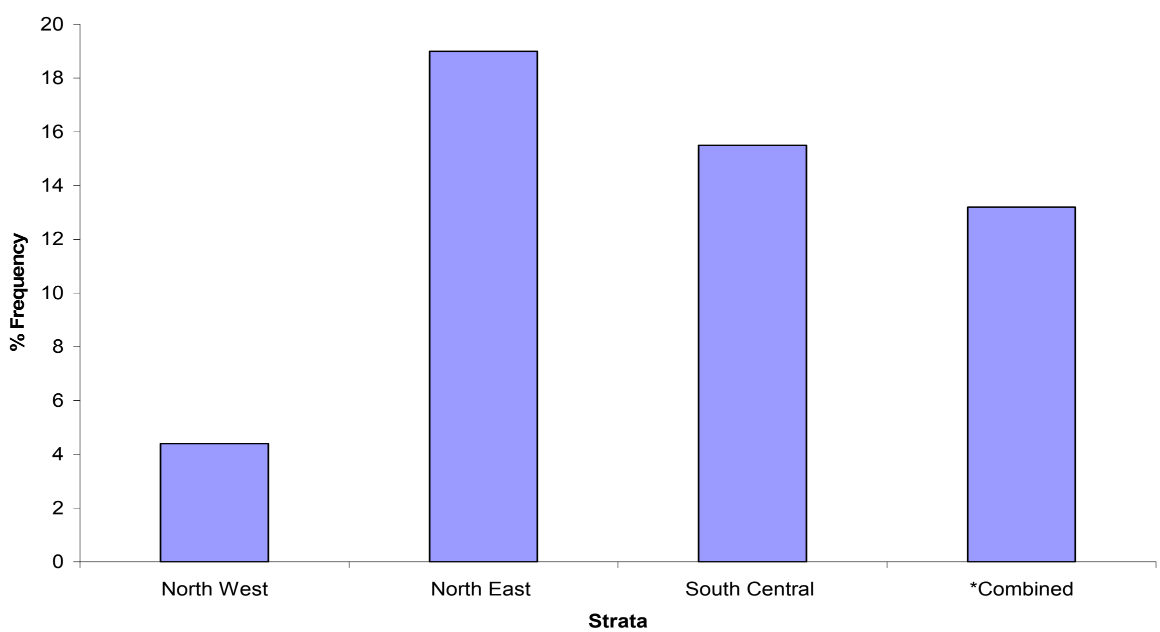
*Weighted. Pearson Chi-square: 765.063, p<0.001; Missing Values=3 (0.1%)

Table 15 Duration of Stay of the Households in the Area

Strata	Duration of stay of households in the local area				
	Resident	IDP<2yrs	IDP≥2yrs	Voluntary new arrival	Total
North West	828	39	76	11	954
*Row %	86.8	4.1	8.0	1.2	100%
*95% CI	77.6-92.6	2.5-6.6	3.6-16.8	0.6-2.2	
North East	788	56	67	16	927
*Row %	85.0	6.0	7.2	1.7	100%
*95% CI	76.0-91.0	3.8-9.4	3.8-13.5	1.0-3.0	
South Central	802	74	68	22	966
*Row %	83.0	7.7	7.0	2.3	100%
*95% CI	69.7-91.2	4.1-13.9	3.2-15.0	1.0-5.2	
Combined	2418	169	211	49	2847
*Row %	84.4	6.4	7.3	1.9	100.0%
*95% CI	76.9-89.7	4.2-9.7	4.5-11.8	1.0-3.3	

Missing Values=25 (0.9%)

Figure 3 Percentage of Households Hosting Internally Displaced Persons



*Weighted mean

Pearson Chi-square: 73.339, $p<0.001$; Missing Values=5 (0.2%)

4.1.2 Main Source of Household Income

Households were asked to list the main sources of income from the most important to the least important. However in this analysis, only the first main source of income was considered. On the combined perspective of the main source of income: animal sources, casual labour, crop sales and farming and trade are the main sources in descending order. There was a significant difference in the main sources of income between the rural and urban and rural settlements which had higher sources of income from animal and crop sale/ farming. Relief assistance as the most important source of income was significantly higher in the urban than in the rural settlements.

There were a higher number of households that had causal labour as their main source of income in the relatively peaceful strata in North West and North East with about half this number in South Central Somalia. Either crop sales and farming or animal and animal products were frequently reported as the main source in South Central Somalia, accounting for over 70% of the households while households in the North West had causal labour, animal and trade as their main sources of income. Households in North East most frequently reported causal labour as their most important income source (53%) with animal products and trade accounting for 12.2% and 13.7% of the households respectively. Interestingly, the number of households which regarded relief assistance as their main source of income was very small and decreased with improving security situation. North West had a significantly higher number of households reporting relief food as their main income source (7.5%) followed by North East (2.6%) and least was South Central (1.5%). The number of households on remittances and gifts also followed a similar trend with 3.4%, 2.9% and 1.2% of households for North West, North East and South Central respectively.

Table 16 below shows the different main sources of income per strata.

Table 16 Main Sources of Households Income by Strata

Zones	Animals and animal products	Crop sales/ farming	Trade	Casual labour	Relief assistance	Salaried/wage/ employment	Remittances/ gifts/zakat[$]	Other	Total
North West	197	34	150	399	71	60	32	9	952
*Row %	20.7	3.6	15.8	41.9	7.5	6.3	3.4	0.9	100%
*95% CI	13.1-31.1	1.6-7.8	12.3-19.9	35.1-49.0	5.1-10.8	4.5-8.7	1.9-6.0	0.3-2.8	
North East	113	26	127	490	24	71	27	47	925
*Row %	12.2	2.8	13.7	53.0	2.6	7.7	2.9	5.1	100%
*95% CI	6.6-21.5	0.6-11.5	10.8-17.4	45.7-60.2	1.6-4.3	5.3-11.0	1.9-4.4	2.1-11.7	
South Central	429	378	63	70	15	13	12	0	980
*Row %	43.8	38.6	6.4	7.1	1.5	1.3	1.2	0.0	100%
*95% CI	31.9-56.4	27.3-51.2	3.6-11.2	3.2-15.3	0.6-3.9	0.6-3.1	0.3-4.7		
Combined	739	438	340	959	110	144	71	56	2857
*Row %	32.1	23.0	10.2	24.4	3.3	3.8	2.1	1.1	100%
*95% CI	25.1-40.0	16.8-30.6	8.1-12.8	20.7-28.6	2.3-4.6	2.9-4.9	1.2-3.5	0.6-2.3	

*Weighted; [$] Islamic charitable contribution.
Pearson Chi-square: 1266.255, p<0.001; Missing Values=15 (0.5%)

4.1.3 Water

The source of drinking water was spread along all the different sources of water and varies with strata. It is however interesting to note that the North East had a significantly higher number of households with tap water piped into the dwelling than the other two strata. This may be due to the higher number of urban settlements in North East in the sample. In South Central, unprotected well and surface water accounted for the main water source in 27% and 19.4% of the households respectively. In North West unprotected well, Berkad and water tanker or truck were the main sources of water for 17.3, % 15.9% and 17.7% of the households respectively. Table 17 shows the different sources of water per strata. Overall, 32.4% of the population had access to improved water source as shown in figure 4. The improved water sources are a combination of sources regarded as safe for drinking and domestic use.

On whether households treat their water, only 4.6% of the households in North West said they treated their water as opposed to 18.9% and 12.4% in North East and South central respectively. Chlorination was said to be the method of treatment mostly used by 86.6%, 91.3%, and 97.4% of households in North West, North East and South Central respectively. No significant difference was noted in the types of water treatment used by households in different strata. However it is important to note that the chlorination mostly mentioned in this survey was mainly chlorination at the source in areas with tap water and is based on the respondent's assumption that the water is treated at source. It therefore may not necessarily capture the intended indicator of household water treatment. Anecdotally, minimal household water chlorination is done however it will be worth looking into more details in future surveys.

Figure 4 Access to improved and unimproved water source

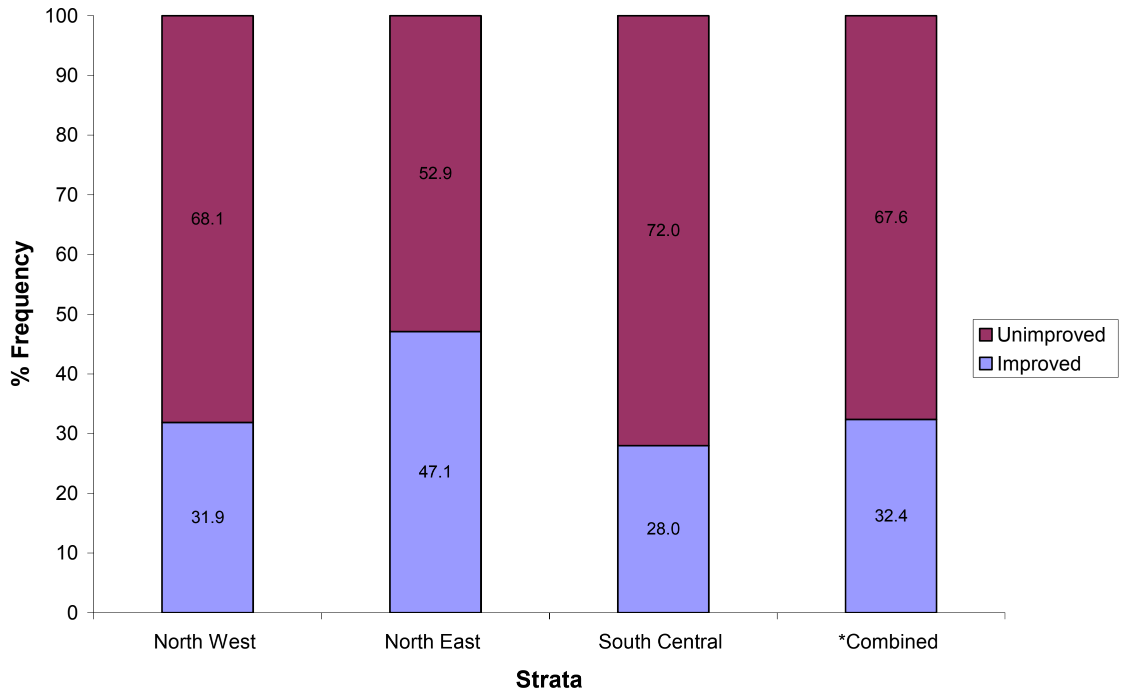


Table 17 Main Sources of Household Water

Zones	Piped Water Into Dwelling	Piped Water Into Yard Or Plot	Public Tap/Standpipe/ Kiosk	Tube Well/Borehole	Protected Well	Unprotected Well	Protected Spring	Rain Water Catchment	Roof Top	Berkad	Rain Water Catchment	Tanker Truck	Cart With Small Tank/Drum/Vendor	Surface Water	Unprotected Well	Total
North West	33	32	99	34	76	165	30	34	0	152	34	169	58	6	165	953
Row %	3.5	3.4	10.4	3.6	8.0	17.3	3.1	3.6	0	15.9	3.6	17.7	6.1	0.6	17.3	100%
95% CI	1.2-9.4	1.4-7.7	4.9-20.8	0.9-13.0	3.2-18.7	9.4-29.6	0.5-16.2	1.5-8.4		8.5-28.1	1.5-8.4	9.2-31.5	2.3-15.1	0.2-2.1	9.4-29.6	
North East	223	37	66	47	59	47	5	1	0	312	1	72	34	1	47	927
Row %	24.1	4.0	7.1	5.1	6.4	5.1	0.5	0.1	0	33.7	0.1	7.8	3.7	0.1	5.1	100%
95% CI	15.3-35.8	1.8-8.8	2.5-18.7	2.1-11.5	2.2-17.2	2.2-11.4	0.2-1.5	0.0-0.8		21.6-48.3	0.0-0.8	4.4-13.2	0.8-15.0	0.0-0.8	2.2-11.4	
South Central	85	2	1	89	98	267	1	118	1	68	118	30	34	192	267	990
Row %	8.6	0.2	0.1	9.0	9.9	27.0	0.1	11.9	0.1	6.9	11.9	3.0	3.4	19.4	27.0	100%
95% CI	2.7-24.1	0.1-0.8	0.0-0.7	3.3-22.3	3.4-25.3	15.1-43.3	0.0-0.7	4.4-28.4		1.9-21.8	4.4-28.4	0.4-19.5	0.6-16.4	9.5-35.4	15.1-43.3	
***Combined**	341	71	166	170	233	479	36	153	1	532	153	271	126	199	479	2870
Row %	10.0	1.7	4.0	6.9	8.8	20.6	1.0	7.6	0.1	14.0	7.6	7.7	4.2	11.1	20.6	100%
95% CI	5.5-17.3	1.0-3.0	2.2-7.2	3.2-14.1	4.3-17.0	13.4-30.3	0.2-4.2	3.2-17.0	0.0-0.4	9.0-21.0	3.2-17.0	4.3-13.6	1.7-9.8	5.6-20.6	13.4-30.3	

*Weighted

4.1.4 Dietary intake

The number of meals usually eaten in the household per day ranged from one meal to more than three meals. In the North West a high number of households (64.8%) had three meals a day while the number of meals eaten usually was split in between two meals and three meals in North East (45.2% and 41.4% of the households respectively). The majority (73.7%) of the South Central households consumed only two meals a day. Overall, 57.6% and 35.2% of all households consumed two and three meals respectively while only 6.8% reported consuming only one meal a day.

Regarding food variety, the majority of households in all strata reported consuming more than three food groups during the day before the survey, and this was not significantly different between strata (p=0.163). The mean number of food types consumed ranged from one to eleven food types with a mean of 5.32 (95% CI 5.21-5.43), 5.95 (95% CI 5.83-6.06) and 5.32 (95% CI 5.20-5.45) for North West, North East and South Central respectively. The combined mean number of food types eaten by households was 5.52 (95% CI 5.46-5.59). Overall, there was a higher consumption of cereals, milk and milk products, oils and sweets as compared to fresh fruits, vitamin A rich vegetables and meat products, which were poorly consumed across the strata. Locally available micronutrient rich products like fish, egg and organ meat were also poorly consumed. Figures 5 and 6 below illustrate the frequency of number of food type and food types consumed.

Figure 5 Number of Food Groups Consumed per Day

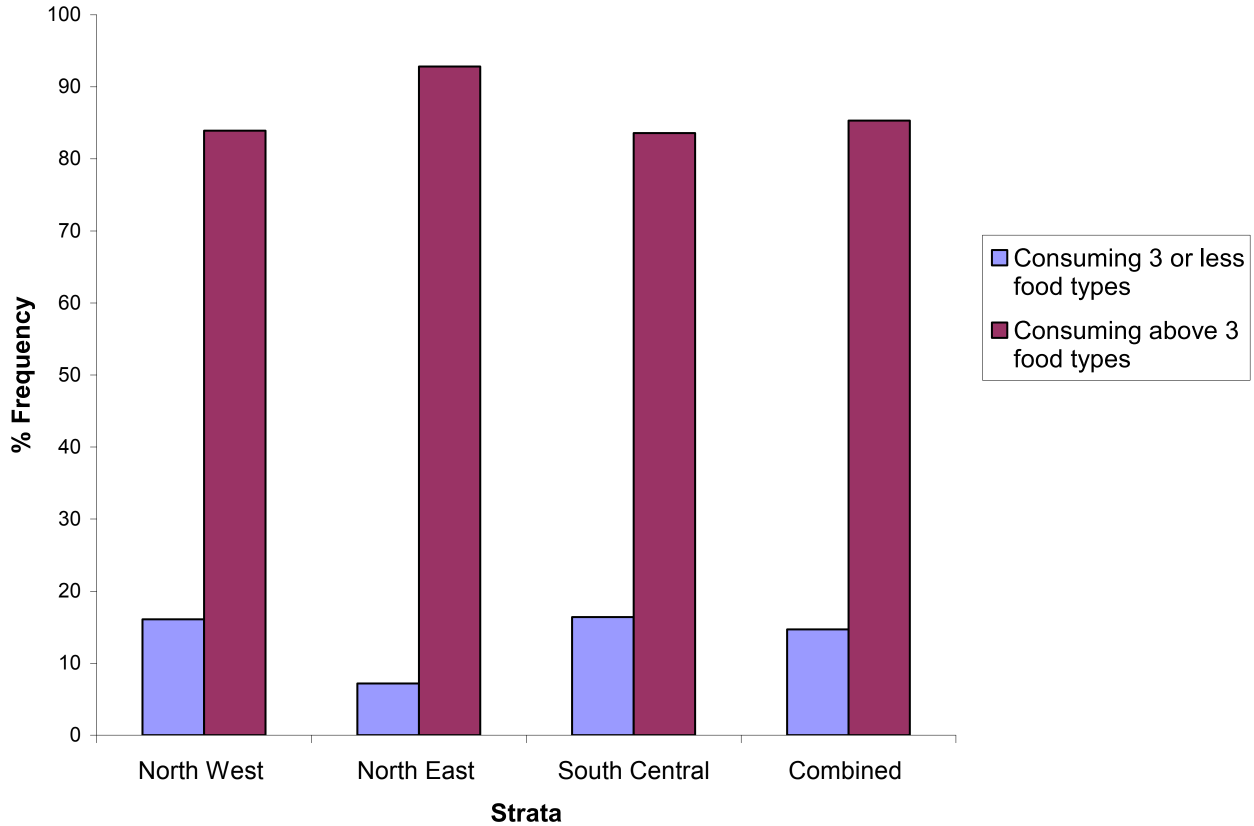
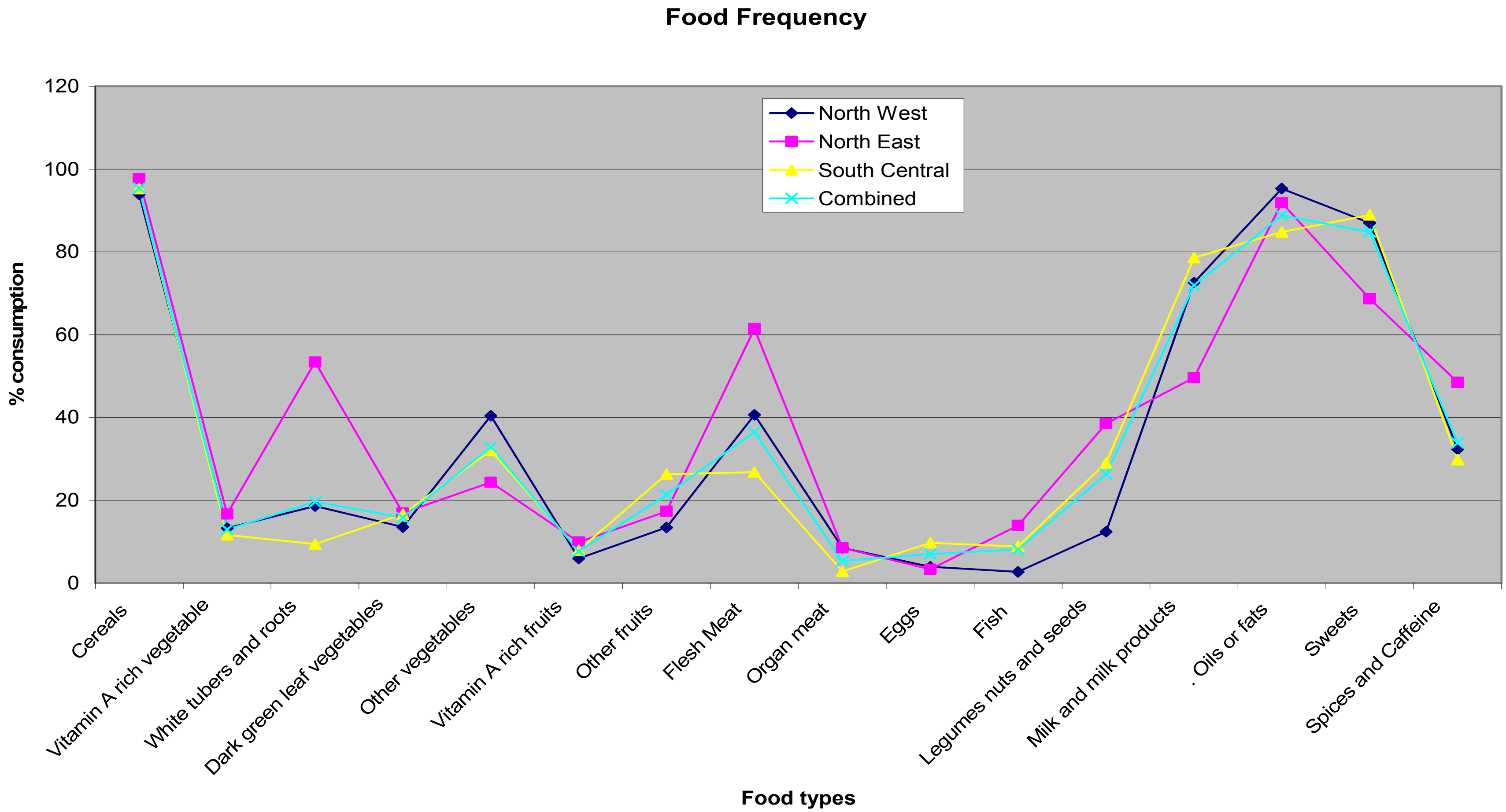


Figure 6 Frequency of Household Food Consumption



Differences in the consumption of food groups between strata were tested by Chi Squared: *Cereals P=0.269, Vitamin A rich Vegetables p=0.102, White tubers and Roots P<0.001, Dark green leafy vegetables p=0.145, other Vegetables P=0.060, Vitamin A rich fruits P=0.097 Other fruits P=0.015, Flesh meat P<0.001, Organ meat p=0.024, Eggs P=.033, Fish p=0.057, Legume and Nuts P=0.004, Milk and Milk Products p<0.001, Oils and fats P=0.093, Sweets p=0.003, Spice and Caffeine p= 0.033.*

4.1.5 Salt household iodisation

Salt samples were tested in all households using the improved iodised salt field test kits from MBI International-India. The percentage of households consuming adequately iodised salt (iodine concentration above 15ppm) was analysed from the total number of salt samples tested. There were some instances noted in some salt samples showing slight change after some time which indicated iodine less than 15ppm. About 80% of all households surveyed had their salt tested and this was similar across the strata. There were significant differences in the number of households utilising iodised salt among the strata (P<0.001). There were only three households utilising iodised salt in North West and only one household in the North East. South Central had the highest number of households (n=56) utilising iodised salt. The households in South Central utilising iodised salt were mainly from clusters that were on the boarder of Kenya and Somalia especially in clusters from Gedo region.

Household salt iodine utilisation was 3.9% for the combined strata with 0.4%, 0.1% and 6.7% in North West, North East and South Central respectively. Table 18 below shows the breakdown of the salt testing results. Additionally, only 6% (95% CI 2.5-13.5) of all households had the package for the salt available and labelled as iodised. This was significantly different (p<0.001) between strata with less than 2% in the North West and North East and 9.3% in South Central.

Table 18 Household Salt iodine test result using the rapid test

	Salt not tested or no Salt at home	No. of Salt Samples Tested	Not iodised	Less than 15 ppm	15ppm and above
North West	202	752	735	14	3
*Row % *95% CI	21.1	78.9	97.7 96.2-98.7	1.9 1.0-3.3	0.4 0.1-1.8
North East	108	819	812	6	1
*Row % *95% CI	11.7	88.3	99.1 98.1-99.6	0.7 03-1.5	0.1 0.0-0.9
South Central	128	840	739	45	56
*Row % *95% CI	13.2	86.8	88.0 71.4-95.5	5.3 1.4-18.1	6.7 2.1-19.3
Combined	438	2411	2286	65	60
*Row % *95% CI	15.4	84.6	92.5 82.8-96.9	3.6 1.2-10.4	3.9 1.3-11.3

*Weighted Pearson Chi-square: 95.470, p<0.001; Missing Values=21 (0.7%)

4.2 Children 0-59 months

4.2.1 Prevalence of acute malnutrition in 6-59 Months

The ratio of boys to girls in each strata is within expected levels of 1.0 to 1.1. Anthropometric measurements were done for all children aged 0-59 months, but the prevalence of acute malnutrition was calculated using only the measurements of children aged 6-59 months. The overall total prevalence of acute malnutrition is shown in Table 19. Tables 20 and 21 also show the prevalence of stunting and underweight, respectively. The distribution of weight-for-height Z-scores is shown in figure 7. The analysis was done on 2,955 children aged 6-59 months and data from children with a weight-for-height Z-score within +4 and -4 on the sample mean was used to calculate the prevalence of malnutrition. The weight-for-height Z-scores from the WHO 2006 Standards were used. However, the results using the NCHS Reference 1978 are shown in Annex 1-3 for comparison. Table 19 shows that the overall total acute malnutrition rate was 13.9% (95% CI: 11.9-16.0), but there was a significantly higher prevalence of acute malnutrition in south central as compared to the north-east and north-west. In addition, the prevalence of severe acute malnutrition (SAM) was higher in the north-west and south central as opposed to the north-east.

Table 19 Prevalence of Acute Malnutrition in children aged 6-59 Months based on WHO 2006 Growth Standards

Zones	N	Global acute malnutrition (<-2 z-score) and/or Oedema	Moderate acute malnutrition (<-2 z-score and >=-3 z-score, no oedema)	Severe acute malnutrition (<-3 z-score and/or oedema)
North West	959	13.9% (11.6-16.5 C.I.)	9.8% (8.0-11.7 C.I.)	4.1% (3.0-5.6 C.I.)
North East	873	10.7% (8.6-12.7 C.I.)	9.4% (7.7-11.1 C.I.)	1.3% (0.5- 2.0 C.I.)
South Central	1124	16.5% (13.0-20.6 C.I.)	10.6% (8.2-13.6)	5.9% (3.9- 8.7)
Combined	2955	13.9% (11.9-16.0 C.I.)	10.0% (8.3-11.6 C.I.)	4.0% (3.1- 4.9 C.I.)

Values in brackets are the 95% confidence interval.
*Prevalence of oedema: 0.6% (n=17)

Figure 7 Distribution of Weight for Height Z-Scores

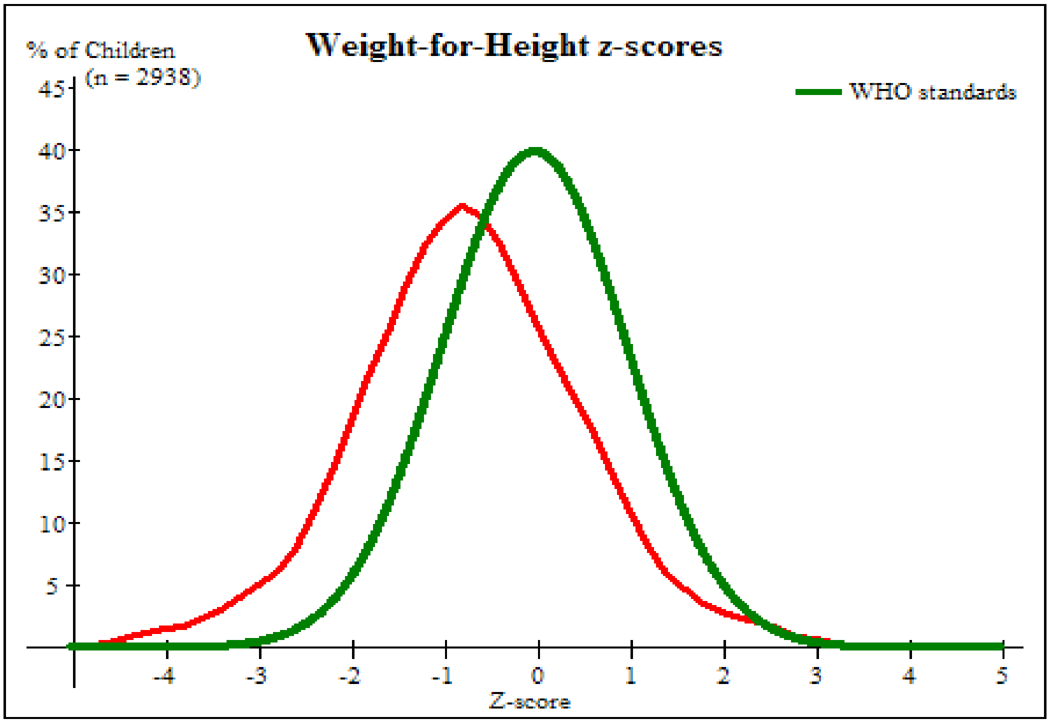


Table 20 Prevalence of Stunting in children 6-59 months based on WHO 2006 Growth Standards

Zones	N	Prevalence of Stunting (<-2 z-score)	Moderate Stunting (<-2 z-score and >=-3 z-score)	Severe Stunting (<-3 z-score)
North West	937	19.5% (16.3-23.2)	13.6% (11.4-16.1)	6.0% (4.2- 8.4)
North East	860	16.5% (12.6-21.3)	11.6% (8.8-15.2)	4.9% (3.5- 6.8)
South Central	1103	31.6% (27.2-36.2)	18.9% (16.3-21.7)	12.7% (9.8-16.4)
Combined	2890	23.2% (21.0-25.4)	15.1% (13.5-16.7)	8.1% (6.8- 9.5)

Values in brackets are 95% confidence interval

Table 21 Prevalence of Under Weight in Children 6-59 Months Based on WHO 2006 Growth Standards

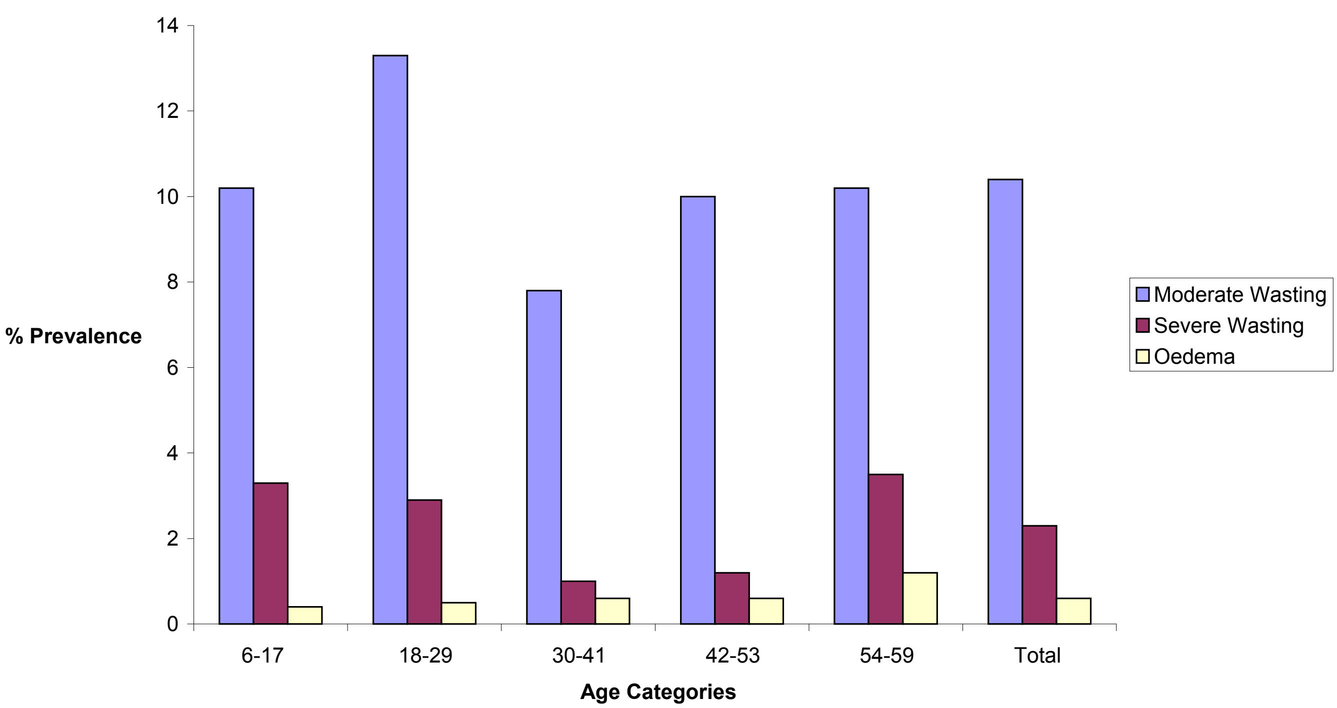
Zones	N	Prevalence of under Weight (<-2 z-scores)	Moderate under weight (<-2 z-score and >=-3 z-score)	Severe under weight (<-3 z-score)
North West	965	18.5% (15.4-22.1)	14.4% (11.8-17.5)	4.1% (3.1- 5.5)
North East	877	12.8% (9.8-16.5)	10.1% (7.9-13.0)	2.6% (1.6- 4.2)
South Central	1121	25.4% (19.9-31.8)	17.5% (13.8-21.9)	7.9% (5.6-11.1)
Combined	2965	19.5% (17.1-22.0)	14.3% (12.7-16.0)	5.2% (4.1- 6.5)

Values in brackets are 95% confidence intervals

4.2.2 Prevalence of acute malnutrition by age group

The figure below shows prevalence of acute malnutrition by age group. A high prevalences of severe acute malnutrition were observed in children below 29 months of age as well as children above 54 months. This was however not statistically tested.

Figure 8 Prevalence of Acute Malnutrition by Age (Weight-For-Height Z-Scores and/or Oedema)



4.2.3 Prevalence of Acute Malnutrition based on MUAC

The prevalence of total acute malnutrition based on MUAC was low and differed significantly between strata (Chi squared test, P<0.001). The MUAC reading was taken from children aged 6-59 months only. The prevalence of total malnutrition (<12.5cm) was low in the North East (4.8%) compared to the North West and South Central (7.3% and 9.8% respectively).

Table 22 Prevalence of Acute Malnutrition in Children 6-59 Months Based on MUAC

Strata	N	Severe (<11.5 cm)	Moderate (11.5 – <12.5 cm)	Total Malnourished (<12.5cm)	At Risk (12.5-13.5 cm)	Normal (>13.5)
North West	964	17	53	70	112	780
Row % 95% CI		1.8 (1.1-2.8)	5.5 (3.7-8.2)	7.3 (5.2-10.1)	11.6 (8.6-15.5)	81.1 (76.2-85.2)
North East	879	10	32	42	108	729
Row % 95% CI		1.1 (0.5-2.4)	3.6 (2.1-6.1)	4.8 (3.0-7.5)	12.3 (9.6-15.6)	82.9 (78.7-86.5)
South Central	1148	21	91	112	265	771
Row % 95% CI		1.8 (1.1-3.1)	7.9 (5.7-10.9)	9.8 (7.0-13.5)	23.1 (19.2-27.5)	67.2 (60.8-73.0)
Combined	2989	48	176	224	485	2280
Row % 95% CI		1.7 (1.2-2.5)	6.7 (5.2-8.5)	8.4 (6.6-10.7)	18.6 (16.1-21.5)	73.0 (68.9-76.7)

4.2.4 Infant Anthropometry 0-5 months

4.2.4.1 Prevalence of acute malnutrition in Infants

The overall ratio of boys to girls in infants 0-5 months was 1.1 which was within the expected range. Infant anthropometry was not disaggregated by zone due to the small sample size.

The analysis of infant anthropometry was done on 222 infants who had a weight-for-height Z-score within +4 and -4 of the sample mean was. The weight-for-height Z-scores from the WHO 2006 Standards were used. However, the results using the NCHS Reference 1978 are shown in the Annex for comparison. As shown in table 23 the overall total acute malnutrition rate was 17.1 % (12.6 - 22.9), with a similar prevalence between boys and girls. This was above the WHO threshold of 15% GAM. The severe acute malnutrition was high in this age group compared to children aged 6-59 months.

Similarly, table 24 and 25 show the prevalence of stunting and underweight while figure 9 and 10 show the distribution of the height-for-age and weight-for-age respectively. The prevalence of stunting was 15.2 % (10.6 - 21.2) while the prevalence of under weight was 27.1 % (21.7 - 33.3)

Table 23 Prevalence of Acute Malnutrition in infant aged 0-5 Months based on WHO 2006 Growth Standards[44]

Gender	N	Global acute malnutrition (<-2 z-score) and/or Oedema	Moderate acute malnutrition (<-2 z-score and >=-3 z-score, no oedema)	Severe acute malnutrition (<-3 z-score and/or oedema)
Boys	116	16.4 % (10.4 - 24.8)	10.3 % (6.0 - 17.3 95% C.I.)	6.0 % (3.0 - 11.9.)
Girls	106	17.9 % (11.3 - 27.2)	7.5 % (3.6 - 15.1 95% C.I.)	10.4 % (5.7 - 18.1)
Combined	222	17.1 % (12.6 - 22.9)	9.0 % (6.2 - 12.8 95% C.I.)	8.1 % (5.2 - 12.5)

Values in brackets are the 95% confidence interval.

[44] Oedema was not tested for this age group

Figure 9 Distribution of Weight for Height Z-Scores in Infants 0-5 Months

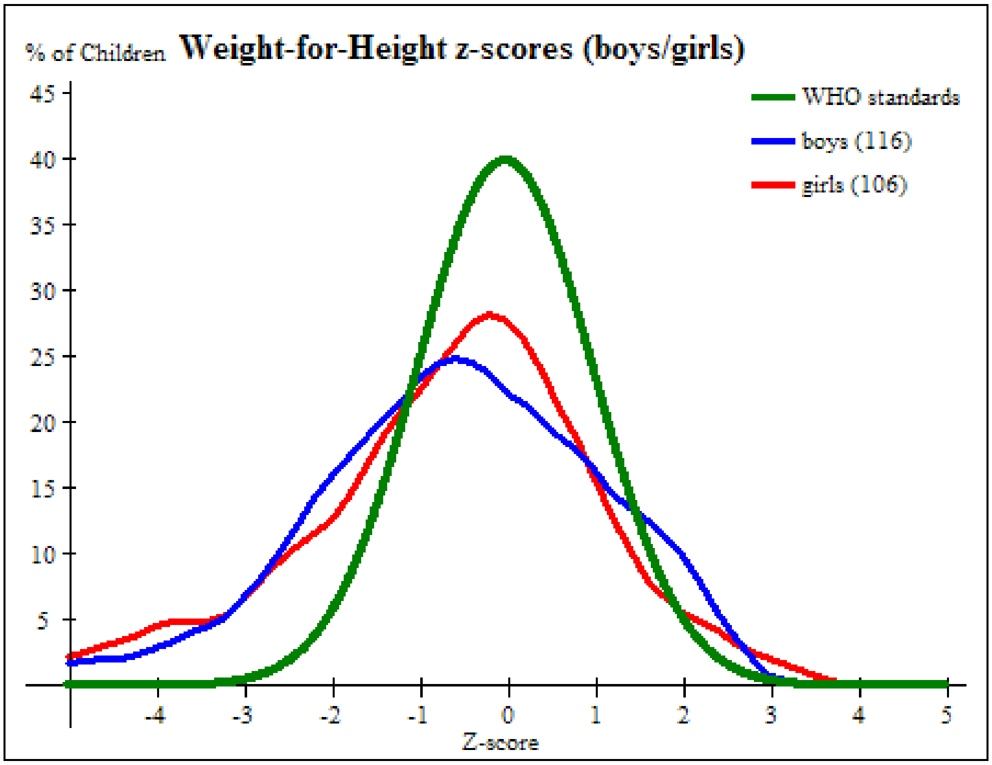


Table 24 Prevalence of Stunting in infants based on WHO 2006 Growth Standards

Zones	N	Prevalence of Stunting (<-2 z-score)	Moderate Stunting (<-2 z-score and >=-3 z-score)	Severe Stunting (<-3 z-score)
Boys	122	13.1 % (8.5 - 19.7)	12.3 % (7.7 - 19.0)	0.8 % (0.1 - 6.1)
Girls	109	17.4 % (10.8 - 27.0)	11.9 % (6.2 - 21.6)	5.5 % (2.8 - 10.7)
All	231	15.2 % (10.6 - 21.2)	12.1 % (8.0 - 18.0)	3.0 % (1.6 - 5.8)

Values in brackets are 95% confidence interval

Figure 10 Distribution of Height for Age Z-Scores in Infants 0-5 Months

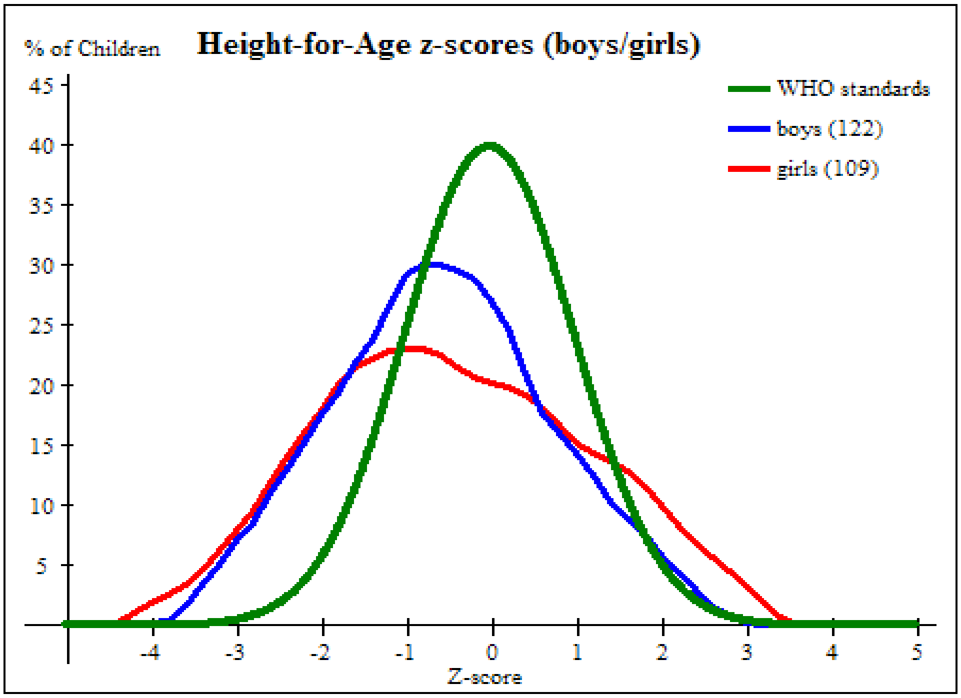


Table 25 Prevalence of Under Weight in Infant 0-5 Months Based on WHO 2006 Growth Standards

Zones	N	Prevalence of under Weight (<-2 z-scores)	Moderate under weight (<-2 z-score and >=-3 z-score)	Severe under weight (<-3 z-score)
Boys	120	25.0 % (17.4 - 34.5)	18.3 % (10.6 - 29.8)	6.7 % (3.6 - 11.9)
Girls	116	29.3 % (22.5 - 37.3)	24.1 % (17.4 - 32.4)	5.2 % (2.5 - 10.2)
All	236	27.1 % (21.7 - 33.3)	21.2 % (15.4 - 28.4)	5.9 % (3.4 - 10.2)

Values in brackets are 95% confidence intervals

4.2.4 Anaemia in Children 6-59 months

The tables and figure below show the prevalence of anaemia and distribution of haemoglobin concentrations in children 6-59 months. The prevalence of anaemia was generally high across strata and of serious public health concern, with an overall prevalence of 59.3% (54.8-63.6). Although the prevalence of anaemia in the North West was relatively low as compared to the other two strata, there was no significant difference between the North West and North East in the proportion of anaemia (RR =1.249; 95% CI 0.989-1.577).

On the other hand, there was a significant difference between Urban and Rural settlements with children in Rural settlements having risk of developing anaemia 50% more than their counterparts in the Urban settlements (RR=1.54, 95% CI 1.266-1.864). 63.6% of rural children were anaemic while 44.0% of children in the Urban were anaemic. The prevalences of severe and moderate anaemia were almost twice as high in the rural settlements as compared to the urban settlements. The IDP sample size was considered insufficient to be able to provide a valid comparison with the other groups. The prevalences of anaemia by sex were also not significantly different despite the girls having lower prevalence than boys with 56.0% and 62.4 % respectively. RR=1.169 (0.994-1.376), P=0.059

Similarly there was no significant difference in the prevalences of anaemia between the acutely malnourished and well nourished groups with 61.6% and 58.7% respectively (RR=1.049, 95% CI 0.903-1.219). There was however a significantly higher prevalence of anaemia in children below 2 years as opposed to those above 2 years (Chi squared test, p<0.001). The prevalence of anaemia was 73.7% (95% CI 67.7-78.9) and 51.9% (95% CI 46.2-57.5) for those below and above 2 years respectively.

Table 26 Prevalence of Anaemia in Children 6-59 Months by Strata

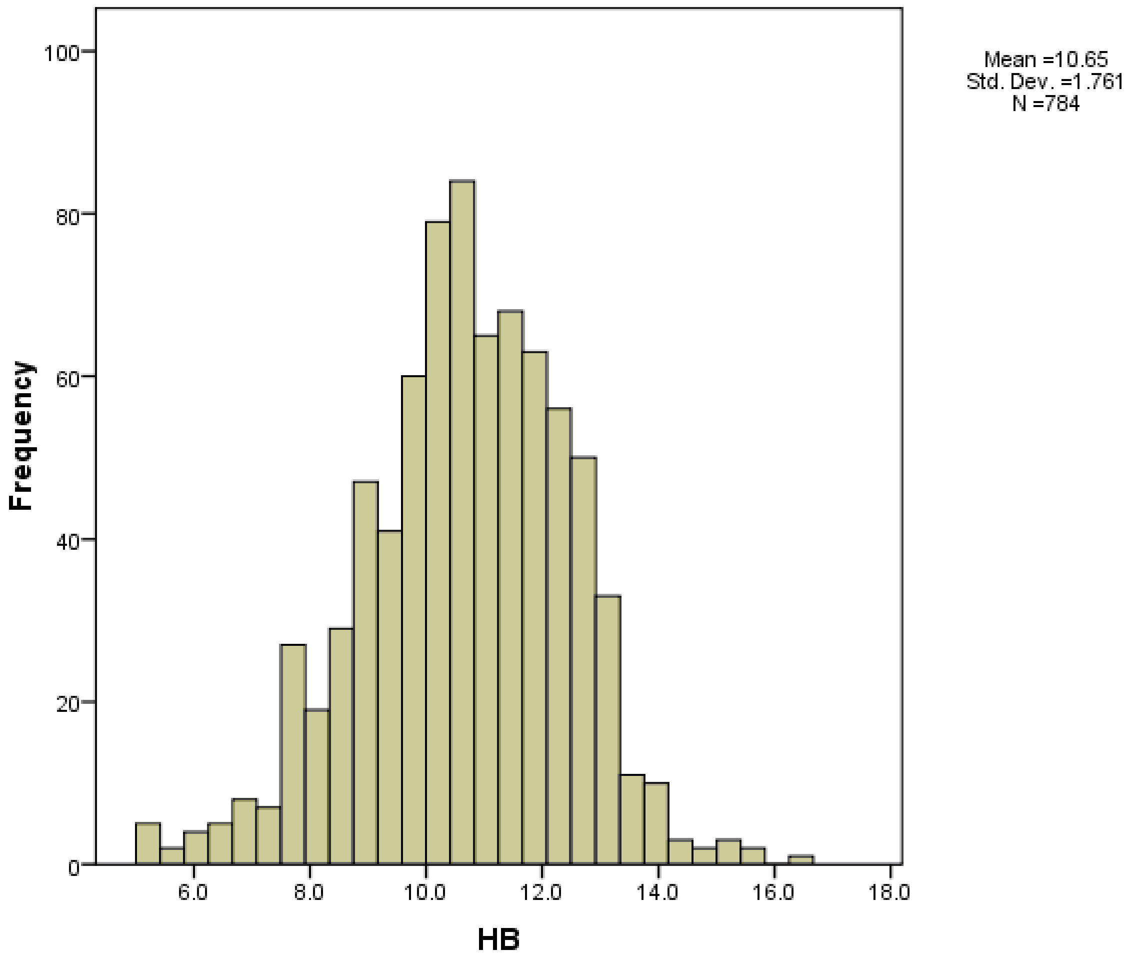
Zones	N	Mean Hb (g/dl)	Min	Max	Total Anaemia (%) <11g/dl	Mild Anaemia (%) 10.9-10.0g/dl	Moderate Anaemia (%) 9.9-7.0g/dl	Severe Anaemia (%) <7.0
North West	301	11.2±1.8	5.1	16.4	45.2 (38.0-52.6)	20.9 (16.1-26.7)	22.6 (16.2-30.2)	1.7 (0.7-3.8)
North East	237	10.6±1.6	5.8	15.4	56.4 (47.7-64.2)	27.2 (21.2-34.8)	26.6 (20.0-34.4)	2.1 (0.9-4.8)
South Central	246	10.1±1.8	5.1	15.1	68.7 (61.6-75.0)	22.8 (17.6-28.9)	40.7 (33.8-47.8)	5.3 (2.9-9.4)
*Combined	784	10.5±1.8	5.1	16.4	59.3 (54.8-63.6)	23.0 (19.6-26.7)	32.7 (28.4-37.2)	3.6 (2.3-5.8)

Table 27 Prevalence of Anaemia in Children 6-59 Months by Type of Settlement

Population Group	N	Mean Hb (g/dl)	Total Anaemia (%)	Mild Anaemia (%)	Moderate Anaemia (%)	Severe Anaemia (%)
Urban	216	11.1 (10.8-11.4)	44.0 (38.5-49.7)	22.1 (16.7-28.6)	19.2 (15.4-23.7)	2.8 (1.3-5.7)
Rural	517	10.3 (10.1-10.6)	63.6 (57.5-69.2)	22.8 (18.6-27.7)	36.6 (31.0-42.5)	4.2 (2.4-7.1)

Chi-Square=18.744, P<0.001

Figure 11 Distribution of Haemoglobin Concentration in Children 6-59 Months (g/dl)



4.2.5 Serum Transferrin Receptor (sTfR)

The tables below show the distribution and prevalence of iron deficiency among children aged 6-59 months. There was no significant difference in median sTfR (Non-Parametric Median test; p=0.745) as well as the prevalence of iron deficiency (Chi squared, P=0.957) between strata. The prevalence of iron deficiency was similar across the strata and over 60% in all three. Overall, iron deficiency was 58.9% (53.5-64.1). Table 29 shows the proportion of children who were anaemic and had iron deficiency as well which is the characteristic of iron deficiency anaemia. As shown in the table a higher number of children who were anaemic were also iron deficient with an overall prevalence of 73.9% (67.3-79.5)

Table 28 Mean, Median and IQR of sTfR in Children aged 6-59 Months

Strata	Mean	Median	Inter Quartile Range	Min	Max
North West	13.1 ± 10.8	9.2	5.9	4.8	73.0
North East	12.1 ± 8.0	9.0	6.1	4.8	49.1
South Central	12.0 ± 9.2	9.5	5.5	3.5	80.4
Combined	12.4 ± 9.5	9.3	5.7	3.5	80.4

Table 29 Prevalence of Normal and High Transferrin Receptors in Children aged 6-59 months

	Normal (≤8.3 mg/L)	High TFR (>8.3 mg/L)	Total
North West	103	152	255
Row%	40.4%	59.6%	100.0%
95%CI	(32.8-48.5)	(51.5-67.2)	
North East	88	130	218
Row%	40.4%	59.6%	100.0%
95%CI	(30.8-50.7)	(49.3-69.2)	
South Central	91	127	218
Row%	41.7%	58.3%	100.0%
95%CI	(33.7-50.2)	(49.8-66.3)	
*Combined	282	409	691
Row%	41.1%	58.9%	100.0%
95%CI	(35.9-46.5)	(53.5-64.1)	
Urban	89	98	187
Row%	47.0%	53.0%	100.0%
95%CI	(39.5-54.7)	(45.3-60.5)	
Rural	173	293	466
Row%	38.0%	62.0%	100.0%
95%CI	(32.0-44.3)	(55.7-68.0)	

* Weighted. There was no significant difference between strata in TFR levels Chi –Square =0.132, P=0.957 There was no significant difference between Urban and Rural settlements. Chi-Square=3.540, P=0.071

Table 30 Iron Deficiency Anaemia in Children Aged 6-59 months

Strata	N		Iron sufficient	Iron deficient	Iron deficiency anaemia
North West	248	Anaemic	21	92	
			18.6%	81.4%	37.1%
			(10.5-30.7)	(69.3-89.5)	
North East	202	Anaemic	27	90	
			23.1%	76.9%	44.6%
			(15.1-33.7)	(66.3-84.9)	
South Central	214	Anaemic	43	101	
			29.9%	70.1%	47.2%
			(21.7-39.5)	(60.5-78.3)	
Combined	664	Anaemic	91	283	
			26.1%	73.9%	42.6%
			(20.5-32.7)	(67.3-79.5)	
Urban	179	Anaemic	17	65	
			20.2%	79.8%	36.3%
			(12.2-31.5)	(68.5-87.8)	
Rural	447	Anaemic	67	206	
			25.7%	74.3%	46.1%
			(19.4-33.3)	(66.7-80.6)	

4.2.6 Prevalence of Vitamin A deficiency

The prevalence of Vitamin A deficiency in children 6-59 months was high when assessed using the RBP cut offs of 0.825 µmol/L with a significant difference between strata (P=0.015). Vitamin A deficiency was highest in South Central. Overall, Vitamin A deficiency was 33.3%, with all strata showing values exceeding the WHO threshold of above 20% which classifies the prevalence of Vitamin A as severe. Interestingly, there was not a significant difference between rural and urban settlements. There was a significant difference in Vitamin A deficiency between those with high CRP (>5mg/l) and those with normal CRP (<5mg/l) (RR 1.46 95% CI 1.1-2.0)

Table 31 Vitamin A Deficiency in Children Aged 6-59 Months

	ALL CASES INCLUDED					HIGH CRP CASES (> 5.0mg/L) EXCLUDED				
	N	Mean RBP	<0.825µmol/L	>0.825 µmol/L	Public health	N	Mean RBP	<0.825µmol/L	>0.825 µmol/L	Public health
North West	255	0.96±0.24	74	181	Severe	223	0.98±0.24	57	166	Severe
Row%			29.0%	71.0%				25.6%	74.4%	
95% CI			(21.7-37.6)	(62.4-78.3)				(18.3-34.5)	(65.5-81.7)	
North East	218	0.97±0.23	60	158	Severe	187	0.99±0.23	45	142	Severe
Row%			27.5%	72.5%				24.1%	75.9%	
95% CI			(20.0-36.6)	(63.4-80.0)				(16.4-33.8)	(66.2-83.6)	
South Central	218	0.89±0.28	94	124	Severe	189	0.91±0.27	77	112	Severe
Row%			43.1%	56.9%				40.7%	59.3%	
95% CI			(33.3-52.8)	(47.2-66.1)				(31.2-51.1)	(48.9-68.8)	
Combined	691	0.94±0.25	228	463	Severe	599	0.96±0.25	179	420	Severe
Row%			36.2%	63.8%				33.3%	66.7%	
95% CI			(30.6-42.1)	(57.9-69.4)				(27.5-39.6)	(60.4-72.5)	
Urban	187	0.94±0.22	61	126	Severe	161	0.96±0.22	46	115	Severe
Row%			32.5%	67.5%				28.7%	71.3%	
95% CI			(24.9-41.0)	(59.0-75.1)				(20.6-38.3)	(61.7-79.4)	
Rural	466	0.95±0.26	146	320	Severe	407	0.97±0.26	115	292	Severe
Row%			35.6%	64.4%				32.3%	67.7%	
95% CI			(28.9-42.8)	(57.2-71.1)				(25.5-39.9)	(60.1-74.5)	

Chi-Square=16.104, P=0.015. No significant difference between Urban and Rural

4.2.7 CRP Distribution

The cut off of > 5 mg/L[45] was used to categorise participants as suffering from inflammation. Since RBP is an acute phase protein and will be decreased during inflammation, subjects with a CRP concentration above 5 mg/L were excluded from the analysis of vitamin A deficiency. The table below shows the frequency of the CRP levels. There was no significant difference between strata (P=0.912) and the overall prevalence of high CRP was 13.2% (10.4-16.7).

Table 32 Distribution of CRP in Children 6-59 months

	≤ 5.0 mg/L	>5.0 mg/L	Total
North West	223	32	255
	87.5% (83.3-90.7)	12.5% (9.3-16.7)	100.0%
North East	187	31	218
	85.8% (81.3-89.3)	14.2% (10.7-18.7)	100.0%
South Central	189	29	218
	86.7% (80.2-91.3)	13.3% (8.7-19.8)	100.0%
Combined	599	92	691
	86.8% (83.3-89.6)	13.2% (10.4-16.7)	100.0%

4.2.8 Indicators of Morbidity and Infant and Young Child Feeding Practices

Table 33 below shows the indicators of infant morbidity and infant and young child feeding practices. Most indicators of infant feeding were poor. Exclusive breastfeeding and early initiation of breast feeding among others were poor across all the strata. The proportion of children ever breastfed at a certain point in their lives was high and was a significantly higher in South Central. Early initiation of breast feeding was however low with again significant differences across the strata. This indicator defines the number of infant or children who were put to the breast within 1 hour of birth.

45 D I Thurnham, G P McCabe, C A Northrop-Clewes, P Nestel (2003) Effects of subclinical infection on plasma retinol concentrations and assessment of prevalence of vitamin A deficiency: meta-analysis. Lancet

Table 33 Indicators of Morbidity and Infant and Young Child Feeding Practices

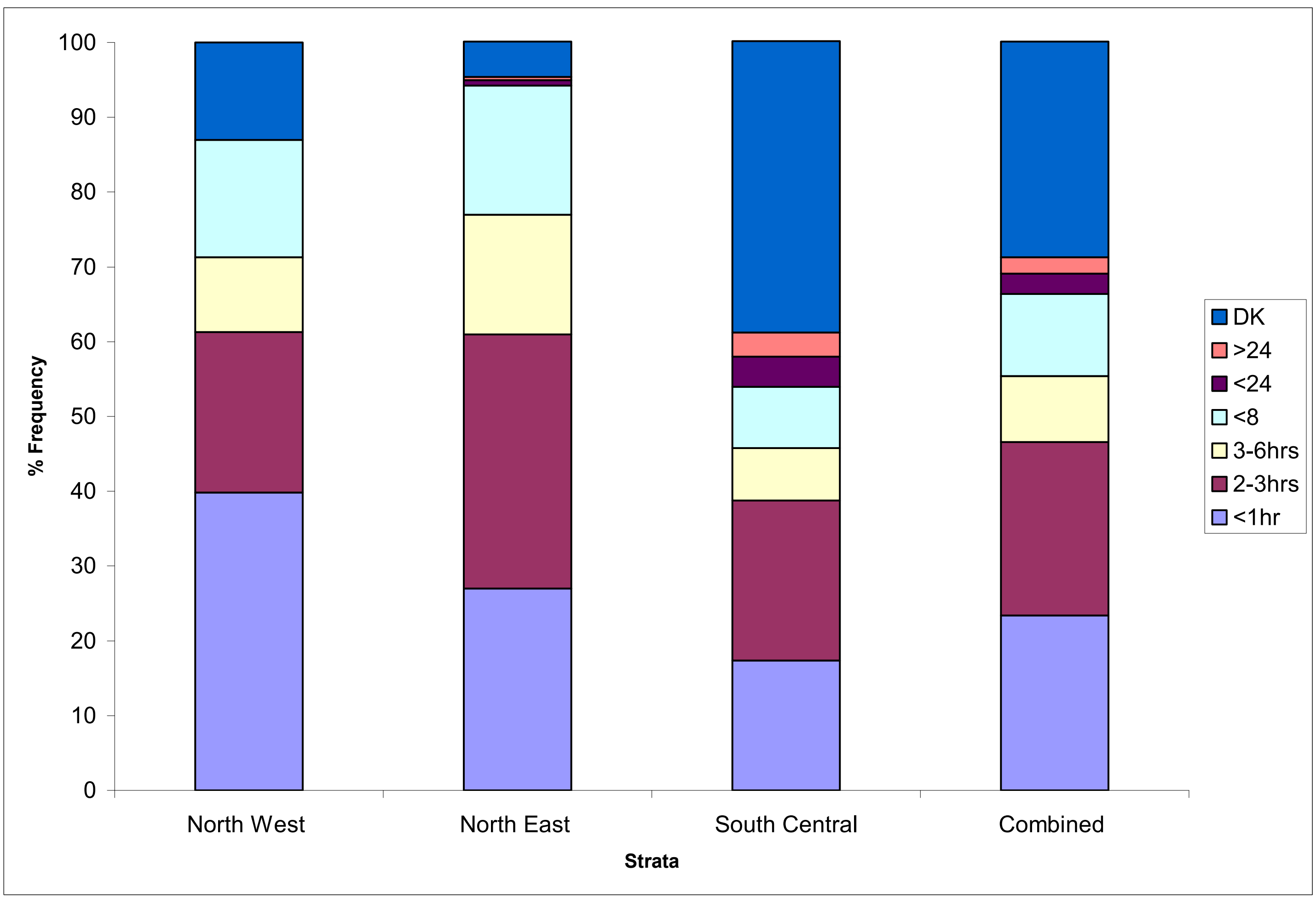
Indicator	Sampled age range	North West		North East		South Central		Combined	
		N	Prevalence (%)	N	Prevalence (%)	N	Prevalence (%)	N	Prevalence (%)
Ever Breastfed*	0-23	338	77.2% (68.7-83.9)	293	87.4% (81.2-91.7)	431	91.4% (86.3-94.8)	1062	87.5% (83.7-90.5)
Early Initiation of Breastfeeding#	0-23	261	39.8% (30.6-49.9)	256	27.0% (17.2-39.7)	402	17.4% (11.7-25.1)	919	23.4% (18.5-29.1)
Exclusively Breastfed(<6 months)	0-6	71	12.7% (6.7-22.7)	96	6.3% (1.6-21.6)	109	2.8% (0.9-8.2)	276	5.3% (3.1-9.2)
Continued Breastfeeding at 12 months	12-15	58	60.3% (45.7-73.3)	60	45.0% (32.9-57.8)	90	64.4% (49.4-77.1)	208	60.8% (50.6-70.1)
Continued Breastfeeding at 24 months	20-23	47	6.4% (1.6-21.8)	36	8.3% (2.5-24.4)	86	34.9% (24.0-47.7)	169	26.8% (17.1-34.6)
Introduction of solids, semi solids or soft food	6-8	47	38.3% (28.5-49.2)	86	11.6% (4.8-25.6)	72	12.5% (5.6-25.8)	205	17.1% (11.5-24.5)
Reported Prevalence of Diarrhoea	0-23	347	21.6% (17.1-27.0)	329	20.4% (13.9-28.8)	453	18.8% (13.6-25.3)	1129	19.7% (16.0-23.9)
Continued Feeding During Diarrhoea	0-23	75	48% (36.5-59.7)	69	21.7% (10.8-38.9)	89	60.7% (48.7-71.5)	233	51.5% (43.2-59.7)
Increased Feeding During Diarrhoea&	0-23	75	25.3% (16.8-36.3)	69	0%	89	5.6% (2.4-12.6)	233	9.6% (6.2-14.5)
Use of ORS during Diarrhoea$	0-23	75	73.3% (61.8-82.4)	67	52.2% (40.9-63.4)	95	31.6% (21.1-44.4)	237	44.5% (35.9-53.4)
Reported Prevalence of ARI***	6-23	347	25.4% (19.7-32.0)	329	31.6% (24.4-39.8)	453	16.3% (11.1-23.4)	1129	20.7% (16.8-25.3)
Reported Prevalence of Suspected fever**	6-23	347	13.0% (8.9-18.6)	328	24.0% (19.0-29.9)	450	26.2% (20.8-32.4)	1126	22.8% (19.2-26.9)

*Chi-Square=35.911, P=.001
** Chi-Square=33.730, P<0.001
*** Chi-Square=23.870, P=0.006
# Chi-square =145.008, P<0.001
$ Chi-Square 29.632, P<0.001
& Chi-Square 49.371, P<0.001

4.2.9 Breast feeding practice

The Exclusive Breastfeeding indicator shows the percentage of infants 0 - <6 months who are currently being exclusively breastfed, i.e., who are receiving only breast milk and no water, other liquids or solids. Drops or syrups of vitamins, mineral supplements, or medicines are allowed. This indicator provides a measure of the degree to which women have adopted behaviours consistent with the WHO recommendation that infants should be fed exclusively on breast milk from birth to about six months. As seen in table 33 above, the prevalence of exclusive breastfeeding is 5.3% for the combined strata. This indicator is very low and it is evident from the data that most women gave water to their children. This however is contrary to the WHO definition of exclusive breastfeeding. The prevalence of continued breastfeeding at 12 months and at 24 months measures the percentage of children 12-16 and 20-23 months who are breastfed. This therefore is a measure of the breastfeeding duration. The prevalence of continued breastfeeding was 60.8% and 26.8% for children 12-16 months and 20-23 months respectively. This implies that some women stop breastfeeding earlier than two years.

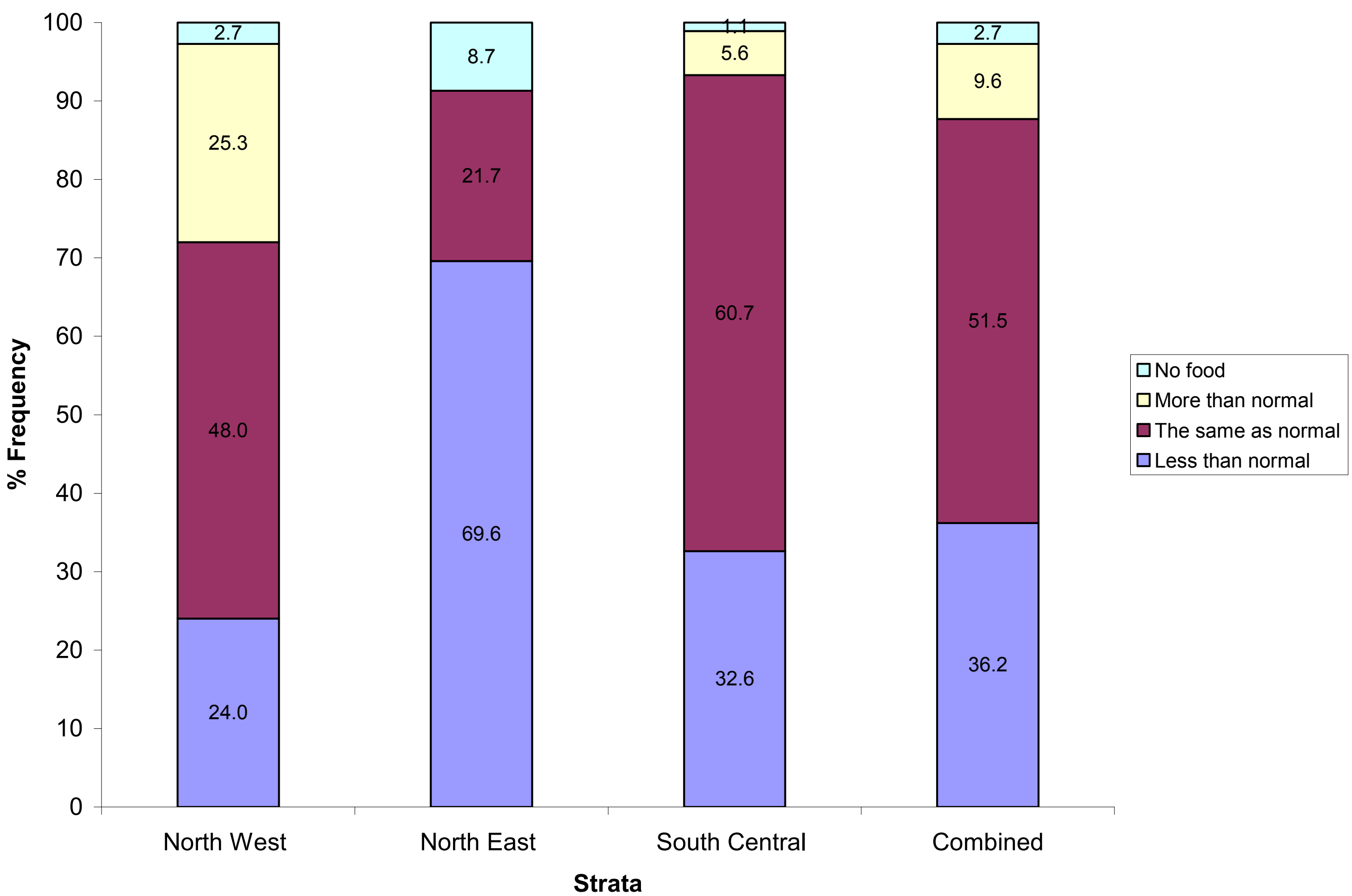
Figure 12 Breast Feeding Initiation



4.2.10 Feeding during Diarrhoea

The purpose of the questions on diarrhoea was to assess the mother's response if she thought her baby had diarrhoea. We did not evaluate heath seeking behaviour but rather assessed the quality of home based management of diarrhoea. The percentage of children offered continued feeding during diarrhoeal episodes was assessed in children and infant less than 24 hours. This indicator measures the change in frequency with which foods (breastfeeding and/or other foods) are offered during diarrhoea compared to when the child is healthy. As shown in the figure below, about 36.2%, 51.5% and 9.6% were offered feeding less than normal, same as normal and more than normal respectively during episodes of diarrhoea. It is however sad to find that 9.6% and 2.7% of the combined strata would give reduced or no feeding at all under this condition. Reduced feeding, as well as withdrawal during diarrhoea, can reduce the chances of a full recovery and is an important risk factor for developing severe malnutrition.

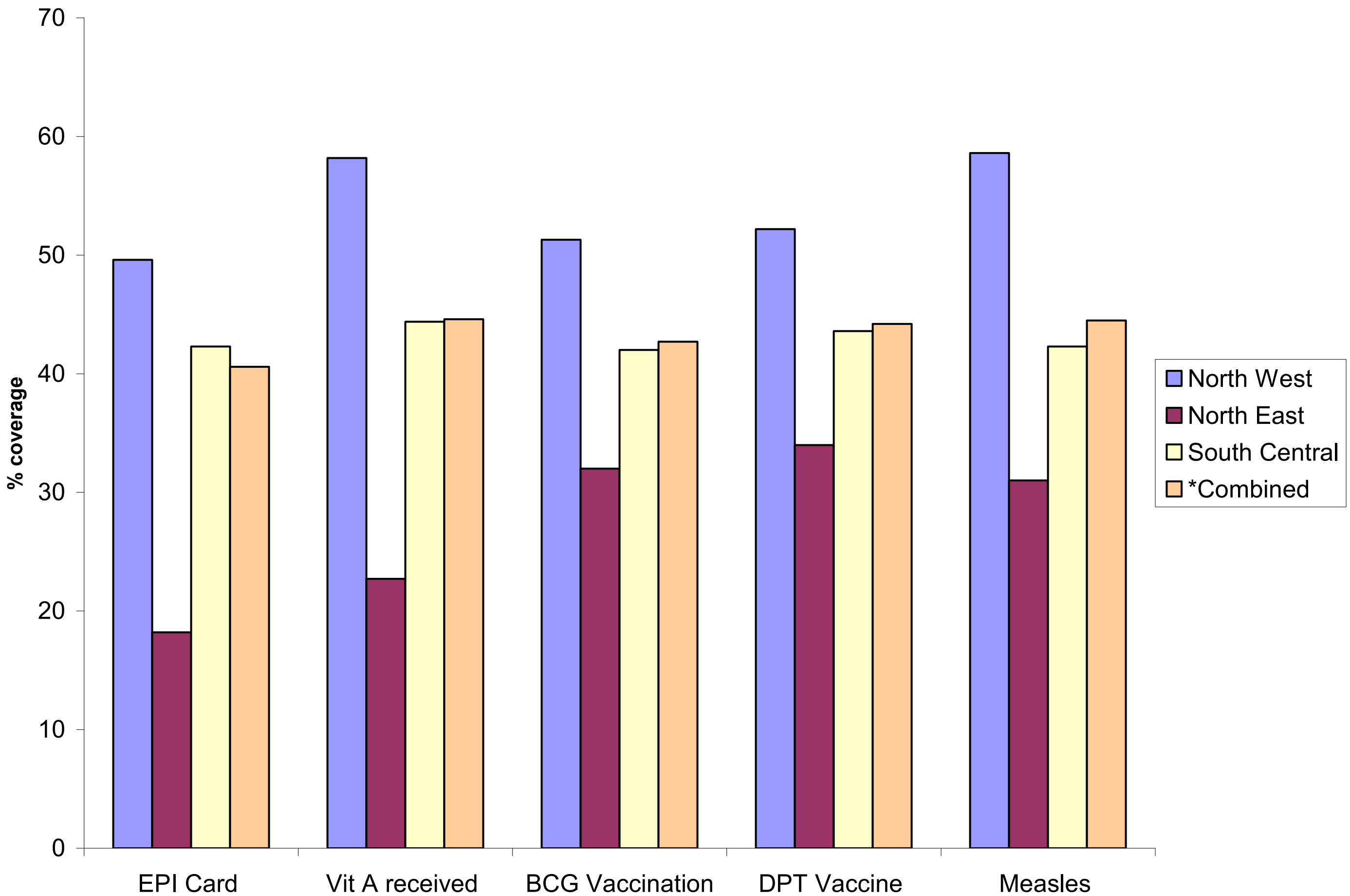
Figure 13 Pattern of Feeding During Diarrhoea



4.2.11 Immunisation coverage

The immunisation coverage was low across all the strata. The North East showed much lower levels than the other two strata. North West had immunisation coverage of slightly above 50% for most vaccines. The figure below shows the immunisation coverage of all three strata.

Figure 14 Immunisation Coverage of Children Aged 6- 23 Months



4.3 Women of Reproductive Age

4.3.1 Characteristics of the Women Sampled in the Assessment

Women aged between 15-49 years old were sampled in and the mean, maximum and minimum age of the women is shown in table 34. There were a higher number of women in South Central which accounted for 35.8% of the total women recruited in the three strata. This was however due to the higher number of clusters captured in this stratum. The majority of women enrolled were married, with lower percentages being widowed, divorced and never married, as shown in table 35 below. On the physiological status of women, a higher number of women were neither lactating nor pregnant which accounted for 42.7% while 36.6% were lactating and smaller percentages of 19.8% and 0.8% were pregnant and both pregnant and lactating respectively. Table 36 describes the physiological status of the women per strata.

Table 34 Number and Mean Age of Women

Strata	N	Mean	Minimum age	Maximum age
North West	856 (30.6%)	30.9 (30.4-31.5)	15	49
North East	941 (33.6%)	28.8 (28.3-29.4)	15	49
South Central	1004 (35.8%)	28.8 (28.3-29.3)	15	49
Combined	2801 (100%)	29.4 (29.1-29.8)	15	49

Table 35 Marital Status of Women

	N	Never Married	Married	Divorced	Widowed
North West	856	74 (8.6%)	704 (82.2%)	46 (5.4%)	32 (3.7%)
North East	941	134 (14.2%)	744 (79.1%)	29 (3.1%)	34 (3.6%)
South Central	1004	79 (7.9%)	858 (85.5%)	51(5.1%)	16 (1.6%)
Combined	2801	287(10.2%)	2306 (82.3%)	126 (4.5%)	82 (2.9%)

Table 36 Physiological Status of Women

	Pregnant	Lactating	Neither Lactating or Pregnant	Pregnant and Lactating	Total
North West	124 (15.9%)	277 (35.4)	373 (47.7%)	8 (1.0%)	782
North East	154 (19.1%)	280 (34.7%)	366 (45.3%)	8 (1.0%)	808
South Central	212 (24.0%)	350 (39.5%)	319 (36.0%)	4 (0.5%)	885
Combined	490 (19.8%)	907 (36.6%)	1058 (42.7%)	20 (0.8%)	2475

Missing values on the physiological status =11.6%

4.3.2 Body Mass index

The body mass index (body weight (Kg)/Height (Meters^2)) was calculated from the measured weights and heights from 1,929 non-pregnant women. The mean BMI of the population was 22.5 kg/m$^{2.}$ The prevalence of the different classes of BMI is shown in table 37 and figures 15 and 16. The mean sitting height/standing height ratio (Cormic Index) was 50.5% and there was a significant positive correlation between the BMI and the index (P=0.01). Correction of BMI for using the Cormic Index is required for before comparison of prevalence data between populations. However, different equations for this correction exist in the literature and no consensus currently exists on the best method for use with Somali populations. For these reasons the data in this report is presented as unadjusted BMI.

Using the cut offs <18.5 and ≥ 30.0 for thinness and obesity (adult cut offs for grade 1 thinness and grade 2 overweight) gives an overall prevalence of 21.5% (95% CI 19.4-25.8) and 6.7% respectively. Both thinness and obesity were significantly different in the North East (X^2 test P<0.001), with a lower prevalence of thinness of 14.7% (11.8-17.3) and higher prevalence 12.2% (9.2-15.5) for obesity as compared to the other two zones. There was also a significant difference in the prevalence of thinness and obesity among rural and urban population with the rural having a higher prevalence of thinness and the urban having a higher prevalence of obesity

Table 37 Distribution of BMI Classes in Non-Pregnant Women (15-49 Years) by Strata

Strata	<16	16.0-16.9	17-18.4	18.5-25.0	25.1-30.0	30.1-40.0	>40	Total
North West	36	25	74	333	120	51	5	644
Row%	5.6%	3.9%	11.5%	51.7%	18.6%	7.9%	0.8%	100.0%
95% CI	(4.0-7.8)	(2.7-5.6)	(8.8-14.8)	(46.0-57.3)	(15.5-22.3)	(5.5-11.2)	(0.3-2.1)	
North East	15	19	58	329	128	71	5	625
Row%	2.4%	3.0%	9.3%	52.6%	20.5%	11.4%	0.8%	100.0%
95% CI	(1.5-3.7)	(1.9-4.8)	(7.0-12.1)	(48.2-57.1)	(17.0-24.5)	(8.0-15.8)	(0.2-2.9)	
South Central	16	36	106	411	64	25	2	660
Row%	2.4%	5.5%	16.1%	62.3%	9.7%	3.8%	0.3%	100.0%
95% CI	(1.4-4.3)	(4.0-7.5)	(12.7-20.1)	(55.6-68.5)	(6.6-13.9)	(2.0-7.0)	(0.1-1.2)	
***Combined**	67	80	238	1073	312	147	12	1929
Row%	3.3%	4.6%	13.6%	57.8%	14.0%	6.2%	0.5%	100.0%
95% CI	(2.4-4.4)	(3.7-5.8)	(11.6-16.0)	(53.6-61.8)	(11.8-16.5)	(4.7-8.1)	(0.3-1.0)	
Urban	16	14	46	273	122	69	2	542
Row%	3.2%	2.7%	9.0%	51.5%	21.7%	11.5%	0.4%	100.0%
95% CI	(2.0-5.1)	(1.7-4.2)	(7.0-11.4)	(45.6-57.3)	(17.9-26.0)	(8.5-15.4)	(0.1-2.9)	
Rural	47	64	181	733	161	67	8	1261
Row%	3.4%	5.5%	15.5%	60.3%	10.5%	4.4%	0.4%	100%
95% CI	(2.3-4.9)	(4.3-7.0)	(13.0-18.5)	(55.2-65.2)	(8.5-13.0)	(2.8-6.7)	(0.2-0.9)	

*Weighted

Chi-Square= 97.003, P<0.001 Missing 362 (13%) Similarly there are significant difference between Rural and Urban. Chi-Square=123.263, P<0.001

Figure 15 Distribution of Different Classes of BMI of non-Pregnant Women

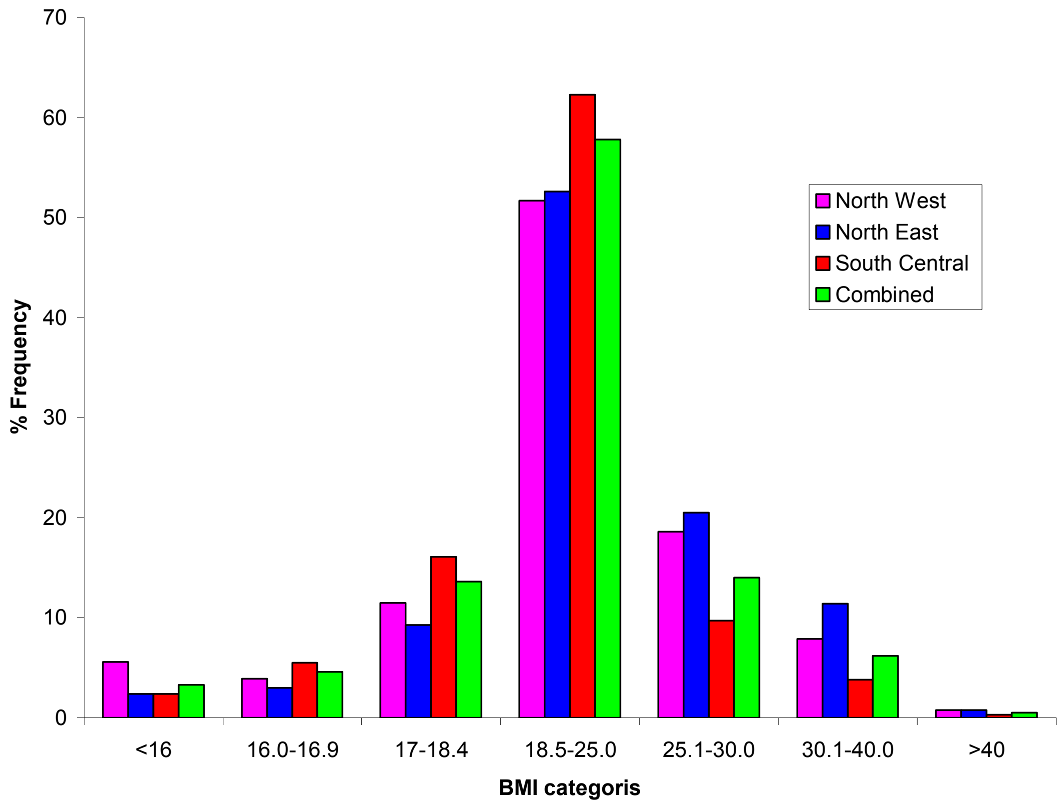
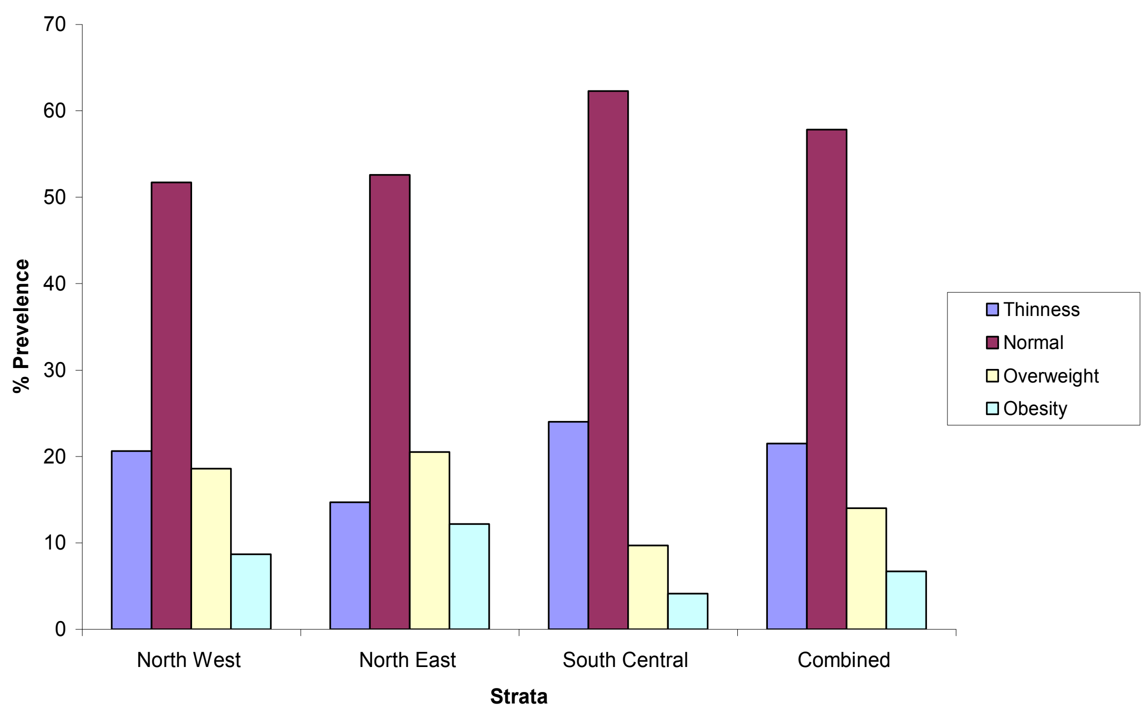


Figure 16 Prevalence of Thinness, Normal Body Mass, Overweight and Obesity in Women



4.3.3 Education background

The level of women' level was measured by asking if they had ever attended school and the level of education attained. Those who had attended school were then asked to read two sentences in the Somali language. Overall reported attendance was low, with the lowest levels seen in the North West where only 15% had attended school at some point in their lives. The highest attendance levels were recorded in the North East, but even here attendance was only 41%.

Amongst those who had attended school only one third to one half were able to read the test text in full. The lowest literacy was seen in the South Central where only 33% could read the sentences in full. Table 38 shows the frequencies of reading responses.

Table 38 School Attendance of Women by Strata

Strata	Yes	No
North West	132	724
Row%	15.4%	84.6%
95% CI	(12.1-19.4)	(80.6-87.9)
North East	381	560
Row%	40.5%	59.5%
95% CI	(34.2-47.1)	(52.9-65.8)
South Central	232	772
Row%	23.1%	76.9%(70.5-82.3)
95% CI	(17.7-29.5)	
*Combined	745	2056
Row%	24.4%	75.6%
95% CI	(20.9-28.3)	(71.7-79.1)

Weighted. Chi-Square=106.189, P<0.001

Table 39 Reading Ability among Women Who Had Attended School

Strata	Can not read	Able to read in part	Able to read full sentence	Physically impaired	Total
North West	13	51	67	1	132
Row% 95% CI	9.8% (5.6-16.7)	38.6% (30.1-48.0)	50.8% (39.5-62.0)	08% (0.1-5.2)	100.0%
North East	59	141	181	0	381
Row% 95% CI	15.5% (10.4-22.4)	37.0% (31.3-43.0)	47.5% (41.2-53.9)	0	100.0%
South Central	81	70	75	1	227
Row% 95% CI	35.7% (26.3-46.3)	30.8% (23.4-39.4)	33.0% (24.6-42.7)	0.4% (0.1-3.1)	100.0%
*Combined	153	262	323	2	740
Row% 95% CI	25.6% (20.4-31.5)	33.9% (29.1-39.0)	40.2% (35.0-45.6)	0.4% (0.1-1.5)	100.0%

4.3.4 Consumption of Tea

The consumption of tea has been negatively associated with the bio-availability of ingested iron. All women interviewed during the survey were asked about their consumption of tea including the frequency and time of consumption. The consumption of tea ranged from a few times a day to those who do not drink tea at all. However, most women interviewed reported consuming tea a few times a day. This accounted for 71.9% of the combined groups as shown in figure 17. Table 40 shows the timing of tea consumption in relation to meals.

Figure 17 Frequency of Tea Consumption

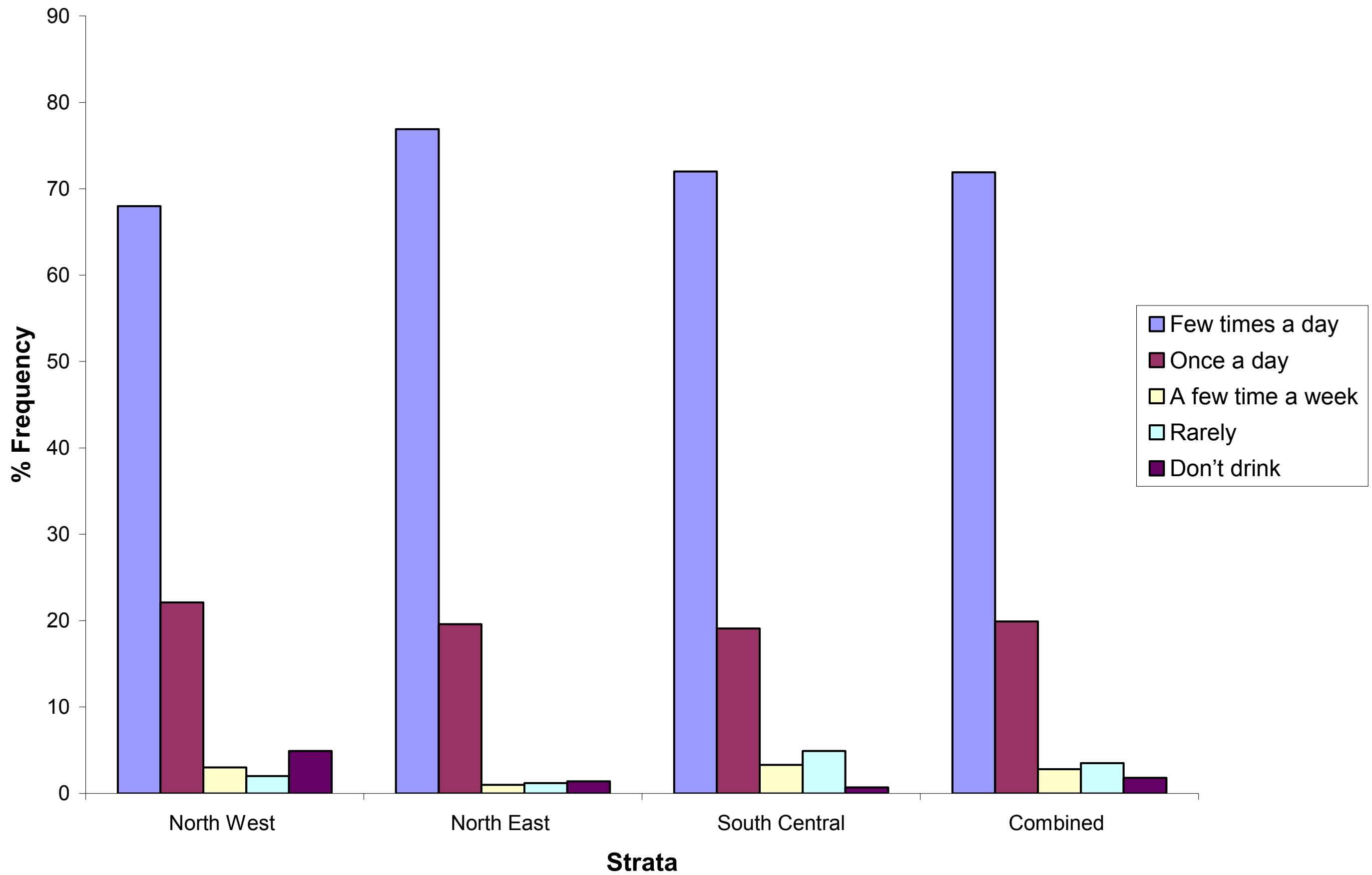


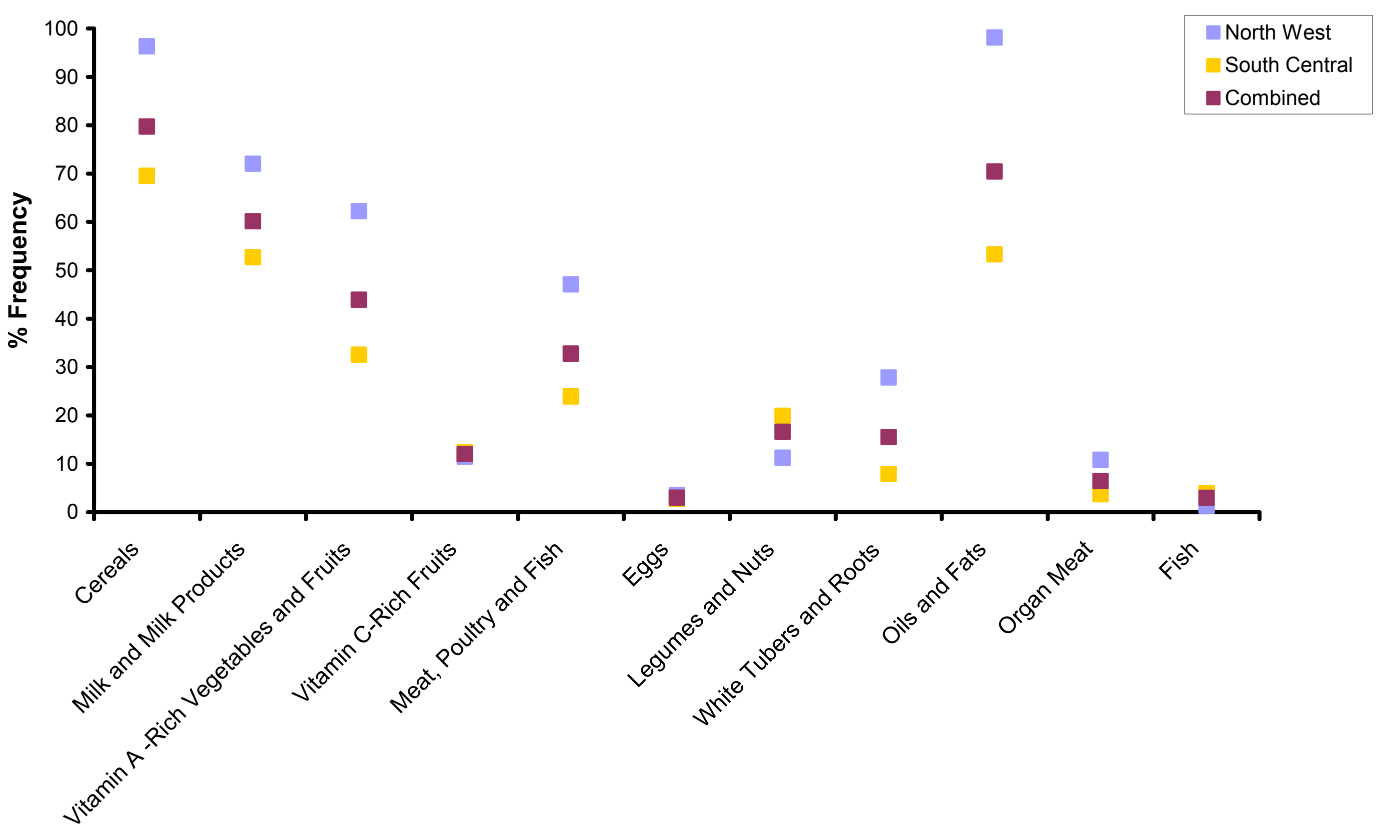
Table 40 Tea Consumption in Relation to Meals

Strata	During a meal	After meal	In between meals	Total
North West	216	443	163	822
	26.3% (20.0-33.7)	53.9% (46.7-61.0)	19.8% (14.7-26.2)	100.0%
North East	359	374	208	941
	38.2% (31.3-45.6)	39.7% (32.0-48.1)	22.1% (17.0-28.2)	100.0%
South Central	380	311	306	997
	38.1% (32.9-43.6)	31.2% (26.9-35.8)	30.7% (24.8-37.2)	100.0%
*Combined	955	1128	677	2760
	35.4% (31.7-39.2)	38.1% (34.7-41.6)	26.6% (22.8-30.8)	100.0%

4.3.5 Food frequency questionnaire

Women in the North West and South Central strata who had their haemoglobin measured were also asked about the foods eaten the previous day before the survey. This data was not collected in the North East which was the first strata survey. There were a higher number of women consuming more than three food groups in the North West compared to South Central, 69.8% (95% CI 59.9-78.2) and 53.6% (95% CI 37.5-68.9) respectively. The consumption of more than three food groups overall was 61.0% (95% CI 50.7-70.5). The pattern for food consumption was similar for both strata with a high consumption of cereals, milk and milk products, oils and fats, and low consumption of vitamin C rich fruits, eggs organ meat, legumes and nuts, as shown in figure 18 below. There was no significant association between women consuming less than three food types and those consuming more than three food types with anaemia RR=1.1 (95% CI 0.878-1.407), P=0.385.

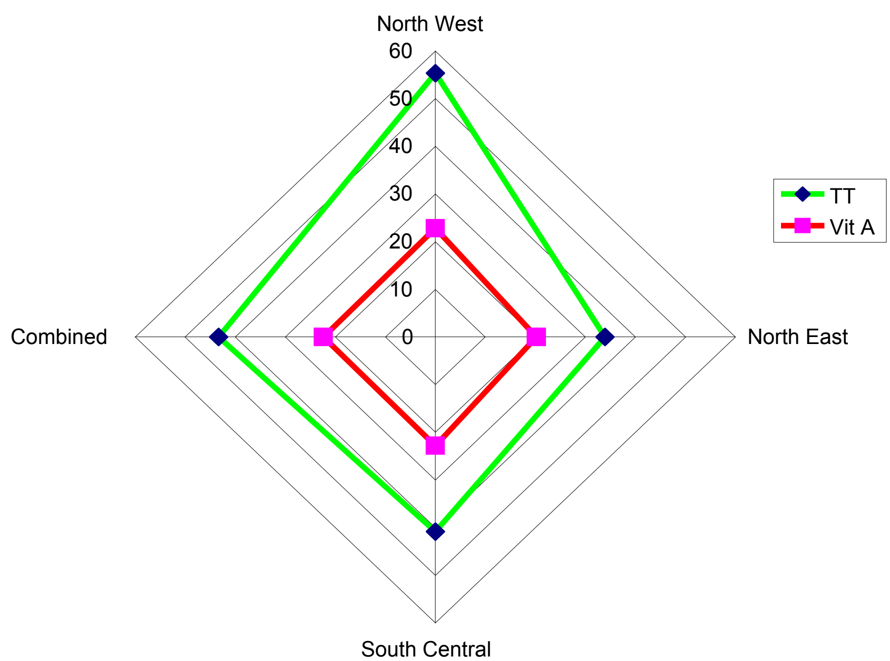
Figure 18 Food Groups Consumed by Women



4.3.6 Immunisation

Out of the 2,800 women who responded to the question as to whether they had given birth within the last two years before the survey, 48.3% (95% CI 44.9-51.7) responded in the affirmative. There was a slightly lower positive response rate in the North East with 41.7% (95% CI 36.9-46.6) as compared to 48.1% (95% CI 43.4-52.9) and 50.4% (95% CI 45.1-55.8) in North West and South Central respectively. This change was, however, not significant. The immunisation coverage for both tetanus and Vitamin A supplementations were generally poor. However, vitamin A supplementation coverage was very low as shown in figure 19 below.

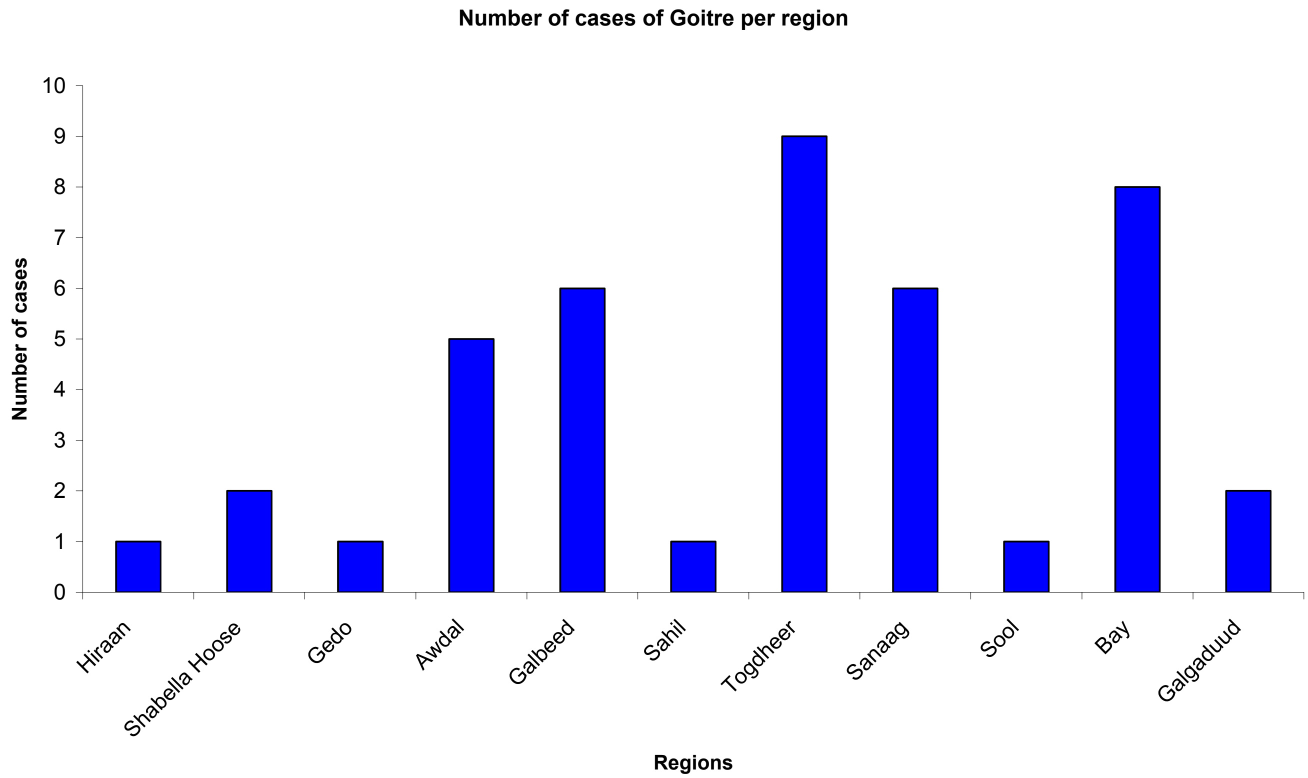
Figure 19 Immunisation Coverage among Women



4.3.7 Goitre prevalence

The absence or presence of visible goitre was determined in the North West and South Central strata. This indicator was not assessed in the North East. This was due to initial concerns that it was not culturally acceptable to observe women's neck for swelling. There was a significant difference in the prevalence of goitre among women of reproductive age in the North West and South Central (P=0.022). The North West had a goitre prevalence of 3.3 % (2.2-4.9) as opposed to 1.4% (0.8-2.6) in South Central. The presence of the cases however was small was concentrated in some regions within the Toghdeer region in North West and Bay in South Central. Although the number of cases was small it may indicate where there are pockets of deficiency or excess with a zone. Figure 20 below therefore demonstrates the number of cases according to the regions.

Figure 20 Distribution of Goitre Cases in Women



4.3.8 Urinary iodine concentration in non pregnant women

For analytical quality control purposes, samples of urine from two healthy volunteers were analysed in conjunction with the survey samples. These QC samples were included as triplicate aliquots and the laboratory was blinded to their identity. The coefficient of variation from their analysis was 1.3% and 0.7% respectively. The mean urinary iodine concentrations from the two healthy volunteers were 121.7 and 184.9 µg/L.

Similarly, for internal quality control the laboratory used four standard solutions at different concentrations, and, in addition, two pooled urine samples were included in each analysis batch. These controls were run alongside the test samples on the microplates. The coefficient of variation was less than 10% with a range of 3.4 to 8.6%, which was considered very good.

Of the 1761 samples collected during the survey, 19 subjects provided insufficient urine samples for analysis while the results from 75 subjects were discarded due to sample labelling problems .These discarded samples were distributed equally among strata and target age groups. Similarly, since pregnant women have a higher cut-off of urinary iodine concentration due to their higher iodine demand, 152 pregnant women were excluded from the main analysis.

Table 41 shows the descriptive statistics for the urinary iodine concentration in women. Due to the non-normal distribution of the data, the median UIC was used to describe the population urinary iodine characteristics. As shown in the table, the median urinary iodine concentration within each stratum indicates more than adequate intake in the North West and excessive urinary iodine concentration in the North East and South Central with 224.4, 397.7 and 312.8 µg/L respectively. The overall median urinary iodine concentration for the combined strata was 325 µg/L, indicating excessive urinary iodine intake.

Table 42 below shows the categorisation of the urinary iodine concentration in women. It can be observed that over 50% of the women had UIC that was either more that adequate or excessive. On the other hand, a lower percentage of the women were in the lower extreme indicating deficiency.

There was no significant correlation between iodine status and consumption of food groups that were rich in iodine such as sea food. It was difficult to investigate correlations between goitre and iodine status due to the small number of goitre cases. However 14 out of the total 22 cases of goitre that were identified during the survey showed iodine concentration that was either more than adequate or excessive. However, goitre formation could have occurred during a period in the past when iodine intakes were different than those measured during the survey.

Table 41 Urinary Iodine Concentration in Non-Pregnant Women by Strata

Strata	Mean	**Median**	SD	Min	Max	Inter quartile Range
North West	714.3 (534.1-894.0)	**224.4**	1275.6	24.1	7712.5	566.4
North East	580.1 (496.8-663.3)	**397.7**	592.5	48.6	4596.3	551.5
South Central	719.3 (540.8-897.8)	**312.8**	318.2	39.4	9059	473.3
Combined	672.3 (592.9-761.6)	**325.1**	1117.9	24.1	9059.2	555.4
Urban	554.1 (440.8-667.5)	**327.9**	790.2	30.2	7712.5	453.2
Rural	743.7 (644.1-843.3)	**358.2**	1158.2	6.8	9059.2	635.8

Table 42 Distribution of UIC in Non-Pregnant Women According to WHO Categories

Strata	N	<100 µg/L	100-199 µg/L	200-299 µg/L	>300 µg/L
North West	195	43	47	20	85
		22.1%	24.1%	10.3%	43.6%
		(14.7-31.6)	(16.5-33.8)	(7.4-14.0)	(32.5-55.4)
North East	197	16	33	26	122
		8.1%	16.8%	13.2%	61.9%
		(4.5-14.2)	(11.2-24.3)	(7.8-21.4)	(48.5-73.7)
South Central	212	27	41	34	110
		12.7%	19.3%	16.0%	51.9%
		(6.8-22.7)	(13.8-26.4)	(11.0-22.9)	(41.0-62.6)
Combined	604	86	121	80	317
		14.3%	20.1%	14.1%	51.6%
		(10.0-20.1)	(16.1-24.8)	(10.8-18.1)	(44.3-58.8)
		20	33	38	98
Urban	189	11.2%	18.9%	21.7%	48.2%
		(5.2-22.7)	(11.7-29.0)	(13.7-32.7)	(33.5-63.1)
		73	99	58	292
Rural	522	13.5%	18.7%	12.3%	55.6%
		(8.7-20.3)	(14.5-23.8)	(9.7-15.5)	(47.1-63.7)

4.3.9 Anaemia in Women

A total of 850 women had their blood tested for haemoglobin. These included 165 pregnant women and 685 non-pregnant women. The mean haemoglobin concentration and prevalence of anaemia was analysed in these two categories. The overall mean haemoglobin was 11.9 g/dL for non pregnant women and 10.8 g/dL for pregnant women. It is however important to note that the sample size for pregnant women might not be sufficient to make a reliable statistical inference and that the gestational age of the women, which influences haemoglobin concentration, was not determined. The overall anaemia prevalence for the combined non pregnant women was 46.6% (95% CI 41.3-51.9) with both North East and South Central having over 50% anaemia and North West having a relatively lower prevalence of anaemia of 38.5%. There was a significant difference in the prevalence of anaemia among non pregnant women in rural and urban settlements. The majority of the anaemia was mainly moderate. Twenty-one cases of severe anaemia among the non-pregnant women were noted with 5, 10 and 6 cases in the North West, North East and South Central respectively. In contrast, only 5 cases of severe anaemia were noted in the pregnant group with 3 and 2 cases from North East and South Central and no severe cases in North West. The table below shows the mean haemoglobin and prevalence of anaemia.

Table 43 Prevalence of various categories of Anaemia among Pregnant and Non Pregnant Women

Strata	N	Non Pregnant Women Mean	Mild Anaemia 11.0-11.9 g/dl	Moderate Anaemia 8.0-10.9g/dl	Severe Anaemia <8.0g/dl	Total Anaemia	Pregnant Women N	Mean	Mild Anaemia 11.0-11.9 g/dl	Moderate Anaemia 8.0-10.9g/dl	Severe Anaemia <8.0g/dl	Total Anaemia
North West Row% 95 CI	260	12.3 (12.0-12.6)	39 15.0% (10.1-21.7)	56 21.5% (16.6-27.4)	5 1.9% (0.9-4.2)	100 38.5% (31.5-45.9)	60	11.4 (10.9-11.9)	9 15.0%(7.9-26.7)	14 23.3% (12.3-39.9)	0 0	23 38.3% (26.3-51.9)
North East Row% 95 CI	237	11.6 (11.3-11.9)	47 19.8% (15.1-25.6)	62 26.2% (20.2-33.2)	10 4.2% (2.2-7.9)	119 50.2% (42.8-57.6)	53	10.8 (10.2-11.3)	10 18.9% (10.8-30.8)	15 28.3% (16.0-45.0)	3 5.7% (1.9-15.5)	28 52.8% (38.5-66.7)
South Central Row% 95 CI	188	11.7 (11.4-12.1)	39 20.7% (14.7-28.4)	50 26.6% (19.8-34.7)	6 3.2% (1.4-7.3)	95 50.5% (41.3-59.7)	52	10.5 (10.1-11.0)	11 21.2% (11.4-35.8)	15 28.8% (19.5-40.4)	2 3.8% (1.0-13.9)	28 53.8% (40.9-66.3)
Combined Row% 95 CI	685	11.9 (11.7-12.1)	125 18.7% (15.1-23.0)	168 24.9% (20.9-29.3)	21 3.0%(1.8-4.9)	314 46.6% (41.3-51.9)	165	10.8 (10.5-11.2)	30 18.9% (12.8-27.1)	44 27.1% (20.3-35.2)	5 3.0% (1.1-7.9)	79 49.1% (40.8-57.4)
Urban Row% 95 CI	206	12.3 (12.0-12.9)	36 16.5% (11.3-23.3)	43 19.9% (13.4-28.5)	6 3.5% (1.6-7.5)	85 39.8% (32.2-48.0)	52	11.1 (10.6-11.6)	6 10.0% (4.3-21.4)	16 30.3% (17.0-48.0)	1 1.5% (0.2-9.8)	23 41.8% (26.9-58.3)
Rural Row% 95 CI	438	11.8 (11.5-12.0)	80 18.8% (14.1-24.6)	114 26.1% (21.0-31.9)	14 3.0% (1.6-5.6)	208 47.9% (41.0-55.0)	103	10.8 (10.4-11.2)	18 16.9% (10.2-26.6)	26 26.6% (18.5-36.5)	4 3.9% (1.3-10.9)	48 47.3% (37.9-56.9)

4.3.10 Soluble Tranferrin Receptor

The tables below show the mean, median, ranges and prevalence of iron deficiency respectively for all women as well as just non-pregnant women. The prevalence of high sTfR concentrations for all women and just pregnant women was 44.1% (95% CI 39.5-48.9) and 42.5 (95% CI 37.5-47.6). There was no significant difference in the prevalence of iron deficiency across strata (P=0.839) and neither was there any significant difference between rural and urban settlements (P=0.069). As shown in table 46, a higher number of the anaemia cases are due to iron deficiency. The prevalence of iron deficiency anaemia was also high as shown in the same table.

Table 44 Mean and Median of sTfR in Women

	All Women						Non Pregnant Women					
	N	Mean ±SD	Median	Inter Quartile range	Minimum	Maximum	N	Mean ±SD	Median	Inter Quartile Range	Minimum	Maximum
North West	274	10.5±7.5	7.6	5.1	4.21	54.88	228	10.5±7.8	7.6	5.06	4.21	54.88
North East	229	10.9±8.0	7.8	4.44	4.11	49.98	191	10.7±7.7	7.6	4.49	4.65	49.98
South Central	217	10.0±6.7	7.6	5.05	3.34	59.24	166	9.4±6.5	7.5	4.27	3.34	59.24
Combined	720	10.5±7.4	7.6	4.99	3.34	59.24	585	10.2±7.4	7.5	4.59	3.34	59.24
Urban	210	9.9±6.7	7.5	3.48	4.21	49.98	171	9.8±7.0	7.4	3.42	4.21	49.98
Rural	466	10.9±7.7	7.8	5.77	3.34	59.24	381	10.6±7.6	7.8	5.14	3.34	59.24

Table 45 Prevalence of Normal and High Transferrin Receptors in Women 15-49 years

Strata	All Women			Non Pregnant Women		
	Iron sufficient (≤8.3 mg/L)	Iron deficient (>8.3 mg/L)	Total	Iron sufficient (≤8.3 mg/L)	Iron deficient (>8.3 mg/L)	Total
North West	163	111	274	139	89	228
Row% 95%CI	59.5% (52.9-65.7)	40.5% (34.3-47.1)	100.0%	61.0% (54.9-66.7)	39.0% (33.3-45.1)	100.0%
North East	132	97	229	113	78	191
Row% 95%CI	57.6% (50.1-64.9)	42.4% (35.1-49.9)	100.0%	59.2% (52.1-65.9)	40.8% (34.1-47.9)	100.0%
South Central	119	98	217	94	72	166
Row% 95%CI	54.8% (46.7-62.7)	45.2% (37.3-53.3)	100.0%	56.6% (47.2-65.6)	43.4% (34.4-52.8)	100.0%
*Combined	414	306	720	346	239	585
Row% 95%CI	56.8% (52.0-61.5)	43.2% (38.5-48.0)	100.0%	58.5% (53.3-63.5)	41.5% (36.5-46.7)	100.0%
Urban	132	78	210	112	59	171
Row% 95%CI	63.3% (55.1-70.8)	36.7% (29.2-44.9)	100.0%	66.0% (58.8-72.4)	34.0% (27.6-41.2)	100.0%
Rural	252	214	466	211	170	381
Row% 95%CI	53.3% (47.5-58.9)	46.7% (41.1-52.5)	100.0%	54.7% (48.2-61.0)	45.3% (39.0-51.8)	100.0%

*Weighted. *Weighted. No significant difference in sTfR levels among the three strata. P=0.580. There was no significant difference between urban and rural setting, P=0.069

Table 46 Prevalence of Iron Deficiency amongst Normal and Anaemic Women

	All Women					Non Pregnant Women				
Strata	N	Hb category	Iron sufficient	Iron deficient	Iron deficiency anaemia	N	Hb category	Iron sufficient	Iron deficient	Iron deficiency anaemia
North West	264	Anaemic	33 34.40% (22.2-49.1)	63 65.60% (50.9-77.8)	23.9%	220	Anaemic	27 34.20% (22.4-48.3)	52 65.80% (51.7-77.6)	23.6%
North East	213	Anaemic	35 31.50% (22.6-42.0)	76 68.50% (58.0-77.4)	35.7%	180	Anaemic	31 33.30% (24.2-43.9)	62 66.70% (56.1-75.8)	34.4%
South Central	198	Anaemic	28 28.30% (18.0-41.5)	71 71.70% (58.5-82.0)	35.9%	150	Anaemic	23 31.50% (19.4-46.8)	50 68.50% (53.2-80.6)	33.3%
Combined	675	Anaemic	96 30.50% (23.4-38.6)	210 69.50% (61.4-76.6)	31.1%	550	Anaemic	81 32.60% (25.0-41.4)	164 67.40% (58.6-75.0)	29.8%
Urban	203	Anaemic	35 41.60% (27.3-57.5)	47 58.40% (42.5-72.7)	23.2%	166	Anaemic	29 42.80% (29.6-57.3)	37 57.20% (42.7-70.4)	22.3%
Rural	429	Anaemic	49 24.40% (16.8-33.9)	151 75.60% (66.1-83.2)	35.2%	351	Anaemic	45 27.90% (19.1-38.9)	118 72.10% (61.1-80.9)	33.6%

4.3.11 Prevalence of Vitamin A Deficiency in Women in Reproductive Age

Prevalence of Vitamin A based on a cut-off of 1.24µmol/L RBP was relatively high compared to the children. Although there was some difference between strata this was not significantly different between them (P=0.246) and the overall Vitamin A prevalence was 54.4 % (95% CI 48.3-60.4). This therefore categorizes the vitamin A deficiency in Women as severe. Just like the other age groups there was no significant difference between rural and urban settlements (P=0.826)

Table 47 Prevalence of Vitamin A Deficiency in Women

	ALL WOMEN					EXCLUDING HIGH CRP ABOVE 5mg/L				
	N	Mean RBP	<1.24µmol/L	≥1.24µmol/L	Public health	N	Mean RBP	<1.24µmol/L	≥1.24µmol/L	Public health
North West	274	1.22	145	129	Severe	210	1.24	104	106	Severe
Row%			52.9%	47.1%				49.5%	50.5%	
95% CI		(1.18-1.27)	(46.4-59.3)	(40.7-53.6)			(1.20-1.28)	(43.5-55.6)	(44.4-56.5)	
North East	229	1.28	115	114	Severe	162	1.30	79	83	Severe
Row%			50.2%	49.8%				48.8%	51.2%	
95% CI		(1.23-1.34)	(43.4-57.0)	(43.0-56.6)			(1.25-1.35)	(41.0-56.5)	(43.5-59.0)	
South Central	217	1.20	129	88	Severe	180	1.21	106	74	Severe
Row%			59.4%	40.6%				58.9%	41.1%	
95% CI		(1.13-1.28)	(49.2-68.9)	(31.1-50.8)			(1.14-1.29)	(48.1-68.9)	(31.1-51.9)	
Combined	720	1.22	389	331	Severe	552	1.24	289	263	Severe
Row%			55.8%	44.2%				54.4%	45.6%	
95% CI		(1.18-1.27)	(50.1-61.3)	(38.7-49.9)			(1.20-1.28)	(48.3-60.4)	(39.6-51.7)	
Urban	210	1.23	113	97	Severe	151	1.24	77	74	Severe
Row%			53.7%	46.3%				50.7%	49.3%	
95% CI		(1.20-1.27)	(47.5-59.8)	(40.2-52.5)			(1.20-1.28)	(43.7-57.7)	(42.3-56.3)	
Rural	466	1.24	241	225	Severe	365	1.26	184	181	Severe
Row%			53.0%	47.0%				51.8%	48.2%	
95% CI		(1.19-1.29)	(46.3-59.6)	(40.4-53.7)			(1.21-1.31)	(44.7-58.9)	(41.1-55.3)	

Chi-Square =4.362, P=0.246. Similarly no significant difference between rural and Urban (P=0.826)

4.3.12 Distribution of CRP Concentrations

The tables below show the distribution of CRP by strata. The level of CRP was similar across the strata and normally distributed within target groups but slightly higher in North East with 29.3% as opposed to 23.4% and 17.1% in North West and South Central (P=<0.020)

Table 48 Distribution of CRP

	Normal ≤ 5.0 mg/L	High >5.0 mg/L	Total
North West	210	64	274
Row % 95% CI	76.6% (70.5-81.8)	23.4% (18.2-29.5)	100.0%
North East	162	67	229
Row % 95% CI	70.7% (65.1-75.8)	29.3% (24.2-34.9)	100.0%
South Central	180	37	217
Row % 95% CI	82.9% (76.6-87.9)	17.1% (12.1-23.4)	100.0%
Combined	552	168	720
Row % 95% CI	78.8% (75.1-82.1)	21.2% (17.9-24.9)	100.0%

4.4 School age children

The mean age of the school age children enrolled into the study was 8 years old. Three hundred, 267 and 301 school age children were recruited in North West, North East and South Central respectively. The sex distribution of the school children was within the expected range, with the percentage of males in the combined strata being 49.8%, as shown in table 49.

Table 49 Sex distribution of School Age Children

Strata	Male	Female	Total
North West	146	154	300
Row% 95 CI	48.7% (42.2-55.1)	51.3% (44.9-57.8)	100.0%
North East	144	123	267
Row% 95 CI	53.9% (47.0-60.7)	46.1% (39.3-53.0)	100.0%
South Central	148	153	301
Row% 95 CI	49.2% (43.1-55.3)	50.8% (44.7-56.9)	100.0%
Combined	438	430	868
Row% 95 CI	49.8% (45.8-53.8)	50.2% (46.2-54.2)	100.0%

4.4.1 Presence of visible Goitre

The presence or absence of enlargement of the thyroid gland was observed in this group. As explained in the methods section, palpation of the thyroid gland was not done due to the complexity in performance and high degree of inter-reader variability. The presence of visible goitre in this group was generally very low with only 4 (1.3% (95%CI 0.4-4.3)) and 1 (0.3% (95%CI 0.0-2.4)) child having visible goitre in North West and South Central respectively. This indicator was not collected in the North East. The overall prevalence of visible goitre in school age children was 0.7% (95%CI 0.2-1.8)

4.4.2 Urinary iodine concentration in school aged children

The results from the analysis of urinary iodine concentration in school aged children follow a similar trend as seen in women, despite the higher median values in this group. The median values were significantly different between strata ($p<0.001$) with 295.5, 619.4, and 397.4 μg/L for North West, North East and South Central respectively. The combined median value was 417.1μg/L which indicates a median urinary iodine intake above the upper limit of 300µg/L. While the North West had a median UIC indicating more than adequate intake, both the North East and South Central had median UICs that were indicative of excessive iodine intakes.

In the WHO classification of the urinary iodine concentrations, in table 51 about 60.7%, 85.9%, 78.5% and 75.4% of the children had either urinary iodine concentration that was more that adequate or excessive in North West, North East, South Central and for the combined children respectively. There was no significant difference (P=0.292) between rural and urban school aged children. Overall, 62% had excessive urinary iodine concentrations.

Table 50 Urinary Iodine Concentration (UIC) in School Aged Children

Strata	*Mean*	***Median***	*SD*	*Min*	*Max*	*Inter quartile Range*
North West	*823.0 (647.6-998.3)*	***295.5***	*1361.3*	*10.7*	*9922.3*	*786.4*
North East	*869.4 (869.4-1131.1)*	***619.4***	*1048.5*	*8.0*	*6717.4*	*1101.2*
South Central	*779.4 (674.2-884.5)*	***397.4***	*869.1*	*5.0*	*5603.6*	*861.1*
Combined	*866.5 (787.3-945.8)*	***417.1***	*1104.2*	*5.0*	*9922.3*	*926.3*
Urban	*966.2 (801.3-1131.1)*	***542.4***	*1244.0*	*10.7*	*9922.3*	*1007.3*
Rural	*859.0 (764.7-953.4)*	***400.4***	*1063.0*	*5.0*	*8533.4*	*1038.9*

Table 51 Classification of UIC in School Aged Children According to WHO Categories

Strata	N	Insufficient	Adequate	More than adequate	Excessive
North West	234	44 18.8% (12.4-27.5)	48 20.5% (14.1-28.9)	26 11.1% (7.5-16.2)	116 49.6% (36.7-62.5)
North East	249	14 5.6% (2.4-12.4)	21 8.4% (5.1-13.7)	24 9.6% (5.7-16.0)	190 76.3% (64.5-85.1)
South Central	265	20 7.5% (3.7-14.8)	37 14.0% (9.2-20.6)	41 15.5% (10.7-21.8)	167 63.0% (51.3-73.4)
Combined	748	78 10.0% (6.9-14.2)	106 14.6% (11.2-18.8)	91 13.3% (10.2-17.2)	473 62.1% (54.4-69.2)
Urban	221	22 11.8% (6.1-21.5)	22 10.7% (5.9-18.7)	15 7.4% (3.7-14.2)	162 70.1% (54.0-82.3)
Rural	490	54 10.2% (6.5-15.6)	75 14.6% (10.7-19.6)	70 14.5% (10.7-19.3)	291 60.7% (51.1-69.6)

4.4.3 Anaemia in School Age Children

The mean haemoglobin in school aged children was 12.7 g/dl, 12.0 g/dl, and 11.9 g/dl for the North West, North East and South Central strata respectively. The combined haemoglobin mean was 12.1g/dl. The mean haemoglobin was significantly different (P<0.001) between the strata with the North West having a higher mean haemoglobin. The prevalence of anaemia was low in the North West with 15.4% as compared to 33.0% and 36.5% in the North East and South Central respectively. A high proportion of the anaemia was mild and moderate anaemia. There was only one case of severe anaemia in North West and six in South Central while there was none in the North East. Overall, the combined anaemia prevalence in this age group was 29.8%. Although there was some difference between urban and rural settlements with the urban having a slightly lower prevalence of anaemia as compared to the rural, this difference was statistically weak (P=0.061). Table 52 shows the different categories of anaemia per strata and in different settlement types.

Table 52 Prevalence of Anaemia in School Aged Children

	Normal >11.5g/dl	Mild Anaemia (11.0-11.5 g/dl)	Moderate Anaemia (8.0-10.9g/dl)	Severe Anaemia (<8.0g/dl)	Total Anaemia
North West	226	15	25	1	41
Row%	84.6%	5.6%	9.4%	0.4%	15.4%
95 CI	(78.7-89.2)	(3.1-9.9)	(6.5-13.4)	(0.1-2.7)	(10.8-21.3)
North East	146	30	42	0	72
Row%	67.0%	13.8%	19.3%	0.0%	33.0%
95 CI	(58.0-74.9)	(9.3-19.9)	(13.5-26.8)		(25.1-42.0)
South Central	155	24	59	6	89
Row%	63.5%	9.8%	24.2%	2.5%	36.5%
95 CI	(54.7-71.5)	(6.8-14.1)	(17.5-32.5)	(1.0-5.8)	(28.5-45.3)
Combined	527	69	126	7	202
Row%	70.2%	9.3%	19.1%	1.5%	29.8%
95 CI	(64.8-75.1)	(7.1-11.9)	(15.0-23.9)	(0.6-3.3)	(24.9-35.2)
Urban	176	26	30	0	56
Row%	77.2%	10.6%	12.2%	0	22.8%
95 CI	(68.5-84.0)	(6.9-15.9)	(8.2-17.9)		(16.0-31.5)
Rural	310	41	89	7	137
Row%	66.9%	9.5%	21.6%	2.1%	33.1%
95 CI	(60.0-73.1)	(6.8-13.0)	(16.4-27.9)	(0.9-4.6)	(26.9-40.0)

4.4.4 Transferrin Receptor

Table 53 below gives the median and mean sTfR concentrations and the proportions of iron deficiency anaemia by strata. There was no significant difference in the mean and median transferrin receptor across the strata (p=0.145). The prevalence of iron deficiency in this group was relatively low, with 17.8%, 20.4% and 22.9% in the North West, North East and South Central Somalia respectively, as shown in table 54. Overall the combined iron deficiency prevalence was 20.8%. There was no significant difference between strata and between the rural and urban populations (P=0.476).

Table 53 Mean, Median and Range of sTfR in School Age Children

Strata	Mean ± SD	**Median**	Inter Quartile range	Minimum	Maximum
North West	7.7 ± 3.9	**6.71**	1.62	4.50	37.70
North East	7.4 ± 2.5	**6.93**	1.88	4.21	29.51
South Central	8.3 ± 6.9	**7.07**	1.99	4.12	76.46
Combined	7.8 ± 4.7	**6.85**	1.81	4.12	76.46

Table 54 Prevalence of Normal and High Transferrin Receptors in School Age Children

Strata	Normal (≤8.3 mg/L)	High TFR (>8.3 mg/L)	Total
North West	217	47	264
Row%	82.2%	17.8%	100.0%
95%CI	(76.0-87.0)	(13.0-24.0)	
North East	176	45	221
Row%	79.6%	20.4%	100.0%
95%CI	(71.1-86.1)	(13.9-28.9)	
South Central	162	48	210
Row%	77.1%	22.9%	100.0%
95%CI	(69.3-83.4)	(16.6-30.7)	
*Combined	555	140	695
Row%	79.2%	20.8%	100.0%
95%CI	(74.6-83.1)	(16.9-25.4)	
Urban	196	37	233
Row%	84.4%	15.6%	100.0%
95%CI	(78.5-88.9)	(11.1-21.5)	
Rural	324	99	423
Row%	76.1%	23.9%	100.0%
95%CI	(70.3-81.1)	(18.9-29.7)	

* Weighted. There was no significant difference between strata in TFR levels Chi –Square =2.100 P=0.476.There was significant difference between Urban and Rural settlements. Chi-Square=4.772, P=0.035

Table 55 Anaemia and Transferrin Receptors in School Age Children

Strata	N	HB Category	Iron sufficient	Iron deficient	Iron deficiency anaemia
North West	254	Anaemic	23 59.0% (42.0-74.1)	16 41.0% (25.9-58.0)	6.3%
North East	201	Anaemic	50 76.9% (59.5-88.3)	15 23.1% (11.7-40.5)	7.5%
South Central	201	Anaemic	38 59.4% (43.5-73.5)	26 40.6% (26.5-56.5)	12.9%
Combined	656	Anaemic	111 63.0% (51.9-72.8)	57 37.0% (27.2-48.1)	8.7%
Urban	218	Anaemic	41 77.1% (66.6-85.0)	11 22.9% (15.0-33.4)	5.0%
Rural	399	Anaemic	66 58.7% (45.4-70.9)	45 41.3% (29.1-54.6)	12.3%

4.4.5 Prevalence of Vitamin A Deficiency in School Age Children

The prevalence of Vitamin A deficiency in school age children was similar to that of the younger children of 6-59 months. There was significant difference between strata (p=0.019) with 21.3% (95% CI 14.8-29.8), 26.1% (95% CI 19.8-33.5) and 40.3% (95% CI 29.6-52.0) for North West, North East and South Central respectively. All the prevalence rates per strata and combined exceeded the WHO 20% prevalence classification for severe public health problem. The overall Vitamin A deficiency for school age children was 31.9% (95% CI 25.8-38.6). There was no significant difference between Urban and Rural populations (P=0.243).

Table 56 Vitamin A Deficiency in school age using the 0.825 μmol/L

	Including High CRP cases					Excluding High CRP cases				
	N	Mean RBP	<0.825μmol/L	>0.825 μmol/L	Public health	N	Mean RBP	<0.825μmol/L	>0.825 μmol/L	Public health
North West	264	0.96±0.22	67	197	Severe	239	0.98±0.21	51	188	Severe
Row%			25.4%	74.6%				21.3%	78.7%	
95% CI			(18.7-33.5)	(66.5-81.3)				(14.8-29.8)	(70.2-85.2)	
North East	221	0.96±0.24	62	159	Severe	203	0.97±0.23	53	150	Severe
Row%			28.1%	71.9%				26.1%	73.9%	
95% CI			(22.0-35.1)	(64.9-78.0)				(19.8-33.5)	(66.5-80.2)	
South Central	210	0.90±0.26	86	124	Severe	191	0.91±0.26	77	114	Severe
Row%			41.0%	59.0%				40.3%	59.7%	
95% CI			(30.4-52.4)	(47.6-69.6)				(29.6-52.0)	(48.0-70.4)	
Combined	695	0.94±0.24	215	480	Severe	633	0.95±0.24	181	452	Severe
Row%			33.8%	66.2%				31.9%	68.1%	
95% CI			(27.8-40.3)	(59.7-72.2)				(25.8-38.6)	(61.4-74.2)	
Urban	233	0.95±0.23	64	169	Severe	212	0.96±0.22	52	160	Severe
Row%			27.6%	72.4%				24.2%	75.8%	
95% CI			(21.2-35.1)	(64.9-78.8)				(18.6-30.9)	(69.1-81.4)	
Rural	423	0.95±0.24	132	291	Severe	386	0.96±0.24	113	273	Severe
Row%			33.9%	66.1%				32.7%	67.3%	
95% CI			(26.4-42.4)	(57.6-73.6)				(25.1-41.3)	(58.7-74.9)	

4.4.6 C-Reactive Protein.

C-reactive protein (CRP) is an acute phase protein and a high serum concentration is an indicator of inflammation. It is important to determine concentrations of CRP as during inflammation, such as that caused by infection, the levels of other serum proteins such as retinol binding protein may be depressed. This can lead to spurious estimates of nutritional deficiencies. The prevalence of high CRP was low in school aged children with no significant difference between groups, as shown in table 57.

Table 57 Frequency of CRP distribution

Strata	Normal ≤ 5.0 mg/L	High >5.0 mg/L	Total
North West	239	25	264
Row % 95% CI	90.5% (87.5-92.9)	9.5% (7.1-12.5)	100%
North East	203	18	221
Row % 95% CI	91.9% (87.3-94.9)	8.1% (5.1-12.7)	100%
South Central	193	17	210
Row % 95% CI	91.0% (86.9-93.8)	9.0% (6.2-13.1)	100%
Combined	635	60	695
Row % 95% CI	91.0% (88.7-92.8)	9.0% (7.2-11.3)	100%

No significant difference between the strata. Chi-Square =0.354

5.0 Malaria

The sex distribution of the subjects tested for malaria was skewed with more women subjects recruited than their male counterparts (65% and 35% respectively). This sex ratio disparity was not significantly different between strata (p=0.140). Similarly, the age distribution was also skewed as shown in the table below. The age has been categorised as those five years and below and those above five years. The age in months has been rounded to the nearest year in order to ease data entry and reduce confusion. The age categories were significantly different between strata, with the North East having a significantly lower number of children under-five years.

Table 58 Distribution of Age Categories in Subjects Tested for Malaria

	5 year and below	Above 5 years	Total
North West	529	947	1476
	35.8% (31.7-40.2)	64.2% (59.8-68.3)	100.0%
North East	380	1078	1458
	26.1% (23.3-29.1)	73.9% (70.9-76.7)	100.0%
South Central	576	1039	1615
	35.7% (33.0-38.4)	64.3% (61.6-67.0)	100.0%
Combined	1485	3064	4549
	34.0% (32.1-36.0)	66.0% (64.0-67.9)	100.0%

The overall prevalence of malaria infection was 1.0%, with no significant difference between strata. Despite the fact that the North East had a higher prevalence of 2.1%, with North West 1.3% while South Central had, surprisingly, the lowest prevalence of malaria with only 0.5%% positive subjects. This difference was however not significant between strata (p=0.091). The table below shows the malaria parasite test results. There was also no significant difference between the two age categories (p=0.936).

Table 59 Malaria Positive Prevalence

Strata	Positive	Negative	Total
North West	20	1500	1523
	1.3% (0.5-3.1)	98.5% (96.8-99.3)	100.0%
North East	30	1431	1463
	2.1% (1.1-3.8)	97.8% (96.2-98.8)	100.0%
South Central	8	1607	1615
	0.5% (0.1-1.8)	99.5% (98.2-99.9)	100.0%
Combined	58	4538	4601
	1.0% (0.6-1.7)	98.9% (98.3-99.4)	100.0%

The proportion of positive responses regarding whether the subject slept under a net was slightly above 15.3%, with a slightly higher bed net use in the North East compared to the other two strata. This difference between strata was significant (p=0.031). There was no significant difference between age categories (p=0.677), neither was there any significant difference in the type of net slept under.

Table 60 Mosquito Net Usage

Strata	Yes	No	Total
North West	193	1330	1523
	12.7% (7.1-21.5)	87.3% (78.5-92.9)	100.0%
North East	422	1043	1465
	28.8% (18.6-41.7)	71.2% (58.3-81.4)	100.0%
South Central	199	1412	1611
	12.4% (6.6-21.9)	87.6% (78.1-93.4)	100.0%
Combined	814	3785	4599
	15.3% (10.9-21.0)	84.7% (79.0-89.1)	100.0%

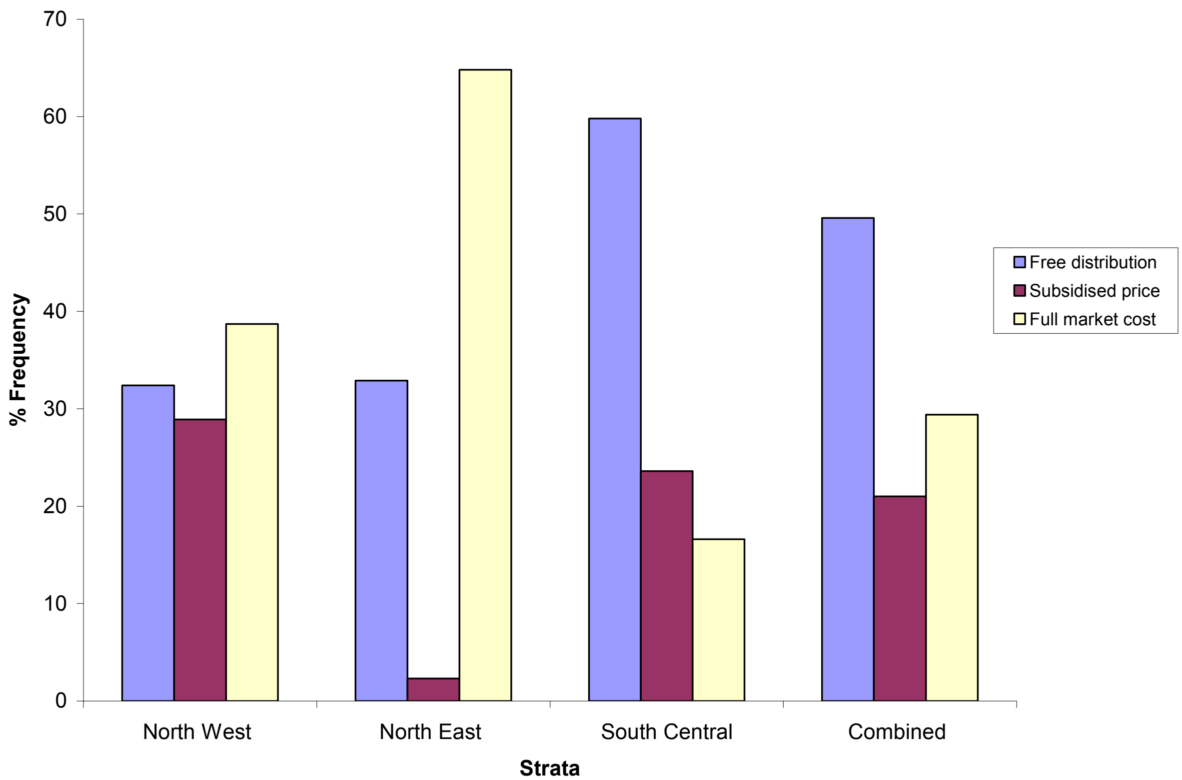
The mean number of mosquito nets owned in all the strata was two per household with 1.46 (±0.7), 1.5 (±0.9), and 1.9 (±1.0) in the North West, North East and South Central respectively. The type of net possessed varied with a higher number of long lasting insecticide treated nets (LLITN) in South Central Somalia as compared to the other two strata, as shown in the table below. This difference between the type of nets within the strata was significant (p=0.022). There was, however, no significant relationship between the type of net and malaria positivity. The sample size was however small to allow a robust statistical inference.

Table 61 Type of Mosquito Nets Owned by the Respondents

	LLITN	Normal Net	Total
North West	157	113	270
	58.1%	41.9%	100%
	(41.0-73.6)	(26.4-59.0)	
North East	211	289	500
	42.2%	57.8%	100%
	(26.0-60.2)	(39.8-74.0)	
South Central	228	65	293
	76.0%	21.7%	100%
	(60.5-86.8)	(11.5-37.0)	
Combined	596	467	1063
	62.6%	36.2%	100%
	(52.1-72.0)	(26.8-46.8)	

The cost of the LLITNs owned by the households varied, with a high number of nets obtained for free or at a subsidised price in South Central compared to the other two strata. The figure below shows the different responses on the cost of the nets. The normal nets have not been included in this analysis as no relief organisation is involved in current distribution.

Figure 21 Costs of LLITN



6.0 Constraints

Somalia is a large country and the majority of the regions have a poor road network. Logistical organisation was therefore a major problem. However, this was over come by conducting the survey in phases and moving to the next phase upon completion of one phase. Puntland, Somaliland, Central and South Somalia were therefore treated as separate phases. Training for the teams was done at the start of every phase with new staff recruited from the respective zone.

Logistics, however, remained a problem even within the same phase but this was overcome by the teams moving from one region to the other until that phase is completed. For example, in Somaliland there were 6 regions and all the 6 teams worked in one region before moving to the next region. Thus, all the teams were within close reach for both ease of monitoring and for management of supplies in case of shortage. Teams were provided with supplies sufficient for the number of clusters to be covered. A checklist of the supplies, with the quantities required, was provided to the team leaders and teams were only released to the field upon confirming that the exact qualities of supplies were issued. Thuraya satellite phones were provided to team supervisors going to areas outside of the mobile phone network and extra equipment including HemoCues and weighing scales etc., were given to teams in remote areas just in case there was a breakdown. Despite our best efforts some logistic problems still occurred when two teams sent to remote areas in Gerisa and Erigavo experienced a shortage of some essential supplies.

Another major challenge was the recruitment of capable teams for the survey as well as hiring serviceable cars that can access the remote areas of Somalia. This was overcome by the presence of FSNAU staff in the field. FSNAU does regular nutritional assessments in Somalia and therefore the participation of their staff in the Micronutrient Study project eased a lot of problems. They were familiar with capable staff who can deliver quality service and also good transport service providers. FSNAU staff also assisted greatly in liaising with local authorities. They were able to provide adequate ground preparations before the start of the survey and seek approval for conducting the assessment in the regions.

Insecurity was also a major challenge mainly in the South and Central Somalia. In this area both the Micronutrient Study Coordinator as well as FSNAU had restricted movement. So a thorough training was provided to the teams and pilot testing was repeated for some teams with unsatisfactory performance. Each team was supervised at the start of their first cluster, which was located within reach of the supervisors, and teams were only sent to remoter areas after satisfactory performance in the first cluster.

The South and Central Somalia is ravaged by clan tensions. Team selections were therefore based on the clans in the cluster to be assessed. FSNAU staff were also useful in this area and ensured teams were sent to clan areas they belonged to or did not have any rivalry with. In South Somalia insecurity is at the highest and here every village has it's own authority which is independent of the next village. However, permission to conduct the survey was granted in almost all the clusters except six clusters in Merka district.

The presence of road blocks manned by militias in the south Somalia was also a major obstacle to safe movement of supplies for the teams. This forced us to fly supplies to specific destination while the staff moved by road. In this case supplies for three teams working in the *Shabelles* were airlifted to an airstrip (K50) which was within reach for the teams operating in the area.

The complexity of the biological sample collection, handling and storage was also a major challenge. This was however overcome by recruiting into each survey team at least two qualified laboratory technicians. The inclusion of the laboratory staff into the teams improved sample collection quality as well as reduced the time taken to cover a cluster. A cluster took on average one and half days.

Although it was not pronounced, there were some misconceptions about the biological sample collection in some survey populations. This was tackled through publicity during the official opening of the training where top officials from the Ministry of Health attended and was also aired in the Zone's local television stations. Each survey team was also accompanied by a respected elder in that cluster who acted as a guide. The elder was useful in explaining the purpose of the tests and also knocking on the doors of houses and introducing the teams to the family before the consent was requested. The presence of testing facilities and treatment for anaemia and Malaria also improved acceptance.

In summary, the factors that contributed to the successful completion of the survey in the volatile context of Somalia included: the participation of FSNAU staff that were well versed with the geopolitical situation of Somalia; recruitment of good quality survey teams; good supply chain management; the provision of Haemoglobin and Malaria testing and treatment to survey participants; and the presence of community leaders who accompanied the survey teams during fieldwork

The planning, data collection and report writing took a period of about 17 months. Planning of the survey took place from November 2008 to February 2009, while the data collection period was from March to August and sample shipment, laboratory analysis and report writing took place from September 2009 to March 2010. It is however important to note that more time should be allocated in the future when implementing similar projects in such complex countries. A minimum of 20 months is recommended based on experience with this survey.

7.0 Comparison with other Studies

Studies and surveys that have been performed in Somalia are more or less restricted to emergency assessments and focus mainly on food security and anthropometric assessments. It is unfortunate that little work has been done on micronutrient nutrition but in this section the results form the current survey are compared against other available data.

One main document that could have potentially provided useful comparison data is the MICS 2006 survey report. However, there were some concerns raised over the soundness of the malnutrition data and thus the need to interpret the same with caution. On the other hand, the MICS studies have a larger sample size hence the likelihood of more representativeness. In this section we will refer to the MICS 2006 report but comparisons will be interpreted with caution.

The use of improved water source in Somalia is indicated in this report to be overall 32.4%. MICS 2006 similarly reported on a close percentage of improved water use in Somalia of 29%. It is important to note however the gap between these two surveys is about 4 years and improvement of access to safe water might have taken place during this time albeit small.

The prevalence of acute malnutrition for the combined zones/strata is 13.9 % (95% CI 11.9-16.0), stunting 23.1% (21.0-25.4) and under weight 19.5% (17.1-22.0). Despite the many nutritional assessments done in Somalia there are minimal data that provide national malnutrition prevalence. FSNAU does large assessments that are based on livelihood zones. However, the median national figure derived from 34 representatives surveys show a GAM prevalence of 19% and SAM of 4.6%[46] which are comparable to the results of this report. The MICS 2006 survey showed a prevalence of wasting of about 11%, stunting 38% and an under weight prevalence of 36%. However it is not very clear whether the prevalence reported for wasting MICS 2006 included oedema. The earlier MICS 1999 survey reported a wasting prevalence of 17%.

Exclusive breast feeding in children below 6 months was found to be 9% in the MICS 2006 survey, higher that the 5.3% found in this report. However, the 9% therefore is still within the 95% interval (3.1-9.2) reported in this report. Continued breast feeding reduced from 60.8 (50.6-70.1) to 26.8% (17.1-34.6) in the 12-15 and 20-23 months olds in this study. The continued breast feeding however is high in the

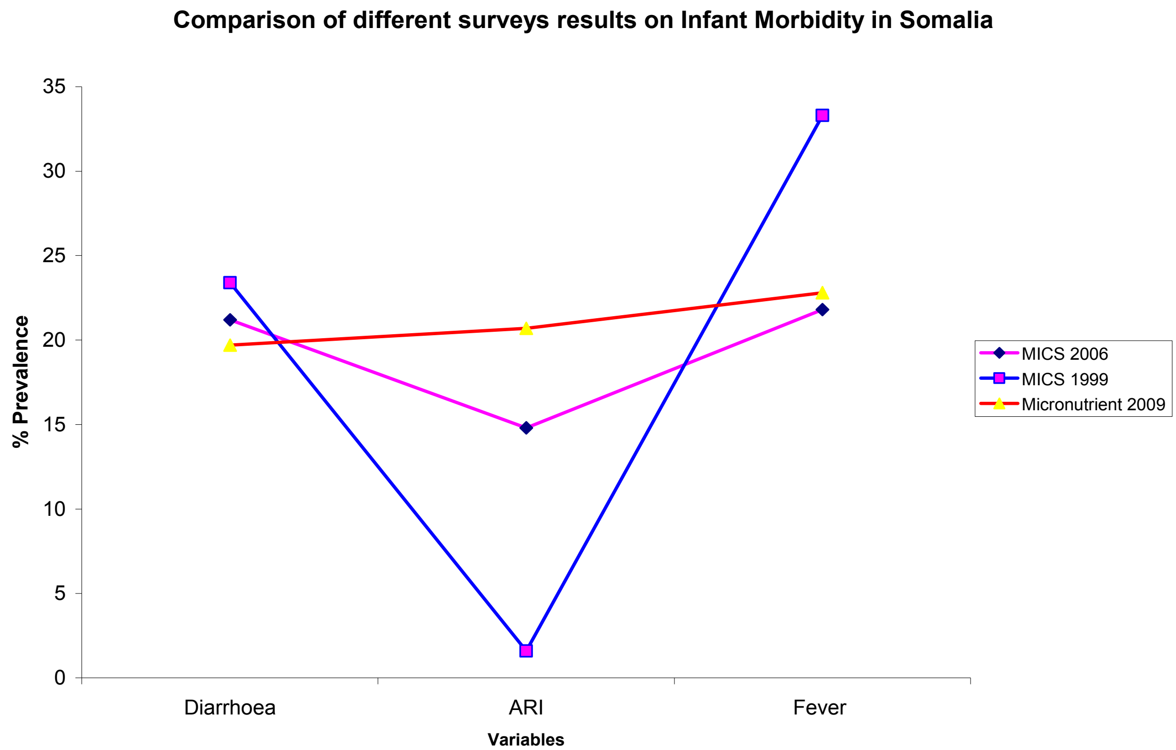
46 FSNAU (2009) Technical Series. Report No VI.25. Nutrition Situation Post Gu' 2009.

MICS 2006 with 50% and 35% for 12-15 and 20-23 months respectively. Timely initiation of breast feeding was reported in the MICS 2006 to be 26% which is comparable to the 23.4% (95% CI: 18.5-29.1) and the prevalence is within the margin of error.

The vitamin A supplementation coverage reported here for the under fives is 44.6% (37.6-51.8) and slightly over 20% for women. However, the MICS 2006 survey reported lower coverage figures of 24% and 9% for children under five and women respectively. The MICS 1999 showed relatively high values of vitamin A supplementation of children under fives months and women at 39.2% and 13.4% respectively. It is however important to note that our data might have been skewed by the national health days that was conducted in North West and Central regions of Somalia before our study.

The number of children 0-23 months who had diarrhoea, acute respiratory infection and fever was 19.7%, 20.7% and 22.8% respectively in Somalia. These figures are comparable to MICS 2006 which reported 21.2%, 14.8% and 21.8% for diarrhoea, ARI and fever respectively. The MICS 1999 also reported 23.4%, 1.6% and 33.3% for diarrhoea, ARI and fever respectively. It is however important to note that while our study reported on the morbidity of children between 0-23 months the MICS had a wider age range of 0-59 months. It is interesting to note the very low prevalence of ARI recorded in the MICS 1999 survey. The graph below shows a comparison of infant morbidity recorded in the three studies.

Figure 22 Comparison of Infant and Young Child Morbidity



There is, unfortunately, minimal information available on anaemia prevalence from previous assessments. Surveys done in Somaliland in 2001 reported a prevalence of anaemia of about 58.9% in children under the age of five[47]. This data is similar to the overall anaemia prevalence of 59.3% obtained in this study. Comparing our data from the North West strata where the 2001 study was conducted, we find a slightly lower prevalence (45.2%) of anaemia. No regional of national data on anaemia in women is available; however comparable ethnic groups in Djibouti refugee camps had a prevalence of 44.5% (37.6-50.4) in non pregnant women[48] as compared to 46.6% in this report. This anaemia prevalence is similar, however is it worth noting that the Djibouti population are refugees in camps and mainly depend on relief aid, contrary to Somalia. The anaemia prevalence in children under five in Djibouti was 66.6% which is slightly higher than the prevalence in this report. Similarly, a WHO anaemia survey in the Somalia region of Ethiopia gave a high prevalence of anaemia of 85.6%[49] among children between 6-59months. The sample size was however small (124) and the actual methodology of the survey could not be ascertained due to lack of access to the whole report.

47 WHO (2005) Global Database on Anaemia Somalia (www.who.int/vmnis/anaemia/data/database/countries/som_ida.pdf)

48 CIHD/UNHCR (2008) Anaemia, Infant Feeding And Anthropometric Validation Survey, Djibouti

49 WHO (2005) Global Database on Anaemia-Ethiopia. (www.who.int/vmnis/anaemia/data/database/countries/eth_ida.pdf)

WHO also conducted an anaemia assessment in three villages in Shebelle region in 1989 which showed a high prevalence of anaemia of 72.2% with a 4.5% severe cases[50] on a sample size of 280 women.[51]

Previous data on iron deficiency in Somalia is, to our knowledge, completely lacking and it is therefore hard to make any comparisons. However studies done in Dadaab refugee camps on pregnant Somali women gave a prevalence of iron deficiency of 51.0% at gestation between 16-24 weeks and 64% at 30-34 weeks[52]. This information, though not directly comparable due to the state of the different populations, can be used to provide some indication of the likely prevalence of iron deficiency in Somalia. In fact, the findings in this report give national estimates for iron deficiency of 42.7% for all women and 41.2% for non pregnant women.

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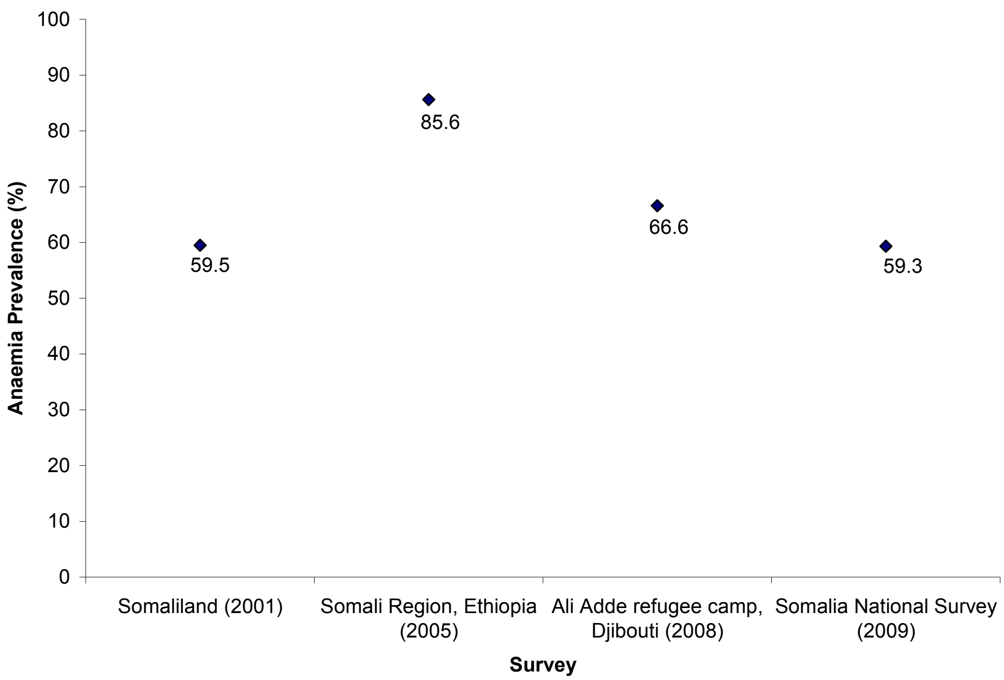
50 WHO (2005) Global Database on Anaemia-Somalia. (www.who.int/vmnis/anaemia/data/database/countries/som_ida.pdf)

52 UNHCR/CICH (2003). An effectiveness trial of antenatal multiple micronutrient supplementation: report on main findings and provisional recommendations. Dadaab Refugee Camp, NE Kenya,

All this different figures discussed above show a high prevalence of anaemia and all the survey results exceed the WHO population anaemia classification of 40% which indicates a severe public health problem[53]. The graph below shows a comparison of the surveys of anaemia prevalence in children of Somali origin.

Figure 23 Comparison of Anaemia prevalence between different populations in children 6-59 months



The urinary iodine survey results found in this current study indicate high and in some cases excessive intakes of iodine. No previous surveys or studies exist in Somalia on iodine status. However, studies done in five refugee settings in Kenya, Ethiopia, Uganda, Algeria and Zambia showed median levels that also indicated excessive iodine intake. In a study in Kebribeya, which is a refugee camp in Ethiopia that hosts Somali refugees, a median UIC of 254 μg/L in 10-19 year old adolescents was found.[54] Similarly, a study done in Dadaab in Kenya, which hosts Somali refugees, showed excessive urinary iodine

53 World Health Organization. 2001. Iron Deficiency Anaemia: Assessment, Prevention, and Control. A guide for programme managers.WHO/NHD/01.3

54 Seal, A. J., Creeke, P. I., Gnat, D., Abdalla, F., & Mirghani, Z. (2006). Excess dietary iodine intake in long-term African refugees. Public Health Nutr; 9 (1), pp. 35-39.

concentration with a median UIC 845µg/l and 660 µg/l in Ifo and Dagahaley refugee camps respectively. This study was done among pregnant women attending antennal clinics[55]. It is worth noting however that these findings are based on refugee settings where the excess iodine could be linked to food aid and excess iodine content in salts (for example Kenyan salt). The Somalia population has no access to iodized salt and neither does the population depend on relief aid to the same extent. It is therefore an area of further interest to establish the source of the excess.

In this study, only 3.9% of the household were consuming adequately iodized salt. In comparison, MICS 2006 reported 1.2% of the Women using iodized[56] salt while the MICS 1999 survey showed household salt iodization less than 1%[57]. It is however worth mentioning that in the MICS 2006 the analysis of the number of household utilizing iodized salt was done by the inclusion of households that had no salt at home. This therefore pushes the percentage of household utilizing iodized salt to a lower value. At the time of the report writing, the MICS 1999 document could not be made available and thus the methodology could not be ascertained.

55 Ismail A. R.Kassim, Laird J. Ruth, Paul I. Creeke, Danielle Gnat, , Fathia Abdalla, and Andrew J. Seal. Excessive iodine intake amongst Long-Term Food Aid Dependent Pregnant Women in Dadaab Refugee Camps Kenya. In preparation.

56 UNICEF (2006) Multiple Indicator Cluster Surveys (MICS) and Millennium Development Goals (MDG) Indicators, Somalia.

57 UNICEF. 1999. Multiple Indicator Cluster Survey, Tables from Somalia, 1999. United Nations Children's Fund, New York. (available at http://www.childinfo.org/files/somaliatables.pdf

8.0 Discussion and Conclusion

Survey scope and main findings

The implementation of this micronutrient survey in Somalia was an important step in understanding the scope of nutritional deficiencies and providing an evidence base for planning future interventions. The survey also enabled the provision of data at both zonal and national level, which is important in understanding difference within Somalia and identifying areas for high priority intervention. The prevalences of vitamin A and anaemia have both been found to comprise severe public health problems and strategies for there control and reduction should therefore receive urgent consideration. Contrary to expectation, the median urinary iodine in Somalia was also shocking with median levels showing iodine excess suggestive of excessive iodine intake which should also receive urgent consideration due to potential public health implications.

Overall, anaemia prevalence was 59.3% (54.8-63.6), 49.1% (40.8-57.4), 38.5% (33.5-43.7) in children 6-59 months, women and school age children (6-11 years) respectively. These levels exceed the 40% cut off used by WHO to classify anaemia as a high public health priority. Iron deficiency was similarly high in children 6-59 months and women with 58.9% (53.5-64.1) and 41.5%, (36.5-46.7) respectively but relatively lower in school aged children at 20.8% (16.9-25.4). Prevalence of vitamin A deficiency similarly indicated severe situation with prevalence levels exceeding the 20% WHO cut off for severe. The prevalence of Vitamin A deficiency was 33.3% (27.5-39.6) 54.4% (48.3-60.4) 31.9 (25.8-38.6) for children 6-59 months, women and school aged children respectively. It should be noted that vitamin A in this survey was assessed using the concentration of Retinol Binding Protein (RBP) rather than the direct measurement of serum retinol.

Unexpectedly, with household iodised salt utilization of 3.9% (1.3-11.3), the median urinary iodine concentration exceeded the WHO upper limit of 300 µg/L for school aged children and non pregnant women. The overall median UIC was 325.1 and 417.1µg/L for non pregnant women and school aged children respectively, implying over 50% of the population had excessive urinary iodine concentration.

It is however important to note that the Somalia micronutrient study focused on a range of other variables apart from the Micronutrient assessment. In general, the findings of this report highlight alarming situations regarding many indicators, ranging from infant feeding practice to acute malnutrition as well as micronutrient nutrition. Concerted and multi-sectoral efforts are required to improve the alarming heath and nutrition situation in Somalia as a whole, while targeting specific regions and sub-groups on specific indicators.

Survey coverage and organisation

A delicate security situation existed across the whole of Somalia during the time of the survey, but security concerns and difficulties in gaining humanitarian access were especially acute in certain areas. The situation was also quite fluid with changes occurring rapidly in some parts of the country that would lead to opening or closing of access.

As a result it was decided during the planning phase that excess clusters would be included in the sampling plan on the assumption that some of these would become inaccessible during survey implementation. In addition, some areas were considered to be too insecure to consider accessing and were excluded from the survey sampling frame. These excluded areas were Belet Weyne District in Hiraan region, Jowhar district in Upper Shabelle and Mogadishu and Kismayo cites. These exclusions are indicted on the map at the front of the report.

In the North West and North East 35 clusters were randomly selected for assessment while 40 clusters were selected for assessment in the South Central Somalia. Three clusters in the North West in Sool region (Faradhidhin, Dharkeyn and Carooley) and four clusters in the North East (Xiriro, Ufayn, Eyl town and Bandiradley) were later cancelled after security clearance was denied. In South Central Somalia a total of seven clusters could not be accessed: one cluster in Bulo Burte and six clusters in Merka District. Therefore, a total of 32, 31 and 33 clusters were assessed in North West, North East and South Central respectively.

The need to exclude certain areas in South Central from the sampling frame and the decision by authorities in Merka to not grant administrative permission for the survey to proceed means that the results from South Central need to be carefully considered in terms of representativeness. However, on the whole the survey covered a wide span of Somalia and the data obtained from the three strata is able to provide a useful picture of nutritional status in Somalia.

The use of well experienced survey teams and conducting the survey in three phases further improved the quality and enabled close supervision of teams. In the North East and North West teams moved from region to region and close supervision and logistics were easily achieved using this arrangement. Daily quality controls of machines, reviewing and counterchecking of filled questionnaires and biological sampling records further helped in improving both interviewing techniques and sample collection. The use of FSNAU Nutrition field analyst based within Somalia was important in team selection and supervision as well as logistic and planning of team routes.

Household characteristics

The type of dwelling was similar between North West and South Somalia, however a lower number of make shift dwellings were recorded in the North East. Two factors may have contributed to this observation. Firstly, the number of clusters selected in North East had a higher number of urban clusters as compared to the other two clusters. It was observed that there were a higher number of permanent and semi-permanent structures in the urban clusters. Secondly, unlike the North West and South Central, that had 2 and 5 IDP clusters respectively, the North East did not have any IDP clusters. IDP and rural clusters have a higher number of makeshift structures than the urban settlements.

Overall, there was significant ($p=<0.001$) difference in the gender of the household head by with a higher number of household headed by men. However, in the North East there was a higher number of households headed by women. The reason for this is not well understood, however it this difference may be due the high number of household sampled from the Urban settlements. But this may not explain entirely the higher rate of women headed households in North East. On the other hand, from the demographic data it can be seen that a higher number of never married women were included in the sample in North East (14.2%) as compared to North West and South Central with 8.6% and 7.9% respectively.

The question on whether households hosted refugees differed between strata with North West having lower number of households hosting refugees as compared to North East and South Central Somalia. However, the number of households hosting refugees in North East and South Central are similar suggesting that many people fleeing the war in parts of South Central either move to safer areas within the South Central Somalia or move to Puntland regions which is much closer to the South than the North West strata. Clan affiliation may also be an important determinant of migration patterns and the locations where settlement of IDPs occur. Movement of people across international borders into Yemen and elsewhere may also be significant.

The main sources of income differed significantly between strata. Casual labour was the main source of income in North West (41.9%) and North East (53.0%) but comprised a small percentage in South Central Somalia (7.1%). The assumption of this scenario is mainly thought to be due to the relative peace and stability in the two regions as compared to South Central Somalia. However, seasonal affects can not be ruled out. The availability of peace builds a culture of investor confidence and this create jobs in construction, ports, hardware etc. The same trend also applies to income sources from salaries and remittances. South Somalia is the main agricultural area of Somalia which puts crop sales and farming as the main source of income for the majority in the south compared to animal husbandry in the other two strata.

It is interesting to note the small percentage of households who reported receiving relief food and this is an important issue to explore further. While it can be assumed that most aid agencies supplement household resources rather than providing full support, as in some refugee camps, it is also important to consider the possibility of respondent bias. Despite informing the respondents that the interview or questions asked will not affect their food, health and any other services offer, it is important to keep in mind that this question may have been affected by the assumption that they might get more food aid.

The availability of improved water was relatively higher in North East (47.1%) with North West (31.9%) and South Central (28.0%) having lower access to improved water. The higher percentage in North East may again be related to the higher number of urban clusters. It is interesting to note there is an overall increase of 4% access to improved water from the finding in the last MICS 2006, although this lies within the confidence interval. Household water treatment using chlorination was the most popular type of treatment across all strata. No significant difference was noted in the type of water treatment. However, it is important to note that the chlorination mentioned in this survey was mainly chlorination at source in areas with tap water and is based on the assumption of the respondents that the water is treated at source. It therefore does not capture the intended and important indicator of household water treatment. Anecdotally, minimal household water chlorination exist however it would be worth looking into this I more detail in future surveys.

Dietary intake

The number of meals eaten per day was significantly different with South Central Somalia having a higher percentage (73.7%) of household families only eating two meals a day as compared to the other two strata. The mean number of food types eaten was above 5 food types per day. It is however saddening that a higher number of locally available and micronutrient rich food groups are poorly consumed. Food types like fish, egg, organ meat, fruits and Vitamin A rich vegetables and fruits are least consumed. Poor food diversity and a narrow food types coupled with the current economic crises and lack of knowledge of diets contribute timely to the narrow food groups and poor utilization of the locally available food sources. Anecdotally, selling of macro and micro nutrients rich food for different type of cereals like rice and pasta lead to higher consumption of a monotonous cereal diets and contribute to both the macro and micronutrient malnutrition rates. Further in-depth studies on food consumption patterns and barriers to consumption of locally available food types are important to pursue in the future.

Anthropometry in women

Almost 21.5% of the women were underweight with a BMI of less that 18.5 kg/m^2, while about 14.0% were overweight and 6.7% were obese. There was a significant difference in these categories between strata with North East having less than 15% underweight while the North West and South Central had 21.0% and 23% respectively. The trend seems to follow anthropometric indicators in children. On the other hand a higher number of overweight women was seen especially in North East and North West with 12.2 % and 8.7% respectively. These results have however not been standardised using the Cormic index and currently there is no standard for assessing adult malnutrition. It is however important to note that these figures still suggest a significant energy deficiency in women in Somalia that is a public health problem.

Providing specific attention to rural women is needed due to the higher rate of malnutrition. On the other hand it will be useful to sensitise the public on the risks of overweight and obesity which is likely to increase in subsequent years. Cultural practices of high fat diets coupled with little activity play an important role in weight increase which is common among the Somali women, especially after delivery. Despite the fact that the risk attributable to being overweight on morbidity and mortality differs with populations the need to monitor this group in the future will be important.

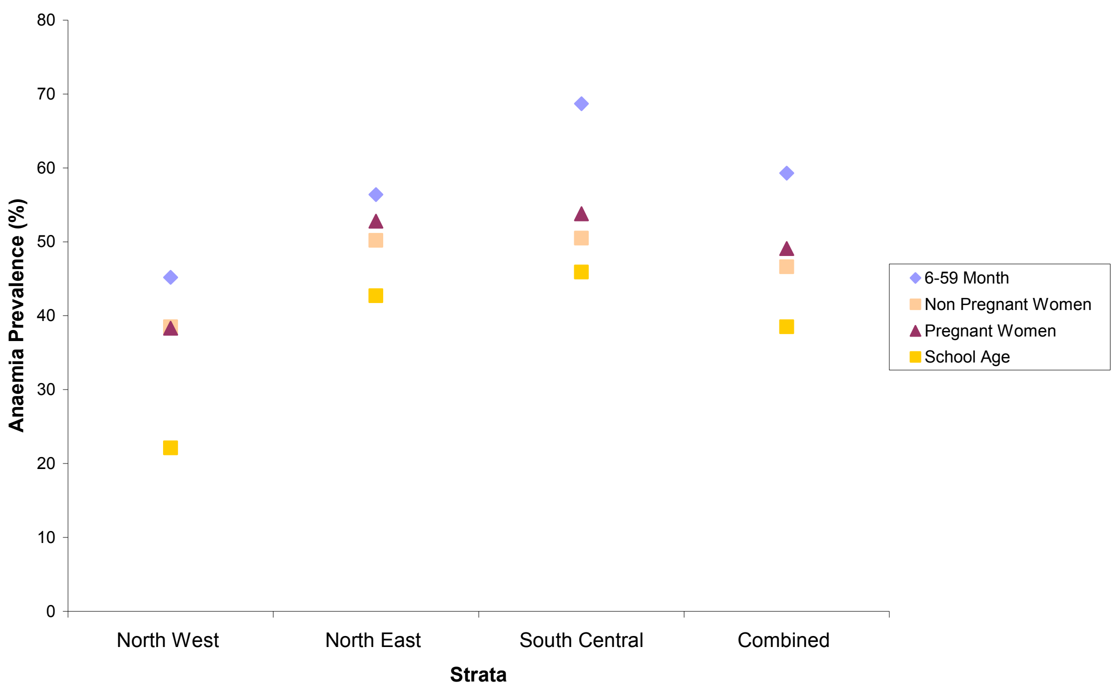
Anaemia and iron deficiency

As shown in the graph below, the prevalence of anaemia is alarming across the three different target groups. Except for school age children all other combined groups have an anaemia prevalence higher than the 40% cut-off suggested by WHO[58] indicating that anaemia prevalence in Somalia is in a severe state and an urgent public health priority. The prevalence of anaemia in less than two years children was also alarming with 73.7% (95% CI 67.7-78.9) prevalence. Rural children are more affected by anaemia than those in urban settings in spite of the prevalence being over 40% for all groups. Poorly diversified food and poor consumption of micronutrient rich foods together play a key role in contributing to the high

58 World Health Organization. 2001. Iron Deficiency Anaemia: Assessment, Prevention, and Control. A guide for programme managers.WHO/NHD/01.3

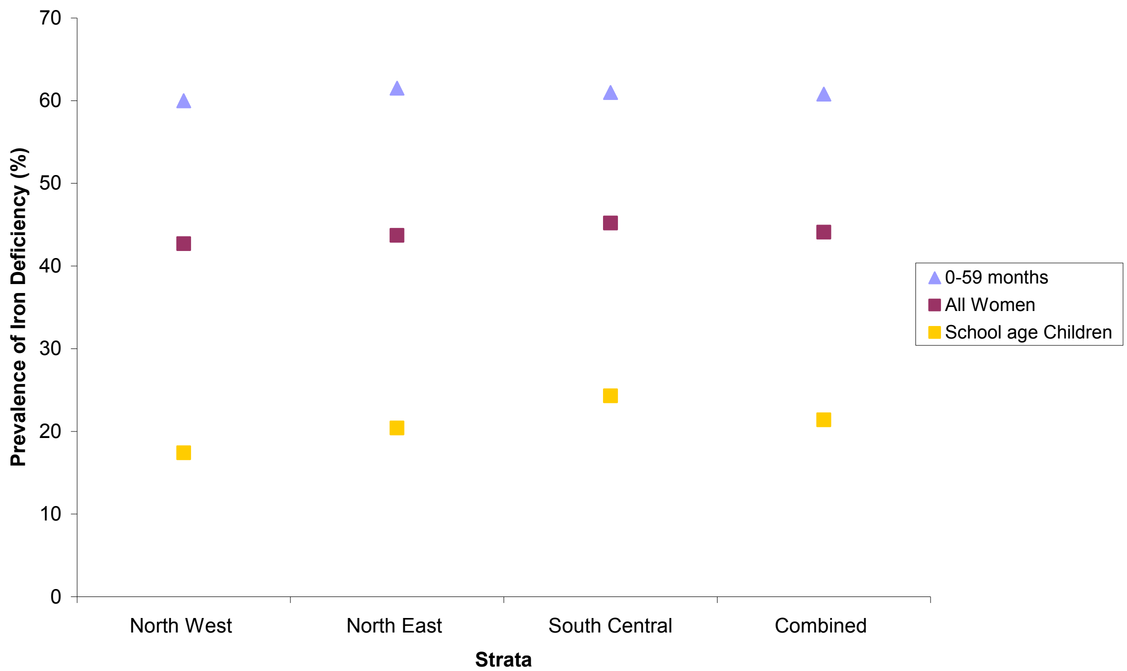
prevalence of anaemia in Somalia. The consumption of tea by the majority of the target groups with food will reduce the absorption of dietary iron. Tea is in many cases used to soften pancakes for kids and taken with most foods by older people. The poor infant feeding practices, limited exclusive breastfeeding and poor consumption of locally available food similarly contribute to the high prevalence of anaemia and a possible cause for the high level of anaemia in the under two years. Anaemia is associated with impaired physical and cognitive development in children, poor mental and physical performance in adults, increased risks of infectious diseases, and numerous other problems. Urgent remedial action to address this problem needs to be considered for Somalia.

Figure 24 Anaemia Prevalence of All Sampled Groups



The prevalence of iron deficiency is also above 40% except for school age children (see figure). With iron deficiency there is less variation in prevalence by strata but the pattern seen for anaemia in the different age groups is also reflected in the figures for iron deficiency, with school aged children having least deficiency and children 6-59 months having the worst status.

Figure 25 Comparison of Iron Deficiency in Different target group



The malnutrition prevalence in children 6-59 months are serious and critical in some strata. The overall GAM prevalence for Somalia was 13.9% in this report which places represents a serious public health problem according to the WHO classification of wasting. South Somalia however had a higher prevalence of malnutrition of about 16.5%, which is classified as critical. In considering differences between strata it should be borne in mind that the survey was done in phases and each phase fell into a different season. The survey periods and the seasons are shown in annex eight.

Global acute malnutrition in infants 0-5 months was similarly high, with a combined prevalence of 17.1% (12.6 - 22.9). The prevalence of severe acute malnutrition was also very high at 8.1 % (5.2 - 12.5). These prevalence are much higher than the prevalence of malnutrition in children 6-59 months and exceed the WHO threshold of 15%. It is however important to note that the measurement of length in infant was a big challenge and interpretation of these results must be done with care. The prevalence of stunting which might have been on a more accurate measurement was low with 15.2 % (10.6 - 21.2) as compared to that of children 6-59 months (23.2%). The poor infant feeding with low exclusive breastfeeding could be contributing to the high malnutrition prevalence in this age group.

Overall, the prevalence of malnutrition in Somalia is serious and calls for immediate attention. As explained earlier, poor infant feeding, timely complementary feeding and lack of adequate utilization of locally available micronutrients rich food contribute greatly to the high rate of malnutrition in Somalia. Poor breastfeeding practices and early introduction of foods, coupled with unregulated advertisements and sales of powdered milk and other sources of infants products, is also contribute to poor infant and young child feeding practices contribute to the high prevalence of malnutrition. Other factors that are likely to contribute to the problem are high food prices and limited access to food sources, leading to a reduced consumption of balanced diets and a high dependency on a monotonous cereal-based diet.

Malaria prevalence was extremely low in all the strata and especially for South Central Somalia despite previous assumptions of a relatively high prevalence. A similar previous study in South Central Somalia reported a prevalence of malaria of 15.7% in a sample size of 10,587[59]. Malaria is highly season dependent in Somalia and the previously published study was conducted in South Central during the *Gu* season which is expected to have a high malaria prevalence. This current micronutrient study was carried out in July in South Central Somalia which was during the *hagaa* season when a low number of malaria cases may be expected.

However, the bed net use is comparable to the above publication with 15.3% bed net use for the whole country and 12.4% for South Central, which was identical to the previously measured usage. It is important to note that over those who owned nets 29% (95% CI 59.9-80.0) did not sleep under a mosquito net. This could be due to insufficient number of nets at home rather than deliberately choosing not sleeping under the net.

Vitamin A deficiency

The prevalence of Vitamin A deficiency was high in both children 6-59 months and school age children. These levels exceed the 20% threshold by WHO and characterise vitamin A deficiency as severe in these groups and thus a priority public health problem. It is worth noting that the prevalence of Vitamin A was low in women as compared to the above age groups. When interpreting these results it is important to note that vitamin A status was assessed using the concentration of RBP. There are still no internationally agreed cut-offs for use with RBP. However, Gorstein et al suggests that a 0.825 μmol/L cut-off provides the most optimal screening proficiency that is comparable to 0.70 of retinol in children[60].

59 Abdisalan M. Noor, Grainne Moloney, Mohamed Borle, Greg W. Fegan, Tanya Shewchuk, and Robert W. Snow. (2008)The Use of Mosquito Nets and the Prevalence of Plasmodium falciparum Infection in Rural South Central Somalia

60 Gorstein, J. L., Dary, O., Pongtorn, Shell-Duncan, B., Quick, T., & Wasanwisut, E. (2007) Feasibility of using retinol-binding protein from capillary blood specimens to estimate serum retinol concentrations and the prevalence of vitamin A deficiency in low-resource settings. Public Health Nutrition 11: 513-520.

This cut off has also been used in the analysis of DHS surveys in Uganda and was the one we adopted for this survey. Higher levels of vitamin A are necessary for older age groups and Baingana et al[61] have used 1.24 μmol/l as a cut-off for women. This was the value we also used in the analysis of the current survey.

An interesting finding is the lack of a difference in the deficiencies between rural and urban settlements. Although there was no significant difference in the prevalence of Vitamin A and use of food types, there could be a relatively higher access to animal products in the rural areas that might be the cause of balancing out the prevalence of the two groups.

There is no available data in Somalia to compare with the prevalence of Vitamin A determined in this survey. However a high prevalence of Vitamin A is usually thought to be prevalent in sub Saharan Africa[62]. Seal et al have also shown high prevalence of Vitamin A deficiencies in Kebribeya refugee camp in Ethiopia that is inhabited by Somali refugees. The prevalence of Vitamin A in here was 20.5%[63].

Iodine status

The finding of excessive iodine intake in Somalia is interesting and unexpected. Iodine intake and the risk of health problems is a delicate balance with both extremes of high and low levels of iodine having adverse consequences on health. This results in a narrow optimal range of iodine nutrition. Excessive iodine intakes have been associated with goitre, hypothyroidism and hyperthyroidism. The most severe consequences include iodine induced hyperthyroidism which may lead to death in extreme conditions, usually due to heart related problems. [64,65,66]

Household iodised salt utilization was generally poor in Somalia. The relatively higher number of iodised salts in South Central was mainly on the clusters that are at the boarder between Kenya and Somalia

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61 Baingana, R. K., Matovu, D. K., & Garrett, D. (2008) Application of retinol-binding protein enzyme immunoassay to dried blood spots to assess vitamin A deficiency in a population-based survey: The Uganda Demographic and Health Survey 2006. Food and Nutrition Bulletin 29: 297-305.

62 WHO (2005) Global prevalence of vitamin A deficiency in populations at risk 1995–2005: WHO global database on vitamin A deficiency.

63 Andrew J. Seal, Paul I. Creeke, Zahra Mirghani, Fathia Abdalla, Rory P. McBurney, Lisa S. Pratt, Dominique Brookes, Laird J. Ruth, and Elodie Marchand (2005) Iron and Vitamin A Deficiency in Long-Term African Refugees. Journal of Nutrition.

64 Laurberg, P., Bulow, P., I, Knudsen, N., Ovesen, L., & Andersen, S. (2001). Environmental iodine intake affects the type of non-malignant thyroid disease. Thyroid, 11, (5), pp. 457-469.

65 Delange F. (2002) Iodine deficiency in Europe and its consequences: an update. European Journal of Nuclear Medicine and Molecular Imaging; 29: 404–416.

66 Zhao, J. Clive E. West. Karin Haks, Sabine C. de Greeff, Nico Bleichrodt, Peihua Wang and Xiaoshu Hu. (2001) Iodine excess and its relation to cognitive development: epidemiological evidence from China. In Zhao Jinkou Iodine deficiency and iodine excess in Jiangsu province, China. Thesis Wageningen university, Netherlands.

and particularly in Gedo region. Salt in Somalia is mainly obtained from sea beds on the red sea and the Indian Ocean. A few sources are also reported to come from in mountain tops, especially in South Central. A few examples of imported iodised salts were found in some shops in major cities in the North East and North West. This salt, however, is not very popular due the cost and perhaps lack of knowledge on the importance of iodine on health. Salt produced in various areas such as: Garcad and Huudiye in North East and Zeila in the North West can be bought at very low cost. A 400 gram packet of salt that can be used for about several weeks is sold at 1,000 Somali shilling and a 50kg sack of salt costs about 160,000 (5 USD).

The prevalence of Goitre was higher in North West as opposed to South Central. Although palpation of goitre was not done, it is however important to note that a visible goitre prevalence of 3.3% in North West is significant and an analysis of how this correlates with urinary iodine concentration is currently under way.

The results reported here therefore argue against the use of household salt iodisation utilisation as an indicator for assessing the risk of iodine deficiency. They also question the need for nationally targeted iodine programmes in Somalia at the current time. However, these results do not in any way rule out the possibility of there being geographic pockets of iodine deficiency or population sub-groups that are iodine deficient and requiring intervention. Further studies would be needed to address these questions.

8.0 Recommendations

In order to address the problems of malnutrition identified by the survey, a one day consultative meeting was convened by FSNAU for all stake holders and conducted on March 30th 2010 at the Somalia Secretariat Support (SSS) Baobab Conference Room. The following recommendations are informed by the results of this consultation.

A. <u>Iodine Intake</u>

1) Exploring the Results Further

a) Given the high iodine intakes reported for both children and adults there is need for further research on the sources of iodine. FSNAU will contact SWALIM to discuss the possibility of investigating the iodine content of water sources in Somalia..

b) Further investigations could be conducted on the levels of dehydration of individuals from the sampled populations; this may provide insight on the high iodine concentration reported, as high levels of dehydration in an individual may increase the iodine content in urine. This will be discussed further with ICH.

c) Comparative studies that assess the level of iodine among similar populations in the region for example populations from Dadaab refugee camp and Ethiopia should be reviewed in order to compare the results and assess for any similarities among the groups that can explain the high iodine levels observed.

d) There is need to consult and discuss the results with international experts that conduct research on iodine, this would assist greatly in further understanding the possible causes of the high iodine results reported. A core group of experts should be called together to identify further research needs.

2) Policy Restriction on Provision of iodized Salt

a) It was suggested that the promotion of iodized salt and or efforts to promote the internal production of iodised salt in the country are minimized, until the source of excessive iodine intake is clarified.

b) The Health Sector should also be advised to restrict any promotion of the consumption of iodized salt until further research is conducted on the source of ingested iodine. However, it is stressed that there is currently *no evidence* of any ill effects from iodine intake in Somalia and it would be inappropriate to raise unnecessary alarm.

c) Aid agencies should be advised not to distribute relief food that contains iodised salt until further research on the source of ingested iodine. Where possible, distributed food aid products should not be fortified with iodine.

3) Goitre Clinical Case Detection

a) Further analysis may be required on to understand the clinical implications that high iodine intake has on the Somali population. The reporting of high iodine intakes alone does not indicate whether unfavourable physiological consequences are occurring. Thyroid function tests are required to investigate the effects..

B <u>Anthropometric Findings (Focus on Women and Children)</u>

1) Further Research

a) FSNAU should conduct further research and disseminate the BMI values findings for the women collected during the study after adjustment using the Cormic index. This will assist in interpretation of the results on women's nutritional status and provide fuller information for appropriate response planning.

b) Additional analysis should also be conducted by FSNAU to compare these results with MUAC data collected from women in other studies conducted at a similar time.

c) Further research is also required to understand the cultural issues affecting women's household food access, perceptions of women's weight and eating habits, and how this could be affecting the high level of acute malnutrition. Studies should include the issues of intra household sharing of food and restriction of certain food types.

2) Campaigns and Programmes Promoting Appropriate Practices

a) Breastfeeding support and counselling programmes are essential for women and infants/children and should be strengthened. These programmes can also be used as an entry point for vitamin A and iron supplementation. These programs are particularly useful for vulnerable groups such as internally displaced populations.

b) Professional communication campaigns that promote appropriate infant and young child feeding practices should be conducted with relevant and helpful information on food preparation, appropriate complementary feeding and weaning and hygienic practices. These should be simple, focused, and regionally specific.

c) A child friendly environment should be provided within IDP camps and in all MCH facilities to support breastfeeding.

d) Positive deviance studies should be shared and used to promote good practices. For example, in Somaliland the rates of exclusive breastfeeding are higher compared to other regions, this can help in informing and encouraging best practices in other regions.

e) A detailed action plan on the IYCF recommendations should be developed from the recommendations of the KAP study carried out in Somalia in 2007.

f) Weight monitoring of women during pregnancy, should be undertaken and used to promote healthy weight gain. Healthy eating habits should be encouraged to prevent both underweight and overweight conditions in women.

g) Women's workloads should be considered when designing programmes to ensure that women are not spending too much time and resources participating in these programmes and therefore compromising the quality and time they spend on other activities.

h) Appropriate food consumption habits should be promoted, including the consumption of foods of adequate quality and quantity and reducing the consumption of tea at meal times, as this affects the absorption of iron and is a risk factor for anaemia.

C <u>Vitamin A and Iron Findings</u>

1) Supplementary/Therapeutic Approaches

a) Given the different levels of vitamin A and iron deficiency in the country, when designing the interventions, a regional specific approach should be used to ensure that the interventions are relevant to the population in the region.

b) Improve optimal immunization coverage and vitamin A supplementation for children and women through e.g. Routine EPI (fixed and outreach) activities and Child health Days. With enhanced logistical support to ensure supplies meet demand etc .

c) Vitamin A and iron supplementation and vaccinations for children and women should be provided at MCH facilities and nutrition centres. In addition, these services should also be provided at birth in skilled delivery points.

d) De-worming programmes for women (including pregnant) and children should be promoted and conducted in various fora such as health centres, schools etc.

e) The nature of pastoralist populations need to be considered when designing outreach programmes to improve health service access. Strategies such as combining child and animal vaccination campaigns at water points or on market days should be considered

f) Teachers in schools should be trained to identify basic signs of micronutrient deficiencies e.g. pallor and fatigue, and thereafter refer the affected children to the relevant treatment centres in the area.

g) Fortification of school meals with iron and micronutrients, especially those provided in school feeding programmes including the fortification of cereals distributed in food distributions.

h) A national protocol on the use of iron supplements in malaria endemic areas should be developed.

i) Improvement in the efficiency of supplementation and vaccination service delivery is required. This includes ensuring that there is adequate and timely supply at all times. Forging of partnerships between the main stakeholders in order to scale up programmes in neglected areas should also be considered.

2) Improving Dietary Diversity

a) Communication campaigns should be initiated to promote diet diversity and improve the consumption of Vitamin A and Iron rich foods in the diet of the population. Close monitoring of consumption should be undertaken in conjunction.

b) Ways need to found to link with relevant sectors to improve the nutrient quality of foods. For example, by linking with the livestock sector and conducting further research on understanding issues surrounding milk quality (e.g. effect of boiling on vitamin levels) or production of higher quality crops such as yellow fleshed cassava.

c) Including nutrition education in the curriculum in schools to promote appropriate feeding and health practices and promote peer-to-peer education in the home.

d) The use of home based fortification programmes using food supplementation products, such as micronutrient powders and lipid nutrient supplements, could be explored but would require careful monitoring to ensure appropriate and safe usage.

e) The possibility of fortifying cereals consumed by the population should be explored in detail. As part of this work a survey should be conducted to determine the specific types of local and imported fortified and un-fortified cereals consumed by the population. This would provide insight on the feasibility of cereal fortification in the regions.

f) Purchasing of food has been identified as the main source of food in the households, therefore response agencies may consider cash transfers for micronutrient rich foods as a means of providing support when designing programmes aimed at improving the food security at household level.

D Overall Recommendations

a) A Micronutrient Task force for Somalia should be developed to provide guidance and co-ordination on implementation of the suggested guidelines.

b) All the recommendations discussed should be linked with the overall nutrition strategy being developed for Somalia.

c) Partnerships with global micronutrient initiatives and other relevant global institutions need to be encouraged for exposure to experiences in other similar contexts and to support the mobilization of appropriate resources for Somalia.

9.0 Annexes

Annex 1 Prevalence of acute malnutrition in Children 6-59 Months (NCHS 1978 Growth Reference)

Zones	Chronic Malnutrition	N	Global acute malnutrition (<-2 z-scores) or Oedema	Moderate acute malnutrition (<-2 z-score and >=-3 z-score, no oedema)	Severe acute malnutrition (<-3 z-score and/or oedema)
North West	WHZ	963	13.6% (11.0-16.7)	10.9% (8.6-13.7)	2.7% (1.7- 4.2)
North East	WHZ	876	9.8% (8.1-11.5)	8.8% (7.3-10.3)	1.0% (0.3- 1.7)
South Central	WHZ	1131	15.6% (12.2-19.7)	11.1% (8.7-14.2)	4.4% (2.8- 7.0)
Combined	WHZ	2970	13.2% (11.6-15.0)	10.4% (9.1-11.8)	2.9% (2.1- 3.9)

Annex 2 Prevalence of Stunting in Children 6-59 Months (NCHS 1978 Growth Reference)

Zones		N	Prevalence of Stunting (<-2 z-scores)	Moderate Stunting (<-2 z-score and >=-3)	Severe Stunting (<-3 z-score)
North West	HAZ	938	14.8% (11.9-18.4)	11.0% (8.6-14.0)	3.8% (2.6- 5.7)
North East	HAZ	865	12.7% (9.7-16.5)	9.5% (7.2-12.4)	3.2% (2.2- 4.8)
South Central	HAZ	1109	26.7% (22.4-31.4)	18.0% (15.5-20.9)	8.7% (6.2-11.9)
Combined	HAZ	2905	18.7% (16.7-20.9)	13.3% (11.8-14.9)	5.4% (4.3- 6.9)

Annex 3 Prevalence of Underweight in Children 6-59 Months (NCHS 1978 Growth Reference)

Zones	N	Prevalence of Under Weight (WA <-2 z-scores)	Moderate under weight (WA <-2 z-score and >=-3 z-score)	Severe under weight (WA <-3 z-score)
North West	966	25.2% (21.9-28.8)	21.1% (18.2-24.4)	4.0% (2.9- 5.6)
North East	879	17.9% (14.5-21.8)	14.8% (12.0-18.0)	3.1% (1.9- 4.9)
South Central	1120	31.3% (25.4-37.8)	23.2% (19.0-28.0)	8.0% (5.7-11.2)
*Combined	2966	25.3% (22.8-28.0)	20.0% (18.1-22.1)	5.3% (4.2- 6.6)

Annex 4 Prevalence of Malnutrition by Sex using WHO Growth Standards

	Categories	GAM	MAM	SAM
WHZ	Combined	13.9% (12.4-15.7)	10.0% (8.8-11.2)	4.0% (3.1- 5.1)
	Boys	15.6% (13.3-18.2)	11.5% (9.8-13.5)	4.1% (2.9- 5.8)
	Girls	12.2% (10.4-14.2)	8.4% (7.1-10.0)	3.8% (2.9- 4.9)
	Categories	Prevalence of Stunting	Moderate Stunting	Severe Stunting
HAZ	Combined	23.1% (21.0-25.4)	15.1% (13.5-16.7)	8.1% (6.8- 9.5)
	Boys	25.4% (22.7-28.4)	15.9% (13.7-18.4)	9.5% (8.0-11.3)
	Girls	20.7% (18.2-23.4)	14.2% (12.4-16.1)	6.5% (4.9- 8.5)
	Categories	Prevalence of Under Weight	Moderate under weight	Severe under weight
WAZ	Combined	19.5% (17.1-22.0)	14.3% (12.7-16.0)	5.2% (4.1- 6.5)
	Boys	21.5% (18.7-24.5)	14.9% (13.1-17.0)	6.5% (5.0- 8.4)
	Girls	17.3% (14.8-20.2)	13.6% (11.6-15.9)	3.7% (2.5- 5.4)

Annex 5 Prevalence of Acute Malnutrition by Percentage of the Median (NCHS 1978 Growth Reference)

	n = 2995
Prevalence of global acute malnutrition (<80% and/or oedema)	261 8.7 % (7.4 - 10.4)
Prevalence of moderate acute malnutrition (<80% and >= 70%, no oedema)	206 6.9 % (5.9 - 8.2)
Prevalence of severe acute malnutrition (<70% and/or oedema)	55 1.8 % (1.3 - 2.7)

Annex 6 Prevalence of acute malnutrition in Infant 0-5 Months (NCHS 1978 Growth Reference)

Zones	N	Global acute malnutrition (<-2 z-scores) or Oedema	Moderate acute malnutrition (<-2 z-score and >=-3 z-score, no oedema)	Severe acute malnutrition (<-3 z-score and/or oedema)
Boys	128	12.5 % (6.8 - 21.8)	3.9 % (1.6 - 9.3)	8.6 % (4.2 - 16.6)
Girls	108	11.1 % (6.3 - 18.8)	5.6 % (2.7 - 11.0)	5.6 % (2.2 - 13.2)
Combined	236	11.9 % (7.7 - 17.9)	4.7 % (2.5 - 8.5)	7.2 % (4.2 - 12.0)

Annex 7 Prevalence of Stunting in Infant 0-5 Months (NCHS 1978 Growth Reference)

Zones	N	Prevalence of Stunting (<-2 z-scores)	Moderate Stunting (<-2 z-score and >=-3)	Severe Stunting (<-3 z-score)
Boys	128	9.4 % (5.1 - 16.7)	7.0 % (3.9 - 12.2)	2.3 % (0.5 -10.0)
Girls	114	7.0 % (4.0 - 12.1)	7.0 % (4.0 - 12.1)	0.0 % (0.0 - 0.0)
Combined	242	8.3 % (5.1 - 13.2)	7.0 % (4.4 - 11.0)	1.2 % (0.3 - 5.4)

Annex 8 Prevalence of Underweight in Infant 0-5 Months (NCHS 1978 Growth Reference)

Zones	N	Prevalence of Under Weight (WA <-2 z-scores)	Moderate under weight (WA <-2 z-score and >=-3 z-score)	Severe under weight (WA <-3 z-score)
Boys	125	7.2 % (3.8 - 13.3)	6.4 % (3.2 - 12.3)	0.8 % (0.1 - 6.1)
Girls	121	9.9 % (6.2 - 15.6)	7.4 % (4.2 - 12.9)	2.5 % (0.7 - 7.9)
Combined	246	8.5 % (5.5 - 13.0)	6.9 % (4.0 - 11.6)	1.6 % (0.6 - 4.4)

Annex 9 Prevalence of Acute Malnutrition in Infants 0-5 Months by Percentage of the Median (NCHS 1978 Growth Reference)

	n = 251
Prevalence of global acute malnutrition (<80% and/or oedema)	38 15.1 % (11.1 - 22.9)
Prevalence of moderate acute malnutrition (<80% and >= 70%, no oedema)	11 4.4 % (2.5 - 8.5)
Prevalence of severe acute malnutrition (<70% and/or oedema)	27 10.8 % (7.7 - 16.6)

Annex 10 Micronutrient Malnutrition Survey Questionnaire

Greeting and reading of information about the survey:

Assalam Aleikum, my name is ______,

We're conducting a national survey on the nutrition and health status of women and children. The questionnaire will take about 40 minutes and we would very much appreciate your participation.
We would first like to ask some general household questions and then ask some questions about the women and children under 12 years who live in your house.
We will also measure weight, height, and may take blood and urine samples to measure your haemoglobin, nutrition status, and find out if you have malaria. The blood sample will be from a finger prick and treatment will be provided if you are found to have malaria or are anaemic.
The survey is totally confidential.
If there are any questions that you do not want to answer, you can tell me and we will go on to the next question. You can also stop the interview at any time.
Participation is voluntary but we hope you will chose to take part as your views are very important to us.

Do you have any questions before we begin?

Can we start the survey now?

HOUSEHOLD QUESTIONNAIRE

This questionnaire is to be administered to the head of the household

Date of Interview (dd/mm/yyyy)		
Zone:	*Somaliland..1* *Puntland ....2* *South-Central zone 3*	
Cluster number		
Cluster name		
Area	*Urban...1* *Rural ....2* *IDP..3*	
Household Number		
Team Number		
Interviewer name		
Results from interview	Completed…………………………………......1 *Not at home……………………………………2* Refused………………………………….…....3 *Partly completed……………………………..4* Other. specify…………………………….…...9 ______________________________________	

HH1. What is your Household size[67]?	*Number __ _____*	
HH2. *Number of children less than 5 years (0-59 months)?*	*Number _______________*	
HH3. Sex of household head[68]?	*Male…………………………………………….1* *Female.…………………………………….…..2*	
HH4. How long has this household lived in this locality?	*Resident ....1* *IDP<2 years...2* *IDP >= 2 years..3* *Voluntary new arrival..................................4* *DK..99*	
HH5. Are you hosting any recently (in the last 6 months) internally displaced persons?	*Yes ....1* *No 2*	2⇨HH7

[67] *Number of persons who live together and eat from the same pot at the time of assessment*

[68] *One who controls and makes key decisions on household resources (livestock, assets, income, and food), health and social matters for and on behalf of the household members.*

	DK...99	
HH6. If you are hosting recent (in the last 6 months) internally displaced persons, how many are you hosting?	*Number* _______________	
HH7. Please list the main sources of your household income from the most important source to the least important. *(rank from 1 for the most important to the least important)*	*Animal & animal product sales…………..*___ *Crop sales/farming ....*___ *Trade ....*____ *Casual labour ....*____ *Relief assistance ....*____ *Salaried/wage employment……….……*___ *Remittances/gifts/zakat ....*____ *Others, specify.....................................*____	
HH8.What type of house does the household live in? *(Observation the type of house)*	Makeshift ………………………….................1 *Temporary (mud houses or sticks)……………………………………..2* Semi permanent (mud/stone with iron sheet)………………........3 *Permanent (block houses/iron sheet).………..4* *Other, Specify ……………………………….....5*	
HH9.What is the status of your housing in this house?	Owned ……………………………...........1 Rented……………………….……………....2 Rent-free………………………….............3 Other specify ………………..........……...4	
HH10. What is the household's <u>main</u> source of drinking water?	Piped water Piped water into dwelling…………………1 Piped water into yard or plot……………..2 Public tap/standpipe/ kiosk………………3 Tubewell/borehole………………………...4 Dug well Protected well……………………….…..5 Unprotected well…………………………..6 Water from spring Protected spring…………………………...7 Unprotected spring……………………......8 Rainwater collection Rooftop………………………………….….....10 Berkad……………………………………....11 Rain water catchment(balli)……………......12 Tanker truck…………………………….....13 Cart with small tank/drum/vendor………..14 Surface water (river stream, dam, lake, pond, canal, irrigation channel)…………..15 Bottled water……………………………… 16 Others (*specify*)…………………………….17 ______________________________	
HH11.Do you usually treat your water to make it safer to drink?	*Yes ....1* *No 2*	2⇨ HH13

	DK..99	
HH12.If treated, what is the method of treatment?	*Boiling..1* *Chlorination ....2* *Strain it through cloth……………………….3* *Use water filter* *(ceramic, sand, composite) ....4* *Solar disinfection ....5* *Let it stand and settle………………………..6* *Others, specify...9*	
This section covers household food consumption and should be directed to the mother or the head of the household		
HH13.Including food eaten in the morning, how many meals do your family normally eat per day?	*One meal ....1* *Two meals ....2* *Three meals..3* *More than Three meals 4*	
HH14.Including food eaten in the morning, how many meals did your family eat **<u>YESTERDAY</u>**?	*One meal ....1* *Two meals ....2* *Three meals..3* *More than Three meals 4*	
HH15.Did all the members of your family eat yesterday? (Record all responses)	*Yes ....1* *No ....2* *DK..99*	1⇨HH 18
HH16.If HH15= NO, Who did not eat yesterday?	*Child under 5 ....1* *5-12 years old...2* *13-19 years old...3* Father ………………………………………...4 *Above 19 years………………………………5* *Others, specify……………………………99*	
HH17.Why did the person not eat?	*Food not enough ....1* *Sickness ....2* *Away from home ....3* *Other specify 99*	
HH18.How many times in the last week did a member of the family go to bed hungry?	*Never ....1* *Once ....2* *More than once..3*	
HH19.We would like to test a small quantity of salt for iodization.	*Not iodized 0 ppm ....1* *Less than 15 ppm.......................................2* *15 ppm or above ....3* *No salt at home ....4* *Salt not tested..5*	4⇨HH 22
HH20.Check on the salt packaging?	*Package not available ……………………...1* *Package available and* *labelled as iodised ………………………..2* *Package available and labelled as NOT iodized……………………………………3*	

HH21. Was a sample of salt collected?	*Yes* .... *1* *No* *2*	
HH22. PLEASE DESCRIBE THE FOODS (MEALS AND SNACKS) THAT YOU OR ANY ONE IN THE HOUSEHOLD ATE YESTERDAY DURING THE DAY AND NIGHT, WHETHER AT HOME OR OUTSIDE THE HOME. START WITH THE FIRST FOOD EATEN IN THE MORNING,(1=YES, 2=NO *A. Cereals* *B. Vitamin A rich vegetable and Tubers* *C. White tubers and roots* *D. Dark green leaf vegetables* *E. Other vegetables* *F. Vitamin A rich fruits* *G. Other fruits* *H. Flesh Meat* *I. Organ Meat (iron rich)* *J. Eggs* *K. Fish* *I. Legumes nuts and seeds* *M. Milk and milk products* *N. Oil and fats* *O. Sweets* *P. Spices and Caffeine*	*Y N DK* *A. Cereals*........ *1 2 9* *B. Vitamin A rich vegetable* ………….*1 2 9* *C. White tubers and roots* .... *1 2 9* *D. Dark green leaf vegetables*........ *1 2 9* *E. Other vegetables*........ *1 2 9* *F. Vitamin A rich fruits* .... *1 2 9* *G. Other fruits*........ *1 2 9* *H. Flesh Meat* .... *1 2 9* *I. Organ t*........ *1 2 9* *J. Eggs*........ *1 2 9* *K. Fish* .... *1 2 9* *L. Legumes nuts and seeds* .... *1 2 9* *M. Milk and milk products*........ *1 2 9* *N. Oils or fats*........ *1 2 9* *O. Sweets*........ *1 2 9* *P. Spices and Caffeine*........ *1 2 9*	

Cereals. *Maize, ground maize, wheat, white wheat, wholemeal wheat, millet, rice, white grain sorghum, red sorghum , spaghetti, bread, white potatoes, cassava, arrowroot, white sweet potatoes, or foods made from roots, canjeera)*

Legumes and Nuts (*cowpeas, beans, lentil , peanut, pumpkin seed, lentil seed, sunflower seed, wild nuts)*

Vitamin-A rich fruits and vegetables (*ripe mangoes, pawpaw, wild fruits such as gob, hobob, berde, isbandlays, kabla, coasta, red cactus fruit,* yellow fleshed *pumpkins, carrots, orange sweet potatoes, yellow cassava, amaranth, kale, spinach, dark green lettuce , onion leaf, pumpkin leaves, cassava leaves)*

Other fruits and Vegetables (*tomato, onion, squash, bell peppers, cabbage ,light green lettuce, white radish, banana, orange, apple, coconut, custard apple, dates, unripe mangoes, grapes, guava, wild fruits and 100% fruit juices)*

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Questionnaire for individual women

This module is to be administered to all women age 15 through 49. Fill in one form for each eligible woman.

Date of Interview (dd/mm/yyyy)		
Zone:	*Somaliland..1* *Puntland ....2* *South-Central zone 3*	
Cluster number		
Cluster name		
Area	*urban ....1* *rural ....2* *IDP...3*	
Household Number		
Individual ID Zone/cluster/household no		
Team Number		
Interviewer name		
Results from interview	Completed……………………………….....1 *Not at home……………………………………2* Refused……………………………….….....3 *Partly completed……………………………..4* Other. specify………………………….…...9 ____________________________________	

W1. Woman's name.	Name ______________________________	
W2. What is the age (yrs) of the woman	Age(yrs) __________________	
W3.Relationship in Household	*Mother .... 1* *Other 2*	
W4.Marital status	*Never Married.. 1* *Married .... 2* *Divorced .... 3* *Widowed... 4*	1⇨W6
W5.Physiological status	*Pregnant .... 1* *Lactating .... 2* *Neither Lactating or Pregnant.......................... 3* *Pregnant and lactating................................... 4*	
W6.Have you ever attended school?	*Yes .... 1* *No.. 2*	2⇨W9.

W7.If yes what level	*Koranic .... 1* *Primary .... 2* *Secondary.. 3* *university/college .... 4* *other Specify 5*	
W8.Are you able to read? If yes, please read out the following sentences for me: *Uurkaagii ugu dambeeyay ma lagu siiyay kiniink.* *Xalay ma hoos seexatay maro kaneeco*	*Cannot read .... 1* *Able to read in part.. 2* *Able to read full sentence .... 3* *Physically impaired 4*	
W9.How often do you drink tea or coffee?	*A few times a day .... 1* *Once a day.. 2* *A few times a week .... 3* *Rarely... 4* *Don't drink.. 5*	
W10.When you drink tea or coffee, do you usually drink it during a meal, directly after or in between?	*During a meal .... 1* *After a meal.. 2* *In between meals... 3*	
W11.Did you give birth within the last two years	*Yes .... 1* *No.. 2*	2⇨W14
W12.During your last pregnancy were you given Tetanus injection	*Yes .... 1* *No.. 2* *DK 9*	
W13.In the first two months after your last birth, did you receive a Vitamin A dose Show capsule.	*Yes .... 1* *No.. 2* *DK 9*	
After questionnaires for all of the children this woman cares for are complete, the measurer must weigh and measure all eligible children living in the household. Inform the respondent that you will be weighing and measuring her and taking a small amount of blood from her finger and a urine sample. Record weight and height below, taking care to record the measurements on the correct questionnaire for each woman. Check the woman's name and number before recording measurements.		
W14. Woman's weight.	*Kilograms (kg)................___ ___ ___ . ___*	
W15. Woman's Height	*Height (cm)…… ___ ___ ___ . ___*	
W16. Woman's Sitting Height	*Height (cm)…… ___ ___ ___ . ___*	
W17. Woman's Hb.	*Hb…………………………… __ __ . __ g/dl* *Refused………………………………..…99*	
W18. Was a blood sample collected from this woman?	*Yes…………………………………………...1* *No…………………………………………….2* *Refused …..……………………………………9*	
W19. Was a urine sample collected from this woman?	*Yes…………………………………………...1* *No…………………………………………….2* *Refused …..……………………………………9*	
W20. Observe for the presence of Goitre	*Visible .goiter………………………………...1* *No goiter …..……………………………………2*	

Women's Dietary Diversity Questionnaire (please administer the following questions on Women who have their blood and urine sample taken)

W21.Was yesterday a day of celebration?
1 – Yes
2 – No

W22. Did you eat anything (meal or snack) outside of the home yesterday?
1 – Yes
2 – No

W23. Please describe the foods (all meals and snacks) that you ate yesterday during the day and night, whether eaten at home or outside the home. Start with the first food you ate yesterday morning. Record the respective codes to the foods mentioned. *When a mixed dish is reported, ask about and tick all of the ingredients in their respective columns.*

	Food group	Once you have filled in all the Yes answers, go back to the food groups not mentioned and ask specifically if any food items from that group was consumed? Yes= 1 No= 2 Don't Know = 9
W23A	Cereals and cereal products (*maize, ground maize, wheat, white wheat, wholemeal wheat, millet, rice, white grain sorghum, red sorghum , spaghetti, bread, chapatti , macaroni, canjera)*	
W23B	Milk and milk products *(Fresh/fermented/powdered sheep, goat, cow or camel milk, Cheese (sour milk), condensed milk, yoghurt)*	
W23C	Vitamin A rich vegetables and tubers *(yellow fleshed pumpkins, carrots, orange sweet potatoes, yellow cassava)*	
W23D	Dark green leafy vegetables *(amaranth, kale, spinach, , onion leaf, pumpkin leaves, cassava leaves, dark green lettuce)*	
W23E	Other vegetables *(tomato, onion, squash, bell pepper, cabbage ,light green lettuce, white radish)*	
W23F	Vitamin A rich fruits *(ripe mangoes, pawpaw, wild fruits such as gob, hobob, berde, isbandlays, kabla, coasta, red cactus fruit,)*	
W23G	Other fruit *(banana, orange, apple, coconut, custard apple, dates, unripe mangoes, grapes, guava, wild fruits and 100% fruit juices)*	
W23H	Organ meat *(liver, kidney, heart or other organ meat)*	
W23I	Meat and Poultry *(beef, lamb, goat, camel, wild game, such as Dik Dik, chicken, duck, other birds such as guinea fowl and francolin)*	
W23J	Eggs *(eggs of chicken, eggs of duck or eggs of other fowl)*	
W23K	Fish *(fresh or dried) and other seafood (shellfish)*	
W23L	Legumes, nuts and seeds *(cowpeas, beans, lentils , peanut, pumpkin seed, lentil seed, sunflower seed, wild nuts)*	
W23M	White roots and tubers (*white potatoes, cassava, arrowroot, white sweet potatoes, or foods made from roots)*	
W23N	Oils and Fats *(cooking fat or oil, ghee, butter, sesame oil, margarine)*	
W23O	Sweets (*sugar, honey, sweetened soda and fruit drinks, chocolate biscuit, cakes,, candies, cookies, Sugar cane and sweet sorghum)*	
W23P	Coffee, tea and Spices (*coffee, tea, spices such as black pepper, cardamoms, cinnamon, ginger, nutmeg, cloves, salt. Condiments such as ketchup, soy sauce, chilli sauce)*	

QUESTIONNAIRE FOR CHILDREN 0-5 MONTHS

This questionnaire is to be administered to all caretakers of a child that lives with them and is under the age of 6 months. A separate form should be used for each eligible infant.

Date of Interview (dd/mm/yyyy)		
Zone:	*Somaliland .... 1* *Puntland .... 2* *South-Central zone 3*	
Cluster number		
Cluster name		
Area	*Urban.. 1* *Rural... 2* *IDP 3*	
Household Number		
Individual ID Zone/cluster/household no		
Team Number		
Interviewer name		
Results from interview	Completed…………………………………......1 *Not at home…………………………………2* Refused……………………………….…....3 *Partly completed…………………………..4* Other. specify…………………………….…..9	

F1. Child's name.	Name ______________________________	
F2. WHAT IS HIS/HER DATE OF BIRTH?	*Day/Month/Year..... __ __/__ __/__ __ __ __* *DK……………………………………………99*	
F3. *Child's age*	*Age (Months)………………….. ___*	
F4. IS [*name*] MALE OR FEMALE?	*Male…………………………………………1* *Female.……………………………………..2*	
F5. Has [name] had diarrhoea in the last 2 weeks?	*Yes.. 1* *No .... 2* *DK.. 99*	2⇨F8
F6. If yes did you feed her:	*Less than normal .... 1* *The same as normal .... 2* *More than normal...................................... 3* *No food 4*	
F7. Did you use ORS to treat diarrhoea (show sample)	*Yes.. 1* *No .... 2* *DK.. 99*	

F8. HAS (*name*) EVER BEEN BREASTFED?	*Yes.. 1* *No .... 2* *DK.. 9*	2⇨F.12 9⇨F.12
F9. How long after birth did you put on the breast?	*<1 hr... 1* *2-3 hr .... 2* *3-6 hr .... 3* *<8 hr... 4* *<24 hr... 5* *>24 hr... 6* *DK.. 99*	
F10. IS HE/SHE STILL BEING BREASTFED?	*Yes.. 1* *No .... 2* *DK.. 9*	2⇨F.12 9⇨F.12
F11. If breastfeeding, how many times a day	*2 times or less... 1* *3-6 times .... 2* *on demand.. 2* *DK.. 9*	
F12. SINCE THIS TIME YESTERDAY, DID HE/SHE RECEIVE ANY OF THE FOLLOWING: *Read each item aloud and record response before proceeding to the next item.* 12A. VITAMIN, MINERAL SUPPLEMENTS OR MEDICINE? 12B. PLAIN WATER? 12C. FORTIFIED FOOD(UNIMIX, PLUMPY NUTS) 12D. SWEETENED, FLAVOURED WATER 12E ORAL REHYDRATION SOLUTION (ORS)? 12F. TEA OR INFUSION? 12G. INFANT FORMULA? 12H. MILK 12I. POWDERED MILK 12J. ANY OTHER LIQUIDS? 12K. SOLID OR SEMI-SOLID (MUSHY) FOOD?	*Y N DK* *A. Vitamin supplements.................... 1 2 9* *B. Plain water................................... 1 2 9* *C. Fortified foods .... 1 2 9* *D. Sweetened water or juice............ 1 2 9* *E. ORS.. 1 2 9* *F. Tea and infusions .... 1 2 9* *G. Infant Formula.............................. 1 2 9* *H. Milk.. 1 2 9* *I. Powdered Milk .... 1 2 9* *J. Other liquids (*specify*) .... 1 2 9* *K. Mushy food................................. 1 2 9*	
F13. After questionnaires for all children are complete, the measurer weighs and measures each child. Inform the respondent that you will now be weighing and measuring the child. Record weight and length/height below, taking care to record the measurements on the correct questionnaire for each child. Check the child's name and line number on the HH listing before recording measurements.		
F14. Child's weight.	*Kilograms (kg)........................ ___ ___ . ___*	
F15. Child's length	*Length/Height (cm)…… ___ ___ ___ . ___*	

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QUESTIONNAIRE FOR CHILDREN 6-59 MONTHS

This questionnaire is to be administered to all caretakers of a child that lives with them and is under the age of 5 years A separate form should be used for each eligible child. Questions should be administered to the mother or primary caretaker of the eligible child .Fill in the child number of each child and the household and cluster numbers in the space at the top of each page. Affix the pre-printed labels on the square above.

Date of Interview (dd/mm/yyyy)		
Zone:	*Somaliland* .... *1* *Puntland*.. *2* *South-Central zone*.................................... *3*	
Cluster number		
Cluster name		
Area	*Urban* .... *1* *Rural* .... *2* *IDP* *3*	
Household Number		
Individual ID Zone/cluster/household no		
Team Number		
Interviewer name		
Results from interview	Completed…………………………………........1 *Not at home* . …………………………………*2* Refused……………………………….……......3 *Partly completed*……………………………....*4* Other. specify…………………………….…....9	

C1. Child's name.	Name ________________________________	
C2. *Child's age*	*Age*……………………………………….. ___	
C3. NOW I WOULD LIKE TO ASK YOU SOME QUESTIONS ABOUT THE HEALTH OF EACH CHILD UNDER THE AGE OF 5 IN YOUR CARE. NOW I WANT TO ASK YOU ABOUT (*name*). ON WHAT DATE WAS (*name*) BORN? *Probe*: WHAT IS HIS/HER BIRTHDAY? *If the mother knows the exact birth date, also enter the day; otherwise, enter 99 for day.*	*Day/Month/Year.....* __ __/__ __/__ __ __ __	
C4. IS (*name*) MALE OR FEMALE?	*Male*…………………………………………….*1* *Female*.……………………………………...*2*	

C5.Does the child have an EPI Card	*Yes* ....1 *No* ....2 *DK*............99	
C6. HAS (*name*) EVER RECEIVED A VITAMIN A CAPSULE (SUPPLEMENT)? *Show capsule.*	*Yes* ....1 *No* ....2 *DK*............9	2⇨C9 DK⇨C9
C7. HOW MANY MONTHS AGO DID (*name*) TAKE THE LAST DOSE?	*Months ago*............__ __ *DK*............99	
C8. WHERE DID (*name*) GET THIS LAST DOSE?	*On routine visit to health centre*............1 *Sick child visit to health centre*............2 *National Immunization Day campaign*............3 Other (*specify*) ____________________8 *DK*............9	
C9. BCG VACCINATION	*Yes* ....1 *No* ....2 *DK*............99	
C10. DPT Vaccination	*Yes* ....1 *No* ....2 *DK*............99	
C11. Measles	*Yes* ....1 *No* ....2 *DK*............99	
C12. Has [name] had ARI in the last two weeks	*Yes* ....1 *No* ....2 *DK*............99	
C13. Has [name] had diarrhoea in the last 2 weeks?	*Yes* ....1 *No* ....2 *DK*............99	2⇨C 16
C14. If yes did you feed her:	*Less than normal*............1 *The same as normal*............2 *More than normal*............3 *No food*............4	
C15. Did you use ORS to treat diarrhoea (show sample)	*Yes* ....1 *No* ....2 *DK*............99	
C16. Fever / suspected of Malaria in the last two weeks	*Yes* ....1 *No* ....2 *DK*............99	
C17. Is this child aged 6-23 months?	*Yes*............1 *No*............2 *Don't know*............99	2⇨C.22
C18. HAS (*name*) EVER BEEN BREASTFED?	*Yes* ....1 *No* ....2 *DK*............9	2⇨C.22

		9⇨C.22
C19. How long after birth did you put on the breast?	*<1 hr .... 1* *2-3 hr .... 2* *3-6 hr .... 3* *<8 hr .... 4* *<24 hr .... 9* *>24 hr .... 9* *DK........ 99*	
C20. IS HE/SHE STILL BEING BREASTFED?	*Yes .... 1* *No .... 2* *DK........ 9*	2⇨C.22 9⇨C.22
C21. If breastfeeding, how many times a day	*2 times or less .... 1* *3-6 times........ 2* *on demand........ 3* *DK........ 9*	
C22. SINCE THIS TIME YESTERDAY, DID HE/SHE RECEIVE ANY OF THE FOLLOWING: *Read each item aloud and record response before proceeding to the next item.* 22A. VITAMIN, MINERAL SUPPLEMENTS OR MEDICINE? 22B. PLAIN WATER? 22C. FORTIFIED FOOD(UNIMIX, PLUMPY NUTS) 22D. SWEETENED, FLAVOURED WATER 22E ORAL REHYDRATION SOLUTION (ORS)? 22F. TEA OR INFUSION? 22G. INFANT FORMULA? 22H. MILK 22I. POWDERED MILK 22J. ANY OTHER LIQUIDS? 22K. SOLID OR SEMI-SOLID (MUSHY) FOOD?	*Y N DK* *A. Vitamin supplements........ 1 2 9* *B. Plain water .... 1 2 9* *C. Fortified foods .... 1 2 9* *D. Sweetened water or juice .... 1 2 9* *E. ORS .... 1 2 9* *F. Tea and infusions........ 1 2 9* *G. Infant Formula .... 1 2 9* *H. Milk........ 1 2 9* *I. Powdered Milk........ 1 2 9* *J. Other liquids (*specify*)........ 1 2 9* *K. Mushy food........ 1 2 9*	
C23. Did the child receive solid or semi solid foods	*Yes .... 1* *No .... 2* *DK........ 9*	9⇨C.25
C24.Since this time yesterday how many times did child eat solid, semi solid or soft foods other than liquids	No of times ----------------------------- --- *DK........ 9*	
C25. After questionnaires for all children are complete, the measurer weighs and measures each child. Inform the respondent that you will now be weighing and measuring the child and taking a small amount of blood from the child's finger. Record weight and length/height below, taking care to record the measurements on the correct questionnaire for each child. Check the child's name and line number on the HH listing before recording measurements.		
C26. Child's weight.	*Kilograms (kg) ....___ ___ . ___*	
C27. Child's length or height. *Check age of child:* *☐ Child under 2 years old. ⇨ Measure length (lying down).* *☐ Child age 2 or more years. ⇨ Measure height (standing up).*	*Length/Height (cm)…… ___ ___ ___ . ___*	

C28. MUAC	*MUAC (cm)* ....___ ___ . ___	
C29.Oedema	*Yes* ....*1* *No*...*2*	
C30. Result.	*Measured*...*1* *Not present*...*2* *Refused* ....*3* *Other (*specify*)*..*8*	
C31. Child's Hb.	*Hb* …………………………… __ __ . __ *g/dl* *Refused* ……………………………………*77.7*	
C32. Was a blood sample collected from this child?	*Yes*……………………………………………...*1* *No*……………………………………………..*2* *Refused*………………………………………*9*	 2⇨END 9⇨END
C34. Is there another child in the household who is eligible for measurement? *☐ Yes. ⇨ Record measurements for next child.* *☐ No. ⇨ End the interview with this household by thanking all participants for their cooperation.* *Gather together all questionnaires for this household and check that identification numbers are at the top of each page. Tally on the Household Information Panel the number of interviews completed.*		

Stick Sample label here

QUESTIONNAIRE FOR SCHOOL AGE CHILDREN 6-11YRS

This questionnaire is to be administered to all caretakers of a child that lives with them and is within 6-11 years. A separate form should be used for each eligible child. Questions should be administered to the mother or primary caretaker of the eligible child .Fill in the child number of each child and the household and cluster numbers in the space at the top of each page. Affix the pre-printed labels on the square above.

Date of Interview (dd/mm/yyyy)		
Zone:	*Somaliland* .... *1* *Puntland* .... *2* South-Central zone ____________________3	
Cluster number		
Cluster name		
Area	*urban* .... *1* *rural* .... *2* IDP___________________________________3	
Household Number		
Individual ID Zone/cluster/household no		
Team Number		
Interviewer name		
Results from interview	Completed…………………………………........1 *Not at home.. …………………………………2* Refused……………………………………........3 *Partly completed……………………………....4* Other. specify……………………………….......9	

S1. Child's name.	Name _________________________________	
S2. WHAT IS HIS/HER DATE OF BIRTH ?	*Day/Month/Year..... __ __/__ __/__ __ __ __* *DK……………………………………………99*	
S3. *Child's age*	*Age……………………………………….* ___	
S4. IS (*name*) MALE OR FEMALE?	*Male…………………………………………..1* *Female..……………………………………..2*	
S5. Child's Hb.	*Hb …………………………… __ __ . __ g/dl* *Refused …………………………………99*	
S6. Was a blood sample collected from this child?	*Yes…………………………………………....1* *No……………………………………………2*	
S8. Was urine sample taken from this Child	*Yes…………………………………………....1* *No……………………………………………2*	
S9. Observe for the presence of Goitre	*Visible goiter ……….. ……………………...1* *No goiter …..…………………………………2*	

Module 7: Malaria Questionnaire
Cluster name ____________________________
Cluster number __________________________
Date____________________________________

Code No	**M1** Name	**M2** Sex 1=male 2=female	**M3** Birth date (dd/mm/yyyy)	**M4** Age	**M5** Relationship to the household 1=mother 2=Father 3=Son 4=Daughter 5=Relative	**M6** How many ITN do you have in the household Write Number 99= None **If 99**⇨M.10	**M7** Did you sleep under an insecticide treated net last night 1=Yes 2= No	**M8** What type of mosquito net did you sleep under 1=LLITN 2= Normal net	**M9** At what cost did you get the Net/LLITNs 1=Free distribution 2=subsidised price 3=Full market cost	**M10** Treated for malaria in the past two weeks. 1=Yes 2= No	**M11** Parasit F 1=Pos 2=Neg 3=Not done

Annex 11 List of Clusters Sampled

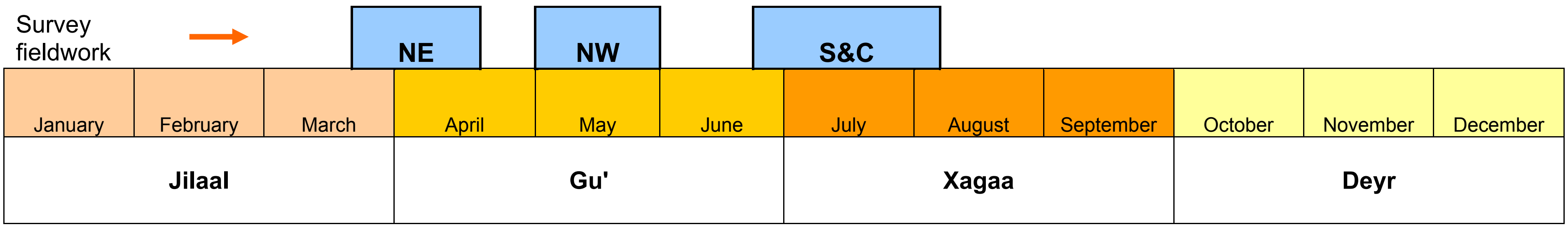
Zones	Regions	District	Name Village/Town	Cluster Numbers	Second Stage Sampling
South Central	Bakool	Teiglow	Daymisame	1	Segmentation
South Central	Bakool	Huddur	Huddur Town	2	Grid Map
South Central	Bay	Berdale	DAAROW	3	Segmentation
South Central	Bay	Baidoa	Sarwiin+Alinjilow	4	EPI
South Central	Bay	Baidoa	Maraayle	5	Segmentation
South Central	Bay	Qansax Dhere	Edaim Qaboobe	6	Segmentation
South Central	Bay	Dinsor	Dhujigaroon/toosiley	7	Segmentation
South Central	Galgaduud	Abudwaq (Cabudwaag)	Balicad weyne	8	EPI
South Central	Galgaduud	Adado (Cadaado)/Galinsoor	Bandiiradleey	9	Segmentation
South Central	Galgaduud	Dusamareb (Dhuusamarreeb)/Guriceel	Ceeldhadhaab	10	Segmentation
South Central	Galgaduud	Eldhere (Ceel Dheer)	Iid madobw	11	Segmentation
South Central	Galgaduud	Eldhere (Ceel Dheer)	Barked M. Gure	12	EPI
South Central	Mudug	Hobyo	Galgaruun	13	EPI
South Central	Galgaduud	Matabaan	Geri Jir	21	Segmentation
South Central	Gedo	Bulahawa	BELET XAAWO Section 2,5	14	Segmentation
South Central	Gedo	Berdubo	Warcaddey	15	EPI
South Central	Gedo	Elwak	Lebi Moqor	16	EPI
South Central	Gedo	Elwak	Baygi taaggi	17	EPI
South Central	Gedo	Elwak	Banbay bacaad	18	Segmentation
South Central	Gedo	Luuq	Godabay 1	19	Segmentation
South Central	Shabelle Dhexe	Mahaday	Shan	22	Segmentation
South Central	Shabelle Dhexe	Balcad	Balad karim	23	Segmentation
South Central	Shabelle Hoose	Afgoi	Faculty of Agriculture Area (IDP camps)	24	Segmentation

South Central	Shabelle Hoose	Afgoi	Elasha B Area (IDP camps)	25	Segmentation
South Central	Shabelle Hoose	Afgoi	Elasha A Area (IDP camps)	26	Segmentation
South Central	Shabelle Hoose	Afgoi	Hawa Abdi Area (IDP camps)	27	Segmentation
South Central	Shabelle Hoose	Awdhegly	Awdhegle.	33	Segmentation
South Central	Shabelle Hoose	Afgoi	Doonka.	35	Segmentation
South Central	Shabelle Hoose	Wanla Weyn	Adeyga.	36	Segmentation
South Central	Shabelle Hoose	Wanla Weyn	Yaaqa.	37	Segmentation
South Central	Juba	Buale	Billi Weyn	38	Segmentation
South Central	Juba	JILIB EAST	Yaaqle	39	Segmentation
South Central	Juba	Salagle	Gumarey	40	Segmentation
North West	Awdal	Borama	Borama Town	1	Grid Map
North West	Awdal	Borama	Borama Town	2	Grid Map
North West	Awdal	Borama	Gorayacawl	3	EPI
North West	Awdal	Baki	Aroweine	4	EPI
North West	Awdal	Lughaya	Geerisa	5	Segmentation
North West	Awdal	Zeila	Daba dilaac/Buurcad/Ilcarmo	6	EPI
North West	Galbeed	Gubadle	Qarwaraabe	7	EPI
North West	Galbeed	Gabiley	Garbadheer (gess Dheer)	8	Segmentation
North West	Galbeed	Gabiley	Xuunshaley	9	Segmentation
North West	Galbeed	Hargeisa	Hargeisa City	10	Grid Map
North West	Galbeed	Hargeisa	Hargeisa City	11	Grid Map
North West	Galbeed	Hargeisa	Hargeisa City	12	Grid Map
North West	Galbeed	Hargeisa	Hargeisa City	13	Grid Map
North West	Galbeed	Hargeisa	Hargeisa City	14	Grid Map
North West	Galbeed	Hargeisa	Gaban Hurudo (habaswein)	15	Segmentation
North West	Galbeed	Hargeisa	Ayaha B	16	Segmentation
North West	Galbeed	Hargeisa	State House	17	Segmentation

North West	Galbeed	Berbera	Waltyeen	18	EPI
North West	Togdheer	Odweyne	Odweine *	19	Segmentation
North West	Togdheer	Odweyne	Ceeg	20	Segmentation
North West	Togdheer	Burao	Burao Town	21	Grid Map
North West	Togdheer	Burao	Burao Town	22	Grid Map
North West	Togdheer	Burao	Beer *Barwaqo,Kadhada,Mashruuca	23	Segmentation
North West	Togdheer	Burao	Qoyta	24	Segmentation
North West	Togdheer	Burao	warta bayle (Berbera)	25	Segmentation
North West	Togdheer	Sheikh	Sheikh town	26	Segmentation
North West	Sanaag	Erigavo	Erigavo town	27	Grid Map
North West	Sanaag	Erigavo	Ardaa	28	EPI
North West	Sanaag	Erigavo	Lasurad	29	EPI
North West	Sanaag	Ceel-afweyn	Bohol sumal	30	EPI
North West	Sanaag	Badhan	Yube	31	Segmentation
North West	Sool	Lasanod	Lasanod Town	32	Grid Map
North East	Bari	Bosaso	Bosaso	1	Grid Map
North East	Bari	Bosaso	Bosaso	2	Grid Map
North East	Bari	Bosaso	Bosaso	3	Grid Map
North East	Bari	Bosaso	Bosaso	4	Grid Map
North East	Bari	Bosaso	Bosaso	5	Grid Map
North East	Bari	Bosaso	Bosaso	6	Grid Map
North East	Bari	Bosaso	Bosaso	7	Grid Map
North East	Bari	Bosaso	Bosaso	8	Grid Map
North East	Bari	Bosaso	Laag	9	Segmentation
North East	Bari	Gardo	Gardo Town	10	Grid Map
North East	Bari	Gardo	Gardo Town	11	Grid Map
North East	Bari	Gardo	Libaxhar	12	Segmentation

North East	Bari	Baargal	Bargaal	15	EPI
North East	Bari	Baargal	Muudiye	16	EPI
North East	Bari	Alula	Halwad	17	EPI
North East	Bari	Alula	kalan/Faranfar	18	EPI
North East	Nugal	Garowe	Garowe	19	Grid Map
North East	Nugal	Garowe	Garowe	20	Grid Map
North East	Nugal	Garowe	Rebanti	21	Segmentation
North East	Nugal	Burtinle	Jalam	22	Segmentation
North East	Nugal	Dangoroyo	DangorayoTown	23	Segmentation
North East	Nugal	Eyl	Qarxis	25	Segmentation
North East	Mudug	Galkayo	Galkaio	26	Grid Map
North East	Mudug	Galkayo	Galkaio	27	Grid Map
North East	Mudug	Galkayo	Galkaio	28	Grid Map
North East	Mudug	Galkayo	Galkaio	29	Grid Map
North East	Mudug	Galkayo	Ba'adweyn	30	Segmentation
North East	Mudug	Galdogob	Galdogob	32	Segmentation
North East	Mudug	Galdogob	Bursalah	33	Segmentation
North East	Mudug	Jeriban	Malaasle	34	Segmentation
North East	Mudug	Jeriban	Balibusle	35	Segmentation

Annex 12 Seasonal Calendar and Timing of Survey Fieldwork in Somalia



Survey Dates:
North East 19th March - 22nd April, 2009
North West 3rd May - 31st May, 2009
South Central 25th June - 5th August, 2009

Annex 13 Seasonal Calendar

Year Significant Event	Month	Age in Months	Regional specific events	Monthly event specific to that year	Recurring yearly events
2009	July	0		Bilowgii Hagaa	
	June	1			
	May	2			
	April	3		Bilowgii Gu'	Rabi-ul- Akhir/
	March	4			Rabiul awal/ Mowliid
	February	5			Safar
	January	6		Bilowgii Jilaal	Muharam/ Sako
2008	December	7			Arafo
	November	8			Sidatal
	October	9		Bilowgii Deyr	Soonfur
	Sept	10			Ramadan/Sonqaad
	Aug	11			Shacbaan/soondhere
	July	12		Bilowgii Hagaa	Rajab/Sabuux
	June	13			JamatulaAkhir
	May	14			Jamatul-Awal
	Apr	15		Bilowgii Gu'	Rabial-Akhir
	Mar	16			Rabici-Awal/Mowliid
	Feb	17			Safar
	Jan	18		Bilowgii Jilaal	Muharam/Sako
2007	Dec	19			Arafo
	Nov	20			Sidatal

	Oct	21		Bilowgii Deyrta	Soonfur
	Sept	22			Ramadan/Soonqaad
	Aug	23			Shacbaan/soondhere
	July	24		Bilowgii Hagaa	Rajab/Sabuux
	June	25			JamatulaAkhir
	May	26			Jamatulawal
	Apr	27		Bilowgii Gu'	Rabu-Akhir
	Mar	28			Rabici-awal/Mowliid
	Feb	29			Safar
	Jan	30		Bilowgii Jiilaalka	Muharam/Sako
2006	Dec	31	Dagaalkii Maxkamadaha iyo Xabashida		Arafo
	Nov	32			Sidatal
	Oct	33		Bilowgii Deyr	Soonfur
	Sept	34			Ramadan/Soonqaad
	Aug	35	Qaraxii Baydhabo/baidoa explosion		Shacbaan/soondhere
	July	36		Bilowgii Hagaa	Rajab/Sabuux
	June	37	Qabsashadii Maxkamadaha ee Xamar		JamatulaAkhir
	May	38			Jamatulawal
	Apr	39		Bilowgii Gu'	Rabu-Akhiri
	Mar	40			Rabici-awal/Mowliid
	Feb	41			Safar
	Jan	42		Bilowgii Jiilaalka	Muharam/Sako

2005	Dec	43		,	Arafo
	Nov	44			Sidatal
	Oct	45		Bilowgi Deyr	Soonfur
	Sept	46			Ramadan/Soonqaad
	Aug	47			Shacbaan/soondhere
	July	48		Bilowgii Xagaa	Rajab/Sabuux
	June	49			JamatulaAkhir
	May	50			Jamatulawal
	Apr	51		Bilowgii Gu'	Rabu- Akhir
	Mar	52			Rabici-awal/Mowliid
	Feb	53			Safar
	Jan	54		Bilowgii Jiilaal	Muharam/Sako
2004	Dec	55			Arafo
	Nov	56			Sidatal
	Oct	57	Doorashadii madaxweyne Abdullahi Yusuf	Bilowgii Deyr	Soonfur
	Sept	58			Ramadan/Soonqaad
	Aug	59		Bartamaha Hagaa	Shacbaan/soondhere

Beginning of Jilaal/Dry period
Beginning of Gu'/Long rainy season
Beginning of Xagaa/ light showers
Beginning of Deyr/Short rainy

Annex 14 Cluster Control Sheet

Region ____________District _________________Cluster

Remember you need a total of:

7 Women 15-49 years (DBS & HB)

7 Children 6-59 months (DBS &HB)

Cluster Number: /____/____ Team Leader:____Team Number: _/____

7 Children 6-11 years DBS & HB

9 Women 15-49 years Urine

9 Adolescents 6-11years Urine

9 Household for salt sample collection

50 Malaria tests all ages

Household Identification *Zone/ cluster no/household number*	Did you speak to people: 1= in the house 2= to neighbors 3= no one	Did the house contain people you needed for your sample quota? 1= yes 2= no	If they refused, what was the reason? 1=not interested 2= no reason given 3=household head not present 4= other	Questionnaire Number given to the household	Number of Women between 15-49 years for **DBS & HB** in each house (A) and running total (B)		Number of Children 6-59 months for **DBS & HB** in each house (A) and running total (B)		Number of Adolescent 6-11yrs for **DBS & HB** in each house (A) and running total (B)		Number of Women between 15-49 years for **Urine** in each house (A) and running total (B)		Number of Adolescents 6-11 years for **Urine** in each house (A) and running total (B))		Number of households for **Salt sample** collection in each household (A) and running total (B))		Number of RDT tests ages	
					A	B	A	B	A	B	A	B	A	B	A	B	A	B

Continue on a new sheet if necessary (remember to fill in all the information at the top of the sheet).

Annex 15 Example Training Schedule

Time	**23rd March 2009 (Day1)**	**24th March 2009 (Day2)**	**25th March (Day3)**	**26th March (Day4)**	**27th March (Day5)**	**28th March (Day6)**	**29th March (Day 7)**
8.00-9.45am	• Official opening of the workshop by Ministry of Health • Introductions of members • Administrative issues – *working hrs , payments, duration of survey etc* • Pre test • Survey overview *Objectives* *Justification* *Methodology* *Target groups* *Analysis*	Practice of anthropometric techniques	Haemoglobin testing and other biological sample collection *HemoCue* *DBS* *Urine Sample*	• Reporting and recording of Data • Practice of recording of information	• Role and responsibilities of survey teams and survey algorithm • Practice of questionnaires and cluster control sheets	Pilot testing of survey tools	Discussion of field procedures *-areas of difficulty* *-Solution* *-Quality of team work*
9.45-10.15am	**Tea Break**						
10.30-12.00 pm	General overview of Micronutrients deficiencies and their assessments	• Cluster and household selection procedures • interviewing techniques. • Questionnaires • cluster control	Safety precautions -Sample storage and cold chain systems	RDT collection technique	Practice of Hemocue and other biological sample collection techniques	Pilot testing of survey tools	• Review anthropometric techniques • Review of Haemoglobin testing with Hemocue • Review blood and urine collection • Review RDT collection
12.15-1.30pm	**Lunch**						

1.30- 3.15pm A break of 20 min for asr prayers	Anthropometric techniques *Weight* *Height/ Length* *MUAC* *Comex index*	Practice of questionnaires	Practice of HB and other sample collection methods	Practice of RDT technique Team selection and appointment of team leaders	Role plays	Pilot testing of survey tools	• Post test • Final instruction for field work
4.30-5.00pm	**Tea break**						

Annex 16 Survey Teams

Somaliland

Team 1

Said Hussein Ege	Team Leader
Saado Jama Aden	Interviewer
Ahmed Hassan Bigile	Measurer
Muna Ali Dualeh	Measurer
Farah Ahmed Arab	Interviewer
Liban Ahmed Hassan	Biological sample collector
Abdirizak Ahmed Hassan	Biological sample collector

Team 2

Hussein Koore	Team Leader
Hassan Ahmed Salah	Interviewer
Fadumo Osman Ogle	Interviewer
Khadar Osman Idiris	Measurer
Amina Ciise Fidhin	Biological sample collector
Ahmed W Cilmi	Biological sample collector
Abdullahi Ahmed Caali	Measurer

Team 3

Mohamed Farah Ahmed	Team Leader
Hadlia Mohamud Ismail	Measurer
Nafiis Hassan Cabdi	Measurer
Mohamud Idle Ducaale	Biological sample collector
Siciid Mohamed Guuled	Biological sample collector
Faisa Hussein Noor	Interviewer
Mohamed Hassan Ganey	Interviewer

Team 4

Osman Ibrahim Hayd	Team Leader
Mahdi Mohamed Taani	Interviewer
Abdirashid Ahmed Jibril	Measurer
Nimco Ismail Sh Ibrahim	Measurer
Shukri Mohamed Ciggeh	Interviewer /Team leader
Hassan Nuur Jama	Biological sample collector
Jama Adan ali	Biological sample collector

Team 5

Noura Ibrahim M	Team Leader
Ifraah Mohamed	Interviewer
Najax abdullahi Hassan	Measurer
Mukhtaar Ahmed Saalex	Measurer
Ali Mire Jaama	Interviewer
Abdi Ahmed Mohamud	Biological sample collector
Abdiqani Mohamed Adan	Biological sample collector

Team 6

Khalif mohamed ali	Team Leader
Fatuma Ali Farah	Measurer
Mohamed Abdullahi Ismail	Biological sample collector
Luul Abdillahi oku	Measurer
Muse Barhahad Warsame	Interviewer
Shamis Dubad Ducaale	Interviewer
Shaakir Nuur Mohamed	Biological sample collector

South Somalia

Team 1
Gedo
Abdikadir Adan Mohamed – Team Leader
Hassan Mohamed Ali – Interviewer
Ali Yussuf Abdullahi – Interviewer
Hodan Hussein Ibrahim – Measurer
Mohamud Haji Farah – Measurer
Ali Haji Dahir – Biological sample collector
Abdisamad Maalim Somow- Biological sample collector

Team 2
Gedo
Adan Abdi Hashi – Team Leader
Abdirahman Mohamed Sheikh –Interviewer
Mohamed Abdullahi Barre – Interviewer
Katra Abdullahi Ibrahim –Measurer
Farhan Hassan Barise –Measurer
Awes Dubane Daar – Biological sample collector
Mahat Abdullahi Abdulle- Biological sample collector

Team 3
Jubas
Awes Sheikh Mohamed –Team Leader
Mohamed Hassan Weheliye- Biological sample collector
Abdulkadir Hassan Arte – Biological sample collector
Halima Farah Godane -Measurer

Omar Hussein Diriye- Measurer
Adan Idle Mohamed – Interviewer
Hussein Abdullahi Issack – Interviewer

Team 4
Bakool
Fatuma Mohamed Ahmed- Team Leader
Abdikadir Haji Noor – Interviewer
Adan Ibrahim Issack – Interviewer
Madkheir Ugas – Measurer
Adan Abdulle Mohamed –Measurer
Yakub Haji Mohamed –Measurer
Mustafe Abdullahi Sheikh–Measurer
Luul Mohamed Noor – Measurer
Adan Mohamed Noor – Biological sample collector
Ahmed Daadle Ahmed – Biological sample collector

Team 5
Bay
Suleiman Aden Mo'alim- Team Leader
Mohamed Ali Abdullahi – Interviewer
Ahmed Abdullahi Makaran – Interviewer
Abdikadir Mohamed Ibrahim - Measurer
Katra Ali Sheikh – Measurer
Abdirahman Mohamed Hussein – Biological sample collector
Mohamed Abdirahman Sheikh – Biological sample collector

Team 6
Shabelle
Asha Hussein Mo'alim- Team Leader
Abdiaziz Mustaf Takow – Interviewer
Ubax Ahmed Haji- Interviewer
Ibrahim Aden Ali- Meausurer
Mohamed Omar Hassan – Measurer
Abdishakur Sheikh Hassan – Biological sample collector
Fardowsa Farah Ahmed – Biological sample collector

Team 7
Shabelle
Saciid Hagai Afrah –Team Leader
Salat Aweis Mohamed – Interviewer
Salah Hussein Hurshe – Interviewer
Faisa Mohamed Jimaale- Measurer
Hawa Mohamud Mohamed - Measurer
Dahir Farah Diiriye- Biological sample collector
Shute Muhuyadin Mohamed – Biological sample collector

Team 8
Shabelle
Mohamed Mohamud Mohamed – Team Leader
Mohamed Ali Hussein – Interviewer

Yussuf Hassan Doyow- Interviewer
Farah Osman Rage- Measurer
Iqra Mohamed Hussein- Measurer
Maryan Dahir Halane – Biological sample collector
Liiban Hirey Siyat – Biological sample collector

Puntland

Team One

Mohamud Fatah Mohamud	Team Leader
Farhia Osman Ali	Measurer
Ahmed Abdi Huseyn	Biological sample collector
Shukri Dalmar Warsame	Biological sample collector
Mohamed Ahmed Hersi	Interviewer
Jamad farah Esse	Measurer
Deqo Ali Hersi	Interviewer

Team two

C/Karim Farah Gutale	Team Leader
Abshiro farah Ali	Biological sample collector
Mohamed A/Lahi Ali	Biological sample collector
A/Rahman Qaxiye Esse	Interviewer
A/Razak Nadiif Ahmed	Interviewer
Fawsia Mohamed Omar	Measurer
A/Rashid Mohamed Barre	Measurer

Team three

Abshir Barre Samatar	Team Leader
Deeqo Mohamed Canod	Biological sample collector
Faiza Abdnur Farah	Biological sample collector
Said Abdullahi Elmi	Measurer
Mohamud Mohamed Barre	Measurer
Iftin Yusuf Mohamed	Interviewer
faduma Yasin Hersi	Interviewer

Team Four

Hassan Ali Awad	Team Leader
Ruqiya Abdullahi Omar	Biological sample collector

Mohamed A/Razak Khalif	Biological sample collector
Mohamed Jama Samatar	Interviewer
Saddam husein Abdi	Interviewer
Nimco A/lahi Ali	Measurer
Sahro Abshir Samriye	Measurer
Team Five	
Mahad Omar Hersi	Team Leader
Anab Ali Warsame	Biological sample collector
Faduma A/Razak Mohamed	Biological sample collector
Mohamed Abdul Ali	Measurer
A/Fatah Barre Nouh	Interviewer
Muhyadin Mohamed Nouh	Measurer
Ahmed Abdisalam Jama	Interviewer
Team Six	
A/Qani jama Mohamed	Team Leader
saynab Saed Salah	Biological sample collector
Sadia Ahmed Warsame	Biological sample collector
Mohamed Nour Gelle	Interviewer
Jama Mohamed Khurshe	Interviewer
Rawda A/Asis Husein	Measurer
Shukri Salad Warsame	Measurer

Central Somalia

Team one	
Hibo Jama Hashi	Team Leader
A/Hakim Mohamed Dini	Biological Sample Collector
Mohamud Abdullahi Dirie	Interviewer
Safiya Dahir Hassan	Interviewer
Ahmed Ibrahim Nur	Biological Sample Collector
Amina Dahir Ashur	Measurer
Khadija Jama Mohamed	Measurer
Team two	
Ali Sheikh Ahmed	Team Leader
Nacimo Warsame Diriye	Interviewer
Zeinab Ahmed Mohamud	Interviewer
Fadumo Mohamed Jimcale	Biological Sample

	Collector
Ali Abdi Omar	Biological Sample Collector
Deeqo Ali Subeyr	Measurer
Mahdi Mohamed Hussein	Measurer
Mohamed Hassan Ali	Biological Sample Collector

Team Three

Ahmed Hassan Ali	Team Leader
Ahmed Abdi Mohamud	Interviewer
Abdullahi Addow Aybakar	Biological Sample Collector
Abdirashid Omar Asayr	Measurer
Abdullahi Osman Hussein	Measurer
Hibo Abdullahi Ali	Interviewer
Qali Ali Gedi	Biological Sample Collector