National Micronutrient Survey
2011-12

স্বাস্থ্য ও পরিবার কল্যাণ মন্ত্রণালয়

Institute of Public Health Nutrition
Directorate General of Health Services
Ministry of Health and Family Welfare
Government of the People's Republic of Bangladesh

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This report summarizes the findings of the National Micronutrient Survey 2011-12 conducted under the authority of the Institute of Public Health Nutrition (IPHN) of the Directorate General of Health Services, Ministry of Health and Family Welfare, and carried out by icddr,b and Mitra and Associates of Dhaka. Financial and technical assistance was provided by United Nation Children's Fund (UNICEF) and Global Alliance for Improved Nutrition (GAIN) for the survey.

Additional information about the National Micronutrient Survey 2011-12 may be obtained from:

Centre for Nutrition and Food Security, icddr,b
68, Shaheed Tajuddin Ahmed Sharani
Mohakhali, Dhaka, Bangladesh
Telephone: 880-2-9882252
Fax: 880-2-861-3362

UNICEF, Bangladesh
BSL Office Complex
1 Minto Road, Dhaka, Bangladesh
Telephone: 880-2-8852266
Fax: 880-2-9335641

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Edited by:
Barbara Hall, Consultant, UNICEF
Ireen Akhter Chowdhury, UNICEF
Ahmed Shafiqur Rahman, icddr,b

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FOREWORD

I am privileged to write the foreword for the first ever National Micronutrient Survey in Bangladesh. Prior to 2011, micronutrient specific area based data showed that micronutrient deficiencies were common in Bangladesh, but representative national data were not available for some of the important essential micronutrients. Therefore, a National Micronutrient Survey was undertaken to generate data for evidence based advocacy, planning and programming for micronutrient deficiency control interventions and to assess the impact of ongoing micronutrient interventions.

This report presents the findings of the National Micronutrient Survey undertaken in 2011. The report provides valuable information which will inform policy and programming in the short, medium and longer term future for the benefit of the people of Bangladesh.

With our support, I expect that the Institute of Public Health Nutrition will use the survey data to develop a National Micronutrient Deficiency Control Strategy to address micronutrient deficiencies in Bangladesh. We hope that the multi-sectoral approach to addressing micronutrient deficiencies will deliver effective and efficient policies and programmes to ensure a significantly better nutrition situation in Bangladesh.

Joy Bangla, Joy Bangabandhu
Long Live Bangladesh

(Mohammed Nasim)
Minister
Ministry of Health and Family Welfare
Government of the People's Republic of Bangladesh

MESSAGE

Although Bangladesh has made good progress in improving the nutrition situation over the last two decades, micronutrient malnutrition still poses a significant public health problem. Along with efforts in a number of other sectors, the Ministry of Health and Family Welfare is implementing number of national and sub-national level interventions to combat micronutrient deficiencies among the population particularly. The Ministry of Health and Family Welfare strives to ensure its strategies and programmes are informed by evidence and driven by strong data.

Therefore the National Micronutrient Survey has been undertaken at a time when the Government of Bangladesh has increased its commitment to nutrition, thereby allowing strategies, programmes and interventions to be reviewed and updated.

We appreciate the continued focus and commitment demonstrated by the Institute of Public Health Nutrition for the initiative taken to conduct this comprehensive National Micronutrient Survey. The survey report provides current deficiency status of all important micronutrients, which are essential for the growth and development of the children. I trust the findings of the survey will now guide us to formulate effective strategies to prevent and control these deficiencies.

Joy Bangla, Joy Bangabandhu
Long Live Bangladesh

(Zahid Maleque)
State Minister
Ministry of Health and Family Welfare
Government of the People's Republic of Bangladesh

MESSAGE

he National Micronutrient Survey 2011-12 is a nationally representative survey designed to provide information on all essential micronutrient deficiencies, understand knowledge and practices related to iodine deficiency disorders, vitamin A and iron-rich food consumption, as well as consumption and purchasing patterns of edible oil and salt in the population of Bangladesh.

The survey presents a valuable opportunity for a thorough review of the country situation in relation to Micronutrient Deficiencies which are of public health importance and current interventions to prevent and control.

Further detailed analysis and interpretation of results of National Micronutrient Survey data presents an interesting challenge for academics, researchers, program personnel and experts from different cross-cutting programmes to provide more in-depth knowledge for future direction and effective implementation of national micronutrient interventions.

We recognise that a strong micronutrient deficiency control programme is multi-sectoral in nature and are committed to working in collaboration with other sectors to ensure success.

(M.M. Neazuddin)
Secretary
Ministry of Health & Family Welfare
Government of the People's Republic of Bangladesh

MESSAGE

It is my pleasure to note that the first ever comprehensive National Micronutrient Survey in Bangladesh had been conducted revealing update situation of the country. It was a long time need for the situation analysis and strategy formulation. The previous experience of discrete initiatives are over and an effective and efficient method of conducting comprehensive survey have been explored. The most important opportunity is that based on the survey findings a national strategy to be formulated to address the micronutrient deficiency situation of the country.

Bangladesh possesses a huge burden of deficiencies of a range of micronutrients including iron and folic acid, vitamin A, iodine, zinc, calcium, B_{12} etc. However, the real parameters were unknown. It's good to observe that programming across Ministries including Health and Family Welfare, Industries, Agriculture etc. are contributing towards controlling micronutrient deficiency related problems. Directorate General of Health Services through its relevant Operational Plans has been contributing significantly to the fight against the menace of hidden hunger.

I congratulate the Institute of Public Health Nutrition (IPHN) to take the lead of conducting the survey, the technical committee for its guidance and at the same time UNICEF, GAIN and icddr,b for their roles of support and technical assistance.

Let we dream for a country free from preventable menace of micronutrient deficiencies.

(Professor Dr. Deen Mohd. Noorul Huq)
Director General of Health Services
Ministry of Health and Family Welfare
Government of the People's Republic of Bangladesh

MESSAGE

Bangladesh has been acclaimed globally for its remarkable success in health and population control achievements, however with a low pace in terms of nutrition. Micronutrient malnutrition still poses a significant public health problem in Bangladesh. One feature regarding the micronutrient deficiencies was dearth of recent data, as a result designing pragmatic programming. The National Micronutrient Survey was a time befitting undertaking at a time when the Government intends to strengthen its nutrition programming through updated strategies.

I appreciate the Institute of Public Health Nutrition and its collaborating organizations and agencies for their initiative to conduct this comprehensive National Micronutrient Survey. I notice with encouragement the possibility of formulating a national strategy on micronutrient deficiency based on the up to date data generated through the survey.

Bangladesh already possess a multi-sector programming targeted towards control of micronutrient deficiencies. Directorate General of Family Planning through its relevant Operational Plans has been putting efforts to that end.

I believe the days are not too far when we can effectively control the outcomes of essential micronutrients deficiencies.

(Md. Nur Hossain Talukder)
Director General of Family Planning
Ministry of Health and Family Welfare
Government of the People's Republic of Bangladesh

ACKNOWLEDGEMENT

The Ministry of Health and Family Welfare, along with other key Ministries, supports a number of micronutrient deficiency control programmes which include supplementation specific target groups with iron and folic acid, vitamin A and zinc. At the same time Ministry of Health and Family Welfare is providing technical support to Ministry of Industries to implement food fortification programmes to reduce iodine and vitamin A deficiency in the population in Bangladesh. Ministries in the food sector actively promote cultivation and consumption of micronutrient rich foods.

Recognising the need to review progress and ensure strategies are based on current data and evidence, the Institute of Public Health Nutrition (IPHN) in collaboration with UNICEF, GAIN and icddr,b conducted the National Micronutrient Survey 2011-12. For the first time, this survey collected biological samples for all essential micronutrients and provided current updates on vitamin A, iron, iodine, vitamin D, calcium, folate, B12 and anaemia.

I express my sincere thanks and gratitude to the Technical Committee Members for their valuable guidance and inputs and their continuous monitoring of the quality of survey methods and analysis throughout the entire process.

I would like to thank UNICEF and GAIN for financial, technical and logistic support in conducting the survey. UNICEF also provided additional support for editing of the report and publication.

I would like to acknowledge the valuable role of all the field team members (technicians, interviewers, supervisors in the field), investigators, laboratory and statistical analysis team members, and administration staff related with the survey for their valuable contributions.

Finally, I would like to thank the local administrators, Chairmen of Upazila Parishad, Health and Family Planning Managers and above all the respondents in the survey areas whose active co-operation and enthusiastic participation made this huge exercise possible.

(Dr. Md. Shah Nawaz)
Director, Institute of Public Health Nutrition
& Line Director National Nutrition Services
Directorate General of Health Services
Ministry of Health and Family Welfare
Government of the People's Republic of Bangladesh

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Acronyms and abbreviations

AGP	Alpha acetylated glycoprotein
BBS	Bangladesh Bureau of Statistics
BDHS	Bangladesh Demographic and Health Survey
BDT	Bangladesh Taka
CI	Confidence interval
CDC	Center for Disease Control and Prevention (USA)
CRP	C-reactive protein
CUS	Center for Urban Studies
CV	Co-efficient of variation
EPI	Expanded Programme on Immunization
ERC	Ethical Review Committee
EQUIP	Ensuring the Quality of Iodine Procedures
FFQ	Food Frequency Questionnaire
FANTA	Food and Nutrition Technical Assistance
GOB	Government of Bangladesh
G	Gram
GDP	Gross domestic product
HKI	Hellen Keller International
HH	Household
icddr,b	International Centre for Diarrheal Diseases Research, Bangladesh
ID	Iron deficiency
IDA	Iron deficiency anemia
IDD	Iodine deficiency disorders
IOM	Institute of Medicine
IPHN	Institute of Public Health Nutrition
IRB	Institutional Review Board
IVACG	International Vitamin A Consultative Group
IZINCG	International Zinc Nutrition Consultative Group
LPG	Liquid petroleum gas
KAP	Knowledge Attitude and Practice
MDG	Millennium Development Goals
MICS	Multiple Indicator Cluster Sampling
MMQAP	Micronutrients Measurement Quality Assurance Program
Mmol/l	Micromole per litre

MUAC	Mid-upper arm circumference
NGO	Non-government organization
NIST	National Institute of Standards and Technology
Ng/ml	Nanogram per millilitre
Nmol/l	Nano mole per litre
NPNL	Non-pregnant non-lactating
PCA	Principal Component Analysis
Pg/ml	Pico gram per millilitre
PHM	Photometeric hemoglobinometer
PPM	Parts per million
PSU	Primary Sampling Unit
QC	Quality control
RDA	Recommended Daily Allowance
RE	Retinol equivalents
RRC	Research Review Committee
SES	Socio-economic status
SOP	Standard Operating Procedure
THFPO	Thana Health and Family Planning Officer
UIC	Urinary Iodine Concentration
UNICEF	United Nation's Children's Fund
USI	Universal Salt Iodization
VITAL EQA	Vitamin A Laboratory – External Quality Assurance
WHO	World Health Organization

Summary of Findings

Household assets: Nationally, 68.7% of households had electricity, 41.6% owned televisions and 12.0% owned refrigerators. A high percentage of households owned mobile phones.

Household food insecurity: Over half of the households (52%) were "food-secure"; 53.5% of the households in the urban clusters and 36.3% of households in the slum clusters were "food-secure"; 12.3% of households were severely "food-insecure".

Household monthly spending: The average monthly expenditure was BDT 8,944.00. It was slightly higher in the urban (BDT11,006.00) than in the rural (BDT 8,393.00) area. Households with "food-secure" had significantly higher spending power than the households which were "severely food-insecure" (BDT 10,357.00 against BDT 6,505.00).

Consumption of oil: The national estimate of per capita daily consumption of oil was 24.4 grams broken as follows: 29.7 g, 25.9 g, and 22.9 g, respectively, in the urban, slum and rural areas. In food-secure households, consumption was 27.8 g compared to 16.4 g in the "severely food-insecure" households.

Type of cooking oil used in households: In all households, consumption was: soybean oil, 89.5%; mustard oil, 17.2%; and "brand" oil in 25.7%. In the rural, urban and slum clusters, 22.8%, 38.6% and 12.7%, respectively, used "brand" oil. However, the vast majority of the households at the national level consumed "open" oil (73.2%).[1]

Sub-clinical vitamin A deficiency status: The prevalence of sub-clinical vitamin A deficiency, as measured by serum retinol level (serum retinol< 0.7 mmol/l), was 20.5% among preschool children (aged 6-59 months); the prevalence was significantly higher in the slum clusters, at 38.1%. The prevalence was 20.9% and 5.4%, respectively, among school-age children and non-pregnant, non-lactating (NPNL) women. Prevalence in school-age children in the slums was 27.1%.

Vitamin A supplementation in preschool children: The national estimate of the coverage was 77%. It was 77.9%, 73.1% and 72.4%, respectively, in the rural, urban and the slum clusters. According to the Asset Index, the coverage was 76.4% in the "poorest" section and 87.5% in the "richest" section of population.

Anemia: The prevalence of anemia in the preschool children was 33.1%. It was 36.6% and 22.8% respectively in the rural and the urban clusters. The prevalence appeared to be lower than the earlier nationally representative estimates of the country (47.0%, NSP 2001); however, this may be accountable to the difference in the assessment methods. Venous hemoCue was used in the *National Micronutrients Survey*. The prevalence of anemia in school-age children was 19.1% and 17.1%, in 6-11 year-olds and 12-14 year-olds, respectively. The prevalence of anemia in NPNL women was 26.0% against 33.0% in the earlier, nationally representative survey (NSP 2001).

Iron deficiency: Iron deficiency was measured by estimating serum ferritin level. In the National Micronutrients Survey, for the first time, nationally representative data on serum ferritin were available. The ferritin value in serum was adjusted for presence of infection by addressing the elevated values of CRP (>10 mg/l) and AGP (>1 gm/l), the biomarkers for infection. The national prevalence of iron deficiency, as measured by low ferritin (preschool children<12 ng/ml; school-age children and NPNL women<15 ng/ml) was 10.7% in preschool children and 7.1%. in NPNL women; and 3.9% and 9.5% in school children aged 6-11 year and 12-14, respectively. The prevalence of iron deficiency in the Bangladesh population was substantially lower than the widely held assumption. The amount of consumption of iron from food is below the daily recommended requirement (RDA) in all the population groups studied. The total consumption of iron from food was 41-82% of the recommended daily requirement across age and gender of the studied population groups. The mean ferritin level in the blood in the studied population

[1]"Branded" refers to selling in bottle, packet, tin with labelling, certification logo and company name/logo. "Open" oil refers to bulk oil sold in a drum.

groups were significantly higher ($p<0.001$) in the areas where groundwater iron concentration was higher than in the areas where groundwater iron was lower. In spite of lower consumption of iron from food, iron deficiency in the population was lower than expected and was presumably linked with high level of iron in the groundwater, which is the largest source for drinking water in the Bangladesh population (80.0%).

Zinc status: For the first time in Bangladesh, the *National Micronutrients Survey 2011-12* provided nationally representative data on zinc status in selected populations. The national prevalence of zinc deficiency was 44.6% in preschool children; 51.7% in the slums and 29.5% in the urban cluster. The national prevalence of zinc deficiency in NPNL women was 57.3%; 66.4% in the slums, 57.5% in the rural and 54.5% in the urban cluster.

The consumption of zinc was well below the RDA in NPNL women: 54.7% in the urban cluster and 47.0% in the slum cluster. Out of total consumption, most of the zinc is derived from plants, which is poorly bio-available.

Vitamin $B_{12}$and folate status: Vitamin B_{12} and folate status were estimated in NPNL women. This was the first time that a *National Micronutrients Survey* had provided nationally representative data on these deficiencies. The national prevalence of folate deficiency was 9.1%. The prevalence of vitamin B_{12} deficiency (frank deficiency and marginal deficiency) was 23.0% at the national level.

Status of iodine and salt iodization: The prevalence of iodine deficiency was 40.0%, as measured by the percentage of school children whose mean urinary iodine concentration (UIC) was below the cut-off mark of 100 µg/l. This showed a rising trend from 33.8% in the 2004/5 data. In NPNL women, the prevalence of iodine deficiency was 42.1%, which has also shown a rising trend from earlier data, at 38.0%. However, according to median UIC, which was above the cut-off mark for defining deficiency (100 µg/l), the trend in iodine deficiency prevalence was on the rise although the country as a whole, based on the total population, was iodine-sufficient. The median urinary iodine concentration in school-age children and NPNL women was 145.7 µg/l and 122.6 µg/l, respectively. According to the Asset Index, the bottom two quintiles, the "poorest" and "poorer" NPNL women, had a median urinary iodine concentration below 100 µg/l, indicating that these women were iodine-deficient.

Around 80% of households used iodized salt (iodine level $\geq$5 ppm), while 57.6% of households used adequately iodized salt (iodine level $\geq$15 ppm). In the rural areas, use of adequately iodized salt was just 51.8%. The national use rate of "brand" salt was 75.8%; however, a substantial percentage (29.2%) of the households in the rural areas still used "open" salt. The consumption of "open" salt was 37.0% and 17.0% in the "poorest" and the "richest" households, respectively. The percentage of use of retailer salt samples with adequately iodized salt ($\geq$20 ppm) was 66.4%.

Nutritional status of preschool children: The prevalence of stunting (height-for-age z-score <-2) in preschool children (6-59 months) was 32.1%: it was higher in the slums (51.1%) than in the urban (31.3%) and rural areas (31.4%). The prevalence of underweight (weight-for-age z-score<-2) at the national level was 30.0%. It was more prevalent in the slum cluster (47.4%) than in the other two clusters – 29.6% in the rural cluster and 28.1% in the urban cluster. The prevalence of wasting (weight-for-height z- score<-2) was 19.3%, with proportionately more children in the slums (20.3%) and rural clusters (21.1%) than in the urban cluster (12.9%).

Micronutrients consumption from food: Although the consumption level of animal source foods has been increasing in the country (*Household Income & Expenditure Survey of Bangladesh*, 2010), the data of the *National Micronutrients Survey* suggests that the population of Bangladesh is still well below the Recommended Daily Allowance (RDA) of food intake for the key micronutrients. The median daily consumption of vitamin A, as expressed by RE, was 270.0, 318.0, and 372.0 REs in preschool children, school-age children and NPNL women, respectively, which were below the RDA amount for the respective age and population groups. Daily median consumption of iron from food was 4.17, 5.21 and 6.64 mg in preschool children, school-age children and the NPNL women, respectively, which were lower than the RDAs for the age and population. The consumption of iron from animal sources, i.e. the form of dietary iron that is readily absorbed in the body, was a low share of the total iron consumption. The percentage of animal source iron of the total iron consumption was 23.0%, 24.0% and 18.0%, in school children, preschool children and NPNL women, respectively. With regard to consumption of zinc from food, the median daily consumption was 3.20 mg and 2.67 mg in the urban and slum clusters, respectively, compared to the RDA of 3-5 mg for zinc in preschool children.

Micronutirients and nutritional status among the slum population: The *National Micronutrients Survey* recorded for the first time micronutrients status among the slums population, addressing a long-felt need for data on key micronutrients. The findings were remarkable, because populations in the slum cluster suffer from key micronutrients deficiencies, and the undernutrition status was higher than in urban and rural areas, yet the SES indicators were not below those in the rural cluster (Table A).

Table A. Prevalence of Micronutrient and Nutritional Status by Cluster

	Rural (%)	Urban (%)	Slum (%)
Subclinical vitamin A deficiency			
Preschool Children	19.4	21.2	**38.1**
School-age children	20.2	22.1	**27.1**
NPNL women	5.4	4.9	**6.9**
Zinc deficiency			
Preschool children	48.6	29.5	**51.7**
NPNL women	57.5	54.5	**66.4**
Nutritional status of preschool children			
Stunting	31.4	31.3	**51.1**
Wasting	21.1	12.9	**20.3**
Underweight	29.6	28.1	**47.4**

1. Introduction

Bangladesh has been making impressive progress in reducing undernutrition and is one of the countries that is on course to likely meet the Millennium Development Goal (MDG) 1 on nutrition. However, the prevalence of micronutrient deficiency persists at a high level. It was estimated that micronutrient deficiency accounted for the loss of $7.9 billion losses in national gross domestic product (GDP). The major micronutrient deficiency affecting the population of Bangladesh concern vitamin A, iron and anemia, zinc and iodine. According to the most recent nationally representative survey, the prevalence of sub-clinical vitamin A deficiency, as measured by low serum retinol level (<0.7 mmol/l) in the pre-school children (6-59 months), was 22.0% (IPHN/HKI 1997-98). In a more recent study conducted in the areas where home gardening was practised, it was reported that around one-fifth (19.6%) of the young children had a serum retinol level of <0.7 µmol/l (Faruque *et al.,* 2006). The vitamin A capsule distribution programme for preschool children (aged 2-<5 years) has successfully contributed to decreasing the magnitude of the problem over the past decade, especially in reducing the prevalence of night blindness. However, there are pockets of areas where there might be severe vitamin A deficiency. Post-partum vitamin A supplementation coverage was only 17.0% (BDHS 2007). To increase the coverage of vitamin A interventions, the Government of Bangladesh, under the auspices of the Ministry of Industry, has initiated the National Oil Fortification Programme. The Programme fortifies locally processed cooking oil (soybean, palm oil) with vitamin A. The current *National Micronutrients Survey* includes the baseline assessment of the current subclinical vitamin A status. The impact of the Oil Fortification Programme can be assessed based on this survey.

Anemia is probably the biggest public health problem of the country, affecting around half of preschool children (BBS/UNICEF. Anaemia Prevalence Survey 2003). Prevalence among under-two children is pervasive: over 60% suffer from anemia (Nutrition Surveillance Project 2001). The most recent nationally representative anemia survey was conducted approximately one decade ago, and it is unanimously recommended by the policy actors of the country for conducting a national survey on anemia and iron deficiency. Until now in Bangladesh, there have been no nationwide data on iron deficiency assessed using serum ferritin or other specific indicators of iron such as sTfR. There are only sporadic small-scale studies using such iron indicators. Therefore, this survey was an attempt to obtain a nationally representative data on iron deficiency for the first time in the country.

Although iodine deficiency disorders (IDD) have been successfully controlled for over a decade, this problem is still a fundamental health public health issue. The prevalence of IDD, as indicated by UIC below a defined cut-off mark (100 µg /l), was 33% in school-age children and 38 percent in NPNL women. The national IDD control programme is mandated to monitor the situation over time; the most recent Iodine Deficiency Disorders and Universal Salt Iodization (IDD/USI) survey was conducted in 2004. Hence, this survey provides the opportunity for informing the updated status of iodine nutrition and of iodine in salt.

Zinc is essential for normal growth and immune function. In children living in countries with an elevated risk of zinc deficiency, zinc supplementation enhances growth, decreases morbidity from diarrhea and pneumonia, and decreases mortality. Zinc is available in animal source foods, meat, fish and eggs, etc. However, the diet of Bangladesh lacks the optimal amount of animal source food and is predominantly staple-based, which is a poor source of zinc. An estimated 50 percent of the population is at risk of inadequate zinc intake based on national food supply data. A recent study conducted in two of the subdistricts in Bangladesh, which examined the efficacy of bio-fortified rice, showed a prevalence of inadequate serum zinc in under-five children and women is 22% and 73%, respectively (Arsenault, 2010). However, since nationally representative data on zinc deficiency were unavailable, the present survey provided, for the first time, nationally representative data on zinc nutrition in the selected population groups. The survey also provided nationwide data on folate and vitamin B_{12} deficiencies in NPNL women.

A conglomerate of multiple micronutrients for the survey was efficient in terms of resources. Perhaps more importantly, there was an essential public nutrition response to inform policy makers on the nation-wide population status of key micronutrients such as iron, zinc, folate, vitamin B_{12}, which was previously unknown, and on the updated status of other key micronutrients such as vitamin A, iodine. Ongoing monitoring of the key micronutrients is required for the population's improved nutrition.

1.1 Objectives

To estimate the status of key micronutrients (vitamin A, iron, iodine) for the selected population groups, i.e. preschool children (6–59 months), school-age children (6–14 years) and NPNL women of reproductive age (15–49 years) for rural, urban and slum cluster in order to:

a) estimate the current prevalence of sub-clinical vitamin A deficiency in preschool children, school-age children, and NPNL women as the baseline for the Government's National Oil Fortification Programme as measured using serum retinol concentrations;

b) assess the current status of iodine deficiency disorder (IDD) among school-aged children and NPNL as measured by UIC;

c) estimate the current prevalence of anemia in the preschool children (6-59 months), school-aged children and NPNL as measured by hemoglobin;

d) estimate current prevalence of iron deficiency in the preschool children (6-59 months), school-aged children and NPNL as measured by ferritin (and CRP and AGP for adjusting for infection);

e) estimate current prevalence of zinc deficiency in the preschool children (6-59 months), and NPNL as measured by serum zinc;

f) assess the share of households using adequately iodized salt by analysing salt samples collected from households;

g) obtain information on the awareness of the survey populations on IDD, vitamin A and iron-rich food consumption, oil consumption and purchasing patterns of the survey population;

h) assess the percentage of households using oil that will be fortified by inquiring about the use of refined oil and collecting the brand names, where possible;

i) compare progress in coverage of adequately iodized salt and the iodine status with the previous findings in the National Iodine Deficiency Disorders and Universal Salt Iodization (IDD/USI) survey;

j) assess prevalence of folate and vitamin B_{12} deficiency in NPNL.

Table 1: Parameters for Analysis

Issues of Interest	Key Indicators
Biochemical assessment	Prevalence of sub-clinical vitamin A deficiency Prevalence of iron deficiency Prevalence of iodine deficiency Prevalence of zinc deficiency Prevalence of folate deficiency Prevalence of vitamin B_{12} deficiency Prevalence of anemia (hemoglobin) Assessment of inflammatory biomarkers (CRP, AGP) Assessment of salt for presence and adequacy of iodization
Dietary Assessment	Dietary consumption pattern, especially vitamin A-, iron- and zinc-rich food consumption Consumption of cooking oil
Anthropometry	Prevalence of underweight (weight-for-age <-2 z-score) among children aged 6-59 months Prevalence of wasting (weight-for-height <-2 z-score) among children aged 6-59 months Prevalence of stunting (height-for-age <-2 z-score) among children aged 6-59 months
Other indicators	Household food insecurity Socio demographic conditions influencing vitamin A deficiency, anemia, iodine deficiency and child nutritional status.

2. Methodology

2.1 Survey Population

The survey population includes preschool children (6–59 months), NPNL women of reproductive age (15–49 years) and school-age children (6–14 years).

2.1.1 Inclusion Criteria for the Household

1. Any household member belonging to any one of the target groups of the survey population. In the case of more than one eligible individual in a household from a particular population group, all are considered for enrollment.
2. The head of household (or another adult in his absence) has given verbal consent for household participation, including that for children.
3. Household members currently living in a selected cluster.

2.1.2 Inclusion Criteria for the Individual

1. The individual is a member of the survey target group.
2. The female participant has given written informed consent for her and her preschool child's participation in the study. For school-age (over ten-year-old) children who are able to communicate, written assent was obtained.

2.2 Sample Size Determination

Sample size was calculated in two different ways depending on the indicators. For the assessment of serum retinol, the sample size for each target group was calculated to detect with statistical significance a minimum assumed decline in the prevalence of low serum retinol between the two surveys, as shown in Table 102 (Annex 7.2). The following formula was used to calculate the sample size.

$$n = \frac{\left[Z_\alpha \sqrt{2PQ} - Z_{1-\beta}\sqrt{P_1Q_1 + P_2Q_2}\,\right]^2}{(P_2 - P_1)^2} \text{ x design effect x factor to adjust non-response rate}$$

Where n= required sample size for each survey, expressed as number of units of analysis,

P_1 = Proportion in the pre-intervention (or the baseline) survey,

P_2 = Proportion in post-intervention survey,

$(P_2 - P_1)$ = Expected difference between the baseline and follow-up surveys,

$P = (P_1 + P_2)/2$ and Q = (1 - P),

$\mathbf{Z}_\alpha$ = 1.96 at α = 0.05 and $\mathbf{Z}_{1-\beta}$ = (-0.842) for power of the test set at 0.80,

and the design effect = 2 and factor to adjust non-response rate of 20%

The sample size thus calculated could detect the statistical significance for the stated change between the baseline and end-line retinol status in each of the cluster separately. However, this would require visiting more than 13,000 households, thus making it unfeasible to carry out the survey due to constraint of logistics, resources and time. Hence, only 3,000 households were considered for the survey, which would be sufficient to detect the stated change in low retinol prevalence between the baseline and end line in all the three clusters together, and would be logistically feasible to carry out. Table 103 (Annex 7.2), which shows actual p values obtained for each target group for differences in the prevalence of vitamin A between the baseline and follow-up surveys, includes 3,000 households in the sample for each survey.

In order to estimate the prevalence of anemia, iron deficiency, iodine deficiency, zinc deficiency, folate deficiency and vitamin B12 deficiency, the minimum sample size was calculated in order to obtain a specified precision, i.e., a confidence interval of a specified width around a single point estimate in the survey for each target group and outcome. The required precision depended on the target group and outcome, as shown in Table 104, (Annex 7.2). The formula used for these calculations is:

$$n = \frac{Z_\alpha^{\ 2}\ P(1-P)}{d^2} \text{ x design effect}$$

P = the current prevalence, $\mathbf{Z}_\alpha$ = 1.96 at $_\alpha$=0.05, d = the half confidence interval
and the design effect = 2

Table 105, 107 (Annex 2) shows the actual confidence intervals obtained for each target group, for anemia, iron deficiency, folate, vitamin B_{12}, urinary iodine and iodine concentration in salt at households and retailers, given that 3,000 households were included in the sample. Based on the feasible sample size calculated in Tables 103, 105, 106 and 107 (Annex 7.2), Table 2 gives the adjusted (i.e. to the whole numbers for field work) and the definitive sample size for each of the parameters in the different population groups.

Table 2: Adjusted Sample Size for Laboratory Parameters

Parameter	Population	Actual sample (3 clusters)	Adjusted to whole numbers for field work
S. Retinol	Preschool children	1176	1200
	NPNL women	954	1050
	School-age children	1455	1500
		Total	*3750*
Hemoglobin	Preschool children	588	600
	NPNL women	954	1050
	School-age children	1455	1500
		Total	***3150***
S. Ferritin	Preschool children	588	600
	NPNL women	954	1050
	School-age children	1455	1500
		Total	***3150***
S. Zinc	Preschool children	969	1050
	NPNL women	1514	1500
		Total	***2550***
S. Folate	NPNL women	954	***1050***
B_{12}	NPNL women	954	***1050***
Urinary iodine	NPNL women	1401	1500
	School-age children	1320	1350
		Total	***2850***
Salt for iodide (Household)-"adequacy of iodized" salt*			***1800***
Retailer's salt- "sale of iodized salt"**			***1650***

*The sample size also covered the sample for "Purchase of iodized salt".

**The sample size also covered the sample for "Adequacy of iodization in salt".

2.3 Sampling Design

The outcomes were estimated for three clusters (rural, urban and slum. The list of the 15,000 primary sampling units (PSUs) selected for the Bangladesh Multiple Indicator Cluster Survey (MICS 2009) was used as the sampling frame to select the required number of PSUs per cluster for this survey. Sampling was carried out in three stages.

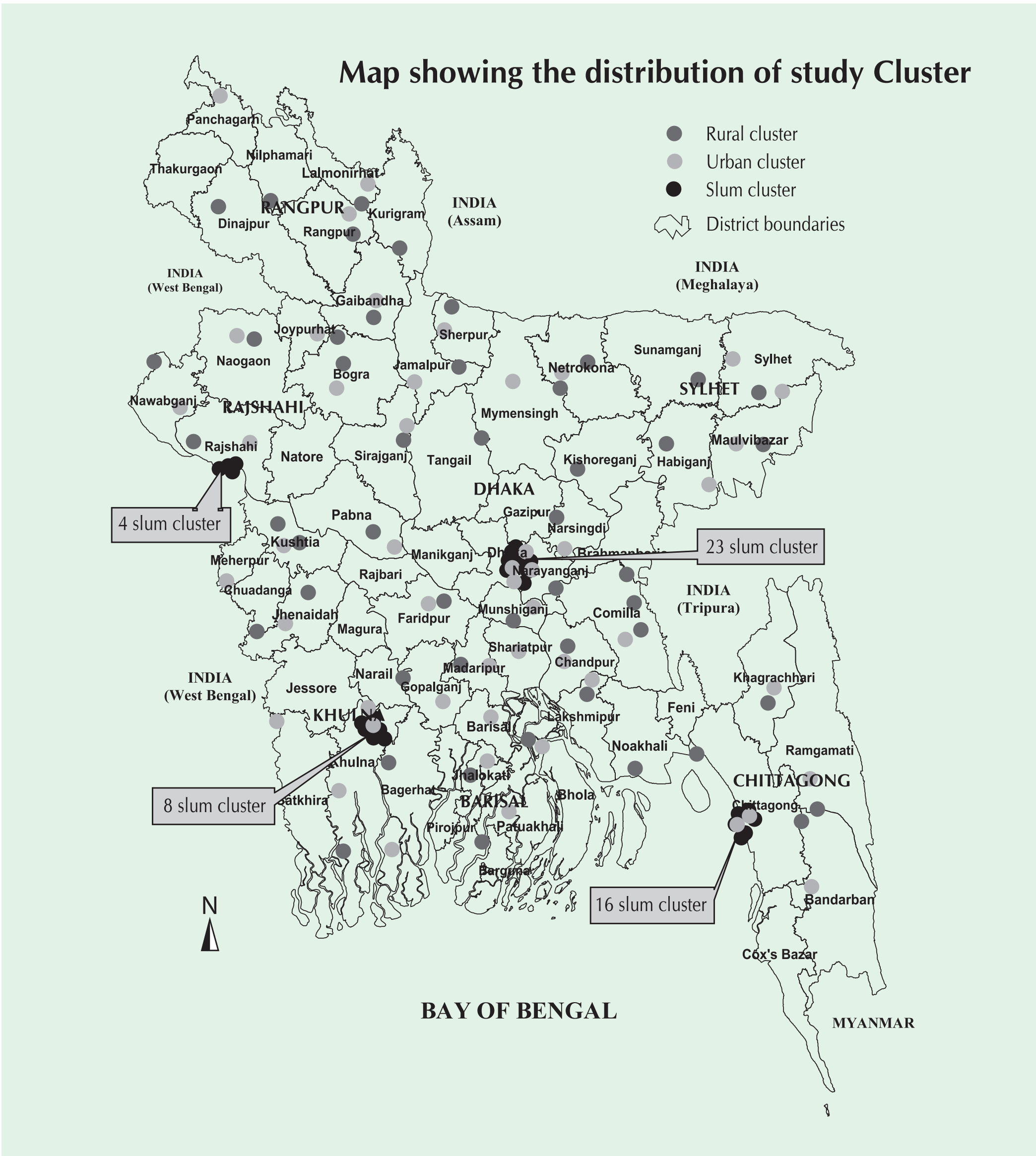
2.3.1 First Stage Sampling: In the first stage, the PSUs were selected by systematic random sampling with equal probability in each cluster. Equal probability of selection was used to preserve equal selection probability for every household in the cluster because the 15,000 PSUs used in the MICS 2009 survey had already been selected by population share to size (PPS). In this way, a total of 150 PSUs were selected, 50 in each clusters.

2.3.2 Second Stage Sampling: In the second stage, the selected PSUs (enumeration area) were subdivided into segments. The size of each segment was as close to 50 households as possible. The field supervisor on arrival in the sampled PSU asked the local people around its size, boundary. He requested a local inhabitant to help and accompany him on a walk through the *mouza*. On the walk, the number of *bari*s (holdings) and the number of households in each *bari* were counted. In this way, the number of holdings containing 50-55 households was identified by drawing a 'segment' on a piece of a paper. This was continued until a second segment (containing the holdings' housing next 50-55 households) was drawn on the paper. When the process was completed for that PSU, one 'segment' having approximately 50 households was chosen at random.

2.3.3 Third Stage Sampling: In the third stage, a list was drawn of the households and their respective eligible study participants in the selected 50-household segment. From this list, 20 households were selected using simple random sampling by random numbers. The computer-generated random numbers (for selecting 20 households from the list of the 50) were produced beforehand. Five sets of random numbers generated were handed over to the field teams. The field teams used all those different sets by turn. These 20 households were the definitive list for data and biological sample collection.

Figure 1 shows the distribution of the sample PSUs in the divisions and districts.

Figure 1: Selected 150 Primary Sampling Units



2.4 Sub-Sampling for Biological Samples (in 20 households)

Since the sample sizes calculated for laboratory testing in different target groups are different, households differed as regards to which target group members were recruited.

Table 3 shows the required number of study participants by each cluster for the collection of the biological samples for different parameters.

Table 3: Cluster Sample Requirements Per Parameter

Parameters	Population group	No. required per cluster (20 households)
Serum Retinol	Preschool children (6-59 months)	8
	NPNL women	7
	School-age children	10
Hemoglobin	Preschool children (6-59 months)	4
	NPNL women	7
	School-age children	10
Serum Ferritin	Preschool children (6-59 months)	4
	NPNL women	7
	School-age children	10
Serum Zinc	Preschool children (6-59 months)	7
	NPNL women	10
Serum Folate	NPNL women	7
Serum Vitamin B_{12}	NPNL women	7
Urinary Iodine	NPNL women	10
	School-age children	9

From these 20 households, a maximum of eight samples from retinol in the preschool children and ten samples for retinol from school-age children were required. Also, ten urine (UIC) samples from NPNL women were required. At first, every odd-numbered household in the list was approached until the target for each of the parameters in each of the population groups was achieved (i.e. Households 1, 3, 5….11, 13…19, in the 20-household form). In the case of a shortfall in the number of samples of a particular population group, the even-numbered households were approached in order to obtain the required number of samples (i.e. Households 2, 4, 6, 8….12, 14….20, in the 20-household form). In the case of more than one participant of a population group residing in a household, all were considered for data and biological sample collection.

Four preschool children from the eight selected for retinol were picked randomly for hemoglobin, ferritin, CRP and AGP. Four random computer-generated numbers were provided by the field teams. The field data collectors selected the four participants according to the given random numbers for estimating hemoglobin, ferritin, CRP and AGP. From the eight pre-school-age children selected for retinol, one was randomly excluded, and the seven remaining were considered for assessing zinc.

All ten school-age children selected for retinol were considered for hemoglobin, ferritin, CRP and AGP. One of the children was randomly excluded and the remaining nine were considered for collecting urine sample.

Seven of the ten NPNL women selected for urinary iodine were randomly selected by the field staff for hemoglobin, ferritin, CRP, AGP, folate and B_{12}. Three random computer-generated numbers were provided to the field team. They selected the three participants according to the given random numbers and excluded them from estimating for hemoglobin, ferritin, CRP, AGP, folate and B_{12}. All ten women selected for urinary iodine were considered for serum zinc assessment.

2.5 Retailer Salt Sampling

The salt retailers were selected by asking the respondents in the households in each cluster where they usually buy their salt. This questioning continued until six different retailers were identified. A survey team member then visited these six retailers to interview them and to collect two salt specimens at each shop. The first specimen was brand name salt ('brand salt'). The second specimen was from an open salt container ('bulk salt'). If there was no 'open' salt in the shop, a second brand specimen was collected.

2.6 Household Salt Samples

Twelve salt samples from the 20 selected households were collected. The household salt samples were collected from the households where at least one NPNL woman or school-age child, or both, resided and were selected for urinary iodine/data collection. One salt sample per household was taken.

2.7 Sample Weight

Sample fractions (or selection probabilities) were different for different domains because population size of the clusters and enumeration area varied widely. Sample weights $W_h = 1/P_h$ where P_h equals the overall selection probability in the h^{th} cluster were used in the analysis of the survey data. The programme used for data analysis of the *National Micronutrients Survey* (STATA 10.0) calculated the estimates as the total weighted number of units of analysis included in the analyses being the same as the unadjusted total.

2.7.1 Estimate of Sample Weight

The *National Micronutrient Survey* (NMS) 2011-12 randomly sampled 50 PSUs from each of the three clusters:

- Rural + other urban clusters ("rural")
- Municipalities (including cities) without slums ("urban")
- Slums in Dhaka, Chittagong, Rajshahi and Khulna ("slum").

Data from the Population Census 2001 of the Bangladesh Bureau of Statistics (BBS) and the Slum Census 2005 of the Centre of Urban Studies (CUS) were used to estimate populations in each domain in 2011. The 2001 census data were disaggregated for rural, urban and slum clusters, and used to project the size of the rural and urban populations for 2001-2050. CUS provided estimates of the populations in non-slum and slum in six cities (Chittagong, Dhaka, Khulna, Rajshahi, Sylhet and Barisal) in 2005.

Data from these two sources were used to estimate the size of the populations in each cluster in 2011 under the assumptions that: (i) the inter-census growth rates of the rural and urban populations during 2001-2011 were similar to the growth rates during 1991-2001; and (ii) the percentage of the slum and non-slum population in 2011 was the same as in 2005.

In 2011, estimates of the populations in the three clusters – rural, and other urban clusters (rural), municipalities and urban slums – were 122.6 million, 23.3 million and 5.5 million, respectively. Despite the large difference in size, 50 PSUs were selected from each cluster, which resulted in differential selection probabilities and representations across the clusters. Sample weights are applied to the households in each cluster to compensate for the differential representations and to derive weighted estimates combining the estimates of the three clusters. The sampled households are weighted by the inverse of the differential probabilities at household, cluster and cluster levels. The procedure used for calculating the selection probability (SP) is given below.

$$SP = \frac{\text{No.of households interviewed in a segment}}{\text{50 householdsinasegment}} \times \frac{\text{1 segment per PSU)}}{\text{No.of segments in a PSU}}$$

$$\times \frac{\text{50 PSUs in a stratum}}{\text{No. of PSUs in a stratum}}$$

$$\times \frac{\text{200 households per PSU}}{\text{Estimated number of households in a stratum}}$$

The sample weight is the inverse of SP Weight = $\frac{1}{SP}$

2.8 Questionnaire and Data Collection

2.8.1 Questionnaires

The *National Micronutrient Survey* used five types of questionnaires: (**i) the Household Questionnaire; (ii) the Preschool Children's Questionnaire; (iii) the School-age Children's Questionnaire; (iv) the NPNL Women's Questionnaire; and (v) the Retailer Questionnaire.** The contents of the questionnaires were finalized upon consultation with the Technical Committee, formed for the survey. Field testing of the questionnaires was conducted, and necessary modification was made. The Institutional Review Board (IRB) of icddr,b approved all the tools, including the research and ethical protocols. The questionnaires were developed in English and then translated and printed in Bangla.

The Household Questionnaire was used to list all the members and visitors in the selected households. Information was collected on the dwelling unit, such as the source of water, type of toilet facilities, materials used to construct the floor and walls, and ownership of various consumer goods. It covered knowledge on the source and health benefits of consumption of vitamin A- and iron-rich food, iodized salt and its benefits and household practice with the use of iodized salt. It was also used to keep record of the collected salt samples from the household.

The NPNL Women's Questionnaire was used to collect information from NPNL women of reproductive age. Women were asked questions on the following topics:

- Background (e.g. age, education, occupation)
- Reproductive history
- Food consumption
- Record of biological parameters collected, e.g. retinol, hemoglobin, ferritin, CRP, AGP, folate, B_{12}, zinc and urinary iodine.

The School-age Children's Questionnaire was used to collect information from children aged 6-14 years. The children were asked questions on the following topics:

- Background (e.g. age, education, occupation of household head),

- Morbidity history
- Record of biological parameters collected, e.g. retinol, hemoglobin, ferritin, CRP, AGP and urinary iodine.

The Preschool Children's Questionnaire was used to collect information from children aged 6-59 months old. The primary caregiver was asked questions on the following topics:

- Background (age of the child, vitamin A supplementation, mother's education)
- Food consumption
- Morbidity history (fever, respiratory infection, diarrhea, malaria, etc.)

The Retailer's Questionnaire was used to collect information from the retailer on the following topics:

- type of salt sold, knowledge related with iodized salt and salt iodization, laws on salt iodization
- knowledge on fortification of oil with vitamin A, type of oil sold, etc.

2.9 Field Operational Guidelines

2.9.1 Standard Operating Procedure

A Standard Operating Procedure (SOP) was developed prior to the start of the survey. It developed through pre-testing and includes guidance on asking survey questions, sampling techniques, anthropometry measurements, and biological sample collection and management.

2.9.2 Survey Monitoring Tools

A survey monitoring tool was prepared to monitor the performance of the interviewers and enumerators and laboratory technicians in the field. The tools objectively assessed various field performances in light of the SOP and quantitatively evaluated the cluster performance. A bi-weekly monitoring reporting form was developed to capture average performance of several clusters, measured in quantitative assessments. These tools were helpful to inform the field team on their strength and weaknesses, and thereby improve the performance subsequently.

2.10 Survey Training, Planning and Organization

2.10.1 Training and Field Work

The training was organized in two stages. In the first stage (5-8 September 2011) held at icddr,b, a cadre of master trainers from Mitra and Associates (data collection agency) and monitoring officers from icddr,b were given theoretical and practical orientation on different aspects of the survey (e.g. on-field cluster identification, study participant selection, study parameter selection, interviewing, anthropometry, management of biological samples such as blood collection, serum separation, aliquot preparation, labelling, maintenance of cold chain). Specialist trainers from icddr,b convened the sessions. It was followed by the second stage, held on 18-30 September 2011, in which the field staff were given the necessary orientation, supervised by icddr,b representatives, Mitra trainers from the first stage and the core trainers of the Mitra. In the process, a total of 87 field data collectors, laboratory technicians and data management assistants were trained for the survey.

Nine field teams from Mitra and Associates, each consisting of five individuals, were engaged in data collection. Each team consisted of one supervisor, two interviewers, one quality control officer and one laboratory technician. The interviewers conducted the interviews. The laboratory technician was responsible for the management of biological samples collection, serum separation, aliquot preparation, labelling, and dispatching to the laboratory. The team supervisor was responsible for the coordination of the activities, logistics management, contacting the local authorities and rapport-building with the community. The quality control officer was responsible for spot checking of the filled-in questionnaires, observation of interviews, and feedback on the activities. icddr,b hired six field-based monitoring officers, who worked very closely with the Mitra teams to supervise the work. Field supervisors from the Institute of Public Health Nutrition (IPHN) visited the fields to monitor the activities.

2.10.2 Daily Plan for the Data Collection Teams

Day 1: Upon arrival in a selected *mouza*, the survey field team visited the sub-district health and family planning officers (Thana Health and Family Planning Officers, or THFPOs),Thana Nirbahi Officer (sub-district administrative officer),ward commissioner and local law enforcement agencies to brief them on the survey and to garner support for assistance to facilitate the survey. The teams then segmented the *mouza* and randomly selected a 50-household segment. They listed the 50 households of the selected segment, randomly selected the required number of study participants, and organized the blood sampling at a local health centre, NGO offices, and the primary schools or the residences provided by the local people.

Day 2-3: The teams collected data on socio-demography, food consumption, morbidity, knowledge and practice-related to the issues on vitamin A, iodine and iron, conducted anthropometry measurements and collected the biological samples (blood, urine) and salt samples from the selected respondents and households/retail shops in the PSU.

Day 4: The teams completed the unfinished work and proceeded to the next PSU according to the travel plan.

The survey started on 4 October 2011 and was conducted in two phases. In the first phase, data were collected from 72 clusters in the divisions of Rajshahi, Khulna, and part of Dhaka. The work of the first phase was continued until 3 November 2011. The second phase followed the Eid holidays (*Eid-ul-azha*) commencing on 14 November to complete the remaining 78 clusters in the division of Sylhet, Barishal, Chittagong, Dhaka and part of Rajshahi. The field work was completed on 20 December 2011.

2.11 Socio-economic Status Indicators

Information on ethnicity, religion, level of education of household head, occupation of household head, number of family members, home ownership, number of rooms, household construction materials, toilet facilities, sources of drinking water, household assets, land ownership and household's monthly expenditure were collected as key indicators of SES.

An asset index was used as a measure of socio-economic status (SES), which was created by using information on household assets. The variables included were land (homestead, land under cultivation), construction materials of the walls, roofs and floors of homes, ownership of household assets (electricity, radio, television, mobile phone, land line, chairs, watches, tables, cupboards, rickshaws, vans, animal-drawn carts, refrigerators, motor boats) and type of toilet facility. The categories for construction materials of the roof and walls were taken into consideration – tin, brick-cement (*pacca*) and other materials, as well those of the floor – brick-cement (*pacca*), mud and other materials. For household assets, each item was categorized as ''owned'' or ''not owned'' by the household. A principal component analysis (PCA) was used to create the Asset Index. A weight was attached to each item from the first principal component. The households were classified into SES quintiles based on the Asset Index: quintile 1 (poorest), 2 (lower-middle/poorer), 3 (middle), 4 (upper-middle/richer) and 5 (richest).

2.12 Household Food Insecurity

The questionnaire consisted of nine occurrence questions that represent a generally increasing level of severity of food insecurity (access), and nine "frequency-of-occurrence" questions asked as a follow-up to each occurrence question to determine how often the condition occurred. Some of the nine occurrence questions concern respondents' perceptions of food vulnerability or stress and the respondents' behavioural responses to insecurity. The questions address the situation of all household members and do not distinguish adults from children or adolescents. All of the occurrence questions ask whether the respondent or other household members felt a certain way or performed a particular behaviour over the previous four weeks. The generic occurrence questions are grouped into three domains: (i) anxiety and uncertainty over the household food supply; (ii) insufficient food quality; and (iii) insufficient food intake and its physical consequences. The questions are provided in Annex 7.5.

2.13 Estimate of Children's Ages

The children's ages were estimated using immunization cards and birth registration certificates. In the absence of the immunization card/birth registration certificates, age was verified by well-tested questions, e.g. historical events, natural disasters, religious festivals, etc. The Bengali calendar was used as required.

2.14 Child Anthropometry

The children's weight was taken using an electronic scale (Tanita Inc., Japan) with 100-gram precision. Calibration of the weighing scales was checked before the start of every day, using the same known weights (5-kg standard weight). Length/height was measured on a locally constructed standardized wooden length/height board. Mid-upper arm circumference (MUAC) of preschool children was measured to the nearest 1 mm using colour-coded MUAC tape.

2.15 Food Consumption Data

To assess food consumption, a seven-day semi-quantitative Food Frequency Questionnaire (FFQ) was used taking into consideration commonly consumed foods, with special attention to vitamin A-, iron- and zinc-rich foods. Food photographs indicating the serving and amount (grams) were used to assess the quantity of consumption. Raw food weight was calculated by using appropriate conversion factors (Ali SKM, 1991). Nutrient values (protein, carbohydrate, lipid, vitamin A, iron, zinc, folate, B_{12}, phytate, energy) were calculated per 100 gram of raw food consumed using the most updated Food Composition Table on Bangladesh Food (Islam, 2010).

2.16 Household Monthly Expenses

The data on household monthly expenses were derived from collective expenses incurred on various items, e.g. food, housing, utilities, transportation, education, recreation, treatment, etc. For example, for the household's approximate monthly food requirements such as rice, oil, salt, sugar, fish and meat, the amount and unit cost for each was collected, and costs were calculated.

2.17 Adjusting Ferritin, Retinol and Zinc for Infection

Ferritin, retinol and zinc were analysed keeping in mind the indicators of infection (CRP, AGP). Adjustment for elevated CRP (>10.0 mg/l) and AGP (>1.0 g/l) was made through a mathematical correction, a procedure increasingly used at present and published in renowned journals (Thurnham, 2010; Engle-Stone, 2011). With regard to the procedure, respondents were divided into four groups – the "incubation" (CRP >10 mg/l and AGP<1 g/l), "early convalescence" (CRP>10 mg/l & AGP>1 g/l), "late convalescence" (CRP<10 mg/l and AGP>1 g/l, and the "healthy/reference" (CRP<10 mg/l & AGP<1 g/l) group. Geometric mean of serum ferritin was calculated for each of these groups. Typically, ferritin value was skewed at the population level; therefore, ferritin value was log-transformed and then back-transformed to obtain the geometric means for each of the groups. The correction factor for ferritin was calculated as the ratio of geometric means of the "healthy/reference" group to that of the infection groups (incubation, early convalescence, late convalescence). Ferritin values in the infection groups were adjusted by multiplication by the group-specific correction factors. For example, the correction factors to adjust ferritin in the preschool children data were 0.79, 0.37, and 0.72, in the "incubation", "early convalescence" and "late convalescence" groups, respectively. By the same technique, the correction factor for retinol and zinc were calculated and used to adjust the retinol and zinc level in serum.

2.18 Biological Sample Collection, Preparation, Transport and Storage

2.18.1 Blood Sample Collection and Processing

Blood samples were collected in a nearby health facility, e.g. a sub-district health complex, a Union subcentre, a primary school, the Expanded Programme on Immunization (EPI) clinic, an NGO clinic, an NGO office, or a residence provide by local people, etc. The selected respondents were given a token indicating their name and identification, and were requested to come to the temporary blood collection unit.

In order to obtain 1200 µl serum, at least 3.5 ml of venous blood was collected in a Venoject tube. After collection, the blood tube was placed in a cool box and allowed to clot. At the end of each day, the whole blood was centrifuged, and the serum was aliqoted into at least four cryovials by pipetting using a disposable pipette. One aliquot of approximately 250 µl was used for the analysis of retinol; one aliquot of 450 µl for ferritin, CRP and AGP; one for zinc and for specimens from the NPNL women; and a third aliquot of 450 µl for the analysis of folate and vitamin B_{12}. A sample ID tag was applied on each of the cryovials. The serum was stored in a freezer (-20ºC or colder) as soon as possible. Alternatively, the serum was kept in a cool box and put into a freezer (-20ºC or colder) within 3-4 hours. Aliquoted samples of the same cluster were kept in cryo-boxes and labelled with the cluster-s name on the box. In this way, the laboratory could easily identify which particular clusters were to be tested in a batch, thus minimizing the possibilities of increasing freeze/thaw cycles. A sample record and handover form was filled indicating the name of the participants, ID number, sample ID number, and type of analysis to be carried out. The samples were carried to the nutritional biochemistry laboratory in Dhaka in dry ice. Samples were received at the laboratory, stored in a -70 ^{0}C freezer and analysed to estimate the blood parameters.

2.18.2 Collection of Urine Samples

The children and women selected for urine sample collection were provided with disposable plastic cups. The samples were transferred to wide-mouthed, screw-capped plastic bottles that were previously washed with de-ionized water and dried. All the samples from one cluster were packed in one carton, transported to the nutritional biochemistry laboratory in icddr,b and stored in a freezer at -20^{0} C, where the analysis was carried out.

2.18.3 Collection of Salt Samples

Salt samples were collected from salt retailer shops and households. Households selected for salt collection were asked to provide a sample of salt used for cooking. Salt samples were collected from the retailers (sold in sealed/labelled/polyethylene packets). Open salt (not sold in sealed labelled polyethylene packets) was also collected. All salt samples were transferred to air-tight containers and stored at room temperature in the nutritional biochemistry laboratory of icddr,b prior to analysis.

Table 4 provides an overview of the indicators that were assessed for each of the population groups.

Table 4: Parameters by Population Group

Indicator	Preschool Children	School -age Children	NPNL Women	Retailers	Household
Serum Retinol	√	√	√		
Serum Markers of Inflammation	√	√	√		
Hemoglobin	√	√	√		
Serum Ferritin	√	√	√		
Serum Zinc	√		√		

Urinary Iodine		√	√		
Serum Folate			√		
Serum B_{12}			√		
Salt Iodine				√	√
Height	√				
Weight	√				

2.19 Data Processing and Analysis

Questionnaires for the *National Micronutrients Survey* were periodically returned to Dhaka for data processing at Mitra and Associates. Data processing consisted of office editing, coding of open-ended questions, data entry, and editing of inconsistencies found by the computer programs. The data were processed by two data entry operators and one data entry supervisor. Data processing was carried out using CSPro, a joint software product of the U.S. Census Bureau, Macro International and Serpro S.A.

Data analysis was performed using the statistical software STATA 10.0 SE (Statacorp, College station, Texas) and SPSS 11.5. Proportions were calculated with a 95% confidence interval. Estimates were weighted to represent the population level and means were calculated with a 95% confidence interval.

2.20 Quality Control

The quality control of the survey data was ensured by training and refresher training of the field staff, and extensive monitoring and supervision of the field activities. icddr,b led the training and refresher training by guiding Mitra and Associates field staff on the questionnaire administration, interviewing techniques, biological sample collection and processing, and anthropometry. A three-pronged monitoring and supervision was conducted. First, six full-time monitoring officers from icddr,b were deployed to observe the interviews, the collection of samples and anthropometry, and then conducted repeat interviews and on-the-spot checks of the data forms. They provided necessary guidance and supportive supervision to the field teams. In another level, investigators of the study from icddr,b and UNICEF provided frequent visits to the field to oversee the activities. At a different level, an independent monitoring team from the Institute of Public Health Nutrition (IPHN) regularly visited the field sites. The quality of the biological sample analysis was confirmed by satisfactory performance in the external quality assurance programmes of the Center for Disease Control and Prevention (CDC), United States of America.

As far as general consistency in data is concerned, the Cronbach's alpha was ~80.0% (reference limit: 70.0–90.0%), which indicates a high correlation among the related variables (e.g. socio-economic and micronutrients status variables) in the data. This statistical assessment confirmed the quality of data collection.

2.20.1 Quality Control of the Laboratory Analysis

2.20.1.1 External Quality Control (EQC)

For external quality control, the Nutritional Biochemistry Laboratory of icddr,b participated in the Micronutrients Measurement Quality Assurance Program (MMQAP) for retinol. This programme is organized by National Institute of Standards and Technology (NIST). The Laboratory had also participated in The Vitamin A Laboratory – External Quality Assurance (VITAL-EQA) program for Retinol, Ferritin, CRP, Folate and Vitamin B_{12}, which is organized by the Global Micronutrient Laboratory at the CDC. The Vitamin A Laboratory-External Quality Assurance program (VITAL-EQA) is a standardization programme designed to support laboratories accurately assessing serum nutrition markers. The performance of each laboratory is shared.

The Laboratory participated in the Ensuring the Quality of Iodine Procedures (EQUIP) programme for urinary iodine (UI) analysis, which is provided by CDC. Three times a year, CDC sends participating laboratories three to five urine samples that have been spiked with iodine (in a range of 10 to 300 µg/L) for UI analysis. At the end of each year, laboratories receive a certificate with tabulated scores for that year.

2.20.1.2 Internal Quality Control

For internal quality control (IQC), the Nutritional Biochemistry Laboratory of icddr,b used the following IQC materials:

1. PreciControl Anemia 1, 2 and 3 (Roche Diagnostics GmbH, D-68298 Mannheim, Germany) for ferritin, folate and vitamin B_{12}.

2. Precinorm Protein and Precipath Protein (Roche Diagnostics GmbH, D-68298 Mannheim, Germany) for CRP and AGP.

3. Bi-level serum toxicology control (UTAK Laboratories Inc. 25020 Avenue Tibbitts Valencia, CA 91355) for zinc.

4. Pooled serum whose values were assigned in the Nutritional Biochemistry Laboratory against standard reference material (SRM) for retinol and zinc. The pooled serum was stored in a freezer and analysed with every batch of samples. The pooled serum was analysed with standard reference material (fat-soluble vitamins, carotenoids and cholesterol in human serum, 968c; National Institute of Standards and Technology, Gaithersburg, MD, USA) in ten replicates within the same day. The mean (X), standard deviation (SD) and 95% confidence interval of this pooled serum were calculated.

The stated assayed control material values corresponding to the methodology and instrumentation employed by the manufacturer were used as the target values. These QC materials were used together with study samples to monitor systemic and random errors. After a significant number of control determinations was completed, the SD and the coefficient variation were calculated.

For retinol measurement, internal standards were added to the sample at the beginning of the extraction procedure to compensate for losses of retinol at each step of the sample preparation. It was also used as a control. If the extraction of the internal standard was below 84%, the analysis was repeated.

Urinary Iodine

For the internal verification, the analysis was carried out on the remaining EQUIP reference sample, which has a certified concentration value for iodine, in triplicate in each micro-plate run. The coefficients of variation for the intra-assays and the inter-assays were calculated for each EQUIP reference material. For recovery, an equal volume of standard and sample were mixed, and then run as a sample. The recovery of urinary iodine was 92-108%.

The results of the QC analyses carried out together with the analysis of the monitoring samples are shown in Table 5. In general, the QC results were in good agreement with the reference values, and it can be assumed that the systemic errors of the monitoring data do not exceed the limit of assigned values.

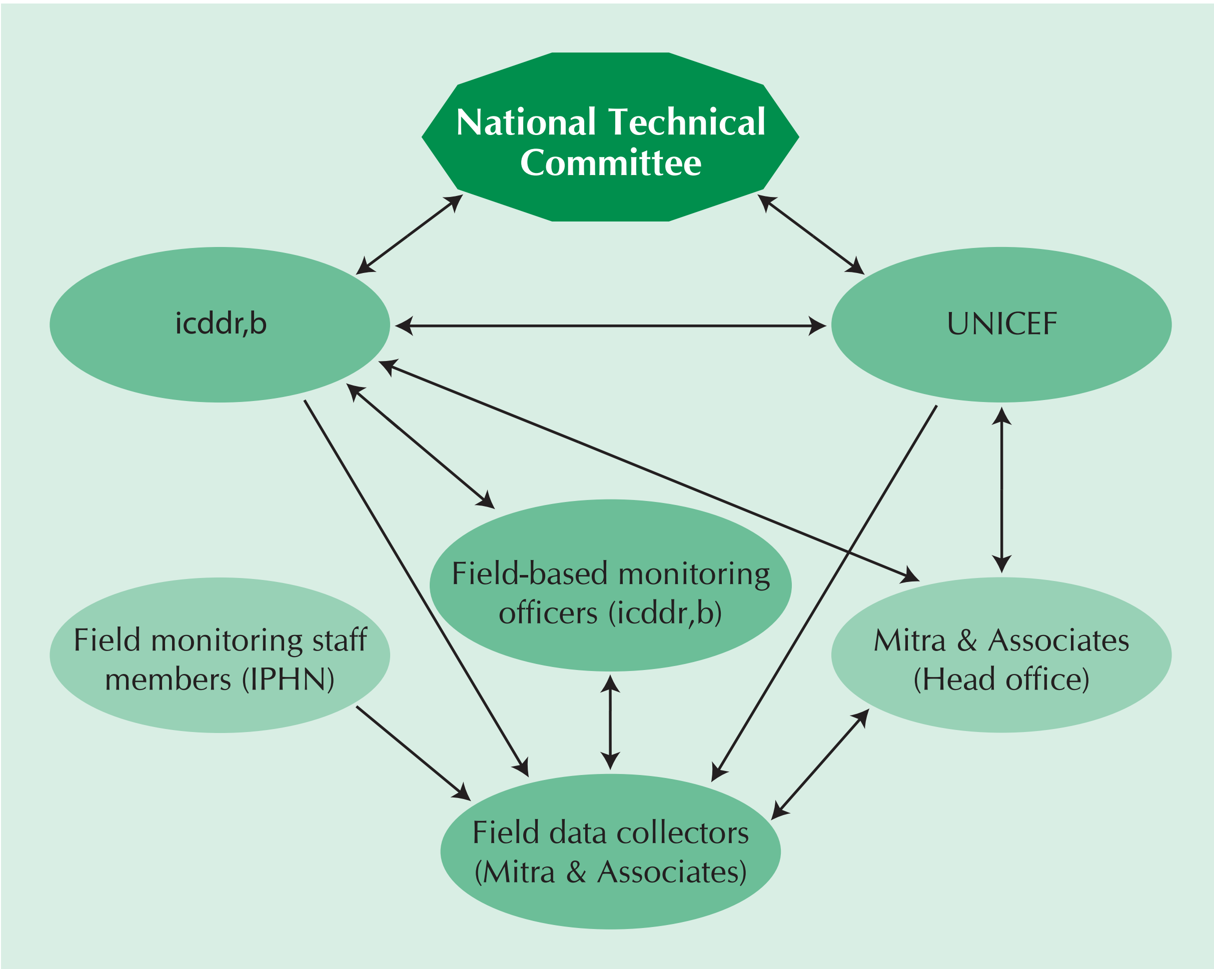
Table 5: Performance of the Internal Quality Control for Laboratory Analysis

Name of quality control standard	Name of parameter	Assigned value	CV %
Precicontrol anemia Lot 163921	Ferritin	(21.6-33.2) ng/ml	4.2
		(285-437) ng/ml	3.9
		(605-927) ng/ml	3.7
	Folate	(2.57-6.77) ng/ml	8.6
		(6.71-10.3) ng/ml	5.8
		(12.1-17.5) ng/ml	5.6
	Vitamin B_{12}	(173-321) pg/ml	4.6
		(426-612) pg/ml	4.6
		(952-1288) pg/ml	3.5
Precinorm protein, Lot 161643-02	CRP	(7.83-11.73) mg/l	8.6
Precipath protein, Lot 157580-02		(37.9-57.1) mg/l	3.9
Precinorm protein, Lot 161643-02	AGP	(58.4-95.6) mg/dl	5.5
Precipath protein, Lot 157580-02		(100-166) mg/dl	5.2
Pool serum	Retinol	52.9-58.0 µg /dl	1.5
Pool serum	Zinc	(0.73-0.96) mg/l	4.5
QC-normal		(0.51-0.85) mg/l	4.1
QC-high		(2.0-3.0)mg/l	4
UI 100604	Urinary Iodine	(414-560.1) µg/l	6.7
UI 100609		(48.3-80.5) µg/l	10.4
UI 100629		(109.6-164.4) µg/l	8.3
UI 100601		(76.7-127.9) µg/l	7.5

2.21 Project Management Structure

A National Technical Committee consisting of experts in the field and spearheaded by the Institute of Public Health Nutrition (IPHN) was formed. The members of the Committee hailed from the academia, research organizations, the Ministry of Industry and related government organizations, programme managers from government sectors and NGOs, and representatives from the development partners. The Technical Committee reviewed the survey protocol and provided guidance in different stages of the survey, e.g. technical protocol, field data collection, report preparation, communication and national dissemination. The Committee convened meetings at different stages of the project. There were independent monitoring teams from icddr,b, UNICEF and the Institute of Public Health Nutrition (IPHN) for monitoring the field activities. Six field-based staff members of icddr,b were in charge to oversee the full-time supervision and monitoring of the field activities. They prepared the biweekly monitoring reports on the field performance, which were collated and summarized in icddrb, and shared with the Technical Committee to monitor progress.

Figure 2: Project Management Structure



2.22 Ethical Approval

Ethical approval for this study was obtained from the Institutional Review Board (IRB) of icddr,b. Board-s Research Review Committee (RRC) provided approval on the technical aspects of the protocol. Then, the Ethical Review Committee (ERC) granted its approval by considering ethical obligation that the study had to follow. The participants and/or the guardian of the participants in the study provided the written informed consent.

3. Results

3.1. Household Characteristics

Bangalees constituted the overwhelming share of the ethnic group (98.1%). With regard to religion, 89.0% of the households practised Islam. The percentage was slightly higher in the slum and rural clusters than in the urban cluster. In regard to the education of the household head, one in four had no formal education. This is in agreement with the *BDHS* 2011, which reports that 26% and 28% of men and women respectively did not have formal education. This percentage was higher in the slums (35.6%). The national estimate of the household heads having completed secondary education was 16.4%, which was consistent with the findings of *BDHS 2011*, which reported 18% and 12% of men and women had secondary or higher education, respectively. Proportionately more household heads from the urban clusters attained secondary or higher education (urban, 29.7%; rural, 13.1%).

Table 6: Household Characteristics

	Rural		Urban		Slum		National	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Ethnic group	(n=661)		(n=693)		(n=649)		(n=2003)	
Bangalee	97.7	95.1-100	99.6	98.9-100	98.9	96.7-100	98.1	96.2-100
Chakma	0.53	0.0-1.5	0.02	0.0-0.08			0.41	0.0-1.1
Marma	0.96	0.0-2.8	0.34	0.0-1.0			0.80	0.0-2.2
Garo					1.1	0.0-3.2	0.04	0.0-0.12
Sautaal	0.26	0.0-0.8					0.19	0.0-0.59
Other	0.47	0.0-1.3					0.36	0.0-1.0
Religion	(n=661)		(n=693)		(n=649)		(n=2 003)	
Islam	90.6	83.4-97.7	86.2	77.5-94.9	95.6	92.2-98.9	89.9	84.2-95.5
Hinduism	7.4	0.9-13.1	13.0	4.3-21.7	3.3	0.6-5.9	8.4	3.1-13.6
Buddism	1.5	0.0-3.8	0.4	0.0-1.0			1.2	0.0-2.9
Christianity	0.4	0.0-1.3	0.3	0.0-0.9	1.0	0.0-3.2	0.44	0.0-1.1
Others								
Education	(n=659)		(n=692)		(n=645)		(n=1 996)	
No education	27.4	22.8-31.9	20.5	15.3-25.6	35.6	28.1-43.2	26.3	22.7-29.8
Primary incomplete	26.7	21.7-31.7	18.3	13.2-23.4	25.8	20.5-31.1	25.0	21.1-28.9
Primary complete	14.4	11.2-17.5	9.3	6.2-12.4	11.4	8.1-14.6	13.2	10.7-15.8
Secondary incomplete	18.2	15.1-21.4	22.0	16.9-27.1	17.5	11.9-23.0	19.0	16.4-21.5
Secondary complete and higher	13.1	9.5-16.6	29.7	22.1-37.3	9.6	6.4-12.7	16.4	12.9-19.8
Assets	(n=661)		(n=693)		(n=649)		(n=2 003)	
Electricity	63.4	50.6-76.1	83.3	74.3-92.3	95.3	92.2-98.5	68.7	59.4-78.0
Radio	8.5	4.8-12.2	11.1	1.3-20.9	4.0	2.2-5.8	8.9	5.4-12.3
Television	35.2	27.1-43.3	62.2	51.6-72.8	58.2	52.0-64.3	41.6	35.1-48.2
Mobile phone	76.0	70.7-81.3	87.0	81.6-92.3	77.9	72.9-82.9	78.4	74.2-82.4
Land line	1.3	0.0-2.8	1.8	0.8-2.9	0.33	0.0-0.77	1.4	0.0-2.5
Refrigerator	7.6	4.0-11.2	28.9	18.1-39.7	8.7	5.4-12.0	12.0	7.9-16.2
Almirah	45.8	34.7-57.0	55.9	49.3-62.4	41.3	32.7-49.8	47.7	39.5-56.0

Asset Index								
Poorest	30.3		14.6		15.4			
Second	25.1		15.9		19.2			
Middle	23.9		15.2		21.2			
Fourth	13.0		20.5		26.6			
Richest	7.7		33.9		17.7			

Note : Estimates weighted to represent at the population level

In regard to the ownership of assets, over the recent years, there has been a considerable increase in mobile phones, televisions and refrigerators. In 2012, ownership of mobile phones was 78.4% at the national level, a phenomenal increase from the *BDHS 2007* estimate (35.0%). Around 42.0% of the population owned a television at the national level, which increased from BDHS 2007 estimate (32.9%). There has been an upward trend in ownership of refrigerators, from 8.0% in 2007 (BDHS 2007) to 12.0%. Nearly seven out of ten households had electricity, an increase from the BDHS 2007 estimate (48.9%). According to the Wealth Index, more of the "richest" households were located in the urban cluster than in the rural or slum cluster (urban, 34%; slums, 17.7%; rural, 7.7%).

3.1.1 Household Construction Materials

Table 7 shows the materials used in home construction. At the national level, 74% of households had floors of earth/sand; 84.6% in rural areas, 41.7% in the urban cluster and 32.2% in the slums. Cement was the second most popular material (22.2%), more commonly used in the urban (56.5%) than in the rural cluster (10.9%).

In regard to household roofs, tin was most common material: 89% had tin roofs nationally, and over 80.0% in all the clusters; followed by cement, at 5.8% of households; and 15.4% in the urban, 3.2% rural and 5.0% in the slum cluster.

In regard to external walls of the households, tin was the most commonly used material (45%); urban cluster (29.3%), rural (49.3%) and slums (46.6%). Cement was another important material for external walls in 15.6% of the households; 38% in the urban cluster, which was significantly higher than in the rural cluster, at 9.3% and 19.3% in slums. In nearly one-fifth (18%) of the households, bamboo with mud was used to construct the external walls.

Table 7: Household Construction Material

Construction material characteristics	Rural (n=661)		Urban (n=693)		Slum (n=649)		National (n=2003)	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Flooring material								
Earth/sand	84.6	77.5-91.7	41.7	29.5-54.0	32.2	23.3-41.1	73.8	67.2-80.3
Wood/planks	0.6	-0.3-1.4	1.3	-0.6-3.1	3.5	0.1-6.9	0.8	0.0-1.6
Palm/bamboo	0.5	-0.3-1.3	0.0	0.0-0.1	3.6	0.1-7.1	0.4	-0.2-1.0
Wood	3.1	-2.8-9.0	0.1	-0.1-0.3	0.2	-0.1-0.5	2.5	-1.9-6.9
Ceramic tiles/mosaic	0.0	0.0	0.2	0.0-0.4	59.6	51.4-67.8	0.0	0.0-0.1
Cement	10.9	5.7-16.2	56.5	45.0-68.0	0.1	-0.1-0.2	22.2	17.0-27.4
Carpet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0-0.0
Other	0.2	-0.1-0.5	0.1	-0.1-0.4	0.8	-0.4-2.0	0.2	0.0-0.5
Main roof								
No roof	1.0	-0.5-2.4	0.3	-0.2-0.7	0.0	0.0	0.8	-0.3-1.9
Thatch/palm leaf	3.9	1.1-6.7	0.6	-0.4-1.6	0.8	0.1-1.5	3.1	1.0-5.2
Bamboo	0.5	-0.1-1.2	0.3	-0.1-0.7	0.5	-0.0-1.0	0.5	0.0-1.0
Tin	90.8	85.9-95.6	81.3	75.0-87.5	90.2	85.2-95.2	88.8	85.0-92.6
Wood	0.1	-0.1-0.4	0.3	-0.0-0.7	1.0	-0.4-2.5	0.2	0.0-0.4
Ceramic tiles	0.0	-0.0-0.1	1.7	-0.0-4.9	0.0	0.0	0.4	-0.3-1.0
Cement	3.2	0.8-5.7	15.4	10.1-20.8	5.0	1.5-8.6	5.8	3.5-8.1
Other	0.4	-0.1-0.8	0.2	-0.3-0.7	2.5	-0.7-5.6	0.4	0.1-0.8
External wall								
No wall	0.0	0.0	0.1	-0.1-0.4	0.0	0.0	0.0	0.0-0.1
Cane/palm/trunks	1.8	0.2-3.4	0.3	-0.2-0.7	0.5	0.0-1.1	1.4	0.3-2.6
Bamboo with mud	19.9	7.4-32.5	12.2	3.1-21.3	11.1	3.9-18.4	18.0	8.3-27.6
Stone with mud	0.1	-0.1-0.2	0.1	-0.1-0.4			0.1	0.0-0.2
Tin	49.3	32.5-66.2	29.3	19.0-39.7	46.6	33.2-60.0	45.1	32.4-57.8
Cement	9.3	2.8-15.8	37.9	25.0-50.7	19.3	11.0-27.7	15.6	10.0-21.1
Stone with lime/cement	0.3	-0.1-0.6	1.0	0.1-1.8	0.6	-0.3-1.6	0.4	0.1-0.8
Bricks	5.9	2.2-9.5	12.7	7.8-17.6	13.2	7.3-19.1	7.5	4.5-10.6
Wood planks/shingles	2.1	-0.5-4.7	2.1	-0.1-4.2	1.3	0.0-2.6	2.1	0.1-4.1
Other	11.3	3.9-18.7	4.4	1.4-7.4	7.2	2.2-12.3	9.8	4.3-15.2

3.1.2 Number of Rooms

Table 8 shows the number of rooms. At the national level, 40.6% of the households had one room. Most of the slum households (77.7%) used one room for living. More than one third of the households in the rural (36%) and urban (34.6%) clusters had two rooms for living; however in the slums only 17.3% of the households had two rooms. At the national level, 17.6% of households had three rooms; 19.1%, 14.9% and 2.6%, respectively, in the rural, urban and slums area. Less than 2% of households at the national level had five rooms.

Table 8: Number Of rooms

Number of rooms	Rural (n=661)		Urban (n=693)		Slum (n=649)		National (n=2003)	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
1	38.1	30.1-46.0	42.8	35.8-49.8	77.7	70.6-84.7	40.6	34.3-46.9
2	36.0	31.3-40.7	34.6	27.8-41.4	17.3	11.6-23.0	35.0	31.3-38.7
3	19.1	10.2-27.9	14.9	9.7-20.2	2.6	0.8-4.4	17.6	10.8-24.4
4	4.7	1.8-7.5	4.9	2.3-7.6	1.8	0.4-3.1	4.6	2.4-6.8
5	1.5	0.2-2.8	2.0	0.2-3.8	0.6	-0.2-1.3	1.6	0.6-2.6

3.1.3 Land Ownership

Table 9: Land Ownership

Land ownership	Rural (n=661)		Urban (n=693)		Slum (n=649)		National (n=2 003)	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Homestead ownership	93.2	89.8-96.5	78.5	71.4-85.6	33.6	25.6-41.5	87.8	84.4-91.2
Homestead ownership in elsewhere	4.9	-1.0-10.8	32.6	15.3-49.9	30.9	20.9-40.8	20.5	13.3-27.7
Any land other than homestead land	45.0	38.7-51.4	24.1	18.1-30.1	15.9	9.8-22.0	39.6	34.5-44.7

Table 9 presents the profile of land ownership: 87.8% of households owned a homestead. The percentage was higher in rural (93.2%) and urban clusters (78.5%) than in the slums (33.6%). One in five households owned a homestead in other places; the percentage was greater in urban (32.6 %) and slums (30.9%) cluster than in the rural cluster, where just under 5% of households had owned homestead in other places. Four in ten households (39.6%) owned land other than homestead land; the percentage was higher in the rural cluster (45%) than in the urban (24%) or slum cluster (15.9%).

3.1.4 Toilets Facilities for the Households

Table 10 shows toilet usage in Bangladesh. Most households in Bangladesh used pit latrines. Nationally, 47.6% used pit latrines with slabs; 44.2%, 60.2% and 47.2% in the rural, urban and slum cluster, respectively. One in five households (21.7%) used pit latrines without slabs, i.e. an ”open pit”, which was slightly higher in the rural (24.5%) than in the urban (14.3%) and slum clusters (7.9%). In the rural, urban and slums clusters, the usage of toilets that flushed to a piped sewer system was 7.9%, 11.8% and 17.6%, respectively. Just 6.6% of the households had toilets that flushed into septic tanks. A very small percentage of households used bucket toilets (1.2%) and hanging toilets (1.6%). At the national level, 4.1% of the households did not have toilet facilities or used open-air toilets in the bush and fields, etc.; the percentage was concentrated mainly in the rural cluster (5.4%).

Table 10: Toilet Facilities

Toilet facilities	Rural (n=661)		Urban (n=693)		Slum (n=649)		National (n=2003)	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Flush to piped sewer system	7.9	2.2-13.7	11.8	4.9-18.6	17.6	8.1-27.1	9.1	4.6-13.6
Flush to septic tank	6.5	2.9-10.1	7.0	1.5-12.5	5.9	2.3-9.5	6.6	3.7-9.5
Flush to pit latrine	6.5	1.1-11.8	4.3	1.5-7.1	3.8	1.1-6.4	5.9	1.9-9.9
Flush to somewhere else	1.4	-0.6-3.4	0.4	-0.1-0.8	4.3	0.0-8.6	1.3	-0.2-2.8
Pit latrine with slab	44.2	32.7-55.7	60.2	49.9-70.5	47.2	35.8-58.6	47.6	38.5-56.7
Pit latrine without slab/ open pit	24.5	15.6-33.3	14.3	7.8-20.8	7.9	4.2-11.6	21.7	14.8-28.6
Bucket toilet	1.4	0.3-2.5	0.8	-0.1-1.7	-	-	1.2	0.4-2.1
Hanging toilet	1.8	0.6-3.1	0.8	-0.1-1.7	0.9	-0.3-2.2	1.6	0.7-2.5
No facility/bush/field	5.4	2.0-8.9	0.2	-0.1-0.5	-	-	4.1	1.6-6.7
Others	0.2	0.0-0.4	0.3	-0.2-0.8	12.4	-0.2-24.9	0.7	0.1-1.3

3.1.5 Cooking Fuel Used in the Households

Table 11 shows cooking fuel used in the households. Wood was the most commonly used cooking fuel in 56.7% of households; 59.8%, 45.8% and 54.5%, in the rural, urban and slum clusters, respectively. Straw/shrubs/grass was the next most common cooking fuel (22.8%), used in 28.4%, 6.5% and 1.9% of the rural, urban and slum clusters, respectively. At the national level, 8.7% of households used natural gas; 33.5% and 34.8% of households in the urban and slum cluster, respectively, and in the rural cluster, there was a very negligible use (0.5%). The other sources of cooking fuel were agricultural crops (6.8%), animal dung (2.2%), coal (0.8%), LPG (0.8%), electric heaters (0.4%) and biogas (0.1%).

Table 11: Cooking Fuel Used in the Households

Cooking fuel	Rural (n=661)		Urban (n=693)		Slum (n=649)		National (n=2 003)	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Electricity	0.0	0.0	1.7	-0.6-4.1	2.2	-1.1-5.6	0.4	-0.1-0.9
LPG	0.0	0.0	3.5	0.5-6.4	1.0	0.2-1.8	0.8	0.1-1.4
Natural gas	0.5	-0.4-1.4	33.5	-0.6-4.1	34.8	20.1-49.4	8.7	3.4-13.8
Biogas	0.0	0.0	0.3	0.5-6.4	1.0	-0.2-49.4	0.1	0.0-0.2
Kerosene	0.0	0.0	0.0	0.0	0.8	-0.2-1.7	0.0	0.0-0.1
Coal	0.9	-0.4-2.3	0.5	-0.2-1.4	0.0	0.0	0.8	-0.2-1.8
Wood	59.8	47.6-72.0	45.8	32.2-59.4	54.5	41.0-67.9	56.7	47.1-66.4
Straw/shrubs/grass	28.4	16.4-40.3	6.5	-0.0-12.9	1.9	0.3-3.6	22.8	13.5-32.2
Agricultural crop	7.5	3.0-11.9	5.6	1.1-10.2	0.5	-0.0-1.1	6.8	3.4-10.2
Animal dung	2.4	0.7-4.2	1.6	0.0-3.1	0.5	-0.0-1.3	2.2	0.9-3.5
Other	0.5	-0.2-1.2	1.1	-0.1-2.3	2.8	0.1-5.5	0.7	0.1-1.3

3.1.6 Household Monthly Expenses

Table 12 shows household monthly expenses. The national average of household expenditure was BDT 8,944.00; BDT 8,393.00, BDT 11,006.00 and BDT 8,779.00 in the rural, urban and slums, respectively. According to household food insecurity status, the household's spending power decreased as households had increasing food insecurity. Household's average monthly expenditure was BDT 10,357.00 in the food-secure households; BDT 8,206.00, BDT 7,324.00, and BDT 6505.00 in cases of mild, moderate and severe household food insecurity, respectively.

Table 12: Household Monthly Expenses

	n	Mean (BDT)	95% CI
Clusters			
National	1931	8 944.00	8 212.00-9 674.00
Rural	638	8 393.00	7 664.00-9 121.00
Urban	669	11 006.00	8 956.00-13 055.00
Slums	624	8 779.00	8 109.00-9 449.00
According to household food insecurity			
Food-secure	888	10 357.00	9 266.00-1 1447.00
Mildly insecure	298	8 206.00	7 304.00-9 109.00
Moderately insecure	487	7 324.00	6 711.00-7 937.00
Severely insecure	258	6 505.00	5 513.00-7 496.00

3.1.7 Household Food Insecurity

Table 13 shows household food insecurity by cluster: 52% of households at the national level were food-secure. The share of food-secure households was lower in the slums (36.3%) than in rural (52.4%) and urban (53.5%) clusters. Just over 12% of households experienced severe food insecurity at the national level as well as in the rural and urban clusters. This percentage was slightly higher in the slum cluster (17.2%).

Table 13: Household Food Insecurity

Clusters	Percentage (%)	95% CI
National		
Food-secure	52.0	45.5-58.4
Mildly insecure	14.1	10.8-17.4
Moderately insecure	21.6	16.1-27.0
Severely insecure	12.3	8.2-16.3
Rural		
Food-secure	52.4	44.0-60.3
Mildly insecure	14.0	9.8-18.2
Moderately insecure	21.6	14.5-28.6
Severely insecure	12.0	6.8-17.1

Urban		
Food-secure	53.5	46.1-60.8
Mildly insecure	14.4	9.4-19.4
Moderately insecure	19.6	13.8-25.4
Severely insecure	12.4	7.7-17.1
Slum		
Food-secure	36.3	25.7-46.9
Mildly insecure	14.8	10.2-19.5
Moderately insecure	31.5	25.4-37.7
Severely insecure	17.2	9.7-24.7

3.2 Morbidity: Preschool Children

3.2.1 Morbidity by Cluster

Table 14: Morbidity in Preschool Children by Cluster

	Rural (n=368)		Urban (n=391)		Slum (n=349)		National (n=1108)	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Diarrhea in the last 2 weeks	9.4	5.3-13.1	7.7	2.3-12.4	15.9	9.6-22.3	9.3	6.4-12.2
Fever in the last 2 weeks	49.0	38.6-59.4	34.4	28.4-40.3	35.5	29.2-41.8	45.4	37.1-53.7
Cough, fast breathing in the last 2 weeks	32.7	26.1-39.4	27.4	19.4-35.2	31.5	24.7-38.3	31.6	26.3-36.8
Measles in the last 6 months	5.1	2.5-7.8	8.1	5.1-11.2	7.1	3.7-10.5	5.8	3.7-7.9

Table 14 shows the status of morbidity in preschool children; 9.3% of the preschool children suffered from diarrhea in the two weeks preceding the survey, which was slightly higher in the slums (15.9%) than in the rural (9.4%) and urban clusters (7.7%). Among preschool children, 45.4% had suffered from fever within the last two weeks preceding the survey. The percentage in the rural areas was slightly higher (49%). Three out of ten (31.6%) preschool children had suffered from coughs and colds in the last two weeks, a similar percentage in all the clusters. Around 6% of the children had had measles in the six months preceding the survey

3.2.2 Morbidity by Socio-economic Status

Table 15 shows the morbidity in preschool children by SES. In regard to suffering from diarrhea in the preceding two weeks of the survey, the “poorest” quintile suffered more (11.6%) than the “richer” (5.7%) and the “richest” ones (2.9%). However, with regard to the occurrence of fever in the two weeks preceding the survey, in general, a similar share of the children had suffered from fever in the “poorest” (45.9%) and the “richest” quintiles (38.2%). More children from the “poorest” section (37.8%) had suffered from coughs and colds than the “richest” households (15.3%). In regard to suffering from measles in the six months the preceding the survey, around the same percentage of the children had suffered in the “poorest” (5.1%) and the “richest” (5.4%).

Table 15: Morbidity in Preschool Children by Socio-economic Status

	Poorest (n=221)		Poorer (n=221)		Middle (n=224)		Richer (n=221)		Richest (n=221)	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Diarrhea in the last 2 weeks	11.6	6.7-16.4	11.9	5.4-18.5	11.7	1.7-21.6	5.7	2.2-9.2	2.9	-0.9-6.8
Fever in the last 2 weeks	45.9	33.5-58.4	40.8	26.4-55.2	59.9	44.0-75.9	44.3	27.6-61.1	38.2	20.1-56.3
Cough and cold	37.8	25.4-50.1	35.1	21.9-48.2	38.6	22.8-54.5	26.4	17.2-35.4	15.3	8.1-22.5
Measles (6 months preceding the survey)	5.1	1.7-8.4	8.8	2.8-14.8	1.6	0.4-2.9	6.9	1.7-12.1	5.4	-0.4-11.4

3.3 Morbidity: School-age Children

Table 16: Morbidity by Cluster

	Rural (n=475)		Urban (n=484)		Slums (n=468)		National (n=1 427)	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Diarrhea in the last 2 weeks preceding the survey	4.6	0.9-8.4	4.9	1.7-8.2	3.2	1.3-5.2	4.6	1.8-7.5
Fever in the last 2 weeks preceding the survey	19.5	13.3-25.7	19.6	12.4-26.8	16.1	11.9-20.1	19.4	14.6-24.2
Measles in the last 6 months preceding the survey	1.0	0.06-2.0	1.7	-0.07-4.1	0.3	-0.008-0.6	1.1	0.2-2.2

Table 16 shows pattern of morbidity in school-age children. The prevalence of diarrhea in the last two weeks was similar across the clusters – 4.6%, 4.9% and 3.2% in the rural, urban and slum clusters, respectively. Around one in five children (19.4%) had suffered from fever within two weeks of the survey, a similar percentage in all the clusters. Just over 1% of the children had suffered from measles within the preceding six months.

3.4 Prevalence of Vitamin A Deficiency

Table 17 shows the prevalence of subclinical vitamin A deficiency. The national prevalence of sub-clinical vitamin A deficiency in preschool children, as measured by estimating the prevalence of low serum retinol (serum retinol <0.7mmol/l), was 20.5%. The prevalence in children in the slum cluster was 38.1%. The national prevalence in school-age children was 20.9%. A higher percentage of school-age children in the slums was vitamin A deficient (27.1%).

The prevalence subclinical vitamin A deficiency in NPNL women was 5.4%, with a higher percentage in the slums (6.9%).

Table 17: Prevalence of Vitamin A Deficiency

	n	Vitamin A deficiency[1,2,6] (%)	95% CI
Preschool children[3]			
National	873	20.5	15.9-25.0
Rural	306	19.4	13.6-25.2
Urban	305	21.2	15.5-26.8
Slums	262	38.1	28.4-47.7
School-age children[4]			
National	1 267	20.9	17.4-24.4
Rural	432	20.2	16.3-24.1
Urban	431	22.1	12.8-31.5
Slums	404	27.1	21.5-32.7
NPNL women[5]			
National	918	5.4	2.8-8.1
Rural	328	5.4	2.1-8.7
Urban	304	4.9	1.7-8.2
Slums	286	6.9	2.9-10.8

[1]Retinol deficiency is defined as serum retinol level of <0.7mmol/l (WHO/IVACG).
[2]Adjusted for elevated CRP (>10mg/l) or elevated AGP (>1 g/l) by mathematical correction (Thurnham *et al.*, 2010; Engle-Stone *et al.*, 2011).
[3]Aged 6-59 months.
[4]Aged 6-14 years.
[5]Aged 15-49 years.
[6]Estimates weighted to represent the population level.

3.4.1 Degrees of Vitamin A Deficiency

Table 18 shows degrees of subclinical vitamin A deficiency in preschool and school-age children, and the NPNL women. At the national level, over half of preschool (56.3%) and school-age children (53.3%) had a mild degree of vitamin A deficiency, while mild deficiency affects over one-third (34.3%) of NPNL women. Although the prevalence of severe degree of the deficiency was low in all the population groups studied (less than 1.0% in most of the clusters), it was slightly higher in preschool children (2.4%) and school-age children (2.2%) in the slums. The normal status of serum retinol in the preschool children was 21.7%, 30.4% and 8.5% in the rural, urban and slum cluster.

Table 18: Degrees of Vitamin A Deficiency

	Preschool children		School-age children		NPNL women	
	%	95% CI	%	95% CI	%	95% CI
National	(n=873)		(n=1 267)		(n=933)	
Normal status[1]	23.1	16.3-29.9	25.5	20.8-30.2	60.3	54.8-65.8
Mild deficiency[2]	56.3	47.6-65.1	53.5	48.8-58.2	34.3	39.0-39.7
Moderate deficiency[3]	20.0	15.5-24.5	19.8	16.7-22.9	5.1	2.6-7.7
Severe deficiency[4]	0.5	0.08-0.8	1.1	0.0009-2.1	0.1	-0.04-0.3
Rural	(n=306)		(n=432)		(n=331)	
Normal status[1]	21.7	13.8-29.6	25.9	19.7-32.1	59.6	52.8-66.3
Mild deficiency[2]	58.7	47.8-69.7	53.8	47.8-59.9	35.1	28.3-41.7
Moderate deficiency[3]	19.1	13.2-24.8	19.4	15.8-23.0	5.3	2.0-8.6
Severe deficiency[4]	0.4	0.0-0.8	0.8	-0.3-1.9	0.06	-0.06-0.2

Urban	**(n=305)**		**(n=431)**		**(n=312)**	
Normal status[1]	30.4	16.1-44.7	25.8	19.5-32.1	63.7	54.1-73.3
Mild deficiency[2]	48.4	35.9-60.8	52.0	45.9-58.1	31.6	22.9-40.2
Moderate deficiency[3]	20.9	15.3-26.5	20.4	12.8-28.1	4.3	1.2-7.4
Severe deficiency[4]	0.2	0.0-0.7	1.7	-1.0-4.5	0.4	-0.4-1.1
Slum	**(n=262)**		**(n=404)**		**(n=290)**	
Normal status[1]	8.5	4.7-12.3	17.0	12.6-21.4	58.7	50.8-66.6
Mild deficiency[2]	53.4	45.2-61.5	55.8	50.1-61.5	34.5	27.1-41.7
Moderate deficiency[3]	35.6	26.5-44.7	24.9	19.4-30.5	6.6	2.7-10.4
Severe deficiency[4]	2.4	0.2-4.6	2.2	0.01-4.4	0.2	-0.2-0.7

[1]Normal status: S. retinol>-1.05 µmol/l.
[2]Mild deficiency: S. retinol >=0.7-<1.05 µmol/l.
[3]Moderate deficiency: S. retinol>=0.35-<0.7 µmol/l.
[4]Severe deficiency: S. retinol<0.35 µmol/l.

3.4.2 Vitamin A Supplementation in Preschool Children

Table 19 shows the coverage of vitamin A supplementation in preschool children. At the national level, 77.0% of the children received vitamin A supplementation before the six months of the survey date: 77.9%, 73.1% and 72.4% in the rural, urban and the slum clusters, respectively. According to the Asset Index, the coverage was higher in the “richest” (87.5%) than the “poorest” (76.4%) quintile.

Table 19: Vitamin A Supplementation in Preschool Children

Clusters	n	%	95% CI
National			
<=6m[1]	932	77.0	69.4-84.2
6-12m[2]		16.5	10.3-22.8
>12m[3]		6.6	2.7-10.4
Rural			
<=6m	319	77.9	68.4-87.4
6-12m		15.6	7.4-23.8
>12m		6.4	1.5-11.4
Urban			
<=6m	320	73.1	66.1-80.2
6-12m		19.6	13.6-25.6
>12m		7.2	2.7-11.6
Slum			
<=6m	293	72.4	63.1-81.7
6-12m		21.3	13.3-29.7
>12m		6.2	1.9-10.5
Asset index			
Poorest			
<=6m	175	76.4	62.3-90.4
6-12m		17.1	4.7-29.1
>12m		6.4	1.3-11.4
Poorer			
<=6m	190	69.6	58.0-81.2
6-12m		19.6	8.8-30.5
>12m		10.6	2.1-19.2

Middle			
<=6m	200	80.0	67.4-92.8
6-12m		12.3	0.9-23.8
>12m		7.6	0.3-14.8
Richer			
<=6m	176	74.5	61.6-87.5
6-12m		22.9	9.8-36.0
>12m		2.5	-0.3-5.3
Richest			
<=6m	191	87.5	81.8-93.1
6-12m		9.5	4.9-14.2
>12m		2.9	0.4-5.5

[1]<=6m: Supplemented within 6 months; [2]6-12m: Supplemented within 6-12 months; [3]>12m: Supplemented earlier than last 12 months preceding the survey.

3.5 Vitamin A Consumption from Food

3.5.1 Vitamin A Consumption in Preschool Children by Cluster

Table 20 shows the daily vitamin A consumption in preschool children. The median intake was 270.4 RE. The median daily consumption of animal-source vitamin A was 52.6 RE. The medians for the rural, urban and slums clusters were 52.4 RE, 61.1 RE and 40.2 RE, respectively. The median intake of plant-source vitamin A was 186.3 RE, 105.3 RE and 111.8 RE in the rural, urban and slums clusters, respectively.

Table 20: Vitamin A Consumption in Preschool Children by Cluster

	National (n=845)	Rural (n=284)	Urban (n=296)	Slum (n=265)
	Median (Retinol Equivalents)			
Total vitamin A	270.4	291.5	230.3	209.1
Animal-source vitamin A	52.6	52.4	61.1	40.2
Plant-source vitamin A	162.8	186.3	105.3	111.8

3.5.2 Vitamin A Consumption in Preschool Children according to the Asset Index

Table 21 shows vitamin A consumption in preschool children by SES. The animal-source vitamin A consumption increased from the "poorest" (median, 11.8 RE) to the "richest" (median, 99.9 RE) quintiles. The plant-source vitamin A consumption was similar over the two extremes of the SES (94.8 RE in the "poorest" and 96.1 RE in the "richest" quintiles).

Table 21: Vitamin A Consumption in Preschool Children according to the Asset Index

	Poorest	Poorer	Middle	Richer	Richest
	Median (Retinol Equivalents)				
Total vitamin A	115.8	314.4	367.3	576.4	230.6
Vitamin A from animal sources	11.8	39.0	76.8	90.0	99.9
Vitamin A from plant sources	94.8	207.6	286.2	196.9	96.1

3.5.3 Vitamin A Consumption in the Preschool Children by Household Food Insecurity Status

Table 22 shows vitamin A consumption in preschool children by household food insecurity status. Consumption decreased as households had an increasing level of food insecurity, especially with regard to total vitamin A consumption and vitamin A consumption from animal sources.

Table 22: Vitamin A Consumption in the Preschool Children by Household Food Insecurity Status

	Food-secure	Mildly insecure	Moderately insecure	Severely insecure
	Median (Retinol Equivalents)			
Total vitamin A	333.0	314.4	189.6	140.7
Vitamin A from animal sources	75.4	42.1	32.7	7.0
Vitamin A from plant sources	193.5	193.3	110.1	136.3

3.5.4 Vitamin A Consumption in School-age Children by Cluster

Table 23 shows consumption of vitamin A in school-age children. The median consumption was 321.3 RE, 300.1 RE and 260.3 RE in the rural, urban and slums clusters, respectively. The median consumption from animal sources was lower in the slums (median 29.8 RE) than in the other clusters (40.1 RE in rural and 44.7 RE in the urban clusters).

Table 23: Vitamin A Consumption in School-age Children by Cluster

	National	Rural	Urban	Slums
	Median (Retinol Equivalents)			
Total vitamin A	318.4	321.3	300.1	260.3
Vitamin A from animal sources	40.5	40.1	44.7	29.8
Vitamin A from plant sources	226.1	237.0	194.1	201.9

3.5.5 Vitamin A Consumption in School-age Children by SES

Table 24 shows vitamin A consumption in school-age children by SES. The "richest" group had a higher consumption of vitamin A from animal sources (median, 141.9 RE) than the "poorest" group (median, 13.1 RE). In contrast, vitamin A consumption from plant sources was more homogenous across the SES groups.

Table 24: Vitamin A Consumption in School-age Children According to the Asset Index

	Poorest	Poorer	Middle	Richer	Richest
	Median (Retinol Equivalents)				
Total vitamin A	236.8	374.1	364.1	348.1	281.9
Vitamin A from animal sources	13.1	45.7	44.9	46.1	141.9
Vitamin A from plant sources	208.6	297.7	283.6	212.5	138.0

3.5.6 Vitamin A Consumption in School-age Children by Household Food Insecurity Status

Table 25 shows the consumption of vitamin A in school-age children by household food insecurity status. The median consumption in regard to total and animal-source vitamin A consumption was increasingly lower as the households were more food-insecure. The median for animal-source vitamin A consumption was 74.8 RE in the food-secure households and 10.1 RE in the severely food-insecure households.

Table 25: Vitamin A Consumption in School-age Children by Household Food Insecurity Status

	Food-secure	Mildly insecure	Moderately insecure	Severely insecure
		Median (Retinol Equivalents)		
Total vitamin A	374.1	368.7	265.5	194.2
Vitamin A from animal sources	74.8	40.1	24.8	10.1
Vitamin A from plant sources	275.5	286.6	201.3	190.5

3.5.7 Vitamin A Consumption in NPNL Women by Cluster

Table 26 shows consumption of vitamin A in NPNL women by cluster. The median consumption of animal-source vitamin A was 28.9 RE, 40.2 RE and 30.3 RE in the rural, urban and slum clusters, respectively.

Table 26: Vitamin A Consumption in NPNL Women by Cluster

	National	Rural	Urban	Slum
	Median (Retinol Equivalents)			
Total vitamin A	372.1	315.9	467.2	412.5
Vitamin A from animal sources	31.8	28.9	40.2	30.3
Vitamin A from plant sources	285.8	258.7	392.3	373.2

3.5.8 Vitamin A Consumption in NPNL Women by Socio-economic status

Table 27 shows vitamin A consumption in NPNL women by SES. The median consumption increased as the SES increased. The median for total consumption was 245.9 RE and 485.3 RE in the "poorest" and the "richest" quintiles, respectively. The median consumption of animal-source vitamin A was 13.1 RE and 90.4 RE, respectively, in the "poorest" and the "richest" groups.

Table 27: Vitamin A Consumption in npnl Women according to the Asset Index

	Poorest	Poorer	Middle	Richer	Richest
	Median (Retinol Equivalents)				
Total vitamin A	245.9	317.6	418.7	389.2	485.3
Vitamin A from animal sources	13.1	23.5	45.1	40.9	90.4
Vitamin A from plant sources	218.9	283.7	383.4	370.9	383.1

3.5.9 Vitamin A Consumption among NPNL Women by Household Food Insecurity

Table 28 shows vitamin A consumption in NPNL women by household food insecurity status. The total consumption and consumption from animal sources were lower as household food insecurity increased. The median for animal source consumption was 46.2 RE and 11.3 RE in the "food-secured" and "severely food-insecure" households, respectively. However, consumption from plant sources was generally homogenous across the food security status.

Table 28: Vitamin A Consumption in the NPNL Women by Household Food Insecurity Status

	Food-secure	Mildly insecure	Moderately insecure	Severely insecure
		Median (Retinol Equivalents)		
Total vitamin A	385.6	306.8	299.5	272.0
Vitamin A from animal sources	46.2	31.1	22.5	11.3
Vitamin A from plant sources	305.5	260.2	234.6	241.1

3.5.10 Vitamin A Consumption Compared to the Recommended Daily Allowance (RDA)

Table 29 shows consumption of total vitamin A (RE) from food compared to the Recommended Daily Allowance (RDA). Median consumption was below the RDA in all the population groups studied.

Table 29: Consumption of Vitamin A Compared to the Recommended Daily Allowance (RDA)

	National consumption (RE) (Median)	RDA[1]
Preschool children[2]	270	300-400
School-age children[3]	318	400-600
NPNL women[4]	372	700

[1]Institute of Medicine (IOM).
[2]Age 1-3 years: 300 RE; age 4-5 years: 400 RE.
[3]Age 6-8 years: 400 RE; age 9-13 years: 600 RE.
[4]Age 15-49 years (NPNL): 700 RE.

3.6 Knowledge about Vitamin A-related Issues

3.6.1 Knowledge about Vitamin A-rich Food Sources

Table 30: Knowledge about Vitamin A-rich Food Sources

	Rural		Urban		Slum		National	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Do you know about vitamin A-rich foods?	(n=661)		(n=693)		(n=649)		(n=2003)	
Yes	74.4	70.8-78.0	71.9	65.2-78.5	71.3	63.0-79.5	73.7	70.7-76.7
No	25.6	22.0-29.2	28.1	21.5-34.8	28.7	20.5-37.0	26.3	23.3-29.3
Green leafy vegetables	(n=485)		(n=492)		(n=477)		(n=1454)	
Mentioned	95.9		96.0		98.4		96.0	
Didn't mention	4.1		4.0		1.6		4.0	
Yellow/orange vegetables and fruits	(n=485)		(n=492)		(n=477)		(n=1454)	
Mentioned	35.9	27.2-44.6	49.2	43.6-54.7	39.5	32.5-46.4	38.7	31.9-45.5
Didn't mention	64.1	55.4-72.8	50.8	45.3-56.4	60.5	53.6-67.5	61.3	54.5-68.1
Small fish	(n=485)		(n=492)		(n=477)		(n=1454)	
Mentioned	45.1	34.1-56.1	48.1	38.7-57.6	37.8	31.0-44.7	45.4	37.0-53.8
Didn't mention	54.9	43.9-65.9	51.9	42.4-61.3	62.2	55.3-69.0	54.6	46.2-63.0

Liver	(n=485)		(n=492)		(n=477)		(n=1454)	
Mentioned	4.0	1.9-6.0	4.2	1.8-6.6	1.8	-0.1-3.7	3.9	2.3-5.6
Didn't mention	96.0	94.0-98.1	95.8	93.4-98.2	98.2	96.3-100.1	96.1	94.4-97.7

Table 30 shows the knowledge of respondents on the issues relating to vitamin A. At the national level, 73.7% stated that they knew which foods were rich in vitamin A. The percentages were similar in all the clusters. Over 95% of the respondents mentioned that green leafy vegetables were a rich source of vitamin A, and the response rate was even across the clusters. Moreover, 49.2% of the urban respondents mentioned that yellow and orange vegetables and fruits were rich sources of vitamin A; the percentage was slighter lower in the rural cluster (35.9%); 48.1% of respondents from the urban cluster and 37.8% from slums mentioned that small fish species was a rich source of vitamin A; 3.9% of the respondents mentioned that liver was a good source of vitamin A.

3.6.2 Knowledge of Health Benefits of Eating Vitamin A-rich Foods

Table 31: Knowledge of Health Benefits of Eating Vitamin A-rich Foods

	Rural		Urban		Slum		National	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Knowledge on benefits of eating vitamin A-rich foods?	(n=661)		(n=693)		(n=649)		(n=2003)	
Yes	68.0	62.9-73.1	76.1	67.3-85.0	70.1	62.7-77.5	69.7	65.3-74.2
No	32.0	26.9-37.1	23.9	15.0-32.7	29.9	22.5-37.3	30.3	25.8-34.7
Good for the eyesight	(n=459)		(n=503)		(n=469)		(n= 1431)	
Mentioned	55.2	45.5-65.0	60.1	50.3-69.8	51.7	44.0-59.4	56.2	48.9-63.5
Didn't mention	44.8	35.0-54.5	39.9	30.2-49.7	48.3	40.6-56.0	43.8	36.5-51.1
Healthy	(n=459)		(n=503)		(n=469)		(n= 1431)	
Mentioned	84.0	79.2-88.7	77.8	70.6-84.9	77.5	71.8-83.2	82.3	78.5-86.2
Didn't mention	16.0	11.3-20.8	22.2	15.1-29.4	22.5	16.8-28.2	17.7	13.8-21.5
Good for the skin	(n=459)		(n=503)		(n=469)		(n= 1431)	
Mentioned	3.7	1.3-6.0	9.5	4.7-14.3	4.3	2.0-6.5	5.0	3.0-7.0
Didn't mention	96.3	94.0-98.7	90.5	85.7-95.3	95.7	93.5-98.0	95.0	93.0-97.0
Prevent night blindness	(n=459)		(n=503)		(n=469)		(n= 1431)	
Mentioned	17.0	12.3-21.7	28.1	23.033.2	14.4	10.1-18.6	19.4	15.6-23.2
Didn't mention	83.0	78.3-87.7	71.9	66.8-77.0	85.6	81.4-89.9	80.6	76.8-84.4
Others	(n=459)		(n=503)		(n=469)		(n= 1431)	
Mentioned	0.2	-0.1-0.4	5.2	1.1-9.2	0.9	-0.1-1.9	1.3	0.2-2.4
Didn't mention	99.8	99.6-100.1	94.8	90.8-98.9	99.1	98.1-100.1	98.7	97.6-99.8

Around 70% of respondents mentioned that they knew the benefits of eating vitamin A-rich food (Table 31), which was generally consistent in all the clusters. Over 50% of the respondents mentioned that eating vitamin A-rich foods was good for the eyesight. Over 80% of the respondents mentioned that eating vitamin A-rich food was good for the health. In the urban cluster, 28.1% mentioned that eating vitamin A-rich food prevented night blindness, compared to 17% and 14.4% in the rural area and slums, respectively. It was mentioned by 9.5% of the respondents in the urban cluster that Vitamin A was good for the skin compared to 4% in the rural and slum clusters.

3.7. Per Capita Oil Consumption

3.7.1 Daily per Capita oil Consumption

Table 32: Per Capita Oil Consumption

	n	Mean (gm)	95% CI
Cluster			
National	2 000	24.4	22.1-26.7
Rural	659	22.9	20.0-25.8
Urban	692	29.7	25.8-33.7
Slum	649	25.9	24.1-27.6
By household food insecurity status[2]			
Food-secure	918	27.8	23.9-31.8
Mildly insecure	305	24.7	19.5-29.8
Moderately insecure	509	20.5	17.8-23.1
Severely insecure	268	16.4	14.5-18.4

[1]Estimates were weighted to represent the population level.
[2]Coates *et al*., 2007.

Table 32 show per capita daily consumption of oil: 24.4 g at the national level; and 22.9 g, 29.7 g and 25.9 g in the rural, urban and slums clusters, respectively. Per capita daily oil consumption decreased as households became more food-insecure, 27.8 g in "food-secure" households against 16.4 g in "severely food-insecure" households.

3.7.2 Type of Cooking oil Used in Households

Table 33: Type of Cooking Oil

	Rural (n=661)		Urban (n=693)		Slum (n=649)		National (n=2 003)	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Soybean	87.6	81.6-93.5	95.9	92.9-98.9	94.1	88.0-100.1	89.5	85.2-93.9
Mustard	20.7	11.7-29.7	6.3	2.2-10.5	7.4	0.7-14.0	17.2	10.2-24.3
Supper/palm	0.1	-0.1-0.3	1.9	-0.3-4.1	0.1	-0.1-0.3	0.5	0.0-0.9
Coconut	0.0	0.0	0.1	-0.1-0.2	0.0	0.0	0.0	0.0
Others	0.2	-0.1-0.6	0.0	0.0	0.0	0.0	0.2	-0.1-0.5
Brand oil	22.8	17.0-28.6	38.6	32.0-45.1	12.7	7.9-17.6	25.7	20.8-30.5
Open oil	76.1	70.2-82.0	60.1	53.6-66.7	86.2	81.0-91.3	73.2	68.3-78.1
Both	0.5	0.0-1.0	1.1	-0.3-2.5	1.1	-0.3-2.4	0.6	0.1-1.1
Others	0.6	0.1-1.2	0.2	-0.1-0.5	0.0	0.0	0.5	0.1-0.9

Table 33 shows the use of cooking oil in the households. Soybean was used in 89.5% of the households: 87.6%, 95.9% and 94.1% in rural, urban and slum households, respectively. In around one in five households (17.2%), mustard oil was used for cooking, which was higher in the rural (20.7%) than in the urban (6.3%) and slum clusters (7.4%). The consumption of palm oil and coconut oil was negligible.

One in four households (25.7%) used "brand" oil for cooking; the rate of usage was 38.6%, 22.8% and 12.7% in the urban, rural and slum clusters, respectively. The rate of usage of "open" oil was 73.2%

at the national level; 86.2% in the slums, followed by 76.1% in the rural cluster and 60% in the urban cluster. A negligible percentage of households used both types of cooking oil.

3.7.3 Monthly Spending on Cooking Oil

Table 34: Monthly Spending on Cooking Oil

	n	Mean (BDT)	95% CI
Clusters			
National	2 003	380.00	347.40-412.60
Rural	661	356.80	319.60-394.10
Urban	693	463.50	399.10-527.10
Slum	649	388.30	361.20-415.40
By household food insecurity status			
Food-secure	919	436.60	385.60-487.60
Mildly insecure	305	358.50	322.40-394.70
Moderately insecure	510	324.00	273.60-374.30
Severely insecure	269	263.40	225.50-301.40

Table 34 shows spending on cooking oil in the households. The national average monthly spending on cooking oil was BDT 380.00 (US$ 4.6), which was lower in the rural cluster (BDT 356.8) and the slum cluster (BDT 388.3) than in the urban cluster, at BDT 463.50. In food-secure households, the monthly spending on cooking oil was BDT 436.60 compared to BDT 263.40 in severely food-insecure households.

3.8 Anemia and Iron Status

3.8.1 Status of Hemoglobin

3.8.1.1 Status of Haemoglobin Concentration by Cluster

Table 35 shows the mean hemoglobin concentration in blood. The means for preschool children were 11.4, 11.7 and 11.4 gm/dl in the rural, urban and slum clusters, respectively; for NPNL women, 12.4, 12.6 and 12.6 gm/dl in the rural, urban and slum clusters, respectively; and for school-age children, 12.3, 12.5 and 12.4 gm/dl, respectively.

Table 35: Mean Hemoglobin by Cluster

	National		Rural		Urban		Slum	
	Mean (g/dl)	95% CI	Mean (g/dl)	95% CI	Mean (g/dl)	95% CI	Mean (g/dl)	95% CI
	(n= 607)		(n=207)		(n=220)		(n=180)	
Preschool children	11.5	11.3-11.7	11.4	11.2-11.7	11.7	11.4-12.1	11.4	11.3-11.6
	(n=1031)		(n=362)		(n=351)		(n=318)	
NPNL women	12.4	12.3-12.6	12.4	12.2-12.6	12.6	12.3-12.8	12.6	12.4-12.8
	(n=1320)		(n=441)		(n=452)		(n=427)	
School-age children	12.3	12.2-12.5	12.3	12.1-12.5	12.5	12.4-12.7	12.4	12.2-12.5

3.8.1.2 Status of Hemoglobin Concentration by Socio-economic Status

Table 36 shows the mean estimates of hemoglobin in the studied population groups by SES. In the preschool children, the means were 11.2 g/dl and 11.7 g/dl in the "poorest" and the "richest" quintiles, respectively; in school-age children, 12.3 and 12.5 g/dl in the "poorest" and the "richest" quintiles, respectively; and in NPNL women, a similar trend was observed, 12.4 g/dl and 12.8 g/dl in the "poorest" and the "richest" quintiles, respectively.

Table 36: Mean Hemoglobin by Socio-economic Status

	Poorest		Poorer		Middle		Richer		Richest	
	Mean (g/dl)	95% CI	Mean (g/dl)	95% CI	Mean (g/dl)%	95% CI	Mean (g/dl)	95% CI	Mean (g/dl)	95% CI
	(n=114)		(n=128)		(n=118)		(n=116)		(n=131)	
Pre-school children	11.2	10.9-11.5	11.5	11.2-11.8	11.7	10.9-12.4	11.4	11.2-11.5	11.7	11.2-12.3
NPNL women	12.4	12.1-12.7	12.5	12.3-12.8	12.3	12.1-12.5	12.4	12.1-12.7	12.8	12.6-13.1
	(n=256)		(n=262)		(n=268)		(n=269)		(n=265)	
School-age children	12.3	11.9-12.6	12.3	12.1-12.5	12.3	12.2-12.5	12.4	12.1-12.7	12.5	12.2-12.8

3.8.1.3 Hemoglobin Concentration by Household Food Insecurity Status

Table 37 shows the mean hemoglobin level according to household food insecurity status. The mean level of hemoglobin in blood (g/dl) was similar in all the studied population groups.

Table 37: Mean Hemoglobin by Household Food Insecurity Status

	Food-secure		Mildly insecure		Moderately insecure		Severely insecure	
	Mean (g/dl)	95% CI	Mean (g/dl)	95% CI	Mean (g/dl)	95% CI	Mean (g/dl)	95% CI
	(n=272)		(n=94)		(n=153)		(n=88)	
Preschool children	11.6	11.3-11.9	11.3	10.8-11.8	11.3	11.-11.5	11.6	11.3-12.0
	(n=490)		(n=138)		(n=272)		(n=131)	
NPNL women	12.5	12.3-12.7	12.3	11.8-12.7	12.4	12.1-12.6	12.7	12.4-13.0
	(n=559)		(n=204)		(n=361)		(n=196)	
School-age children	12.4	12.2-12.6	12.4	12.0-12.7	12.3	12.1-12.5	12.4	12.1-12.6

3.8.2 Prevalence of Iron Deficiency and Anemia

The national prevalence of anemia was 33.1% in preschool children (Table 38). The prevalence in rural, urban and slum clusters was 37%, 23% and 22%, respectively. The national prevalence of anemia was 26% in NPNL women; it was high in the rural cluster 27.4%.

3.8.2.1 Anemia and Iron Status in Preschool Children and NPNL Women

Table 38: Anemia And Iron Status in Preschool Children And NPNL Women

	Preschool children[5]			NPNL women[6]		
	n	%	95% CI	n	%	95% CI
Anemia[1,7]						
National	607	33.1	25.7-40.4	1 031	26.0	20.2-31.6
Rural	207	36.6	27.5-45.6	362	27.4	20.3-34.6
Urban	220	22.8	12.9-32.8	351	21.4	13.7-29.1
Slum	180	22.0	14.1-29.9	318	20.1	12.9-27.3
Iron deficiency[2,3,7]						
National	468	10.7	5.8-15.6	882	7.1	4.2-9.9
Rural	155	9.4	3.2-15.7	314	6.7	3.1-10.2
Urban	164	12.3	4.3-20.2	298	8.7	4.1-13.3
Slum	149	27.2	19.5-34.9	270	7.4	3.8-11.1
Iron Deficiency Anemia[4,7]						
National	449	7.2	2.4-11.9	868	4.8	2.1-7.8
Rural	149	6.1	-0.02-12.1	312	5.0	1.6-8.4
Urban	158	10.1	2.2-18.0	294	4.1	1.4-6.7
Slum	142	13.9	5.5-22.2	262	4.1	1.3-6.8

[1]Anemia is defined as hemoglobin level <12.0gm/dl in NPNL women and <11.0gm/dl in preschool children.
[2]Iron deficiency is defined as serum ferritin level <15.0ng/ml in NPNL women and <12.0ng/ml in preschool children (WHO, 2001),
[3]Adjusted for elevated CRP (>10.0 mg/l) or elevated AGP (>1.0 g/l) by mathematical correction (Thurnham *et al*. 2010; Engle-Stone *et al*. 2011).
[4]Iron deficiency anemia is defined as hemoglobin<12.0 g/dl plus ferritin level<15.0 ng/ml in NPNL women and hemoglobin<11.0 g/dl plus ferritin level<12.0 ng/ml in preschool children.
[5]Age 6-59 months.
[6]Age 15-49 years.
[7]Estimates weighted to represent the population level.

3.8.2.2 Anemia and Iron Status in School-age Children

Table 39: Anemia And Iron Status in School-age Children5

	6-11 y			12-14 y		
	n	%	95% CI	n	%	95% CI
Anemia[1]						
National	995	19.1	13.1-25.1	326	17.1	7.4-26.6
Rural	340	21.7	13.7-29.5	102	18.1	5.4-30.7
Urban	342	11.8	8.3-15.2	110	13.2	2.3-24.1
Slum	313	13.2	7.0-19.4	114	18.1	10.6-25.6
Iron deficiency[2,3]						
National	960	3.9	1.7-6.1	319	9.5	-0.6-19.7
Rural	331	4.1	1.1-6.9	98	10.0	-0.4-23.8
Urban	329	3.6	1.2-5.9	112	8.1	2.1-14.2
Slum	300	3.4	1.2-5.5	109	8.3	1.8-14.8
Iron deficiency anemia[4,3]						

National	944	1.3	0.2-2.4	312	1.8	-0.2-3.9
Rural	324	1.1	-0.3-2.5	97	1.8	-0.8-4.6
Urban	325	2.1	1.1-4.0	108	1.7	-0.6-4.1
Slum	295	1.3	-0.1-2.7	107	1.8	-0.3-3.9

[1] Anemia is defined as hemoglobin level <11.5 gm/dl in children 6-11 years old and <12.0 gm/dl in children 12-14 years.
[2] Iron deficiency is defined as serum ferritin level<15.0 ng/ml (WHO 2001).
[3] Adjusted for elevated CRP (>10.0 mg/l) or elevated AGP (>1.0 g/l) by mathematical correction (Thurnham *et al.,* 2010; Engle-Stone *et al*., 2011)
[4] Iron deficiency anemia is defined as hemoglobin<11.5 g/dl plus ferritin level<15.0 ng/ml in children 6-11 years and hemoglobin<12.0 g/dl plus ferritin level<15.0 ng/ml in children 12-14 years.
[5] Estimates weighted to represent the population level.

Tables 38 and 39 show the iron status in the population. The national prevalence of iron deficiency (ID), i.e. low ferritin, in preschool children was 10.7%. The deficiency was higher in the slums than in the rural or urban clusters (slums, 27.2%, rural cluster, 9.4%, urban cluster, 12.3%). In NPNL women, the national prevalence was 7.1%; 8.7% and 6.7% in the urban and rural clusters, respectively. In school-age children, the national prevalence was around 3.9% in children 6-11 years old and 9.5% in children 12-14 years old (Table 39).

The national prevalence of iron deficiency anemia (IDA) was 7.2%and 4.8% respectively in the preschool children, and the NPNL women (Table 38). For school-age children, the prevalence was 1.3% and 1.8% for children 6-11 years old and 12-14 years old, respectively (Table 39).

3.9 Consumption of Iron from Food

3.9.1 Consumption of Iron from Food by Cluster

Table 40 shows the daily consumption of iron from food in the studied population groups. In preschool children, the average daily consumption of total iron was 4.61 mg, 4.65 mg and 4.10 mg in the rural, urban and the slum clusters, respectively. The consumption of animal source (heme iron) was 0.94 mg, 1.12 mg and 0.96 mg in the rural, urban and the slums clusters, respectively. In school-age children, mean consumption in the rural, urban and slums clusters was 5.95 mg, 6.8 mg and 6.15 mg, respectively. The consumption of animal source heme iron was 1.14 mg, 1.28 mg, and 1.09 mg in the rural, urban and slums clusters, respectively. In NPNL women, the mean consumption in the rural, urban and slums clusters was 7.18 mg, 8.24 mg and 7.83 mg, respectively. Consumption of animal source iron was 1.16 mg, 1.18 mg and 1.09 mg in the rural, urban and slum clusters, respectively.

Table 40: Iron Consumption from Food by Cluster

	National (n=845)	Rural (n=284)	Urban (n=296)	Slum (n=265)
	mg/day			
Preschool children				
Daily total iron				
Mean	4.59	4.61	4.65	4.10
Median	4.17	4.19	3.81	3.69
Daily iron from animal sources				
Mean	0.98	0.94	1.12	0.96
Median	0.74	0.71	0.79	0.72
Daily iron from non-animal sources				
Mean	3.61	3.66	3.52	3.13
Median	3.06	3.12	2.77	2.84

School-age children				
Daily total iron				
Mean	6.13	5.95	6.8	6.15
Median	5.21	5.17	5.49	5.19
Daily iron from animal sources				
Mean	1.16	1.14	1.28	1.09
Median	0.90	0.94	0.88	0.70
Daily iron from non-animal sources				
Mean	4.96	4.81	5.52	5.05
Median	4.14	4.10	4.24	4.36
NPNL women				
Daily total iron				
Mean	7.42	7.18	8.24	7.83
Median	6.64	6.42	7.27	6.68
Daily iron from animal sources				
Mean	1.16	1.16	1.18	1.09
Median	0.99	0.99	1.03	0.87
Daily iron from non-animal sources				
Mean	6.25	6.01	7.06	6.74
Median	5.48	5.34	6.13	5.74

3.9.2 Consumption of Iron from Food by Socio-economic Status

Table 41 shows the consumption of iron from food by SES. Consumption tends to increase as the SES improves. In preschool children, the mean consumption of total iron was 3.89 mg in the "poorest" and 4.72 mg in the "richest" quintile. Consumption of animal-source iron was m 0.54 mg in the "poorest" quintile, which increased gradually as the SES increased; it was 1.48 mg in the "richest" quintile of the population. In NPNL women, the mean consumption of total iron was 6.67 mg in the "poorest", against 8.85 mg in the "richest" quintile. The iron consumption from animal-source food was 0.82 mg in the "poorest" and 1.88 mg in the "richest" quintile. In regard to school-age children, the daily consumption of total iron was 5.79 mg in the "poorest" and 6.89 mg in the "richest" group. Consumption of animal-source iron, it was 0.69 mg and 1.88 mg, respectively.

Table 41: Iron Consumption from Food by Socio-economic Status

	Poorest	Poorer	Middle	Richer	Richest
	mg/day				
Preschool children					
Daily total iron					
Mean	3.89	4.40	5.03	5.44	4.72
Median	3.09	4.19	5.24	5.54	4.55
Daily iron from animal-sources					
Mean	0.54	0.77	0.97	1.53	1.48
Median	0.32	0.65	1.01	1.44	1.40
Daily iron from non-animal sources					
Mean	3.34	3.62	4.05	3.91	3.23
Median	2.69	3.06	4.06	3.20	2.82

School-age children					
Daily total iron					
Mean	5.79	5.93	6.13	6.24	6.89
Median	4.50	5.51	5.17	5.48	6.04
Daily iron from animal sources					
Mean	0.69	1.05	1.15	1.43	1.88
Median	0.52	0.95	1.05	0.99	1.81
Daily iron from non-animal sources					
Mean	5.10	4.87	4.98	4.81	5.01
Median	3.85	4.44	4.08	4.41	4.09
NPNL women					
Daily total iron					
Mean	6.67	6.99	7.78	7.48	8.85
Median	6.12	6.27	7.04	6.83	7.97
Daily iron from animal sources					
Mean	0.82	0.98	1.24	1.25	1.88
Median	0.55	0.81	1.0	1.06	1.58
Daily iron from non-animal-sources					
Mean	5.84	6.0	6.53	6.22	6.97
Median	5.01	5.40	6.11	5.33	6.28

3.9.3 Consumption of Daily Iron from Food by Household Food Insecurity

Table 42 shows iron consumption according to household food insecurity status. In preschool children, mean consumption of total iron was 4.97 mg in the food-secure households, compared to 3.59 mg in the severely food-insecure households. Mean consumption of animal source iron (heme iron) was 1.23 mg and 0.43 mg in food-secure and severely food-insecure households, respectively. For school-age children, the mean consumption of total iron in the food-secure households was 6.69 mg, compared to 5.44 mg in severely food-insecure households. Consumption of animal source iron was 1.6 mg in the food-secure households and just 0.61 mg in the severely food-insecure households. NPNL women from food-secure households consumed on average 7.85 mg of total iron, while those from severely food-insecure households consumed 6.89 mg every day. The consumption of animal source heme iron was 1.44 mg in food-secure households and 0.66 mg in food-insecure households. However, consumption of non-animal source iron was generally consistent, irrespective of household food insecurity status: 6.41 mg and 6.23 mg in the food-secure and severely food-insecure households, respectively.

Table 42: Iron Consumption by Household Food Insecurity

	Food-secure	Mildly insecure	Moderately insecure	Severely insecure
	mg/day			
Preschool children				
Daily total iron				
Mean	4.97	3.97	4.63	3.59
Median	4.55	3.89	4.19	2.81
Daily iron from animal sources				
Mean	1.23	0.81	0.77	0.43
Median	1.20	0.61	0.59	0.32

Daily iron from plant sources				
Mean	3.73	3.15	3.86	3.16
Median	3.32	2.84	3.11	2.41
School-age children				
Daily total iron				
Mean	6.69	5.29	6.0	5.44
Median	5.96	4.44	5.33	4.19
Daily iron from animal sources				
Mean	1.6	0.94	0.84	0.61
Median	1.33	0.73	0.58	0.46
Daily iron from plant sources				
Mean	5.08	4.35	5.17	4.82
Median	4.41	3.74	4.44	3.72
NPNL women				
Daily total iron				
Mean	7.85	7.14	6.84	6.89
Median	7.24	6.07	6.23	6.05
Daily iron from animal sources				
Mean	1.44	1.10	0.84	0.66
Median	1.23	1.09	0.68	0.50
Daily iron from plant sources				
Mean	6.41	6.04	6.0	6.23
Median	5.74	4.79	5.25	5.31

3.9.4 Consumption of Iron from Food Compared to the Recommended Daily Allowance

Table 43 shows the daily consumption of iron from food and how it compares with the RDA. The median consumption of iron was below the RDAs in all the population groups studied.

Table 43: Consumption of Iron from Food Compared to the Recommended Daily Allowance

	Daily total iron consumption, median (mg)	RDA[1]
Preschool children	4.17	7-10[2]
School-age children	5.21	8-10[3]
NPNL women	6.64	15-18[4]

[1]Institute of Medicine (IOM).
[2] Age 1-3 year: 7mg; age 4-5: 10 mg.
[3]Age 6-8 years: 10 mg; age 9-13: 8 mg.
[4]Age 15-18 year: 15 mg; Age 19-49: 18 mg.

3.10. Knowledge about Iron-rich Food

Table 44: Knowledge about Iron-Rich Food

	Rural		Urban		Slum		National	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Do you have knowledge about food containing iron?	(n=661)		(n=693)		(n=649)		(n=2003)	
Yes	30.1	24.9-35.2	48.6	38.7-58.5	35.0	27.9-42.1	34.1	29.3-38.8
No	69.9	64.8-75.1	51.4	41.5-61.5	65.0	57.9-72.1	65.9	61.2-70.7
Do you know that fish is an iron-rich food	(n=213)		(n=298)		(n=245)		(n=756)	
Yes	53.8	39.9-67.8	60.7	51.9-69.4	56.2	45.4-67.0	55.9	46.6-65.3
No	46.2	32.2-60.1	39.3	30.6-48.1	43.8	33.0-54.6	44.1	34.7-53.4
Meat	(n=213)		(n=298)		(n=245)		(n=756)	
Mentioned	32.2	21.9-42.6	47.5	38.5-56.5	32.1	21.5-42.7	36.7	29.2-44.2
Didn't mention	67.8	57.4-78.1	52.5	43.5-61.5	67.9	57.3-78.5	63.3	55.8-70.8
Eggs	(n=213)		(n=298)		(n=245)		(n=756)	
Mentioned	38.9	26.7-51.1	39.6	30.8-48.5	28.8	17.7-39.8	38.7	30.3-47.1
Didn't mention	61.1	48.9-73.3	60.4	51.5-69.2	71.2	60.2-82.3	61.3	52.9-69.7
Milk	(n=213)		(n=298)		(n=245)		(n=756)	
Mentioned	28.2	17.2-39.3	28.7	19.7-37.6	19.8	10.6-29.0	28.0	20.3-35.7
Didn't mention	71.8	60.7-82.8	71.3	62.4-80.3	80.2	71.0-89.4	72.0	64.3-79.7
Mentioned other iron-rich foods								
Yes	2.0	0.1-3.9	3.4	-0.3-7.0	3.2	0.6-5.7	2.4	0.8-4.1
No	98.0	96.1-99.9	96.6	93.0-100.3	96.8	94.3-99.4	97.6	95.9-99.2
Do you know about the benefits of eating iron-rich food	(n=238)		(n=297)		(n=263)		(n=798)	
Yes	34.2	26.7-41.6	47.6	37.5-57.7	41.5	34.3-48.6	37.2	31.1-43.4
No	65.8	58.4-73.3	52.4	42.3-62.5	58.5	51.4-65.7	62.8	56.6-68.9
Provides energy	(n=238)		(n=297)		(n=263)		(n=798)	
Yes	56.9	49.5-64.4	53.9	47.5-60.4	57.3	45.2-69.5	56.2	50.7-61.6
No	43.1	35.6-50.5	46.1	39.6-52.5	42.7	30.5-54.8	43.8	38.4-49.3
Provides iron	(n=238)		(n=297)		(n=263)		(n=798)	
Mentioned	14.6	5.3-23.8	9.6	4.1-15.2	8.1	4.0-12.3	13.0	6.3-19.7
Didn't mention	85.4	76.2-94.7	90.4	84.8-95.9	91.9	87.7-96.0	87.0	80.3-93.7
Iron-rich food is healthy	(n=238)		(n=297)		(n=263)		(n=798)	
Mentioned	77.4	68.2-86.7	76.4	69.3-83.4	65.5	54.6-76.3	76.6	70.0-83.2
Didn't mention	22.6	13.3-31.8	23.6	16.6-30.7	34.5	23.7-45.4	23.4	16.8-30.0
Others	(n=238)		(n=297)		(n=263)		(n=798)	
Mentioned	2.6	0.1-5.2	1.2	-0.1-2.4	4.2	1.2-7.1	2.3	0.5-4.1
Didn't mention	97.4	94.8-99.9	98.8	97.6-100.1	95.8	92.9-98.8	97.7	95.9-99.5

Table 44 indicates the knowledge of the respondents about foods rich in iron. One in three (34.1%) of the respondents said that they knew which foods were rich in iron; 30.1% in the rural cluster and 48.6% in the urban cluster Over 50% of the respondents in all the clusters mentioned that fish was a good source of iron. In addition, 37% of the respondents stated that meat was a good source of iron, which was slightly lower in the rural and slums clusters (32.1%), compared with the urban clusters (47.5%).

Moreover, 47.6% of urban respondents said that they knew about the health benefits of eating iron-rich foods. Over 70% of respondents said that iron-rich foods were good for one's health. Only 13% of the respondents at the national level mentioned that iron-rich food provides iron.

3.11 Zinc Nutrition

3.11.1. Prevalence of Zinc Deficiency

The national prevalence of zinc deficiency in the preschool children was 44.6% (Table 45). Urban children were less likely to suffer from zinc deficiency than their rural and slum peers (urban, 29.5%; rural, 48.6%; slum, 51.7%). However, over half of NPNL women suffered from zinc deficiency at the national level and in all the clusters, with the prevalence being highest in the slums (66.4%).

Table 45: Prevalence of Zinc Deficiency[1,2,3]

	n	%	95% CI
Preschool children[4]			
National	662	44.6	34.3-54.9
Rural	228	48.6	35.8-61.4
Urban	236	29.5	17.7-41.3
Slum	198	51.7	40.8-62.7
NPNL women[5]			
National	1 073	57.3	51.1-63.4
Rural	391	57.5	49.9-65.1
Urban	359	54.5	45.5-63.6
Slum	323	66.4	55.1-77.6

[1]Zinc deficiency is defined as S. zinc level of <9.9mmol/l in preschool children and <10.1 mmol/l in NPNL women (IZINCG 2004).
[2]Adjusted for elevated CRP (>10mg/l) or elevated AGP (>1 g/l) by mathematical correction (Thurnham *et al.,* 2010; Reina Engle-Stone *et al*., 2011).
[3]Estimates weighted to represent the population level.
[4]Age 6-59 months.
[5]Age 15-49 years.

3.11.2 Mean Serum Zinc

Table 46: Mean Zinc Concentration in Serum[1,2]

	Preschool children[3]		NPNL women[4]	
	Mean (mmol/l)	95% CI	Mean (mmol/l)	95% CI
National	10.25	9.9-10.6	10.04	9.81-10.27
Rural	10.04	9.63-10.46	10.06	9.77-10.34
Urban	11.02	10.37-11.67	10.05	9.73-10.37
Slum	9.89	9.56-10.23	9.67	9.29-10.05

[1] Adjusted for elevated CRP (>10mg/l) or elevated AGP (>1 g/l) by mathematical correction (Thurnham *et al*., 2010; Engle-Stone et al., 2011).

[2]Estimates weighted to represent the population level.

[3]Age 6-59 month.

[4]Age 15-49 years.

Table 46 shows mean zinc level in serum. The national average levels were 10.25 mmol/l and 10.04 mmol/l in the preschool children and NPNL women, respectively. The mean serum zinc was higher in the urban cluster than in the slums in both the population groups studied.

3.12 Consumption of Zinc from Food

Table 47 shows consumption of zinc from food in preschool children over a seven-day period. The mean animal source zinc consumption in the rural, urban and slums was 8.1 mg, 9.4 mg, and 7.5 mg, respectively. Total zinc consumption decreased as households became gradually more food-insecure. The same trend was observed in regard to consumption of animal source zinc, with a consumption of 10.2 mg and 3.6 mg in the food-secure and severely food-insecure households, respectively.

Table 47: Consumption of Zinc from Food over a Seven-day Period: Preschool Children

Clusters	n	mean (mg)	95% CI
Total zinc consumption			
National	845	22.3	19.8-24.8
Rural	284	22.4	19.1-25.7
Urban	296	22.7	19.7-25.6
Slum	265	18.7	16.5-20.8
Zinc consumption from animal sources			
National	845	8.3	7.2-9.5
Rural	284	8.1	6.6-9.6
Urban	296	9.4	7.9-10.8
Slum	265	7.5	6.1-8.8
Zinc consumption from non-animal sources			
National	845	13.9	12.2-15.7
Rural	284	14.3	12.1-16.5
Urban	296	13.3	11.4-15.1
Slum	265	11.2	9.8-12.5
By household food insecurity status			
Total zinc consumption			

Food-secure	382	25.4	22.4-28.3
Mildly insecure	125	20.6	16.8-24.3
Moderately insecure	210	20.4	13.8-27.1
Severely insecure	128	13.7	10.2-17.2
Zinc consumption from animal sources			
Food-secure	382	10.2	9.0-11.4
Mildly insecure	125	7.8	5.4-10.3
Moderately insecure	210	6.6	4.3-8.9
Severely insecure	128	3.6	2.7-4.5
Zinc consumption from non-animal sources			
Food-secure	382	15.2	12.9-17.4
Mildly insecure	125	12.7	9.3-16.0
Moderately insecure	210	13.8	9.3-18.3
Severely insecure	128	10.1	7.2-13.1

Table 48 shows the consumption of zinc by NPNL women over a seven-day period. Consumption of total zinc was 29 mg, 32.3 mg and 28.4 mg, in the rural, urban and slum clusters, respectively; zinc consumption from animal sources was 8.9 mg, 9.4 mg and 8.1 mg, respectively. In regard to household food insecurity, consumption of total zinc gradually decreased as households became increasingly food-insecure. The similar observation was noted for the consumption of zinc from animal sources.

Table 48: Consumption of Zinc from Food over a Seven-day Period: NPNL Women

Clusters	n	mean (mg)	95% CI
Total consumption of zinc			
National	1412	29.6	27.0-32.3
Rural	486	29.0	25.4-32.6
Urban	482	32.3	29.8-34.8
Slum	444	28.4	25.6-31.3
Zinc consumption from animal sources			
National	1412	9.1	7.8-10.2
Rural	486	8.9	7.3-10.6
Urban	482	9.4	8.4-10.5
Slum	444	8.1	6.6-9.1
Zinc consumption from non-animal sources			
National	1412	20.6	18.8-22.4
Rural	486	20.0	17.6-22.4
Urban	482	22.9	21.0-24.7
Slum	444	20.3	18.2-22.3
By household food insecurity status			
Total consumption of zinc			
Food-secure	674	33.3	30.6-35.9
Mildly insecure	193	28.5	18.7-38.2
Moderately insecure	365	25.8	22.7-28.9
Severely insecure	180	22.5	18.8-26.2

Zinc consumption from animal sources			
Food-secure	674	11.3	9.7-12.8
Mildly insecure	193	8.3	6.3-10.3
Moderately insecure	365	6.4	5.2-7.6
Severely insecure	180	5.1	3.3-6.9
Zinc consumption from non-animal sources			
Food-secure	674	22.1	20.2-23.1
Mildly insecure	193	20.1	12.1-28.2
Moderately insecure	365	19.4	16.8-21.9

3.12.1 Consumption of Zinc from Food Compared to the Recommended Daily Allowance

Table 49A shows the daily consumption of zinc from food and how this compares with the RDA. In general, preschool children (6-59 month) are slightly below the RDA of consumption for zinc. The status of consumption in NPNL women was even worse. In general, for NPNL women in the urban cluster, the median consumption was half the RDA, and in the slums, just one-third of the RDA.

Table 49A: Consumption of Zinc from Food Compared to the Recommended Daily Allowance

	Daily total consumption of zinc from food (mg); median	RDA[1]
Preschool children		
Rural	3.20	
Urban	3.23	3-5[2]
Slum	2.67	
NPNL women		
Rural	3.93	
Urban	4.47	8-9[3]
Slum	3.61	

[1]Institute of Medicine (IOM).

[2]Age 1-3 years: 3 mg; age 4-5 years: 5 mg.

[3]Age 15-18 years: 9 mg; age 19+: 8 mg.

Table 49B: Consumption of Zinc from Food Compared to the Recommended Daily Allowance

RDA for zinc for NPNL women (mg)	Clusters	Total daily mean intake from animal source (mg)	Total daily mean intake (mg)	% of RDA	Prevalence of zinc deficiency (%)
9.0[1]	National	1.92	4.87	54.1	57.3
	Rural	2.02	4.88	54.2	57.5
	Urban	1.67	4.93	54.7	54.5
	Slum	1.33	4.23	47.0	66.4

[1]Institute of Medicine.

Table 49B shows the average daily zinc consumption from food by NPNL women, 4.88 mg, 4.93 mg and 4.23 mg in the rural, urban and slum clusters, respectively, which corresponds to 54.2% and 54.7.0% and 47.0% of the RDA, respectively.

3.12.2 Categories of the Phytate-zinc Molar Ratio

Table 50 shows the molar ratio of phytate to zinc in the food of the studied population groups. Phytate present in the food is an inhibitor of zinc absorption. The phytate to zinc molar ratio, which is an indicator of relative proportion of phytate to zinc in the food, is an indicator of zinc absorption. The higher the ratio, the greater the amount of phytate in relation to zinc and the less the zinc absorption. The International Zinc Nutrition Consultative Group (IZING) devised three categories of phytate-zinc molar ratios to account for dietary quality facilitating zinc absorption. Table 50 shows that, in general, Bangladeshi food for preschool children falls in the moderate category (phytate to zinc molar ratio of 5:15), at around two-thirds. The diet of urban children was more conducive to zinc absorption (phytate to zinc molar ratio of <5); 26.3% of urban children were classified within this category, compared to children in the rural and slum clusters, at 23.6% and 17.2%, respectively. The ratio in the diet of one-fourth of school-age children in the slums was >15.0, indicating a high content of phytate. The diet of one-third of NPNL women in the slums had a ratio >15.0. This could be linked to a very high rate of zinc deficiency in the slums populations.

Table 50: Phytate-zinc Molar Ratio in Preschool Children by Population Group and Cluster

	Phytate-zinc molar ratio[1]					
Preschool children	<5.0		5.0-15.0		>15.0	
	%	95% CI	%	95% CI	%	95% CI
National	23.9	17.8-30.1	63.1	57.9-68.1	13.0	7.7-18.2
Rural	23.6	15.7-31.5	62.1	55.3-68.9	14.1	7.1-21.2
Urban	26.3	18.4-34.2	64.9	59.3-70.6	8.6	3.6-13.7
Slum	17.2	8.6-25.7	69.6	58.2-81.1	13.1	4.3-21.8
School-age children						
National	14.1	7.2-21.0	65.3	59.2-71.4	20.5	13.5-27.5
Rural	15.8	6.8-24.8	62.9	55.1-70.6	21.2	12.1-30.4
Urban	10.1	4.8-15.5	72.7	64.2-81.2	17.1	8.4-25.6
Slum	2.4	0.8-4.1	73.2	66.1-80.3	24.2	16.9-31.6
NPNL women						
National	7.5	3.2-11.9	65.1	57.5-72.6	27.3	18.6-35.9
Rural	8.9	3.3-14.6	62.4	52.3-72.5	28.5	17.1-40.0
Urban	3.2	0.9-5.6	75.2	69.6-80.9	21.4	15.1-27.8
Slum	2.1	0.4-3.7	64.1	57.6-70.6	33.7	27.2-40.2

[1] World Health Organization

3.12.3 Mean Phytate-zinc Molar Ratio

Table 51 shows the mean phytate-zinc molar ratio in the foods consumed by the studied populations. The ratio in the preschool children was 9.0. In the rural, urban and slums clusters, the ratio was 9.13, 8.42, and 9.77, respectively. In NPNL women, the ratio was 12.0 at the national level; 12.0, 11.67 and 13.45 in the rural, urban and slum clusters, respectively. In school-age children, the ratio at the national level was 10.67; 10.6, 10.6 and 12.5 in the rural, urban and slums, respectively.

Table 51: Mean Phytate-zinc Molar Ratio by Population Group and Cluster

	n	mean	95% CI
Preschool children			
National	843	9.01	8.02-10.0
Rural	284	9.13	7.82-10.44
Urban	296	8.42	7.42-9.42
Slum	263	9.77	8.78-10.75
NPNL women			
National	1412	12.0	10.6-13.5
Rural	486	12.0	10.2-13.7
Urban	482	11.67	10.6-12.7
Slum	444	13.45	12.7-14.1
School-age children			
National	1428	10.67	9.3-12.0
Rural	476	10.60	8.8-12.4
Urban	484	10.60	8.95-12.2
Slum	468	12.50	11.5-13.4

3.13 Prevalence of Folate and Vitamin B_{12} Deficiency

The prevalence of folate deficiency was 9.1% at the national level (Table 52); 8.6% and 11.4% in the rural and urban clusters, respectively.

3.13.1 Folate Status in NPNL Women

Table 52: Folate Status of NPNL Women

Prevalence of folate deficiency[1,2]	n	%	95% CI
National	849	9.1	5.3-12.9
Rural	294	8.6	3.6-13.5
Urban	288	11.4	6.6-16.3
Slum	267	7.9	3.3-12.4

[1]S. Folate level <6.8 nmol/l (Lindstorm *et al.*, 2011)
[2]Estimates weighted to represent the population level.

3.13.2 Consumption of Folate from Food

Table 53 shows folate consumption from food over a seven-day period. As households became increasingly more food-insecure, the contribution of animal source folate decreased.

Table 53: Consumption of Folate from Food

Household food insecurity	Folate from plant sources over a 7-day period (μg)	Folate from animal sources over a 7-day period (μg)
Food-secure	1 057.5	109.3
Mildly insecure	946.9	90.5
Moderately insecure	935.5	62.6
Severely insecure	1 153.1	39.6

3.13.3 Vitamin B12 Status in NPNL Women

Table 54: Vitamin B12 Status in NPNL Women

Prevalence[4] of Vitamin B12 Deficiency		n	%	95% CI
National	Deficiency[1]	872	6.1	2.1-10.1
	Marginal deficiency[2]		15.9	12.0-19.9
	Normal status[3]		77.9	70.8-85.0
Rural	Deficiency[1]	303	5.7	0.5-11.0
	Marginal deficiency[2]		15.8	10.8-20.8
	Normal status[3]		78.4	69.3-87.6
Urban	Deficiency[1]	295	7.5	3.0-11.9
	Marginal deficiency[2]		16.0	10.3-21.7
	Normal status[3]		76.5	67.6-85.3
Slum	Deficiency[1]	274	6.5	1.9-11.0
	Marginal deficiency[2]		18.1	11.5-24.6
	Normal status[3]		75.5	67.4-83.5

[1]Serum B12 level <200 pg/ml.
[2]Serum B12 level 200.0-300.0 pg/ml.
[3]Serum B12 level >300.0 pg/ml.
[4]Estimates weighted to represent the population level.

At the national level, 22% of NPNL women (Table 54) suffered from vitamin B12 deficiency. The percentage was similar in all the clusters, albeit slightly higher in the slums, at around 25%.

3.13.4 Consumption of Vitamin B12 from Food: NPNL Women

Table 55 shows the daily consumption of B12 from food. The mean consumption was 1.98 mg, 2.43 mg and 2.10 mg in the rural, urban and slum clusters, respectively. The consumption followed a decreasing trend as the households become increasingly more food-insecure. The mean consumption was 2.58 mg in the food-secure households and 1.07 mg in the severely food-insecure households.

Table 55: Consumption of Vitamin B12 from Food

	n	Mean (mg)	95% CI
Clusters			
National	1412	2.07	1.76-2.39
Rural	486	1.98	1.59-2.37
Urban	482	2.43	1.79-3.06
Slum	444	2.10	1.6-2.6
By household food insecurity status			
Food-secure	674	2.58	2.11-3.06
Mildly insecure	193	1.69	1.12-2.27
Moderately insecure	365	1.69	1.30-2.08
Severely insecure	180	1.07	0.83-1.30

3.14 Salt Iodization

3.14.1 Consumption of Iodized Salt

Table 56A shows the profile of salt consumed at the household level. The national estimate of usage of iodized salt (≥5 ppm) at the household level was 80.3%. The percentages were 76.7%, 91.7% and 91.1% in the rural, urban and the slum clusters, respectively. At the national level, 57.6% of the households used adequately iodized salt (≥15 ppm). Three out of four households in the urban cluster and slums used adequately iodized salt, while the percentage was just over 50% in the rural cluster.

Table 56A: Status Of Household Salt[1]

	n	%	95% CI
Presence of iodine(≥5 ppm)			
National	1692	80.3	75.1-85.5
Rural	564	76.7	69.8-83.5
Urban	574	91.7	88.1-95.4
Slum	554	91.1	84.6-97.5
Presence of adequate iodine (≥15 ppm)			
National	1692	57.6	50.4-64.8
Rural	564	51.8	42.8-60.9
Urban	574	75.4	68.0-82.9
Slum	554	76.9	64.7-89.0
Brand salt[2]			
National	1709	75.8	66.1-85.5
Rural	566	70.8	58.1-83.4
Urban	576	92.3	87.8-96.6
Slum	567	88.2	79.5-96.9
Open salt[3]			
National	1709	24.2	24.4-33.8
Rural	566	29.2	16.5-41.9
Urban	576	7.7	3.3-12.1
Slum	567	11.8	3.0-20.5

[1]Estimates weighted to represent the population level.
[2]Sold in sealed plastic packets, e.g. 0.5 kg to1kg packets.
[3]Kept in bulk containers and sold in small amounts, e.g. in a few hundred grams wrapped in paper.

The estimate of household consumption of “brand” salt was 75.8% at the national level. More urban households consume “brand” salt than rural ones (92.3% against 70.8%). The percentage of “open” salt consumption in the households was 24.2% at the national level. More rural households consumed “open” salt than urban ones (29.2% against 7.7%).

Table 56B: Consumption of Iodized Salt by Socio-economic Status

Consumption of iodized salt[1]				Consumption of adequately iodized salt[2]			
	n	%	95% CI		n	%	95% CI
According to the Asset Index							
Poorest	347	73.1	60.0-86.3	Poorest	347	51.9	40.2-63.6
Poorer	327	82.1	73.2-90.1	Poorer	327	56.3	46.6-66.0
Middle	342	80.4	72.2-88.5	Middle	342	57.8	48.8-66.8
Richer	337	88.2	82.0-94.4	Richer	337	64.8	51.8-77.9
Richest	338	86.0	78.4-93.4	Richest	338	65.1	51.8-78.1
By household food insecurity status							
Food-secure	777	84.2	77.6-90.7	Food-secure	777	63.3	55.0-71.6
Mildly insecure	260	86.2	77.4-94.9	Mildly insecure	260	54.9	37.3-72.6
Moderately insecure	432	75.0	67.2-82.8	Moderately insecure	432	51.4	42.0-60.8
Severely insecure	223	66.9	55.7-78.1	Severely insecure	223	48.9	37.1-60.7

[1]Salt iodization level >=5 ppm.
[2]Salt iodization level>=15 ppm.

Table 56B shows the use of iodized salt across different SES at a national level. The consumption rate of iodized salt increases as the SES rises. A similar trend was observed in regard to usage of adequately iodized salt. The usage of both iodized and adequately salt decreased as households became increasingly more food-insecure.

3.14.2 Reasons for not Consuming Salt Packets

Table 57: Reasons for not Consuming Salt Packets

If not consuming salt packets, why?	n	%	95% CI
Do not like the taste	362	14.9	4.8-24.9
Too expensive		83.9	77.3-90.5
Not available		18.7	3.1-34.3
Do not believe it is iodized		11.5	2.0-21.8
Cannot buy it in a small amount		23.9	16.8-30.9
Do not know		0.5	-0.4-1.4
Others		2.3	0.03-4.7

The most common reason for not taking salt packets was that it was “too expensive”, as mentioned by 83.9% of the household respondents. Another important reason was that one “cannot buy it in a small amount”, which was mentioned by approximately one-fourth of household respondents (23.9%). Among other notable reasons were “not available” (18.7%)”, “do not like the taste” (14.9%) and “do not believe it is iodized” (11.5%)(Table 57).

3.15 Iodine Nutrition

Iodine status can be reported as a mean and/or median UIC (µg/l) (Andersson *et al*., 2012). Prevalence of inadequate iodine intake or iodine deficiency is reported as percentage of the population with a mean UIC <100 µg/l. Historically, in Bangladesh and in other countries, iodine nutrition is reported in this way; hence this was used in the present survey to find a trend related to earlier national surveys (e.g. National IDD and USI Survey of Bangladesh 2004/05). On the other hand, the median UIC was also used to define the iodine status of the entire population, based on the cut-off point of 100 µg/l. If the median is >= 100 µg/l, the population as a whole is deemed iodine-sufficient; nevertheless, a percentage of that population might have a mean UIC below 100 µg/l, hence be deficient in iodine. In the *National Micronutrients Survey*, iodine nutrition is reported using both definitions.

3.15.1 Prevalence of Iodine Deficiency in School-age Children

Table 58 shows the prevalence of iodine deficiency in the school-age children as measured by UIC: 40% of the school-age children had inadequate iodine (UIC<100.0 µg/l); and 5.6%, 13% and 21.4% of them had severe, moderate and mild iodine deficiency, respectively.

Table 58: Prevalence Of Iodine Deficiency in School-age Children[9]

	National (n=1154)		Rural (n=390)		Urban (n=388)		Slum (n=376)	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Iodine deficiency[1]	40.0	29.3-50.6	40.8	26.8-54.8	39.3	25.2-53.3	27.4	14.7-40.2
Severe iodine deficiency[2]	5.6	2.1-9.1	6.7	2.0-11.5	2.1	0.6-3.7	1.2	0.3-2.1
Moderate iodine deficiency[3]	13.0	8.8-17.1	12.9	7.7-18.0	13.1	5.6-20.7	14.3	3.3-25.4
Mild iodine deficiency[4]	21.4	15.6-27.1	21.1	13.7-28.6	23.9	16.2-31.6	11.9	6.7-17.0
Optimum[5]	23.4	18.4-28.4	23.1	16.5-29.6	22.8	17.0-28.6	33.2	23.2-43.1
More than adequate[6]	14.6	6.0-23.1	16.2	5.1-27.4	7.8	3.9-11.7	18.5	11.9-25.2
Excessive[7]	13.9	8.2-19.5	12.6	5.3-19.8	18.3	8.5-28.2	15.5	10.1-21.0
Particularly high[8]	8.0	2.5-13.5	7.2	0.09-14.2	11.6	3.5-19.7	5.1	0.3-10.0

[1].UIC<100.0 µg/l.
[2]UIC<20.0 µg/l.
[3]UIC 20.0-<50.0 µg/l.
[4]UIC 50.0-< 100.0 µg/l.
[5]UIC 100.0-<200.0.
[6]UIC 200.0-<300.0 µg/l.
[7]UIC ≥300.0 µg/l.
[8]UIC ≥500.0 µg/l (WHO, 2001).
[9]Weighted to represent the population level.

Table 59: Iodine Status in School-age Children By Cluster

Urinary iodine concentration (µg/l)	Rural (n=390)	Urban (n=388)	Slum (n=376)	National (n=1 154)
Median	146.2	136.3	173.5	145.7
25th percentile	58.9	66.1	91.6	61.3
75th percentile	270.3	334.1	270.9	283.9
Boys	**(n=188)**	**(n=199)**	**(n=188)**	**(n=566)**
Median	163.3	167.6	173.5	166.7
25th percentile	68.2	90.7	92.8	73.3
75th percentile	270.3	384.0	259.6	283.9
Girls	**(n=202)**	**(n=198)**	**(n=188)**	**(n=588)**
Median	122.9	106.7	172.3	122.7
25th percentile	51.5	57.5	91.6	51.5
75th percentile	273.2	324.7	280.1	273.2

Table 60: Iodine Status in School-age Children according to the Asset Index

Urinary iodine concentration(µg/l)	Poorest (n=234)	Poorer (n=232)	Middle (n=226)	Richer (n=227)	Richest (n=235)
Median	93.6	146.8	147.4	152.5	151.3
25th percentile	44.2	54.6	66.4	59.5	127.1
75th percentile	204.1	285.2	287.8	299.9	312.9

Table 59 shows that the median UIC in school-age children was 145.7 µg/l at the national level. The estimate was above 100.0 µg/l in all the clusters – rural, urban and slums. The median UIC was higher than 100.0 µg/l in boys and girls. It was 93.3 µg/l in the "poorest "quintile of the population (Table 60).

3.15.2 Prevalence of Iodine Deficiency in NPNL Women

Table 61 shows iodine status in NPNL women. The national prevalence of iodine deficiency (UIC<100.0 µg/l) was 42%. The prevalence of severe and moderate iodine deficiencies was 7.1% and 17.5%, respectively. The prevalence of optimum iodine level was 24.9%.

Table 61: Prevalence of Iodine Deficiency in NPNL Women[9]

	National (n=1273)		Rural (n=452)		Urban (n=433)		Slum (n=388)	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Iodine deficiency[1]	42.1	31.7-52.5	44.7	31.3-58.1	33.3	19.3-47.2	33.5	23.5-43.4
Severe iodine deficiency[2]	7.1	3.7-10.5	8.3	3.8-12.8	3.3	1.0-5.6	1.6	0.08-3.2
Moderate iodine deficiency[3]	17.5	12.1-22.9	19.0	12.0-26.1	12.4	5.4-19.4	12.2	5.7-18.6
Mild iodine deficiency[4]	17.4	12.4-22.1	17.3	11.4-23.3	17.5	10.4-24.6	19.6	14.2-24.9
Optimum[5]	24.9	18.9-30.8	24.3	16.7-31.8	27.1	19.3-34.8	26.2	18.8-33.5
More than adequate[6]	11.9	8.9-14.9	11.3	7.3-15.1),	13.5	9.6-17.5	17.5	12.2-22.5
Excessive[7]	11.6	6.5-16.7	9.7	3.9-15.4	19.0	5.3-32.7	13.6	9.2-18.1
Particularly high[8]	9.3	3.9-14.7	9.9	2.9-16.9	7.0	3.5-10.5	9.1	2.4-15.7

[1]UIC< 100.0 µg/l.
[2]UIC< 20.0 µg/l.
[3]UIC 20.0-<50.0 µg/l.
[4]UIC 50.0-<100.0 µg/l.
[5]UIC 100.0-<200.0.
[6]UIC 200.0-<300.0 µg/l.
[7]UIC ≥300.0 µg/l.
[8]UIC ≥500.0 µg/l (WHO 2001).
[9]Weighted to represent the population level.

Table 62: Iodine Status in NPNL Women by Cluster

Urinary iodine concentration(µg/l)	Rural (n=452)	Urban (n=433)	Slum (n=388)	National (n=1 276)
Median	112.8	151.1	154.9	122.6
25th percentile	41.6	76.9	75.1	50.4
75th percentile	225.1	306.6	280.5	257.7
Iodine deficiency (%)	44.7	33.2	33.4	42.1

Table 63: Iodine Status in NPNL Women according to the Asset Index

Urinary iodine concentration(µg/l)	Poorest (n=262)	Poorer (n=259)	Middle (n=254)	Richer (n=248)	Richest (n=253)
Median	99.3	92.7	145.1	137.8	201.0
25th percentile	33.1	39.7	68.3	57.2	100.1
75th percentile	197.7	250.5	383.8	211.7	354.6

Table 62 shows that the median UIC in NPNL women was 122.6 µg/l at the national level. The estimate was above 100.0 µg/l across all the clusters – rural, urban and slums. The median UICs were below 100.0 µg/l in the "poorest" and "poorer" quintiles of the population (Table 63).

3.16 Iodine Status in Retailers' Salt

3.16.1 Iodine Content in Retailers' Salt

Table 64 shows the status of iodine in retailer's salt: 91.9% of the samples had iodine levels ≥5 ppm. The percentage was lower in the rural than in the urban cluster (85% against 96%).

The percentage of retailer salt samples with adequately iodized salt (≥ 20 ppm)[2] was 66.4%. Fewer shops in the rural cluster than in the urban cluster sold adequately iodized salt (57.3% against 68.5%).

Table 64: Iodine Status of Retailer's Salt[1]

	n	%	95% CI
Presence of iodine (≥ 5 ppm)			
National	1 566	91.9	90.5-93.2
Rural	514	85.0	81.9-88.1
Urban	544	94.8	93.0-96.7
Slum	508	95.6	93.8-97.6
Presence of adequate iodine (≥ 20 ppm)[2]			
National	1 566	66.4	64.1-68.7
Rural	514	57.3	53.1-61.6
Urban	544	68.5	64.6-72.5
Slum	508	73.2	69.3-77.1

[1]Based on samples collected from the retailer shops.
[2]National IDD/USI Survey, Bangladesh, 2004-05.

With regard to iodine content of retailer salt, 8.1% of the salt samples contained negligible iodine (<5 ppm)(Table 65). In addition, 33.5% of retailer salt samples had inadequately iodized salt (< 20 ppm). There were very few salt samples (~0.0%) with excess iodine (>100 ppm).

Table 65: Iodine Content: Retailer Salt By Cluster[1]

	National (n=1566)		Rural (n=514)		Urban (n=544)		Slum (n=508)	
ppm[2]	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Nil	8.1	6.7-9.4	14.9	11.8-18.1	5.1	3.2-7.0	4.3	2.5-6.1
5.0-<20.0	25.4	23.3-27.6	27.6	23.7-31.5	26.2	22.5-29.9	22.4	18.8-26.1
20-<40.0	42.9	40.4-45.3	35.7	31.6-39.9	42.4	38.3-46.6	50.6	46.2-54.9
40.0-<60.0	20.8	18.8-22.8	18.4	15.1-21.8	22.4	18.9-25.9	21.4	17.8-25.1
60.0-<80.0	2.1	0.9-3.3	2.1	0.88-3.3	2.7	1.3-4.1	1.1	0.23-2.1
80.0-<100.0	0.44	0.11-0.77	0.97	0.12-1.8	0.36	-0.14-0.87	0.0	0.0
100.0-<200.0	0.19	-0.002-0.4	0.0	0.0	0.55	-0.7-1.1	0.0	0.0
200.0-<300.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
>300.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

[1]Iodine level, based on collected samples from retailer shops.
[2]Parts per million.

3.16.2 Relationship of the Respondent to the Owner of the Retail Shops

Table 66: Relationship of the Respondent to Owner of the Retail Shops

	Combined (n=1 567)	Rural (n=515)	Urban (n=544)	Slum (n=508)
	%	%	%	%
None (Owner)	89.9	94.8	92.5	82.1
Employee	4.7	2.1	5.3	6.5
Brother-in-law	0.1	0.4		
Nephew	1.0	0.8	0.4	2.0
Sister	0.1	0.4		
Wife	1.8	1.2	1.1	3.1
Daughter	0.4	0.4	0.4	0.4
Brother	2.0	-	0.4	5.9

Table 66 shows the relationship of the respondent with the owner of the retail shop. In most of the cases, the respondent was the owner of the shop (89.9%). In around 5% of the cases, the respondents were employees of the shop owner. This percentage was slightly higher in the urban (5.3%) and slum clusters (6.5%) than in the rural cluster (2.1%). Family members constituted a minor percentage of the respondents.

3.16.3 Education of Retail Shopkeepers

Table 67 shows the education level of the respondents. Around one in ten of the respondents (9.1%) did not have any form of institutional education. Around one in four of the respondents (24.6%) had completed secondary or higher education in all the clusters.

Table 67: Education of Retail shopkeepers

	Combined (n=1567)		Rural (n=515)		Urban (n=544)		Slum (n=508)	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
No education	9.1	7.7-10.5	8.1	5.7-10.5	9.3	6.9-11.8	9.8	7.2-12.4
Primary incomplete	17.6	15.7-19.5	16.3	13.1-19.5	15.2	12.2-18.2	21.4	17.8-25.0
Primary complete	19.5	17.5-21.5	18.8	15.4-22.2	22.2	18.7-25.7	17.3	14.0-20.6
Secondary incomplete	29.2	26.9-31.4	33.6	29.5-37.6	29.2	25.3-33.1	24.6	20.8-28.3
Secondary complete and higher	24.6	22.4-26.7	23.1	19.4-26.7	23.9	20.3-27.4	26.8	22.9-30.6

3.17 Purchase, Sale and Storage of Salt

3.17.1 purchase and Sale of Salt, by Type (Retailers)

Table 68 shows the purchase and sale of crude and open salts by retail shopkeepers. Nearly one in five respondents (18.3%) stated that they sold open salt. The percentage was higher in the rural cluster (38.3%) than in the urban (14.3%) and slum clusters (2.3%). Just 1.0% of the respondents stated that they sold crude salt. In regard to the source where open salt is bought, two-thirds of respondents (66.9%) stated that they bought it from wholesalers, while one fourth (27.1%) bought it from markets.

Table 68: Purchase and Sale of Crude and Open Salt (Retailers)

	Combined		Rural		Urban		Slum	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
	(n=1567)		(n=515)		(n=544)		(n=508)	
Selling of crude salt	1.0	0.5-1.4	2.1	0.9-3.3	0.4	0.0-0.8	0.4	0.0-0.9
Selling of open salt	18.3	16.4-20.2	38.3	34.0-42.4	14.3	11.4-17.3	2.3	1.0-3.6
Buying crude salt from?	(n=15)		(n=11)		(n=2)		(n=2)	
Wholesaler	20.0	0.0-42.9	9.1	0.0-29.9	100	-	-	-
Market	53.3	24.7-81.9	72.7	41.3-100.0	-	-	-	-
Other	26.7	1.3-52.0	18.2	-8.0-45.0	-	-	100	-
Whom do you buy open salt from?	(n=287)		(n=197)		(n=78)		(n=12)	
Factory	0.7	0.0-1.6			2.6	0.0-6.1		
Retailer	1.4	0.03-2.7	2.0	0.04-4.0				
Wholesaler	66.9	61.4-72.3	66.0	59.3-72.6	74.3	64.4-84.2	33.3	2.0-64.6
Market	27.1	22.0-32.3	29.4	23.0-35.8	20.5	11.3-29.6	33.3	2.0-64.6
Other	3.8	1.6-6.1	2.5	0.3-4.7	2.6	0.0-6.1	33.3	2.0-64.6

3.17.2 Source of Salt Packet Purchases (Retailers)

Table 69 shows the purchase and sale of salt packets by retailers. Almost all the respondents (99.2%) said that they sold salt packets. In regard to where the salt packets was bought, 67.6% stated that they had bought salt packets from the wholesalers, while one in five (21%) of the retail shopkeepers bought it from the market.

TABLE 69: PURCHASE AND SALE OF SALT PACKETS (RETAILERS)

	Combined		Rural		Urban		Slum	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
	(n=1 567)		(n=515)		(n=544)		(n=508)	
Selling salt packets	99.2	98.8-99.6	98.3	97.1-99.3	99.4	98.8-100	100	-
If so, where do you purchase salt packets?	(n=1555)		(n=506)		(n=541)		(n=508)	
Factory	2.2	1.4-2.9	1.4	0.4-2.4	1.3	0.3-2.2	3.9	2.2-5.6
Retailer	1.5	0.9-2.1	1.7	0.6-2.9	1.8	0.7-2.9	1.0	0.1-1.8
Wholesaler	67.6	65.2-69.9	69.0	64.9-73.0	70.1	66.1-73.9	63.5	59.3-67.7
Market	22.6	20.5-24.7	24.9	21.1-28.6	22.4	18.8-25.8	20.6	17.1-24.2
Other	6.0	4.8-7.2	3.0	1.5-4.4	4.4	2.7-6.1	10.8	8.1-13.5

3.17.3 STORAGE OF OPEN SALT BY THE RETAILERS' SHOPKEEPERS

Table 70 shows how open salt is stored by retailers: 90% of the respondents stated that they sealed the salt from large sacks in small packets. Nearly half of all respondents (45.9%) stated that they stored the open salt in a ventilated place; this percentage was lower in the urban cluster (30.7%); 42% stated that they stored the open salt in a cool, dry, and dark place; and 7.3% stored the open salt in open sunlight.

TABLE 70: STORAGE OF OPEN SALT (RETAILERS)

	Combined		Rural		Urban		Slum	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
	(n=287)		(n=197)		(n=78)		(n=12)	
Sealed the salt from large sacks in small packets	90.6	87.2-94.0	93.4	89.9-96.9	94.8	89.8-99.8	16.7	0.0-41.4
Mode of storing open salt	(n=285)		(n=195)		(n=78)		(n=12)	
Open sunlight	7.3	4.3-10.4	8.2	4.3-12.1	5.1	0.1-10.1	8.3	0.0-26.6
Damp place	1.4	0.03-2.7	-	-	5.1	0.1-10.1	-	-
Ventilated place	45.9	40.1-51.7	52.3	45.2-59.3	30.7	20.2-41.2	41.6	8.9-74.3
Cool, dry, dark place	42.4	36.6-48.2	38.4	31.5-45.3	53.8	42.5-65.1	33.3	20.5-64.6
Other	2.8	0.9-4.7	1.0	0.0-2.4	5.1	0.1-10.1	16.7	0.0-41.3

3.17.4 PRACTICE OF RETAILERS PACKAGING THEIR OPEN SALT

Table 71 shows the practice of retailers packaging their open salt: less than 1% of the respondents reported that they packaged salt in small packets of 0.5 kg to 1 kg for sale; 71.4% folded the opening of the 0.5 kg to 1 kg packets and 57.1% sealed the 0.5 kg to1 kg packets. Moreover, 42.9% stored the 0.5 to 1 kg packets in cool, dry and dark places, while 28.6% of them stored them in ventilated places.

Table 71: Retailers' Practices of Packaging and Storing Open Salt

	Combined		Rural		Urban		Slum	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
	(n=1 555)		(n=506)		(n=541)		(n=508)	
Packaging salt in small packets of 0.5 kg to 1 kg packets and selling them?	0.9	0.4-1.3	1.6	0.5-2.6	0.4	0.0-0.9	0.8	0.01-1.5
	(n=14)		(n=8)		(n=2)		(n=4)	
Opening of the 0.5 kg to 1 kg packets kept folded	71.4	44.3-98.4	100.0	-	100.0	-	50.0	-
Seal the small packets made from 0.5 kg to 1kg packets	57.1	27.4-86.1	100.0	-	100.0	-	100.0	-
Mode of storing the 0.5 kg to 1kg packets used to make small packets	(n=14)		(n=8)		(n=2)		(n=4)	
Ventilated places	28.6	1.5-55.6	25.0	0.0-63.7	-	-	50.0	-
Cool, dry, dark places	42.9	13.2-72.5	75.0	36.2-100.0			-	-
Other	28.6	1.5-55.6	-	-	100.0	-	50.0	-

3.18 Retailers' Knowledge about Iodized Salt

3.18.1 Retailers' Knowledge about Iodized Salt – Source of Information

Table 72 shows the knowledge of retailers with regard to iodized salt. Among the respondents, 81.1% had heard about iodized salt. With regard to the source of knowledge, four of the five respondents (79.4%) had heard about it on television; 70.7%, 81.7% and 85.6% in the rural, urban and slum clusters, respectively. One in four of the respondents (26.3%) heard about it on the radio. About one in five of the respondents (18.6%) knew about it from newspapers, 14.7% in the rural and 21.1% in the urban clusters. One in five of the respondents (21.3%) heard about it from health care workers; a higher percentage in the urban cluster (25.3%) than in the slums (16.1%). A considerable percentage (31.1%) of the respondents knew about iodized salt from friends and relatives; the percentage was higher in the rural (38.6%) than in the urban cluster (26.9%). Interestingly, only 9% of the respondents knew about it from the label of the packet. Other very minor sources of information were seminars, the Internet, NGOs and government officials, etc.

Table 72: Knowledge about Iodized Salt and its Source (Retailers)

	Combined		Rural		Urban		Slums	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
	(n=1 567)		(n=515)		(n=544)		(n=508)	
Heard about iodized salt	81.1	79.2-83.1	80.4	76.9-83.8	83.5	80.3-86.5	79.5	76.0-83.1
Where did you learn about iodized salt?	(n=1 272)		(n=414)		(n=454)		(n=404)	
Television	79.4	77.1-81.6	70.7	66.3-75.1	81.7	78.1-85.2	85.6	82.2-89.1
Radio	26.3	23.9-28.7	23.7	19.5-27.7	30.4	26.1-34.6	24.5	20.3-28.5
Newspaper	18.6	16.5-20.7	14.7	11.3-18.1	21.1	17.3-24.9	19.8	15.9-23.7
Poster/leaflet	8.6	7.1-10.2	5.3	3.1-7.4	6.4	4.1-8.6	14.6	11.1-18.1

Health care worker	21.3	19.1-23.5	22.0	17.9-25.9	25.3	21.3-29.3	16.1	12.5-19.6
Friend/relative	31.1	28.5-33.5	38.6	33.9-43.3	26.9	22.7-30.9	27.9	23.5-32.3
School child	8.4	6.8-9.9	7.5	4.9-10.0	7.9	5.4-10.4	9.9	6.9-12.8
School teacher	7.5	6.1-9.0	10.1	7.2-13.1	5.7	3.5-7.8	6.9	4.4-9.4
From label of packets	9.0		11.5		6.8		8.9	
Other[1]	1.7		2.2		1.8		1.0	

[1] Seminar, Internet, retailer, NGO, government official.

3.18.2 Retailers' Knowledge about Iodized Salt-type of Salt and Iodine Content

Table 73 shows the knowledge of retailers about salt iodization. Less than 1% of the respondents stated that crude salt contained iodine. Around 16% did not know if crude salt contained iodine. Among the respondents, 3% stated that open salt contained iodine. Over one half of the respondents (52.9%) stated that all salt packets contained iodine, while another 43.7% stated that some of the salt packets contained iodine.

Table 73: Knowledge about Iodized Salt (Retailers)

	Combined		Rural		Urban		Slum	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Does crude salt contain iodine?	**(n=1272)**		**(n=414)**		**(n=454)**		**(n=404)**	
Yes, all	0.9	0.4-1.4	1.0	0.02-1.9	1.3	0.3-2.3	0.5	0.0-1.1
Yes, some	2.8	1.9-3.7	3.4	1.6-5.1	2.6	1.1-4.1	2.4	0.9-3.9
No	80.4	78.2-82.6	79.2	75.3-83.1	78.6	74.8-82.4	83.6	80.0-87.2
Do not know	15.8	13.8-17.8	16.4	12.8-20.0	17.4	13.9-20.9	13.4	10.0-16.7
Does open salt contain iodine?	**(n=1272)**		**(n=414)**		**(n=454)**		**(n=404)**	
Yes, all	2.9	2.0-3.8	3.6	1.8-5.4	3.9	2.1-5.7	1.0	0.02-1.9
Yes, some	8.6	7.1-10.2	9.1	6.3-11.9	10.6	7.7-13.4	5.9	3.6-8.2
No	75.8	73.5-78.2	71.7	67.4-76.1	74.2	70.2-78.2	81.9	78.1-85.7
Do not know	12.6	10.7-14.4	15.4	11.9-18.9	11.2	8.3-14.1	11.1	8.1-14.2
Do packet salts contain iodine?	**(n=1272)**		**(n=414)**		**(n=454)**		**(n=404)**	
Yes, all	52.9	50.1-55.6	50.2	45.4-55.1	61.9	57.4-66.3	45.5	40.6-50.4
Yes, some	43.7	40.9-46.4	45.9	41.1-50.7	36.3	31.9-40.7	49.8	44.8-54.6
No	1.5	0.9-2.2	3.1	1.4-4.8	-	-	1.7	0.4-3.0
Do not know	1.8	1.0-2.5	0.7	0.0-1.5	1.7	0.5-2.9	2.9	1.3-4.6

3.18.3 Retailers' Knowledge about Benefits of Iodized Salt

Table 74 shows the retail shopkeepers' knowledge of the benefits of iodized salt. Seven of the ten respondents (71.3%) stated that they knew the benefits of iodized salt. Among them, 72.3% reported that iodized salt "prevented goiter". Around one quarter of them (27.2%) knew that the iodized salt "prevented cretinism". Approximately one in five respondents stated that iodized salt "promoted mental development/intelligence" (21.1%) and "promoted growth" (20.1%). Less than 10% of the respondents stated that iodized salt "prevented abortion and stillbirth". Nearly 70% of the respondents stated that iodized salt was "healthy".

Table 74: Knowledge of the Benefits of Iodized Salt (Retailers)

	Combined		Rural		Urban		Slum	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
	(n=1 272)		(n=414)		(n=454)		(n=404)	
Knowledge of the benefits of iodized salt?	71.3	68.8-73.7	72.0	67.6-76.3	70.9	66.7-75.1	71.0	66.6-75.4
	(n=907)		(n=298)		(n=322)		(n=287)	
Prevents goiter	72.3	69.4-75.2	64.8	59.3-70.2	75.8	71.1-80.4	76.3	71.3-81.2
Prevents cretinism	27.2	24.3-30.1	20.5	15.9-25.0	29.8	24.7-34.8	31.4	25.9-36.8
Promotes mental development/intelligence	21.1	18.4-23.7	20.5	15.9-25.1	18.3	14.1-22.5	24.7	19.7-29.7
Promote growth	20.1	17.4-22.6	16.1	11.9-20.3	24.5	19.8-29.2	19.2	14.6-23.7
Prevents abortion and stillbirth	9.0	7.2-10.9	8.4	5.2-11.5	9.0	5.9-12.1	9.8	6.3-13.2
Healthy	68.8	65.7-71.8	71.1	65.9-76.3	67.4	62.2-72.5	67.9	62.5-73.3
Others	5.3	3.8-6.7	5.4	2.8-7.9	3.7	1.6-5.8	7.0	4.0-9.9

3.18.4 Retailer's Knowledge about Testing of Salt for Iodine

Table 75 shows the knowledge of the respondents on the testing of salt for iodine and their practice of testing the salt. Around one-third of the respondents (31.5%) stated that they knew how to test salt for iodine; the percentage is similar across all the clusters. Over 80% of the respondents stated that the "home-made" technique was the method for testing salt for iodine, while just over 10% mentioned the "test kit" method for testing the salt. Knowledge about the "test kit" method was less common among the slums respondents (4.1%) than among the urban respondents (17.1%). In regard to testing the salt that they sell, one half of the respondents (51.1%) used the home-made or test kit methods; the percentage was higher in the urban (60.5%) than in the slum cluster (45.5%). Of those who tested the salt that they sold for iodine, 87% used the home-made method. Among those who mentioned that they knew how to test salt for iodine, 81.8% knew that "salt" was an ingredient to test the salt for iodine. About 90% of them correctly stated that a "pinch" of salt was required. Around 16.7% of the respondents stated that they knew that "cooked rice" was an ingredient to test salt for iodine. Among them, over 80% correctly said that a "small amount" of cooked rice was required. Over 85.0% of the respondents stated that they knew that "lemon juice" was an ingredient to test salt for iodine. Among them, 95% correctly said that a "few drops" of lemon juice were required.

Table 75: Testing of Salt for Iodine (Retailers)

	Combined		Rural		Urban		Slum	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
	(n=1272)		(n=414)		(n=454)		(n=404)	
Knowledge about testing salt for iodine	31.5	28.9-34.1	30.9	26.4-35.3	33.5	29.1-37.8	30.0	25.4-34.4
How do you test salt for iodine?	(n=401)		(n=128)		(n=152)		(n=121)	
Test kit	11.7	8.5-14.8	12.5	6.7-18.3	17.1	11.1-23.1	4.1	0.5-7.7
Home-made	83.5	79.9-87.1	82.0	75.2-88.7	79.6	73.1-86.1	90.1	84.7-95.4
Both	4.7	2.6-6.8	5.5	1.5-9.4	3.3	0.4-6.1	5.8	1.5-10.0

Testing salt for iodine using either method	51.1	46.2-56.0	45.3	36.5-54.1	60.5	52.6-68.3	45.5	36.4-54.4
How do you test your salt for iodine?	**(n=205)**		**(n=58)**		**(n=92)**		**(n=55)**	
Test kit	13.7	8.9-18.4	15.5	5.9-25.1	20.7	12.2-29.1	0.0	-
Home-made	86.3	81.6-91.1	84.5	74.8-94.1	79.3	70.9-87.7	100.	-
	(n=401)		**(n=128)**		**(n=152)**		**(n=121)**	
Knowledge of which ingredients are required for testing salt for iodine	81.8	78.0-85.5	79.7	72.6-86.7	83.6	77.5-89.5	81.8	74.8-88.7
How much salt should be used for testing?	**(n=326)**		**(n=102)**		**(n=127)**		**(n=97)**	
A pinch	88.0	84.4-91.5	90.2	84.3-96.1	86.6	80.6-92.6	87.6	80.9-94.2
A level teaspoon	9.5	6.3-12.7	7.8	2.5-13.1	8.7	3.7-13.6	12.4	5.7-19.0
Other amounts	0.6	-0.2-1.4	2.0	-0.7-4.6	0.0	-	0.0	-
Do not know	1.8	0.3-3.3	0.0	-	4.7	1.0-8.4	0.0	-
	(n=401)		(n=128)		(n=152)		(n=121)	
Knowledge of which ingredients are required for testing salt for iodine (cooked rice)?	16.7	13.1-20.3	18.8	11.9-25.6	19.7	13.3-26.1	10.7	5.1-16.3
How much cooked rice should be used for testing?	**(n=59)**		**(n=21)**		**(n=28)**		**(n=10)**	
A small amount	81.4	71.1-91.5	66.7	44.6-88.6	85.7	71.9-99.5	100.	-
5 grains	18.6	8.4-28.8	33.3	11.3-55.3	14.3	0.5-28.1	0.0	-
	(n=401)		**(n=128)**		**(n=152)**		**(n=121)**	
Knowledge of which ingredients are used for test salt for iodine (lemon juice)?	87.3	84.0-90.5	85.2	78.9-91.3	86.2	80.6-91.7	90.9	85.7-96.1
How much lemon juice should be used for testing?	**(n=342)**		**(n=107)**		**(n=127)**		**(n=108)**	
A few drops	95.3	93.1-97.5	94.4	89.9-98.8	93.7	89.4-97.9	98.1	95.5-100.
Other amounts	2.6	0.9-4.3	4.7	0.6-8.7	3.1	0.07-6.2	0.0	-
Do not know	2.0	0.5-3.5	0.9	-0.9-2.7	3.1	0.07-6.2	1.9	-0.7-4.4

3.18.5 Retail Shopkeeper's Knowledge about the Salt Law

Table 76 indicates the knowledge of the retail shopkeepers concerning the salt law. One fourth of the respondents (27.5%) stated that they knew about the salt law. The percentage was higher in the urban (32.0%) and rural (29.5%) clusters than in the slums (20.9%). With regard to punitive measures in case of violation of the law, one in five of the respondents (20.4%) stated that they "[did] not know" about any punitive measure in place; this percentage was higher in the slums (30.2%) and urban clusters (23.1%) than in the rural (10.5%) area.

Table 76: Knowledge about the Salt Law (retailers)

	Combined		Rural		Urban		Slum	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
	n=1567)		(n=515)		(n=544)		(n=508)	
Do you know that there is a salt law?	27.5	25.3-29.7	29.5	25.6-33.4	31.8	27.9-35.7	20.9	17.3-24.4
Is there any punishment for violating the salt law?	(n=431)		(n=152)		(n=173)		(n=106)	
Yes	71.2	66.9-75.5	83.6	77.6-89.5	68.8	61.8-75.7	57.5	48.0-67.1
No	8.4	5.7-10.9	5.9	2.1-9.7	8.1	4.0-12.1	12.3	5.9-18.6
Do not know	20.4	16.6-24.2	10.5	5.6-15.4	23.1	16.8-29.4	30.2	21.3-39.1
If so, what is the punishment?	(n=307)		(n=127)		(n=119)		(n=61)	
Imprisonment	9.4	6.1-12.7	4.7	1.0-8.4	9.2	3.9-14.5	19.7	9.4-29.9
Fine	34.5	29.2-39.8	37.0	28.5-45.5	27.7	19.5-35.8	42.6	29.8-55.3
Both	56.0	50.4-61.6	58.3	49.6-66.9	63.0	54.2-71.8	37.7	25.1-50.2

3.18.6 Retailers' Knowledge on Reading the Results of Testing Salt for Iodine

Table 77 shows the retail shopkeeper's knowledge on the results of testing salt for iodine. More than 86% of the respondents correctly mentioned that the colour of salt turns violet/bluish if it contains iodine.

Table 77: Retailer's Knowledge about the Results of Testing Salt for Iodine

	Combined		Rural		Urban		Slums	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
What colour does the salt turn if it contains iodine?	(n=401)		(n=128)		(n=152)		(n=121)	
White	4.7	2.6-6.8	2.3	-0.3-5.0	7.9	3.5-12.2	3.3	0.07-6.5
Violet/bluish	86.8	83.4-90.1	89.8	84.5-95.1	83.5	77.6-89.5	87.6	81.6-93.5
Other	3.2	1.5-4.9	4.7	1.0-8.3	2.6	0.06-5.2	2.5	-0.3-5.2
Do not know	5.2	3.1-7.4	3.1	0.07-6.1	5.9	2.1-9.7	6.6	2.1-11.8

3.18.7 Retailer's Practice Regarding Testing Salt for Iodine

Table 78 shows the retail shopkeeper's practice in regard to testing salt for iodine. Every four of the ten respondents stated that they never carried out testing, with a majority of the respondents (59%) reporting that they "sometimes" tested the salt for iodine.

Table 78: Retailers' Practice Regarding Testing Salt for Iodine

	Combined		Rural		Urban		Slum	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
How often do you test the salt that you sell for iodine?	(n=401)		(n=128)		(n=152)		(n=121)	
Never	40.6	35.8-45.4	41.4	32.7-50.0	36.8	29.1-44.5	44.6	35.6-53.6
Sometimes	58.8	54.0-63.7	57.0	48.3-65.7	63.1	55.4-70.9	55.3	46.4-64.3
Always	0.5	-0.2-1.2	1.5	-0.6-3.7	-	-	-	-

3.18.7.1 Iodine Level in Household Salt and Iodine Status in NPNL Women

Table 79: Iodine Level in Household Salt and Iodine Status in NPNL Women

Iodine level in household salt (ppm)	Median urinary iodine (µg/l) in NPNL women
<15.0	69.7
15.0-29.0	130.8
>=30.0	175.2

Table 79 shows the relationship between iodine levels in household salt and corresponding iodine status in NPNL women. In Bangladesh, iodine adequacy of household salt is defined by the presence of iodine in salt at concentration≥15 ppm. The table shows that at an inadequate iodine concentration in salt (<15 ppm), NPNL women were iodine deficient (median UICs below 100 µg/l, the cut-off defining iodine deficiency). However, with adequate iodine in the household salt (≥15 ppm), the iodine status was sufficient.

3.18.7.2 Relationship Between Iodine Levels in Household Salt and Iodine Status of School-age Children

Table 80: Relationship Between Iodine Levels in Household Salt and Iodine Status of School-age Children

Salt iodization level of household salt (ppm)	Median urinary iodine (µg/l) in school-age children
<15.0	91.5
15.0-29.0	157.6
>=30.0	187.9

Table 80 shows the relationship between iodine levels in household salt and iodine status in school-age children. In Bangladesh, iodine adequacy of household salt is defined by the presence of iodine in salt at a concentration ≥15 ppm. The table shows that at an inadequate iodine concentration in the salt (<15 ppm), the children were iodine deficient (median UICs below 100 µg/l, the cut-off defining iodine deficiency); however, with adequate iodine in the household salt (≥15 ppm), the iodine status was sufficient.

3.18.8 Source of Household Respondents' Knowledge about Iodized Salt and about Which Type of Salt Contains Iodine

Table 81: Source of Household Respondents' Knowledge about Iodized Salt and about Which Type of Salt Contains Iodine

	Rural		Urban		Slum		National	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Knowledge about iodized salt	(n=661)		(n=693)		(n=649)		(n=2003)	
	68.8	60.9-76.8	78.7	72.7-84.8	77.3	70.3-84.3	71.2	65.2-77.2
Source of knowledge about iodine	(n=443)		(n=536)		(n=473)		(n=1452)	
TV	62.4	56.1-68.7	84.2	77.6-90.7	81.0	74.8-87.1	68.1	63.5-72.8
Radio	15.5	8.8-22.2	12.8	6.7-18.9	3.3	1.5-5.2	14.4	9.4-19.3

Newspaper	4.2	0.0-8.3	9.4	4.9-14.0	1.4	0.4-2.5	5.3	2.1-8.4
Poster/leaflet	4.0	0.5-7.5	5.5	2.3-8.6	0.3	-0.1-0.7	4.2	1.5-6.8
Health care worker	24.8	17.5-32.1	21.9	15.2-28.5	23.7	17.6-29.8	24.1	18.6-29.6
Friend/relative	28.7	18.5-39.0	22.9	14.8-30.9	22.0	14.8-29.2	27.1	19.6-34.7
School child	4.9	1.7-8.1	3.7	1.5-5.9	2.1	0.6-3.7	4.5	2.2-6.9
Teacher	7.8	3.5-12.0	11.3	6.7-15.8	5.9	2.7-9.1	8.5	5.2-11.8
Others	0.1	-0.1-0.3	0.3	-0.1-0.7	0.7	0.0-1.4	0.2	0.0-0.3
Knowledge about crude salt containing iodine	**(n=443)**		**(n=536)**		**(n=473)**		**(n=1 452)**	
Yes	1.4	-0.2-3.0	1.2	0.2-2.2	0.4	-0.1-0.9	1.3	0.1-2.5
Yes, some	2.3	0.6-4.0	2.1	0.6-3.5	1.3	0.0-2.6	2.2	1.0-3.5
No	75.8	69.7-81.9	85.5	78.6-92.4	75.7	64.3-87.0	78.0	73.1-82.9
Don’t know	20.5	13.5-27.5	11.2	5.1-17.4	22.6	11.1-34.1	18.5	13.1-23.9
Knowledge about open salt containing iodine	**(n=443)**		**(n=536)**		**(n=473)**		**(n=1 452)**	
Yes	4.1	1.8-6.4	2.8	1.0-4.6	6.6	2.4-10.8	3.9	2.2-5.6
Yes, some	8.7	3.3-14.2	4.5	1.7-7.3	6.0	2.3-9.7	7.7	3.6-11.7
No	73.5	65.6-81.4	85.7	78.8-92.5	75.4	69.8-80.9	76.3	70.0-82.7
Don’t know	13.7	8.8-18.5	7.1	2.6-11.5	12.1	7.5-16.6	12.1	8.4-15.8
Knowledge about salt packets containing iodine	**(n=443)**		**(n=536)**		**(n=473)**		**(n=1 452)**	
Yes	75.6	63.6-87.5	75.6	69.1-82.0	79.7	73.1-86.3	75.7	67.0-84.5
Yes, some	18.9	8.0-29.7	20.9	13.7-28.1	14.7	8.8-20.6	19.2	11.2-27.1
No	3.1	0.8-5.3	1.2	0.2-2.3	1.8	-0.2-3.9	2.6	0.9-4.3
Don’t know	2.5	0.6-4.3	2.3	0.7-4.0	3.8	1.2-6.4	2.5	1.1-3.9

Table 81 shows that, at the national level, the respondents of 68% of the households knew about iodized salt from television; 62.4%, 84.2% and 81% in the rural, urban and slums clusters, respectively. Radio was a source of knowledge on iodized salt in 14.4% of households; 15.5%, 12.8% and 3.3% in the rural, urban and slums, respectively. The other two major sources were health care workers and friends, from whom one in four of the respondents obtained information; the percentages were generally consistent in all the clusters. Around three of the four respondents stated that salt packets contained iodine. Around 4% of the respondents mentioned that open salt contained iodine. Only 1.3% of the respondents reported that crude salt contained iodine.

3.18.9 Household Respondents 'Knowledge of the Benefits of Iodized Salt

Table 82: Household Respondents Knowledge of the Benefits of Iodized Salt

	Rural		Urban		Slum		National	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Knowledge on the benefits of iodized salt								
	63.8	56.7-70.8	78.0	68.8-87.2	58.6	48.9-68.3	66.8	60.9-72.7
Benefits of iodized salt?								
	(n=443)		(n=536)		(n=473)		(n=1452)	
Prevents goiter	78.1	68.2-87.9	80.9	72.9-88.8	74.0	62.6-85.3	78.7	71.7-85.7
Prevents cretinism	22.4	14.5-30.3	21.1	12.7-29.5	14.8	9.4-20.1	21.8	15.9-27.6
Promotes mental development/ intelligence	6.1	2.2-10.1	5.8	3.5-8.1	7.0	2.5-11.6	6.1	3.3-8.9
Promotes normal growth	12.9	7.3-18.5	9.2	6.1-12.2	6.2	2.1-10.3	11.6	7.6-15.7
Prevents abortion and still-births	0.5	-0.2-1.2	3.5	0.2-6.9	0.6	-0.6-1.9	1.3	0.3-2.4
Healthy	67.3	53.1-81.4	61.6	51.5-71.7	51.3	39.3-63.4	65.1	55.0-75.3
Tests iodine?	(n=443)		(n=536)		(n=473)		(n=1452)	
	12.7	7.0-18.4	21.8	8.9-34.6	9.4	5.8-12.9	14.6	9.4-19.8

At the national level, around 67% of the respondents said that they knew the benefits of consuming iodized salt; 78% in the urban and 58.6% in the slum cluster (Table 82). Over 74% of the respondents in all clusters mentioned that iodized salt prevented goiter. One in five respondents mentioned that iodized salt prevented cretinism; 21.1% in the urban and 14.8% in the slums cluster; only 1.3% of the respondents knew that iodized salt prevented abortion and stillbirths.

3.18.10 Household Respondents' Knowledge on Testing Salt for Iodine

Table 83 shows the household respondent's knowledge of testing salt for iodine: 14.0% of the respondents said that they tested salt for iodine, 22% in the urban and 12% in the rural cluster. Among those who tested iodine in salt, the majority (82.7%) used the home-made method.

One in five of the respondents correctly stated that the testing of salt for iodine required salt and lemon juice, 30% of respondents in the urban cluster, 19.4% in the rural cluster, and 22.9% in the slum cluster; however, only 7.0% of the respondents correctly stated that cooked rice was required in testing salt for iodine.

Eighty percent of the respondents correctly stated that a pinch of salt was required to test the salt, which was slightly higher in the rural and urban (80%) than in the slum cluster (69.7%). Just over a quarter of the respondents correctly stated that "5 grains" of rice were required for the testing. Over 90% of the respondents stated that a "few drops" of lemon juice were required.

Table 83: Household Respondents' Knowledge on Testing of Salt for Iodine

	Rural		Urban		Slum		National	
Do you test for iodine?	**(n=443)**		**(n=536)**		**(n=473)**		**(n=1452)**	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
	12.2	7.0-18.4	21.8	8.9-34.6	9.4	5.8-12.9	14.6	9.4-19.8
	n=54		n=82		n=48		n=184	
Test kit	20.9	1.2-40.6	10.1	-3.1-23.4	10.1	-6.6-26.8	17.0	3.5-30.4
Home-made method	78.6	58.8-98.4	89.9	76.6-103.1	89.9	73.2-106.6	82.7	69.2-96.2
Both	0.5	-0.6-1.5						-0.3-0.9
Knowledge on ingredients to test iodine – salt	**(n=443)**		**(n=536)**		**(n=472)**		**(n=1451)**	
Mentioned	19.1	13.3-24.9	31.2	19.6-42.8	20.3	11.6-28.9	21.9	16.7-27.1
Didn't mention	80.9	75.1-86.7	68.8	57.2-80.4	79.7	71.1-88.4	78.1	72.9-83.3
Knowledge about cooked rice as ingredient to test iodine	**(n=443)**		**(n=536)**		**(n=472)**		**(n=1451)**	
Mentioned	5.2	3.0-7.5	12.5	4.9-20.1	5.8	1.7-10.0	6.9	4.3-9.5
Didn't mention	94.8	92.5-97.0	87.5	79.9-95.1	94.2	90.0-98.3	93.1	90.5-95.7
Knowledge about lemon juice as ingredient to test iodine	**(n=443)**		**(n=536)**		**(n=472)**		**(n=1451)**	
Mentioned	19.4	13.7-25.1	30.8	19.2-42.3	22.9	14.3-31.6	22.1	17.0-27.3
Didn't mention	80.6	74.9-86.3	69.2	57.7-80.8	77.1	68.4-85.7	77.9	72.7-83.0
Amount of salt?	**(n=101)**		**(n=144)**		**(n=98)**		**(n=343)**	
A pinch	80.6	69.7-91.5	81.3	64.6-98.0	69.7	52.9-86.4	80.4	71.7-89.1
A level teaspoon	12.9	5.6-20.3	9.3	2.1-16.6	17.2	5.8-28.6	11.9	6.7-17.1
Do not know	6.4	-2.2-15.0	9.4	-5.5-24.4	13.1	-1.1-27.3	7.6	0.5-14.9
Amount of rice?	**(n=22)**		**(n=32)**		**(n=26)**		**(n=80)**	
Small amount	1.7	-2.2-5.6	0.7	-1.1-2.4	19.5	-12.6-51.6	2.5	-0.8-5.8
5 grains	32.4	-0.6-65.3	16.4	-7.3-40.1	20.9	-8.8-50.6	26.9	6.1-47.7
Others	0.0	0.0	7.5	-9.3-24.3	0.6	-0.9-2.1	2.3	-2.3-6.8
Do not know	66.0	32.4-99.6	75.4	36.7-114.2	59.0	21.1-96.8	68.4	45.1-91.6
Knowledge about lemon juice as ingredient to test iodine	**(n=103)**		**(n=146)**		**(n=108)**		**(n=357)**	
A few drops	94.2	86.0-102.4	90.8	75.9-105.6	86.7	74.5-98.9	92.7	85.8-99.7
Other amounts	0.2	-0.2-0.7	0.0	0.0	1.1	-1.0-3.1	0.2	-0.1-0.5
Do not know	5.6	-2.6-13.8	9.2	-5.6-24.1	12.3	-0.1-24.6	7.1	0.1-14.0
What colour does salt change to when tested for iodine?	**(n=443)**		**(n=536)**		**(n=472)**		**(n=1451)**	
White	29.6	17.3-41.9	35.2	23.8-46.5	25.9	17.5-34.3	30.7	21.5-39.9
Violet/bluish	0.3	-0.2-0.7	2.1	0.3-3.8	0.7	-0.1-1.4	0.7	0.2-1.2
Other	1.3	-0.2-2.9	2.1	-1.1-5.3	2.1	0.3-3.8	1.5	0.2-2.8
Don't know	68.9	56.9-80.8	60.7	50.5-70.9	71.4	62.7-80.0	67.1	58.2-76.0

3.18.11 Household Practice of Including Salt in Livestock Feed

Table 84 shows the household practice of including salt in livestock feed. At the national level, 46.0% of the respondents included salt; among whom, 26.0% used iodized salt.

Table 84: Household Practice of Including Salt in Livestock Feed

	Rural		Urban		Slum		National	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
including salt in livestock feed	(n=485)		(n=266)		(n=80)		(n=831)	
	46.9	39.7-54.1	42.9	30.0-55.8	14.5	0.8-28.1	46.2	39.9-52.6
Type of salt	(n=251)		(n=118)		(n=15)		(n=384)	
Iodized	26.9	17.3-36.6	23.4	8.9-37.8	48.7	22.3-75.2	26.6	18.0-35.3
Not iodized	45.8	35.0-56.6	55.3	38.5-72.0	10.9	-3.4-25.2	46.6	37.0-56.3
Do not know	27.3	17.3-37.3	21.4	7.0-35.7	40.3	14.0-66.7	26.7	17.8-35.7

3.18.12 Source of Salt Purchase in Households

Table 85: Source of Salt Purchase

	National		Rural		Urban		Slum	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Open salt	(n=366)		(n=201)		(n=74)		(n=91)	
City shop	3.2	0.7-5.8	1.2	-0.7-3.2	26.4	7.6-45.3	24.6	3.9-45.2
Village/local shop/*haat*[1]	93.6	89.3-97.8	96.4	92.9-99.9	64.2	45.2-83.1	54.4	34.4-74.4
Others	3.0	0.3-5.5	2.1	-0.4-4.7	9.3	-0.2-18.8	20.9	7.4-34.4
Salt packets	(n=1628)		(n=464)		(n=614)		(n=553)	
City shop	25.4	17.2-33.6	12.6	3.2-21.9	54.9	38.6-71.1	61.3	46.5-76.1
Village/local shop/*haat*	73.9	65.6-82.1	86.9	77.6-96.2	43.9	27.9-59.8	38.1	23.3-52.8
Others	0.6	-0.01-1.3	0.5	-0.5-1.4	1.1	-0.2-2.5	0.5	-0.07-1.0
Crude salt[2]	-	-	-	-	-	-	-	-

[1] *haat* is a common market place
[2] Data on crude salt is not given because the number of observations is too small for meaningful statistical inference.

With regard to the sources of open salt purchases, the "village/local shop" was the most common source: 96.0%, 64.0% and 54.0 % in the rural, urban and slum clusters, respectively. Packet salt was mostly purchased from city shops in the urban (55.0%) and slum clusters (61.0%), but was commonly purchased from village shop/local shops in the rural cluster (86.0%).

3.18.13 Household Practice of Using Salt

Table 86: Household Practice of Using Salt

	National (n=2003)		Rural (n=661)		Urban (n=691)		Slum (n=649)	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Salt storage								
Closed packet/ container	97.3	95.9-98.7	97.4	95.6-99.2	97.1	95.2-98.9	98.5	97.3-99.7
Open packet/container	2.4	1.1-3.8	2.4	0.7-4.1	2.6	0.8-4.4	1.5	0.3-2.6
Both	0.1	-0.02-0.3	0.1	-0.06-0.3	0.2	-0.2-0.6	-	-
Timing for adding salt								

During cooking	98.5	97.6-99.5	98.6	97.3-99.8	98.6	97.7-99.6	97.6	95.5-99.6
After cooking	0.4	-0.009-0.9	0.4	-0.2-1.0	0.5	-0.1-1.1	0.6	-0.3-1.3
Both	0.97	0.35-1.6	1.0	0.2-1.8	0.8	0.03-1.5	1.8	-0.1-3.8
Salt is added to meals at the time of eating								
Always	60.7	52.2-69.1	60.4	49.3-71.5	62.4	54.7-70.0	56.7	48.7-64.8
Sometimes	19.9	12.4-27.3	20.4	10.5-30.3	17.3	12.3-22.2	22.3	16.1-28.5
Never	19.4	15.6-23.1	19.1	14.3-23.8	20.3	14.2-26.3	20.9	13.4-28.3

Table 86 shows that, at the national level, salt was stored in closed packets/containers in 97.0% of the households. The percentages were similar in all the clusters. In 98.5% of households, salt was added to food at the time of eating. The percentage was similar in all the clusters. In 60.0% of the households, salt was "always" taken on plate: 60.4%, 62.4% and 56.7% in the rural, urban and slum clusters, respectively. Moreover, 19.4% of the household respondents never added salt to dishes, and the percentages were similar in all the clusters.

3.19 Anthropometry

3.19.1 Stunting in Preschool Children

Table 87 shows the prevalence of stunting (height-for-age z score<2z) in preschool children. The national estimate was 32.1%. The prevalence in the slums (51.1%) was higher than in the rural (31.4%) and urban (31.3%) clusters. According to the Asset Index, the higher SES tended to have a lower prevalence of stunting. Stunting was observed in 44.3% and 20.6% of the "poorest" and the "richest" quintiles, respectively. The prevalence of stunting was 49.1% in the severe food-insecure households, compared to 28.1% in food-secure households.

Table 87: Prevalence of Stunting in Preschool Children

	n	%	95% CI
Clusters			
National	1016	32.1	26.2-38.0
Rural	344	31.4	23.7-39.1
Urban	361	31.3	24.7-37.9
Slums	311	51.1	44.9-57.2
According to the Asset Index			
Poorest	198	44.3	32.9-55.7
Poorer	205	36.5	24.6-48.3
Middle	205	24.1	13.1-35.1
Richer	202	28.9	17.1-40.7
Richest	206	20.6	9.5-31.7
By household food insecurity status			
Food-secure	461	28.1	17.8-38.3
Mildly insecure	145	39.8	22.9-56.7
Moderately insecure	255	29.4	16.7-42.1
Severely insecure	155	49.1	37.5-60.7

3.19.2 Underweight in Preschool Children

Table 88 shows the prevalence of underweight (weight-for-age z score<-2z) in preschool children. The prevalence at the national level was 30%, which was higher in the slums (47.4%) than in the rural cluster (29.6%). The prevalence was 36.9% in the "poorest" and 17.8% in the "richest" quintiles.

Table 88: Prevalence of Underweight in Preschool Children

	n	%	95% CI
Clusters			
National	1033	30.0	24.7-35.3
Rural	352	29.6	22.8-36.5
Urban	364	28.1	21.0-35.1
Slums	317	47.4	39.3-55.5
According to the Asset Index			
Poorest	205	36.9	28.0-45.7
Poorer	209	36.5	25.8-47.1
Middle	209	27.8	17.6-37.9
Richer	203	24.3	12.9-35.8
Richest	207	17.8	9.8-25.8
By household food insecurity status			
Food-secure	466	24.2	15.7-32.8
Mildly insecure	150	41.3	21.5-61.1
Moderately insecure	258	30.0	17.8-42.3
Severely insecure	159	45.3	35.1-55.6

3.19.3 Wasting in Preschool Children

Table 89 shows the prevalence of wasting (weight-for-height z score<-2z) in preschool children. The national prevalence of wasting was 19.3%. The prevalence was slightly lower in the urban (12.9%) than in the rural (21.1%) and slum clusters (20.3%). The prevalence was generally consistent in all SES groups. In regard to the household food insecurity status, the prevalence of wasting was 19.6% and 25.2% in the food-secure and mildly food-insecure households, respectively.

Table 89: Prevalence of Wasting in Preschool Children

	n	%	95% CI
Clusters			
National	997	19.3	14.4-24.2
Rural	336	21.1	14.8-27.3
Urban	355	12.9	7.6-18.2
Slum	306	20.3	13.0-27.6
According to the Asset Index			
Poorest	195	16.3	8.6-23.9
Poorer	201	20.6	13.4-27.9
Middle	201	24.3	2.9-45.7
Richer	197	19.0	7.6-30.4
Richest	203	16.1	8.1-24.1
By household food insecurity status			
Food-secure	455	19.6	14.7-24.5
Mildly insecure	140	25.2	5.4-44.9
Moderately insecure	249	14.9	6.9-22.8
Severely insecure	153	19.7	10.7-28.7

3.19.4 Height-for-age z-score in Preschool Children

Table 90 shows the mean z-score for height-for-age in preschool children. The children in the slums had lower scores (-1.97) than their rural (-1.29) and urban (-1.30) peers. In general, the z-score for height-for-age increased as the children belonged to an increasingly higher SES.

Table 90: Height-for-age z-score in Preschool Children

	n	Mean	95% CI
Clusters			
National	1017	-1.32	-1.51-(-1.13)
Rural	344	-1.29	-1.54-(-1.04)
Urban	361	-1.30	-1.57-(-1.04)
Slum	312	-1.97	-2.19-(-1.75)
According to the Asset Index			
Poorest	199	-1.66	-1.99-(-1.33)
Poorer	205	-1.52	-1.87-(-1.17)
Middle	205	-1.20	-1.55-(-0.85)
Richer	202	-0.86	-1.56-(-0.17)
Richest	206	-1.10	-1.44-(-0.77)

3.19.5 Weight-for-age Z-score in Preschool Children

Table 91 shows the weight-for-age z-scores in the preschool children; the z-score in the slum cluster (-1.85) was lower than in the urban (-1.19) and rural (-1.48) clusters.

Table 91: Weight-for-age z-score in Preschool Children

	n	Mean	95% CI
Clusters			
National	1033	-1.43	-1.57-(-1.29)
Rural	352	-1.48	-1.65-(-1.31)
Urban	364	-1.19	-1.39-(-0.98)
Slum	317	-1.85	-2.03-(-1.67)
According to Asset Index			
Poorest	205	-1.67	-1.91-(-1.42)
Poorer	209	-1.56	-1.83-(-1.28)
Middle	209	-1.57	-1.76-(-1.38)
Richer	203	-1.10	-1.44-(-0.75)
Richest	207	-1.08	-1.36-(-0.80)

3.19.6 Weight-for-height z-score in Preschool Children

Table 92 shows the weight-for-height z- score in preschool children; the score was higher among children in the urban cluster (-0.61) than their peers in the slum (-0.94) and rural (-0.95) clusters. The z-score increased as the children's SES increased.

Table 92: Weight-for-height z-score in Preschool Children

	n	Mean	95% CI
Clusters			
National	997	-0.88	-1.08-(-0.67)
Rural	336	-0.95	-1.20-(-0.70)
Urban	355	-0.61	-0.84-(-0.37)
Slums	306	-0.94	-1.12-(-0.77)
According to the Asset index			
Poorest	195	-0.86	-1.20-(-0.51)
Poorer	201	-0.99	-1.21-(-0.77)
Middle	201	-0.99	-1.57-(-0.41)
Richer	197	-0.77	-1.29-(-0.24)
Richest	203	-0.70	-1.07-(-0.33)

4. Discussion

4.1 Anemia

The survey revealed a prevalence of anemia in preschool children at the national level of 33.0%. The prevalence of anemia in the preschool children (under-five) was 47.0%, based on the national survey data in rural areas conducted in 2001 (Nutrition Surveillance Project, HKI, 2001). The prevalence of anemia in six-month-old infants was 44.0% according to a study in a rural site in Bangladesh (Eneroth *et al.,* 2010). A nationally representative survey estimated the anemia prevalence in children under two-years of age as 49.0% (Harun-or-Rashid *et al*., 2009).

The prevalence of anemia in NPNL women was 26% in the *National Micronutrient Survey*. According to the Nutrition Surveillance Project, HKI, 2001, the prevalence in NPNL of reproductive age (15-49 years) was 33.2%. The *Anemia Prevalence Survey of Urban Bangladesh*, a nationally representative survey, estimated the prevalence among NPNL women as 32.9% in 2001-03.

The prevalence of anemia was 19.1% and 17.1% in children aged 6-11 years and 12-14 years, respectively. The nationally representative data for children aged 13-14 years revealed a prevalence of 24.6% in the urban cluster in 2001-03 (*Anemia Prevalence Survey of Urban Bangladesh* and *Rural Chittagong Hill Tracts* 2003).

4.1.1 Assessment Methods

The lower prevalence of anemia found in this survey than in earlier estimates might be the following: The *National Micronutrient Survey* used venous blood samples with hemocue, whereas commonly, capillary blood is used with hemocue to assess anemia in Bangladesh and other regions for public health studies. Published literature reported wide variations in the measure of hemoglobin with the Photometric Hemoglobinometer (PHM) method, i.e. hemocue with capillary blood. The reliability of the hemocue with capillary blood method is low; it varies widely from site to site (between samples taken at the same time from two different parts of the body) and over time (samples taken from the same site of the body of the same individual at a few days' interval). This unreliability may lead to misclassification of anemia status in individuals and biases in anemia prevalence estimates (Morris *et al*., 1999). The other studies also reported wide variability in hemoglobin measurement with the capillary hemocue (Xiaoyan, 2009; Rippmann, 1997; Chen *et al*., 1992). The present survey reports a 40% prevalence of anemia in children aged 6-23 months at the national level; 56.3% in the "poorest" quintile and 45% in the slum cluster. Very few population-based studies have been conducted in Bangladesh that employed the similar method (venous hemocue) or the venous cyanomethemoglobin method, the gold standard. A very recent study using the venous cyanomethemoglobin method, conducted by icddr,b (personal communication, manuscript under preparation), among the poor rural community, estimated the prevalence of anemia in children under two at 55%. Another ongoing icddr,b study conducted in a slum in Dhaka and employing the venous hemocue method reported a 48.3% prevalence of anemia in children aged seven months (personal communication). Therefore, when compared with a similar method or the gold standard method after adjusting for age group and SES, the estimates of the present survey were consistent.

4.2 Iron Deficiency

The prevalence of iron deficiency (low serum ferritin) in Bangladesh is much lower than what is assumed: 10.7% in preschool children and 7.1% in NPNL women. It should be noted that, for the very first time in Bangladesh, a nationwide estimate of ferritin was obtained in the *National Micronutrient Survey*. There were only some smaller-scale studies reporting the estimates of iron deficiency. In a 2007 study in a rural sub-district among married, nulliparous women, 11.0% were iron deficient (Khambalia *et al*., 2009). In another study in a rural sub-district, the prevalence was 8.0% among pregnant women (Lindstrom *et al*., 2010). One recent study reported the prevalence of iron deficiency in nulliparous women in a northern district in Bangladesh at 0.0% (Merrill *et al*., 2011). In that study, daily iron intake from water [42 mg (18,71)] was positively correlated with plasma ferritin (r = 0.36) and total body iron (r = 0.35). It also revealed a strong, positive, dose-response association between natural iron content in groundwater, intake of iron from such sources, and iron status of women. They study linked the findings with very high iron in groundwater consumed through drinking water. The study further pointed out that the groundwater iron and therefore the status of iron deficiency in population may not be the unique to that particular district. A British geological survey on the mineral content in groundwater across Bangladesh showed that iron concentration is high in most parts of the groundwater (Kinniburgh *et al.,* 2001). According to this report, the range of groundwater iron in Bangladesh is <0.004 mg/l to 61.0 mg/l, and the medians are 1.4 mg/l and 0.2 mg/l in shallow and deep groundwater, respectively. This survey and other reports have shown that the aquifer environment is reducing (Merrill *et al*., 2010; Roberts *et al*., 2007), indicating that dissolved iron is predominantly ferrous (Fe2+), a form that is readily absorbed through the intestine (Hallberg, 1991). This is supported by an experimental study, which showed natural water with electrolytically reduced iron (ferrous) is readily absorbed (Halksworth *et al*., 2003).

The authors referred to the *British Geological Survey* report and accordingly identified the areas with an arbitrarily termed "high" level of groundwater iron (areas with groundwater iron concentration >=2.8 mg/l), and the areas with a "low" level of groundwater iron (areas with groundwater iron concentration <2.8 mg/l). The mean serum ferritin in the data were compared between these two categories of areas (Table 93).

Table 93: Comparison of Mean Ferritin by Groundwater Iron Status

	Ferritin(ng/ml)[1] (geometric mean)					
	Preschool children		NPNL women		School-age children	
Areas with groundwater iron concentration: 'high" (>=2.8 mg/l)	38.9	P=0.0002	67.9	P=0.0001	57.1	P=0.0001
Areas with groundwater iron concentration: 'low" (<2.8mg/l)	23.1		44.7		42.1	

[1]Ferritin is adjusted for infection.

The mean ferritin level in serum was statistically significantly higher in all the studied population groups in the areas with "high" groundwater iron, as discussed in the following descriptive and multivariate analyses.

Table 94: Serum Ferritin in NPNL Women and Related Variables

	Serum ferritin (ng/ml) (geometric mean)	Household monthly expense (BDT) (geometric mean)	7-day iron consumption from food (mg)
Household food insecurity (FANTA HFIAP* tools)			
Food-secure	45.1	9 509.00	55.0
Mildly insecure	55.7	7 631.00	50.0
Moderately insecure	61.5	7 186.00	47.9
Severely insecure	52.4	6 634.00	48.2
Asset Index			
Richest	49.4	15 017.00	62.0
Richer	49.9	10 117.00	52.3
Middle	41.6	8 910.00	54.5

Poorer	56.8	7 435.00	49.0
Poorest	54.6	5 558.00	46.7
Groundwater iron (GWI)			
GWI>=2.8 mg/l	67.9	7 707.00	49.8
GWI<2.8 mg/l	44.7	8 604.00	54.8

*Coates *et al*., 2007

Table 94 shows that "food-insecure" households had lower household spending power (ranging from BDT 7,631 in "mild food-insecure" to BDT 6,634 in the "severe food-insecure") than the "food-secure" households (BDT 9,509.0). Seven-day iron consumption from food was lower in the "food-insecure" households (48.0-50.0 mg) than in "food-secure" households, where consumption was 55.0 mg. According to the Wealth Index, households of the upper quintiles had gradually increasing spending power. Consumption of iron from food over a seven-day period was similar, with a gradually higher consumption from the bottom to the top quintiles.

However, defying the trend, the serum level of ferritin was lower in the "food-secure" households (45.1 ng/ml) than the households with different degrees of food insecurity (52.0-61.0 ng/ml), which was substantiated by observing the Wealth Index. The mean serum ferritin was 49.0 ng/ml in the top two quintiles, compared to around 55.0 ng/ml in the bottom two quintiles. This unusual occurrence could possibly be explained by the groundwater iron. In the areas with "high" (>=2.8 mg/l) groundwater iron, NPNL women had a higher level of serum ferritin (67.9 ng/ml) than the areas with "low" (<2.8 mg/l) groundwater iron, where mean serum ferritin was 44.7 ng/ml. This was despite the fact that area with "high" groundwater iron had significantly lower household's spending power (BDT 7 707 against 8 604) and consumption of iron was less (49.8 mg against 54.8 mg) as well than the area with "low" groundwater iron. Therefore, serum ferritin in NPNL women did not depend on higher SES or higher level iron consumption from food. However, groundwater iron exerted a positive influence on serum ferritin.

Table 95: Determinants of Serum Ferritin in NPNL Women

Variables	Coefficient	T	P	Standardized effect size (Beta)
Household monthly expenses	-0.000014	-2.26	0.02	-0.12
Iron consumption from food over a 7-day period	0.0006	0.47	0.63	0.02
Mother's institutional education (Ref: No education)	0.011	0.15	0.88	0.0068
Retinol status (s.retinol)	0.18	2.08	0.038	0.09
Para (parity)	-0.009	-0.56	0.57	-0.024
Area of residence (Ref: rural)				
Urban	-0.002	-0.03	0.97	-0.001
Slums	-0.02	-0.13	0.89	-0.006
Asset Index (Ref: poorest)				
Poorer	0.21	2.42	0.016	0.13
Middle	0.07	0.69	0.48	0.04
Richer	0.178	1.34	0.18	0.079
Richest	0.458	2.62	0.009	0.19

Zinc status (s. zinc)	0.013	0.72	0.46	0.034
Groundwater iron (Ref: GWI<2.8 mg/l)				
GWI>=2.8 mg/l	0.46	4.32	0.000	0.22
HH food insecurity (Ref: food-secure)				
Mildly insecure	0.07	0.69	0.48	0.03
Moderately insecure	0.22	2.67	0.008	0.13
Severely insecure	0.17	1.7	0.09	0.08
Serum B_{12}	0.12	1.97	0.05	0.09
Serum folate	0.23	3.08	0.002	0.13
Owns a refrigerator	0.32	2.37	0.018	0.14

To determine the association with serum ferritin (dependent variable) in NPNL women, related independent variables were entered into the multivariate regression analysis (Table 95). Monthly household expenses were negatively associated with serum ferritin (p=0.02). This indicates that the women of poor households have higher levels of ferritin, which is also evident from the descriptive statistics (see Table 94). The is further substantiated by the observation that moderately food-insecure households are associated with higher levels of serum ferritin in NPNL women than in food-secure households (p=0.008). Households with NPNL women in the rural cluster have the lowest household monthly expenses – BDT 7,707.00 (rural), BDT 8,350.00 (slums), and BDT 10,721.00 (urban). However, usage of tube-wells as a source of drinking water (tube-well water is exclusively groundwater, rich in absorbable iron) is greater in the rural (~80%) than in the urban (62%) or slum cluster (30%). This possibly explains the reason for the negative correlation between household spending power and ferritin status in NPNL women.

Among the nutrients, serum retinol and folate were positively associated with serum ferritin in NPNL women.

The environmental factor-the groundwater iron was in highly significant positive association with serum ferritin. The areas with “high” groundwater iron (>=2.8 mg/l) were associated with higher serum level of ferritin in NPNL women than the areas with “low” levels of groundwater iron (<2.8 mg/l)(p<0.001). From the standardized effect size (Beta), groundwater iron had the highest absolute effect size (0.22) among the independent variables.

The similar effect of groundwater iron on iron status was noted in preschool and school-age children by the descriptive and multivariate regression analysis.

The authors explored the effect of food consumption on iron status. Table 96 shows consumption of iron from food in different age groups and genders from the *National Micronutrient Survey* data and the RDA for iron.

Table 96: Iron Consumption Compared to Iron RDI

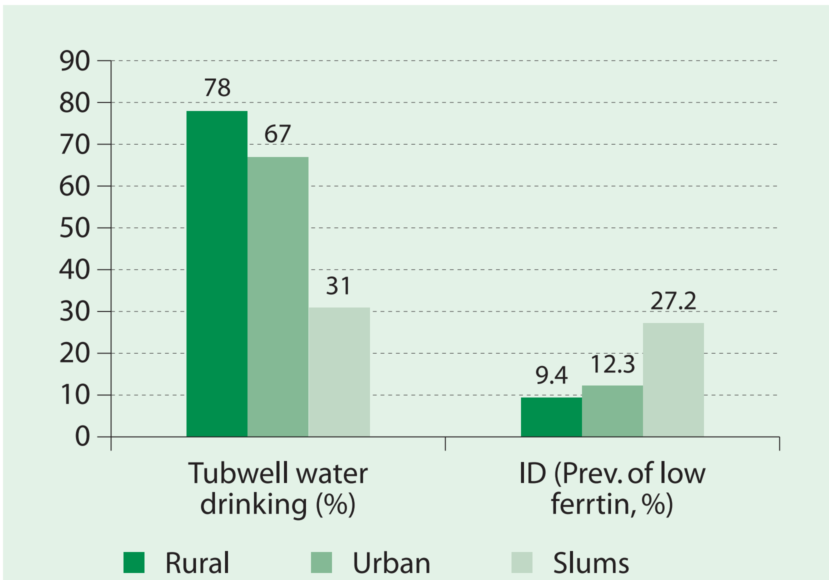
	RDA[1] (mg)	Daily iron consumption (mg)	Daily consumption of iron from animal sources (mg)
Aged 2-3 years	7.0	4.76	0.98
Aged 4-5 years	10.0	4.77	0.98
Boys 9-14 years	8.0	6.60	1.20
Girls 9-14 years	8.0	5.90	0.97
Women 15-50 years	18.0	7.40	1.12

[1]Institute of Medicine (IOM).

Although consumption of animal source food, e.g. meat, fish and eggs, has increased in Bangladesh (HIES, 2010), consumption of iron from food is still well below the RDA. Table 96 shows the daily consumption of iron and food from animal source, as estimated in the *National Micronutrient Survey*. The estimates reveal that daily consumption was below the RDA in each of the age groups and genders. Iron consumption from animal sources, which is rich in heme iron, constitutes a small percentage of the total iron. The findings suggest that iron consumption through food is unlikely to make a positive impact on ferritin status, which is in line with the findings of other contemporary studies in the country (Merrill *et al*., 2011). The findings are also consistent with those of the multivariate regression analyses presented in this report, which did not show any impact of iron consumption from food on serum level of ferritin (Table 95).

There was a question in the *National Micronutrient Survey* on sources of drinking water. Figure 3 illustrates how the drinking of tube-well water (groundwater) affected the iron status in preschool children.

Figure 3: Drinking of Tube-well Water (Groundwater) vs. the Prevalence of Iron Deficiency in Preschool Children



The more tube-well water (groundwater) consumed, the lower the prevalence of iron deficiency (Figure 3). The same trend was observed in NPNL women and school-age children.

The widespread presence of high groundwater iron may contribute to high ferritin status among populations in Bangladesh, irrespective of SES, location of residence or status of food consumption. In the absence of adequate iron from food, food fortification programmes and with a very limited coverage (1%) of multiple micronutrient powder (MNP) supplementation in young children found in this survey. (Table 97), high groundwater iron might have an association with low prevalence of iron deficiency in Bangladesh population, which was observed in the *National Micronutrient Survey*.

Table 97: Coverage of Multiple Micronutrient Powder (MNP) in Under-two Children in Bangladesh

Clusters	n	%	95% CI
National	247	1.3	-0.3-2.9
Rural	78	0.7	-0.8-2.3
Urban	89	3.3	-1.5-8.1
Slum	80	0.0	-

To define target population, evidence-based research suggests that groundwater can offer a cheap, sustainable source of bioavailable iron commonly not taken into account in traditional dietary assessments or intervention planning phases (Merrill, 2012).

The resultant modest prevalence of iron deficiency supports the finding of anemia in this study. Iron deficiency is widely considered the major cause of anemia. However, it can be observed from the data of the *National Micronutrient Survey* that iron deficiency (prevalence of low ferritin) was not a widespread problem in Bangladesh. Consequently, the role played by iron deficiency in causing anemia was less than assumed, resulting in a relatively low prevalence of anemia, as observed in this survey.

4.3 Vitamin A

The prevalence of vitamin A deficiency was 20.5%, 20.9% and 5.4% in preschool children, school-age children and NPNL women, respectively. The status of vitamin A nutrition in general remained similar to the most recent nationally representative survey (Helen Keller International. 1999). The IPHN/HKI survey reported the estimates as 21.7%, 19.6% and 5.0% in the above population groups, respectively. In another study in a rural community, the prevalence in six-month-old infants was 19.0% (Eneroth *et al*., 2010). The current estimates have indicated persistent vitamin A deficiency of a public health significance in preschool and school-age children. The problem was pervasive in the slum cluster, where prevalence was 38% and 27% in the preschool and school-age children, respectively.

The national prevalence of subclinical vitamin A deficiency remained at the same level in all the population groups studied, e.g. preschool children, school-age children and NPNL women, as in the earlier nationally representative survey conducted in 1997 (Helen Keller International. 1999). One of the reasons for this may be the intake of vitamin A from the diet. According to data of the *National Micronutrient Survey*, the median daily consumption of vitamin A in preschool children was 270 REs, compared to the RDA of 300-400 REs. In school-age children, it was 318 REs compared to the RDA of 400-600 REs. In NPNL women, it was 372 REs against the the RDA of 700 RE. Therefore, in all the population groups studied, consumption did not meet the requirements. Again, the Bangladesh diet is dominated by the vitamin A from plant sources (carotenoids). The data revealed that the share of vitamin A from plant sources (carotenoids) to total vitamin A consumption is 77%, 71% and 60% in NPNL women, school-age children and preschool children, respectively. Vitamin A from plant sources is a less bio-available form of vitamin A. Although in this report, the chosen conversion factor for beta carotene to retinol was 12:1 (Institute of Medicine, 2002), increasingly more literature reports that bio-conversion for beta carotene to retinol in the body is even weaker; some literature suggest a conversion factor of 29: 1 for beta-carotene to retinol (Hickenbottom, 2002; Tang *et al*., 2002; Solomons, 1999; Brubacher *et al*., 1985). A recent study states that a higher level of consumption of provitamin A (carotenoids), which is the typical case scenario in Bangladesh, is related to inefficient bio-conversion to retinol in the body (Novotny *et al*., 2010). This may explain the stagnation and persistent higher prevalence of sub-clinical vitamin A deficiency, measured by serum level of retinol in the Bangladesh population.

The data of the *National Micronutrient Survey* show that the slum cluster have a consistently higher level of retinol deficiency than the other two clusters, notably in comparison to the urban cluster. This trend was consistent in all the studied population groups. One possible reason may be dietary intake. In preschool children, the daily median consumption of vitamin A was 209 REs in the slums, against 291 RE and 231 REs of the rural and urban clusters, respectively. The median consumption of vitamin A from animal sources providing more biologically available retinols was 40.2 REs in the slums, compared to 52.4 RE and 61.1 REs of the rural and urban clusters, respectively. School-age children from the slums had a median daily consumption of 260.3 REs, compared to 321.3 and 300.1 REs in the rural and urban clusters, respectively. The daily median consumption of animal-source vitamin A was 29.8 REs in the slums, against 40.1 and 44.7 REs in the rural and urban clusters. Hence, children in the slum cluster may have a lower consumption of total and animal-source vitamin A from food than their peers from the rural and urban clusters. This could be linked with a higher prevalence of subclinical vitamin A deficiency in preschool and school-age children of the slums.

The national coverage of vitamin A supplementation is 77%; it is higher than 72% in all clusters, yet differences do exist in coverage across SES. For example, the coverage was 76.0% in the "poorest" quintile compared to around 87.0% in the "richest" quintile. Therefore, there is room to improve coverage, e.g. at the bottom quintile of the population according to the Wealth Index.

The *Bangladesh Demographic and Health Survey* (BDHS) 2007 reported the coverage of vitamin A supplementation as 84%. However, in the BDHS 2011, there was only a 60% coverage of vitamin A supplementation because they missed the deadline of the national immunization days by six-month prior to the survey (BDHS 2011), thus considerably failed to be taken into consideration in the estimate. In the *National Micronutrient Survey*, the coverage was 77%. This can be explained by the fact that the latest national immunization day prior to the present survey was held on 29 May 2011. The survey started on 4 October 2011 and continued until 20 December 2011. Therefore, the last three weeks of the survey were outside the six-month margin from the last immunization day (29 May 2011), thus, although there were less coverage data missing coverage in this survey than in the BDHS 2011, a small amount of additional coverage estimate was not taken into consideration. Therefore, in general, the coverage of vitamin A supplementation in preschool children remained similar to the BDHS 2007 estimate. Nevertheless, there is need to further increase coverage.

Since the estimates of prevalence of subclinical vitamin A deficiency in general remains the same over the last 15 years, and there are still pocket of areas or underprivileged groups where coverage of supplementation of vitamin A was slightly lower than the rest of the population, the findings of the *National Micronutrient Survey* is a perfect setter to initiate the wide-scale cooking oil vitamin A fortification programme in the country.

4.4 Zinc

National prevalence of zinc deficiency was 44.0% in preschool children and 57.0% in NPNL women. In a study in Bangladesh, the prevalence of zinc deficiency was reported to be 49.7% in children aged 3-7 years (Kongsbak *et al*., 2006). Another study in a rural community reported the CRP adjusted prevalence of zinc deficiency in infant as 56.0% (Eneroth *et al*., 2010). A study in a rural sub-district reported zinc deficiency at 49.0-66.0% in pregnant women (Lindstrom *et al*., 2011). Therefore, in general, the findings for zinc were comparable with other studies.

The relatively high burden of zinc deficiency among the Bangladesh population was likely attributed to dietary intake, which shows that consumption was well below the RDA amount. For the preschool children, the median daily consumption of zinc was 2.67 mg in the slums and 3.23 mg in the urban cluster, against the daily requirement of 3-5 mg (RDA). In NPNL women, consumption was much lower: 4.47 mg in the urban cluster, 3.61 mg in the slum cluster and 3.93 mg in the rural cluster compared to the RDA of 8-9 mg, indicating that NPNL women consumed just 33-50% of the RDA for zinc.

In addition to this issue of low dietary intake, the content of phytate in the food, an inhibitor of zinc absorption, is high in the Bangladesh diet. The phytate-zinc molar ratio is an indicator of relative abundance of phytate to zinc in the food. The higher the ratio, the lower the absorption of zinc. The diet of 26.3% of urban preschool children had a phytate-zinc molar ratio <5 (a ratio favourable for zinc absorption), compared to just 17.2% in the diet of children in the slums, possibly explaining the higher prevalence of zinc deficiency in the children in the slums than their urban peers. The diet of one-third of NPNL women had a very high phytate-zinc molar ratio (>15), indicating a high inhibition of zinc absorption from the diet.

Therefore, compounded with low intake from diet, the issue of phytate in food possibly explains for very high prevalence of zinc deficiency in NPNL women as well as in preschool children in Bangladesh.

4.5 Iodine

The national estimate of usage of iodized salt (≥5 ppm) at the household level was 80.3%, which was generally similar to the estimate in the preceding *National IDD/USI Survey* 2004-5 (81.4%). The usage of iodized salt was lower in the rural households than in the urban or slum clusters (rural, 76.7%; urban, 91.7%, slums, 91.1%). At the national level, 57.6% of the households used adequately iodized salt (≥15 ppm), which was a slight improvement from the 2004-5 estimate (51.2%). However, the difference between the two estimates was not statistically significant. Three out of four households in the urban and slum clusters used adequately iodized salt, while the percentage was just over 50.0% in the rural area.

The estimate of household consumption of "brand" salt was 75.8% at the national level, which was generally consistent to the 2004-5 estimates (71.4%). Proportionately more urban households consumed "brand" salt than in rural households (92% against 71%). The percentage of "open" salt consumption in the households was 24.2% at the national level, which showed a declining trend from the 2004-5 estimates (30.1%). More rural households consumed "open" salt than in the urban cluster (29.2% against 7.7%).

With regard to iodine content of retailer salt, 8.1% of the samples had negligible iodine (<5.0 ppm) (Table 65). This estimate was an improvement over the earlier survey (10%, 2004-5). The percentage of retailer salt sample with adequately iodized salt (>=20 ppm) was 66.4%, which improved from 2004-5 estimate (53%). Almost no shops (~0%) had samples with excess iodine (>100 ppm). This percentage was ~2.0% in 2004-5.

According to this survey, although sales adequately iodized salt improved at the retailer level, at the household level, consumption of adequately iodized salt was generally the same as in the previous survey.

With regard to iodine deficiency, at the population level, the survey revealed that the Bangladeshi population was iodine sufficient. This was indicated by the median UICs, which was estimated above the 100.0 µg/l (the cut-off <100 µg/l defines iodine deficiency at the population level) in all the clusters as well as the combined national estimates, in school-age children and NPNL women. However, when observing the trend of iodine deficiency in school-age children from 1999 to 2012, it is on a declining trend, from 42.5% (1999) to 33.8% in 2004-05, followed by an upward trend to 40.0% in 2012 (Figure 4). An inverse trend in median UIC with the prevalence of iodine deficiency was also observed during this period (1999-2012). The median UIC was 125 µg/l in 1999, increased to 162.5 µg/l in 2004/05 and dropped again to 145.0 µg/l in 2012. Similar trends were observed with regard to iodine deficiency and median UIC in NPNL women (Figure 4).

The survey reported on the practice of adding salt to dishes, which was highly prevalent (~99.0%), and showed a rising trend from the 2004/5 data, at 95.0%. This indicates a loss of iodine from salt while cooking could be substantial. Adding salt to dishes causes a substantial loss of iodine through vaporization, which could be as high as 25.0% of the total iodine. This may be one of the factors underlying the falling concentration of iodine in urine of the studied population groups. Educating mothers to cover cooking pots during cooking or to add salt when the food is almost ready may help reduce this loss.

Another issue was use of "open" salt, especially in the rural clusters, where 30% of the households used it. When asked why the respondents did not use "packet" salt, the overwhelming majority (84%) responded that the "packet" salt was "too expensive" (Table 57). About one fourth of them responded that the "packet" salt was not available in "small amounts". According to the Trading Corporation of Bangladesh (*The Financial Express*, 19 June 2012), the price of packet salt increased by 66% in 2012 over a one-year period while a survey carried out by the Bangladesh Small and Cottage Industries Corporation (BSCIC), the price of salt increased by 43.75% in 2012 over a one-year period (*The Financial Express*, 11 September 2012). The recent rising trend of price over the last 1-2 years may have influenced the respondents in using the "open" salt, as supported by the data in Table 98. The use of "open" salt seemed higher in the "poorest" and "severely food-insecure" households. Iodized salt (≥5 ppm) and adequately iodized salt (≥15 ppm) was used less as the households SES decreased and status of household food security decreased (Table 56b).

Table 98: Use of "Open" Salt by Socio-economic Status and Household Food Security Status

	Use of "open" salt (%)
"Poorest" households	37.1
"Richest" households	17.6
"Severely food-insecure" households	31.2
"Food-secure" households	26.7

In support of the above observations, according to the Wealth Index, the bottom two quintiles of NPNL women and the bottom quintile of school-age children, who are socio-economically underprivileged, were iodine deficient (Tables 60 and 63).

Figure 4: Trend of Iodine Status in School-age Children

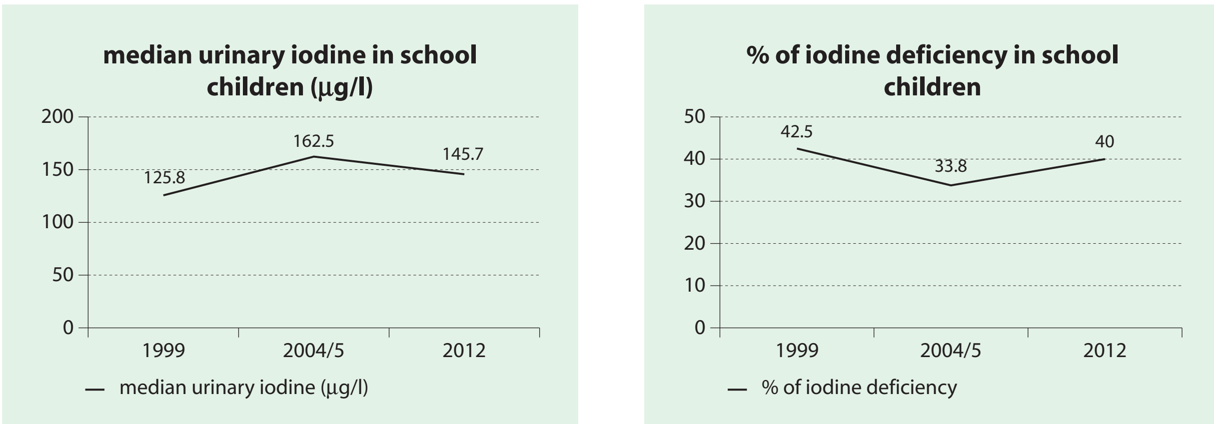
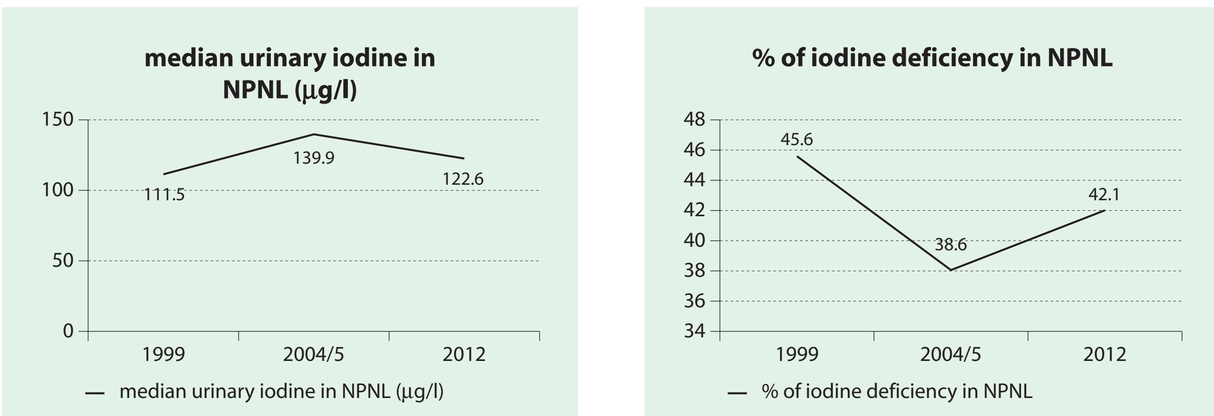


Figure 5: Trend of Iodine Status in NPNL Women



4.6 Folate

With regard to folate deficiency, the national prevalence among NPNL women was 9.1%. In Bangladesh, 18.0% of rural pregnant women were reported to be folate deficient according to a study conducted in 2002 (Lindstorm *et al*., 2010). Another Bangladesh study conducted in 2007 reported folate deficiency of 13.3 % in married, non-pregnant women (Khambalia *et al*., 2009). Therefore, the findings are consistent with those of other studies.

4.7 Nutritional Status in Preschool Children

Prevalence of stunting, underweight and wasting was 32.1%, 30% and 19%, respectively. According to the BDHS 2011, the respective estimates are 41%, 36% and 16%. The difference in the estimates, especially in the stunting and underweight may have been due to the fact that the sample size in the *National Micronutrient Survey* was estimated by taking into consideration micronutrient deficiencies. The given sample size was less than optimal to assess the nutritional status of preschool children.

4.8 State of Nutrition in the Slum Cluster

Together with industrialization, e.g. the ready-made garments industry and rapid urbanization, the informal service sector has been growing exponentially over the last decade. This calls for inevitable expansion of slums population, especially in the metropolitan cities of the country. According to the *Slum Census* 2005 of CUS, the projected current slum population is 5.5 million. Too many people live in congested small places, devoid of adequate utilities and services. The *National Micronutrient Survey* 2011-12 is probably the first analysis of the nutrition situation at a comprehensive scale in the ever-growing slum population of the country. The household's average monthly spending in the slums was higher than in the rural households (BDT 8,944.00 against BDT 8,393.00, 6.5% higher); however, the slums population had a higher burden of malnutrition, as highlighted in Table 99.

Table 99: Prevalence of Micronutient Deficency and Nutrition Status by Cluster

	Rural %	Urban %	Slum %
Subclinical vitamin A deficiency			
Preschool children	19.4	21.2	38.1
School-age children	20.2	22.1	27.1
NPNL women	5.4	4.9	6.9
Zinc deficiency			
Preschool children	48.6	29.5	51.7
NPNL women	57.5	54.5	66.4
Nutritional status of preschool children			
Stunting	31.4	31	51
Wasting	21.1	12	20
Underweight	29.6	28.1	47.4

Table 99 shows that the prevalence of subclinical vitamin A deficiency and zinc deficiency was proportionately higher in the slums than in urban and rural clusters. Vitamin A supplementation coverage in preschool children was 72% in the slums, 73% in the urban cluster and 78% in the rural cluster (Table 19). However, dietary consumption of vitamin A was lower in the slums. According to data shown elsewhere in this report, the daily median consumption of total vitamin A and vitamin A from animal sources was lower in the slums than in the other two clusters in all the studied populations. The same observation holds true with regard to the consumption of zinc from food – the seven-day consumption of total and zinc from animal sources was lower in the slums among preschool children and NPNL women (Tables 47 and 48).

Therefore, the greater burden of malnutrition in the slums could be attributed to the fact that most of the slum dwellers have to pay for rent, which constitutes a significant portion of their spending. Their peers from the rural cluster mostly own their homesteads (homestead ownership: rural, 93%; urban, 78% and slums, 33%) and do not need to pay for houses. A further stress factor for slum dwellers is the fact that they live in expensive metropolitan cities (Dhaka, Khulna, Chiitagong, Rajshahi), where the cost of living is higher than in the rural areas. Compounded with this, slum households may experience more food insecurity. Just 36% of the households in the slums were "food-secure" against 53% in the urban and 52% in the rural clusters. Seventeen percent of households were "severely food-insecure" in the slums, against 12% in the rural and urban clusters (Table 13). Therefore, in spite of having slightly higher spending power than the rural households, the actual financial power is limited in the slum dwellers, resulting in lower levels of micronutrients and a low nutritional status in the slums population.

5. Salient Findings

5.1 Vitamin A

The subclinical deficiency of vitamin A, as measured by low serum retinol (<0.7 mmol/l) was 20.5%, 20.9% and 5.4% in preschool children, school-age children and NPNL women respectively. The prevalence was higher among children in the slums: 38.1% in preschool children and 27.1% in school-age children. Vitamin A consumption from food was below the RDA in all the population groups surveyed. Most of the vitamin A (60-77%), across the population groups studied came from the plant sources (beta-carotene), which is poorly bio-available in the body. Higher bio-available vitamin A from animal sources (retinol) constitutes only a meagre percentage of total consumption. Coverage of vitamin A supplementation in preschool children was 77%: 87% and 76% among the "richest" and "poorest" quintile.

5.2 Anemia and Iron

The prevalence of anemia in preschool children was 33.0%. The prevalence in school-age children was 19.1% and 17.1% in 6-11 and 12-14 year-old children, respectively, and 26% in NPNL women. The prevalence of iron deficiency measured by low ferritin (<12 ng/ml in preschool children; <15 ng/ml in school-age children and the NPNL women) in serum was lower than the widely held assumption. It was 10.7% in preschool children; 7.1 % in NPNL women; 3.9% in school-age children 6-11 years; and 9.5% in children 12-14 years.

The amount of consumption of iron from food is below the RDA in all the population groups studied. The total consumption of iron from food was 41-82% of the RDA across age and sex of the studied population groups. The amount of consumption of heme iron from animal sources, which has higher bio-availability, was a meagre 6-15% of the RDA. Due to a lower consumption of iron from food and the lack of a general food fortification programme, which includes iron, iron deficiency in the population was much lower than expected. It was presumably linked with a high level of iron in the drinking water (groundwater).

5.3 Zinc

The prevalence of zinc deficiency was very high, at 44% in preschool children and 57% in NPNL women. The deficiency was higher in the slums – 52% in preschool children and 66% in NPNL women. The amount of consumption of zinc was well below the RDA. In NPNL women, total consumption was 54.7% of the RDA in the urban cluster and 47% in the slums. Most of the total consumption of zinc comes from plant sources, which is poorly bio-available. Phytate, an inhibitor of zinc absorption in the body that comes from food from plant sources, was high in the foods consumed by Bangladesh population, contributing to a high zinc deficiency.

5.4 Iodine

At the household level, usage of iodized salt (iodine level ≥5 ppm) was 80.3%; the use of adequately iodized salt (iodine level ≥15 ppm) was 57.6%. The estimate of household consumption of "brand" salt was 75.8% at the national level. Around 30.0% of the rural households consumed "open" salt; the consumption of "open" salt was 37.0% and 17.0% in the "poorest" and the "richest" households, respectively. The percentage of retailer salt samples with adequately iodized salt (≥ 20 ppm) was 66.4%. In school-age children, 40.0% had iodine deficiency (UIC below 100.0 µg/l), indicating inadequate iodine in the body. Among NPNL women, 42.1% had iodine deficiency. However, the median of the UIC was 145.7 µg/l and 122.6 µg/l in school-age children and NPNL women, respectively, indicating that, in the population as a whole, iodine nutrition was sufficient. Nevertheless, the poorest quintiles of NPNL women and school-age children were iodine deficient.

The trend of iodine deficiency is rising; 33.8% (2004/05) against 40.0% in school-age children, and 38.6% (2004/05) against 42.1% in NPNL women. The poorest quintiles of the populations were iodine deficient.

5.5 Folate and B_{12}

In NPNL women, the prevalence of folate deficiency was 9.1% and the prevalence of B_{12} deficiency (frank deficiency and marginal deficiency) was 23.0%.

6. Additional Vitamin D Analyses and Calcium Assessment

Introduction: Vitamin D is well known for its crucial role in mineral metabolism and bone growth. It is also essential for the maintenance of calcium homeostasis and bone mineralization. Extreme deficiency of vitamin D in adults causes osteomalacia (Chapuy *et al*., 1992). Vitamin D deficiency causes growth retardation and rickets in children (Holick and Chen, 2008) and osteopenia, osteoporosis and bone fracture in adults (Lanham-New, 2008). It is postulated that a combination of vitamin D insufficiency and low dietary intake of calcium causes rickets in young children (Pettifor, 2004). Vitamin D deficiency in pregnant women has shown to have adverse effects on foetal growth, bone ossification, tooth enamel formation, and neonatal calcium homeostasis (Specker, 1994). Vitamin D deficiency is very likely to occur due to its increasing demand during rapid growth in foetal life, infancy, early childhood and puberty, pregnancy, lactation period and in the geriatric phase (Alfaham *et al*., 1995).

Rationale: Vitamin D deficiency was reported in varying degrees in tropical and subtropical countries among children and women (Atiq *et al*., 1998). National prevalence of rickets in Bangladesh among children aged 1-15 was 1% (*National Rickets Survey*, Bangladesh 2008), with a reported higher prevalence among children aged 1-5 years. However, the consumption of fish, fish products, meat, liver, milk and fortified foods, which are major sources of vitamin D is insufficient in Bangladesh, with no availability of food fortified with vitamin D. Therefore, nutritional vitamin D intake from food is considered low. An inadequate dietary calcium intake mainly based on cereal sources was observed among NPNL women in Bangladesh (Islam *et al*., 2002). The cereal-based diet is known to have high content of phytate that inhibits calcium absorption, which may have an negative effect on vitamin D status and bone metabolism (Clements *et al*., 1987). Traditional avoidance of sun exposure due to wearing veils (*purdah*) in Muslim women or lack of direct exposure to sunshine among Bangladeshi women may attribute to vitamin D deficiency in NPNL women. The study of M.Z. Islam (Islam *et al*., 2002) suggests that vitamin D deficiency and borderline low vitamin D status are common in Bangladeshi women. However, national estimates of vitamin D and calcium status among different population groups – e.g. preschool children, school-age children and NPNL women – were unavailable until now. Upon recommendation from the National Technical Committee for the *National Micronutrient Survey* 2011-12, vitamin D and calcium serum concentration in pre-school children, school-age children and NPNL women were analysed from the remaining samples used for other micronutrients analyses of the *National Micronutrients Survey*.

Objective: To estimate vitamin D and calcium status in three selected population groups, i.e. pre-school-age children, 6-59 months of age (preschool children), school-age children, 6-14 years of age and NPNL women, 15-49 years of age. Specifically the objectives were to:

a) estimate the current prevalence of vitamin D deficiency among preschool children, school-aged children and NPNL women;

b) Assess the current status of calcium deficiency among preschool children, school-aged children and NPNL women.

Sample size: A convenience sample size based on availability of serum samples used for other micronutrients for the *National Micronutrients Survey* 2011-12 was considered for vitamin D and calcium estimation for each of the three population groups i.e. preschool children, school-aged children and NPNL women. A total of 1,649 serum samples was available for analysis of vitamin D and calcium in the 3 target groups (461 samples for preschool children; 557 samples for school-aged children; and 631 samples for NPNL women). An *a posteriori* precision analysis revealed that with a sample size of 461 in preschool children and a prevalence of vitamin D deficiency of 7.5%, based on serum vitamin D level <25.0 nmol/L (Table 6), the precision of the estimate was 6.5%. On the other hand, the precision was 15.4% when prevalence of vitamin D deficiency was estimated at 39.6%, based on serum vitamin D level <50.0 nmol/L (Table 5) in preschool children. Similarly, the precision was 4.2% and 10.5% in school-aged children and 9.4% and 12% in NPNL women, respectively.

Since calcium is closely linked with vitamin D metabolism and both the nutrients are linked with causation of nutritional rickets/osteomalacia and osteoporosis, serum concentration of calcium and vitamin D were measured on the serum samples.

Laboratory analyses of vitamin D and calcium: All the serum samples were analysed for vitamin D and calcium at the Nutritional Biochemistry Laboratory of icddr,b.

Vitamin D

Serum vitamin D_3 was estimated by electrochemiluminiscence immunoassay (ECLIA) on automated Roche immunoassay analyzers, Cobas e601using Vitamin D3 (25-OH) Kit (Cat. no. 03314847190, Roche Diagnostics GmbH, Sandhofer Strasse 116, D-68305 Mannheim, Germany). This assay uses a polyclonal antibody directed against 25-OH vitamin D3. It is a competitive assay that has been standardized against LC-MSMS. Results were determined via a calibration curve, which was generated by vitamin D3 (25-OH) CalSet (Cat. no. 03314855190, Roche Diagnostics).

For internal quality control, commercial quality control material (Elecsys PreciControl Varia, Cat No. 05618860 from Roche Diagnostics) was used. The co-efficient of variation (CV) was 4.9% and 2.7% for control 1 and control 2, respectively.

To assess comparative performances, the Nutritional Biochemistry Laboratory of icddr,b participates in the vitamin D External Quality Assessment Scheme (DEQAS) organized by Imperial College Healthcare NHS Trust, Charing Cross Hospital, London, UK.

Calcium

Calcium was measured by Colorimetric assay (Gindler EM *et al*., 1972) with an endpoint determination and sample blank using a calcium kit (Cat. No. 11489216 216, Roche Diagnostics GmbH, Sandhofer Strasse 116, D-68305 Mannheim, Germany) on an automated clinical chemistry analyzers (Hitachi 902, Roche Diagnostics Mannheim, Germany). Calcium in the sample forms a violet complex with o-cresolphthalein complexone in an alkaline medium. The colour intensity of the purple complex formed is directly proportional to the calcium concentration and is measured photometrically.

For internal quality control, commercial quality control materials, Precinorm U, Cat. No. 10171743 and Precipath U Cat. No. 10171778 (Roche Diagnostics) was used. The co-efficient of variation (CV) was 2.0% and 2.1% for Precinorm U and Precipath U, respectively.

Data processing and analysis: Data for vitamin D and calcium were entered in the main database of the *National Micronutrient Survey* 2011-12 by data entry operators. Data were checked for errors or inconsistency by the investigators before any analysis was performed. Data analyses were performed using the statistical software-Stata 12.0 SE (Statacorp, College station, Texas). The NMS survey database with variables used to assess SES (quintiles), household food security status (four categories) and dietary intake (amount) were used for all analyses disaggregated by these variables. Means and percentages were estimated with a 95% confidence interval (95% CI). All estimates were cluster-adjusted and weighted to represent the results at the population level.

Definition for vitamin D and calcium deficiency: Due to lack of global consensus on the cut-off values for serum vitamin D concentration to classify vitamin D status, analyses were based on two different cut-off values for serum vitamin D levels reflecting vitamin D deficiency for all three groups. The cut-off values used to define vitamin D deficiency were serum vitamin D level <50.0 nmol/L suggested by Institute of Medicine (Ross AC et al. 2011) and serum vitamin D level <25.0 nmol/L used by other surveys, e.g. UK National Diet and Nutrition Surveys (Gregory et al,. 2000; Henderson *et al*., 2002) and studies conducted in Bangladesh (Combs *et al*., 2008; Islam *et al*., 2002).

Calcium deficiency was defined as total serum calcium level <8.8 mg/dL in preschool children and school-aged children and <8.4 mg/dL in NPNL women (Nelson Textbook of Pediatrics, 18th Edition, 2008).

RESULTS:

6.1. VITAMIN D STATUS

6.1.1. Mean Vitamin D Concentration

Table 1 shows the mean serum vitamin D concentration in preschool children, school-aged children and NPNL women; the national means were 56.3, 50.7 and 41.8 nmol/L, respectively. The mean vitamin D concentration was lower among preschool children, school-aged children and NPNL women living in the slum cluster than in the rural and urban clusters; however, the differences among the clusters were not statistically significant.

TABLE 1A: MEAN SERUM VITAMIN D CONCENTRATION AMONG POPULATION GROUPS AND BY CLUSTER

	National		Rural		Urban		Slum	
	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI
	(n=461)		(n=141)		(n=127)		(n=193)	
Preschool children	56.3	50.6, 62.1	56.5	49.1, 63.9	56.2	47.5, 64.9	54.6	48.8, 60.4
	(n=557)		(n=147)		(n=158)		(n=252)	
school-aged children	50.7	46.8, 54.6	51.3	46.3, 56.3	50.3	41.2, 59.4	44.9	39.2, 50.7
	(n=631)		(n=185)		(n=176)		(n=270)	
NPNL	41.8	37.5, 46.2	43.1	37.4, 48.7	38.2	31.5, 45.0	34.2	30.0, 38.4

Tables 2 and 3 show the mean vitamin D concentrations in three population groups disaggregated by household SES and food security status. Although not statistically significant, the mean serum vitamin D concentration was lower in preschool children and higher in school-aged children and NPNL women belonging to the poorest households than in the better-off households. There was no significant difference in the mean vitamin D concentration among households with different food security status in any of the population groups measured (Table 3).

TABLE 2A: MEAN SERUM VITAMIN D CONCENTRATION DISAGGREGATED BY SOCIO-ECONOMIC STATUS

	Poorest		Poorer		Middle		Richer		Richest	
	Mean (nmol/L)	95% CI	Mean (nmol/L)	95% CI	Mean (nmol/L)	95% CI	Mean (nmol/L)	95% CI	Mean (nmol/L)	95% CI
	(n=104)		(n=91)		(n=96)		(n=99)		(n=71)	
Preschool children	52.1	36.8, 67.4	57.4	49.5, 65.4	60.2	52.0, 68.4	55.8	48.3, 63.3	57.5	50.5, 64.5
	(n=93)		(n=106)		(n=114)		(n=132)		(n=112)	
School-aged children	56.7	48.8, 64.6	53.2	47.6, 58.8	49.9	40.1, 59.6	45.3	40.5, 50.2	45.1	38.9, 51.2
	(n=112)		(n=106)		(n=145)		(n=142)		(n=126)	
NPNL women	47.9	35.6, 60.1	43.3	40.2, 46.4	41.6	34.0, 49.2	39.2	33.5, 45.0	34.3	26.4, 42.1

Table 3A: Mean Serum Vitamin D Concentration Disaggregated by Household Food Security Status

	Food-secure		Mildly insecure		Moderately insecure		Severely insecure	
	Mean (nmol/L)	95% CI	Mean (nmol/L)	95% CI	Mean (nmol/L)	95% CI	Mean (nmol/L)	95% CI
	(n=189)		(n=76)		(n=122)		(n=74)	
Preschool children	56.3	52.1, 60.5	53.3	42.2, 64.3	61.9	51.9, 71.9	47.9	33.9, 61.9
	(n=237)		(n=113)		(n=138)		(n=69)	
School-aged children	49.1	43.5, 54.7	50.8	41.5, 60.2	51.9	47.9, 55.8	57.6	48.0, 67.2
	(n=318)		(n=96)		(n=143)		(n=74)	
NPNL women	40.4	36.8, 44.0	40.2	36.2, 44.2	45.9	38.2, 53.5	45.8	21.9, 69.7

Among school-aged children, the mean serum vitamin D concentration was higher in boys (54.2 nmol/L, 95% CI 49, 59.5) than in girls (47.2 nmol/L, 95% CI 41.9, 52.5), although the difference between them was not statistically significant ($p>0.05$). Similarly, prevalence of vitamin D deficiency was lower in boys than in girls (Table 4).

Table 4A: Mean Serum Vitamin D Concentration and Prevalence of Vitamin D Deficiency in School-age Children, Disaggregated by Gender

Gender	National					
	Serum vitamin D concentration, nmol/L		Low serum vitamin D level [<50.0 nmol/L (Ref. IOM)]		Low serum vitamin D level [<25.0 nmol/L (Ref. Gregory J *et.al.*, 2000)]	
	Mean	95% CI	%	95% CI	%	95% CI
Male (n=281)	54.2	49, 59.5	39.3	35.0, 56.1	5.0	0, 11.6
Female (n=276)	47.2	41.9, 52.5	51.6	36.0, 67.2	7.9	1.8, 14.1

6.1.2. Prevalence of Vitamin D Deficiency

As shown in Table 5, the national prevalence of vitamin D deficiency in preschool children, school-aged children and NPNL women was 39.6%, 45.5% and 71.5%, respectively, according to serum vitamin D level cut-off <50.0 nmol/L, compared to 7.5%, 6.5% and 21%, respectively, when the cut-off of <25.0 nmol/L was used (Table 6). The prevalence of vitamin D deficiency was lower in the rural cluster among all three population groups than in the urban and slum clusters, but the differences were not statistically significant.

Table 5A: Prevalence of Vitamin D Deficiency (Serum Vitamin D Level <50.0 nmol/L) in Population Groups and by Cluster

	National		Rural		Urban		Slum	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
	(n=461)		(n=141)		(n=127)		(n=193)	
Preschool children	39.6	24.2, 55.1	38.0	18.0, 57.9	44.6	30.3, 58.9	47.9	34.9, 61.0
	(n=252)		(n=147)		(n=158)		(n=252)	
School-aged children	45.5	35.0, 56.1	41.2	27.4, 55.0	54.2	36.1, 72.2	66.5	53.7, 79.3
	(n=631)		(n=185)		(n=176)		(n=270)	
NPNL women	71.5	59.5, 83.5	70.6	54.8, 86.4	72.4	62.0, 82.7	83.1	75.0, 91.2

TABLE 6A: PREVALENCE OF VITAMIN D DEFICIENCY (SERUM VITAMIN D LEVEL <25.0 NMOL/L) IN POPULATION GROUPS AND BY CLUSTER

	National		Rural		Urban		Slum	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
	(n=461)		(n=141)		(n=127)		(n=193)	
Preschool children	7.5	1.0, 14.0	7.0	0, 15.5	8.9	3.3, 14.6	10.1	3.5, 16.6
	(n=193)		(n=147)		(n=158)		(n=252)	
School-aged children	6.5	2.3, 10.7	4.3	0, 9.5	11.5	4.3, 18.6	14.7	6.8, 22.5
	(n=631)		(n=185)		(n=176)		(n=270)	
NPNL women	21.0	11.5, 30.4	17.1	5.7, 28.6	35.6	21.1, 50.2	31.9	20.2, 43.7

Tables 7 and 8 present the prevalence of vitamin D deficiency defined by serum vitamin D level <50.0 nmol/L and <25.0 nmol/L, respectively, in three population groups disaggregated by quintiles of household SES (NMS 2011-12). The prevalence of vitamin D deficiency was highest among preschool children in the poorest households and lowest among school-aged children and NPNL women in the poorest households compared to households with a higher SES; however, the differences among the households in different quintiles of SES were statistically insignificant (Tables 7 and 8).

TABLE 7A: PREVALENCE OF VITAMIN D DEFICIENCY (SERUM VITAMIN D LEVEL <50.0 NMOL/L) DISAGGREGATED BY SOCIO-ECONOMIC STATUS

	Poorest		Poorer		Middle		Richer		Richest	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI
	(n=104)		(n=91)		(n=96)		(n=99)		(n=71)	
Preschool children	56.4	29.9, 82.9	33.8	12.3, 55.2	39.2	8.7, 69.7	43.2	17.6, 68.7	19.7	3.3, 36.1
	(n=93)		(n=106)		(n=114)		(n=132)		(n=112)	
school-aged children	34.5	6.8, 62.3	35.2	10.0, 60.5	41.4	26.2, 56.5	61.9	51.1, 72.6	67.9	47.2, 88.5
	(n=112)		(n=106)		(n=145)		(n=142)		(n=126)	
NPNL women	55.7	29.5, 81.9	70.3	53.7, 86.9	77.6	65.0, 90.2	72.1	53.7, 90.6	83.7	70.5, 96.9

TABLE 8A: PREVALENCE OF VITAMIN D DEFICIENCY (SERUM VITAMIN D LEVEL <25.0 NMOL/L) DISAGGREGATED BY SOCIO-ECONOMIC STATUS

	Poorest		Poorer		Middle		Richer		Richest	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI
	(n=104)		(n=91)		(n=96)		(n=99)		(n=71)	
Preschool children	15.9	1.1, 30.7	9.0	0, 18.9	1.5	0, 3.1	2.8	0, 7.2	2.3	0, 6.2
	(n=93)		(n=106)		(n=114)		(n=132)		(n=112)	
School-aged children	1.4	0, 3.4	3.8	0, 9.2	8.7	0, 19.8	10.7	0.7, 20.8	10.0	4.1, 15.9
	(n=112)		(n=106)		(n=145)		(n=142)		(n=126)	
NPNL women	15.9	0, 36.6	16.5	3.7, 29.2	21.4	2.2, 40.6	25.5	12.0, 38.9	31.3	13.6, 48.9

Tables 9 and 10 show the prevalence of vitamin D deficiency in the three population groups, disaggregated by household food security status. Among preschool children, the prevalence of vitamin D deficiency from severely insecure households was 64.5%, while it ranged from 34.1% to 37.9% in other households with better food security (Table 9). By contrast, compared to severe and moderately insecure households, the prevalence of vitamin D deficiency was higher in mildly insecure and/or food-secure households among school-aged children and NPNL women; however, the differences among households with different food security status in all population groups were statistically insignificant.

Table 9A: Prevalence of Vitamin D Deficiency (Serum Vitamin D Level <50.0 nmol/L) Disaggregated by Household Food Security Status

	Food-secure		Mildly insecure		Moderately insecure		Severely insecure	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
	(n=189)		(n=76)		(n=122)		(n=74)	
Preschool children	37.9	24.4, 51.3	34.7	7.1, 62.3	34.1	8.6, 59.5	64.5	39.4, 89.5
	(n=237)		(n=113)		(n=138)		(n=69)	
school-aged children	50.2	29.3, 71.1	46.5	25.1, 67.9	40.0	25.0, 54.9	31.8	11.7, 51.9
	(n=318)		(n=96)		(n=143)		(n=74)	
NPNL	75.5	63.8, 87.2	76.8	59.5, 94.1	56.8	30.4, 83.2	65.7	31.6, 99.7

Table 10A: Prevalence of Vitamin D Deficiency (Serum Vitamin D Level <25.0 nmol/L) Disaggregated by Household Food Security Status

	Food-secure		Mildly insecure		Moderately insecure		Severely insecure	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
	(n=189)		(n=76)		(n=122)		(n=74)	
Preschool children	2.2	0, 4.7	16.3	0, 42.2	10.0	0, 22.9	18.6	4.9, 32.3
	(n=237)		(n=113)		(n=138)		(n=69)	
school-aged children	9.5	1.5, 17.5	5.5	0, 12.5	2.3	0, 5.1	6.2	0, 15.5
	(n=318)		(n=96)		(n=143)		(n=74)	
NPNL	21.8	12.6, 30.9	14.1	1.8, 26.5	16.0	0, 35.2	32.5	0, 69.7

6.1.3. Mean Intake of Food from Animal Sources among Groups by Vitamin D Status

Tables 11 and 12 present seven-day mean intake of food from all animal sources and from meat/poultry/fish intake, respectively, broken down by vitamin D deficiency status in the population groups. The amount of animal source food or meat/poultry/fish intake was higher in subjects with serum vitamin D level ≥50.0 nmol/L or ≥25.0 nmol/L than in subjects with lower levels, among preschool children and school-aged children; however, the differences were not statistically significant except among school-aged children when mean intake of animal source food intake was significantly higher in children with vitamin D level ≥25.0 nmol/L compared to vitamin D level <25.0 nmol/L (1,097 g, 95% CI 853, 1,340 against 653 g, 95% CI 472, 834). This trend was less observed in NPNL women, whose amount of food intake from animal sources was lower with vitamin D level ≥50.0 nmol/L than vitamin D level <50.0 nmol/L. However, the differences in intake from animal sources or meat/poultry/fish between groups among NPNL women were not statistically significant.

Table 11A: Seven-Day Mean Intake of Foods from All Animal Sources by Vitamin D Deficiency Status among the Groups

	Animal sources food intake (g)			
	Vit. D deficiency (serum vit. D <50.0 nmol/L)		Vit. D deficiency (serum vit. D <25.0 nmol/L)	
	Yes	No	Yes	No,
	Mean (95% CI)	Mean (95% CI)	Mean (95% CI)	Mean (95% CI)
	(n=200)	(n=261)	(n=37)	(n=424)
Preschool children	618 (308, 928)	811 (583, 1038)	356 (36, 675)	765 (513, 1016)
	(n=303)	(n=254)	(n=58)	(n=499)
School-aged children	842 (702, 983)	1257 (855, 1659)	653 (472, 834)	1097 (853, 1340)*
	(n=462)	(n=169)	(n=155)	(n=476)
NPNL women	1013 (700, 1327)	881 (734, 1029)	908 (445, 1371)	994 (786, 1203)

* The difference between the groups is statistically significant at $p < 0.05$.

Table 12A: Seven-Day Mean Intake of Meat, Poultry and Fish according To Vitamin D Deficiency Status in the Population Groups

	Meat/poultry/fish intake (g)			
	Vit. D deficiency (serum vit. D <50.0 nmol/L)		Vit. D deficiency (serum vit. D <25.0 nmol/L)	
	Yes	No	Yes	No
	Mean (95% CI)	Mean (95% CI)	Mean (95% CI)	Mean (95% CI)
	(n=200)	(n=261)	(n=37)	(n=424)
Preschool children	340 (217, 464)	396 (313, 479)	220 (125, 317)	386 (305, 468)
	(n=303)	(n=254)	(n=58)	(n=499)
School-aged children	577 (495, 658)	683 (486, 880)	446 (339, 554)	648 (520, 775)
	(n=462)	(n=169)	(n=155)	(n=476)
NPNL women	693 (464, 923)	691 (575, 807)	567 (416, 719)	726 (546, 906)

6.2. Calcium Status

6.2.1. Mean Calcium Concentration

Tables 13, 14 and 15 present the national mean serum calcium concentration further disaggregated by different the clusters, SES and household food security status, respectively, among the preschool children, school-aged children and NPNL women. No significant difference in the mean calcium concentration was found in the rural, urban and slum clusters, in the different quintiles of SES, or in households with different food security status in the three population groups.

Table 13A: Mean Serum Calcium Concentration in Population Groups and by Cluster

	National		Rural		Urban		Slum	
	Mean (mg/dL)	95% CI	Mean (mg/dL)	95% CI	Mean (mg/dL)	95% CI	Mean (mg/dL)	95% CI
	(n=461)		(n=141)		(n=127)		(n=193)	
Preschool children	9.1	8.8, 9.5	9.1	8.6, 9.5	9.3	9.1, 9.6	9.5	9.1, 9.8
	(n=557)		(n=147)		(n=158)		(n=252)	
School-aged children	9.3	9.1, 9.5	9.3	9.1, 9.6	9.4	9.1, 9.6	9.1	8.8, 9.5
	(n=631)		(n=185)		(n=176)		(n=270)	
NPNL women	8.9	8.4, 9.3	8.9	8.3, 9.5	8.8	8.4, 9.2	8.7	8.5, 8.9

Table 14A: Mean Serum Calcium Concentration Disaggregated by Socio-economic Status)

	Poorest		Poorer		Middle		Richer		Richest	
	Mean (mg/dL)	95% CI	Mean (mg/dL)	95% CI	Mean (mg/dL)	95% CI	Mean (mg/dL)	95% CI	Mean (mg/dL)	95% CI
	(n=104)		(n=91)		(n=96)		(n=99)		(n=71)	
Preschool children	9.2	9.0, 9.3	9.0	8.6, 9.3	9.1	8.2, 10.0	9.5	9.2, 9.7	9.0	8.3, 9.7
	(n=93)		(n=106)		(n=114)		(n=132)		(n=112)	
School-aged children	9.5	9.1, 9.9	9.3	9.1, 9.5	9.2	8.9, 9.5	9.2	9.1, 9.4	9.3	8.9, 9.7
	(n=74)		(n=106)		(n=145)		(n=142)		(n=126)	
NPNL women	8.9	8.7, 9.2	8.8	8.2, 9.4	8.8	8.0, 9.6	9.0	8.4, 9.6	8.7	8.3, 9.2

Table 15A: Mean Serum Calcium Concentration Disaggregated by Household Food Security Status

Population groups	Food-secure		Mildly insecure		Moderately insecure		Severely insecure	
	Mean (mg/dL)	95% CI	Mean (mg/dL)	95% CI	Mean (mg/dL)	95% CI	Mean (mg/dL)	95% CI
	(n=189)		(n=76)		(n=122)		(n=74)	
Preschool children	8.9	8.4, 9.5	9.3	9.1, 9.6	9.5	9.2, 9.7	9.1	8.9, 9.4
	(n=237)		(n=113)		(n=138)		(n=69)	
School-aged children	9.2	9.1, 9.4	9.3	9.0, 9.5	9.5	9.2, 9.8	9.3	9.0, 9.6
	(n=318)		(n=96)		(n=143)		(n=74)	
NPNL women	8.8	8.2, 9.4	8.8	8.4, 9.3	9.2	8.8, 9.5	8.8	8.5, 9.2

6.2.2. Prevalence of Calcium Deficiency

The national prevalence of calcium deficiency among preschool children, school-aged children and NPNL women was 24.4%, 17.6% and 26.3%, respectively (Table 16). The prevalence of calcium deficiency in preschool children was higher in the rural cluster than the urban and slum clusters and the prevalence was higher in the slums among school-aged children. However, the differences among clusters were not statistically significant. In NPNL women, the prevalence calcium deficiency was similar across the clusters.

Table 16A: Prevalence of Calcium Deficiency by Population Groups and Cluster *

	National		Rural		Urban		Slum	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
	(n=461)		(n=141)		(n=127)		(n=193)	
Preschool children	24.4	9.7, 39.1	26.8	7.7, 45.9	15.9	7.3, 24.5	16.4	5.1, 27.7
	(n=557)		(n=147)		(n=158)		(n=252)	
School-aged children	17.6	10.7, 24.5	15.5	6.7, 24.4	21.5	10.1, 33.0	28.0	15.2, 40.8
	(n=631)		(n=185)		(n=176)		(n=270)	
NPNL women	26.3	6.8, 45.8	26.5	1.0, 52.0	25.2	9.1, 41.3	26.2	15.1, 37.3

***Note**: Calcium deficiency was defined as serum calcium level <8.8 mg/dL for preschool and school-age children, and <8.4 mg/dL for NPNL women.

Tables 17 and 18 present the prevalence of calcium deficiency disaggregated by SES and household food security status, in the three population groups. The prevalence of calcium deficiency was lowest in preschool children and NPNL women from the poorest households and highest among NPNL women from the richest households (Table 17). As shown in Table 18, the prevalence of calcium deficiency from food-secure households among preschool children, school-aged children and NPNL women was 34.2%, 21.6% and 29.8%, respectively, which was higher than the prevalence of calcium deficiency in mildly, moderately or severely food-insecure households (Table 18). However, differences in the prevalence of calcium deficiency in households with different SES or food security status were not statistically significant in any of the population groups.

Table 17A: Prevalence of Calcium Deficiency Disaggregated by Socio-economic Status*

	Poorest		Poorer		Middle		Richer		Richest	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI
	(n=104)		(n=91)		(n=96)		(n=99)		(n=71)	
Preschool children	12.1	2.2, 21.9	36.4	11.1, 61.6	25.0	0, 54.6	13.3	2.0, 24.7	32.7	0, 65.3
	(n=93)		(n=106)		(n=114)		(n=132)		(n=112)	
School-aged children	14.0	1.8, 26.1	10.1	1.4, 18.7	21.2	0, 41.9	25.2	14.7, 35.6	21.4	5.7, 37.1
	(n=112)		(n=106)		(n=145)		(n=142)		(n=126)	
NPNL women	14.9	2.9, 26.9	31.4	0, 66.4	23.4	6.0, 40.8	21.9	7.7, 36.0	38.7	0, 78.9

***Note:** Calcium deficiency was defined as serum calcium level <8.8 mg/dL for preschool and school-age children, and <8.4 mg/dL for NPNL women.

Table 18A: Prevalence of Calcium Deficiency Disaggregated by Household Food Security Status*

	Food-secure		Mildly insecure		Moderately insecure		Severely insecure	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
	(n=189)		(n=76)		(n=122)		(n=74)	
Preschool children	34.2	9.4, 59.1	15.4	3.6, 27.3	10.0	1.4, 18.1	17.4	4.4, 30.4
	(n=237)		(n=113)		(n=138)		(n=69)	
School-aged children	21.6	10.6, 32.7	14.7	0, 29.0	13.3	0, 30.7	14.0	0, 27.2
	(n=318)		(n=96)		(n=143)		(n=74)	
NPNL women	29.8	6.1, 53.6	29.6	0, 61.0	14.1	0, 27.8	20.8	13.7, 27.9

***Note:** Calcium deficiency was defined as serum calcium level <8.8 mg/dL for preschool and school-age children and <8.4 mg/dL for NPNL women.

6.3 Key Findings

Prevalence of vitamin D deficiency

- At the national level, the prevalence of vitamin D deficiency (based on serum vitamin D level <50.0 nmol/L) in pre-school-age children (preschool children) was 39.6%, without a significant variation among rural, urban and slum clusters.
- In preschool children, no significant variation in the prevalence of vitamin D deficiency was observed among different quintiles of SES.
- In preschool children, no significant variation in the prevalence of vitamin D deficiency was observed among households with different food security status.
- At the national level, the prevalence of vitamin D deficiency (based on serum vit. D level <50.0 nmol/L) among school-age children was 45.5%, without any significant variation among the rural, urban and slum clusters.
- In school-aged children, no significant variation was observed in the prevalence of vitamin D deficiency among different quintiles of SES.
- No significant variation in the prevalence of vitamin D deficiency was observed among households with different food security status in school-aged children.
- In NPNL women, the prevalence of vitamin D deficiency (based on serum vit. D level <50.0 nmol/L) was 71.5% at the national level, without any significant variation among rural, urban and slum clusters.
- In the NPNL women, no significant variation was observed in the prevalence of vitamin D deficiency among different quintiles of SES.
- No significant variation in the prevalence of vitamin D deficiency was observed among households with different food security status in NPNL women.

Prevalence of calcium deficiency

- At the national level, the prevalence of calcium deficiency among pre-school-age children was 24.4%, without any significant variation among rural, urban and slum clusters.
- No significant variation was observed in the prevalence of calcium deficiency in the different SES quintiles or in households with different food security status in the preschool children.
- At the national level, the prevalence of calcium deficiency among school-age children was 17.6%, without any significant variation among the rural, urban and slum clusters.
- No significant variation was observed in the prevalence of calcium deficiency among different SES quintiles or among households with different food security status in school-aged children.
- At the national level, in NPNL women, the prevalence of calcium deficiency was 26.3%, without any significant variation among the rural, urban and slum clusters.
- No significant variation was observed in the prevalence of calcium deficiency in different quintiles of SES or among households with different food security status in NPNL women.

References

Alfaham M, Woodhead S, Pask G, Davies D. Vitamin D deficiency: a concern in pregnant Asian women. Br J Nutr. 1995; 73: 881–887.

Ali SMK, Pramanik MMA. Conversion factors and Dietary Calculations. Dhaka, Bangladesh: Institute of Nutrition and Food Science, University of Dhaka, 1991

Andersson M, Karunbunathan V, Zimmermann V. Global iodine status in 2011 and the trends over the past decade. J. Nutr. 2012; 142: 744–750.

Arsenault JE. The current high prevalence of dietary zinc inadequacy among children and women in rural Bangladesh could be substantially ameliorated by zinc biofortification of rice. J. Nutr. 2010; 140: 1683–1690.

Atiq M, Suria A, Nizami SQ, Ahmed I. Vitamin D status of breastfed Pakistani infants. Acta Paediatr. 1998 (7); 87: 737-740.

Bangladesh Bureau of Statistics and UNICEF. Anemia prevalence survey of urban Bangladesh and rural Chittagong Hill tracts. Bangladesh; 2003.

Bangladesh Bureau of Statistics. Bangladesh Household Income and Expenditure Survey; 2010.

Brubacher GB and Weiser H. The vitamin A activity of beta-carotene. International Journal of Vitamin and Nutrition Research. 1985; 55(1):5-15.

Chapuy MC, Arlot ME, Duboeuf F, Brun J, Crouzet B, Arnaud S . Vitamin D3 and calcium to prevent hip fractures in elderly women. New Engl J Med. 1992; 327: 1637 – 1642.

Chen PP, Short TG, Leung DH, Oh TE. A clinical evaluation of the hemocuehemoglobinometer using capillary, venous andarterial samples. Anaesth Intensive Care. 1992; 20:497-500.

Clements MR, Johnson L, Fraser DR. A new mechanism for induced vitamin D deficiency in calcium deprivation. Nature. 1987; 325: 62 – 65.

Coates J, Swindale A, Bilinsky P. Household Food Insecurity Access Scale (HFIAS) for Measurement of Food Access: Indicator Guide. version 3: FANTA; 2007.

Combs GF Jr, Hassan N, Dellagana N, Staab D, Fischer P, Hunt C,Watts J. Apparent efficacy of food-based calcium supplementation in preventing rickets in Bangladesh. Biol Trace Elem Res. 2008; 121:193–204.

Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc. Institute of Medicine. National Academy Press, Washington, D.C.: IOM; 2002.

Driskell WJ, Neese JW, Bryant CC, Bashor MM. Measearment of vitamin A and vitamin E in human serum by high-performance liquid chromography. J Chromatogr 1982 Sep 10; 231 (2):439-44.

Eneroth H, El Arefeen S, AkePersson L, Lonnerdal B, Hossain B, Stephensen C Maternal multiple micronutrient supplementation has limited impact on micronutrient status of Bangladeshi infants compared with standard iron and folic acid supplementation. J. Nutr. 2010; 140: 618–624.

Engle-Stone R, Haskell MJ, Ndjebayi AO, Nankap M, Erhardt JG, Gimou M-M. Plasma retinol-binding protein predicts plasma retinol concentration in both infected and uninfected Cameroonian women and children. J. Nutr. doi: 10.3945/jn.111.145805.

Faruque AS, Khan AI, Malek MA, Huq S, Wahed MA, Salam MA, Fuchs GJ, Khaled MA. Childhood anemia and vitamin a deficiency in rural Bangladesh. Southeast Asian J Trop Med Public Health 2006 Jul; 37(4):771-7.

Gindler EM, King JD. Rapid colorimetric determination of calcium in biologic fluids with methylthymol blue. Am J Clin Pathol. 1972; 58:376-382.

Government of Bangladesh. Population census – 2001, National series Vol. 1, Analytical report 2007. Bangladesh Bureau of Statistics, Planning Division, Ministry of Planning,

Gregory J, Lowe S, Bates CJ, Prentice A, Jackson LV, Smithers G. National Diet and Nutrition Survey of People Aged 4–18 Years. vol. 1. Report of the Diet and Nutrition Survey. London: The Stationery Office; 2000.

Halksworth G, Moseley L, Carter K, Worwood M. Iron absorption from Spatone (a natural mineral water) for prevention of iron deficiencyin pregnancy. Clin Lab Haematol. 2003; 25:227–31.

Hallberg L. Bioavailability of dietary iron in man. Annu Rev Nutr. 1991; 1:123–47.

Harun-or-Rashid, UH, Khatun F, Yoshida Y, Morita S, Chowdhury N, Sakamoto J. Iron and iodine deficiencies among under two children, adolescent girls, and pregnant women of Bangladesh: Association with common diseases**.** Nagoya J. Med. Sci. 2009; 71: 39 - 49.

Helen Keller International and Institute of Public Health Nutrion. Vitamin A Status throughout the Life Cycle in Rural Bangladesh; National Vitamin A Survey 1997-98; Helen Keller International, 1999.

Henderson L, Gregory J, Swan G. National diet and nutrition survey: adults aged 19–64 years. vol. 1: types and quantities of foods consumed. London: The Stationery Office; 2002.

Hickenbottom SJ. Dual isotope test for assessing beta-carotene cleavage to vitamin A in humans. European Journal of Nutrition. 2002 Aug; 41(4):141-147.

Holick MF, Chen TC. Vitamin D deficiency: a worldwide problem with health consequences. Am J Clin Nutr. 2008; 87(suppl): 1080S– 6S.

International Zinc Nutrition Consultative Group Technical Document #1; Food and Nutrition Bulletin. 2004; 25(suppl 2).

Islam MZ, lamberg-Allardt C, Karkkainen M, Outila T, Salamatullah Q, Shamim AA. Vitamin D deficiency: a concern in premenopausal Bangladeshi women of two socio-economic groups in rural and urban region. Eur J Clin Nutr. 2002 Jan; 56(1):51-6.

Islam N, Mahbub A, Nazem NI, Angeles G, Lance P. Slum of Urban Bangladesh: Mapping and Census, 2005. Centre for Urban Studies, MEASURE Evaluation, NIPORT; May 2006.

Islam SN. A Food composition database for Bangladesh with special reference to selected ethnic foods. National Food Policy Capacity Strengthening Programme, USAID; November 2010.

Khambalia, A,, O'Connor, D, Zlotkin S. Periconceptional iron and folate status is inadequate among married, nulliparous women in rural Bangladesh. J. Nutr. 2009; 139: 1–6.

Kinniburgh DG, Smedley PL. Arsenic contamination of groundwater in Bangladesh. 1st vol. Summary. British Geologic Survey Report WC/00/19. British Geologic Survey. Keyworth (UK): 2001.

Kongsbak K, Wahed MA, Friis H, Thilsted SH. Acute phase protein levels, T. trichiura, and maternal education are predictors of serum zinc in a cross-sectional study in Bangladeshi children. J Nutr. 2006 Aug; 136(8):2262-8.

Lanham-New SA. Importance of calcium, vitamin D and vitamin K for osteoporosis prevention and treatment. Proceedings of the Nutrition Society 2008; 67:163–176.

Lindstrom E, El Arefeen S, Raqib R, Lonnerdal B, Hossain B, Ekstrom EC, Acta Obstetricia et Gynecologica Scandinavica. 2011; 90: 47–56.

Looker AC, Dallman PR, Carroll MD, Gunter EW, Jhonson CI. Prevalence of iron deficiency in the United States. JAMA 1997 Mar 26; 277 (12):973-6.

Merrill RD, Labrique AB, Shamim AA, Schulze KJ, Christian PK, West KP Jr. Elevated and variable groundwater iron in rural northwestern Bangladesh. J Water Health. 2010; 8:818–25.

Merrill RD, Shamim, Hasmot Ali H, NusratJahan, Labrique AB, Schultz K, et al. Iron Status of Women is Associated with the Iron Concentration of Potable Groundwater in Rural Bangladesh. J Nutr. 2011.

Merrill R. Iron in Groundwater: A source for anemia prevention. Vitamin and Trace Elements. 2012;1:3.

Mitra and Associate and Macro International. Bangladesh demographic and health survey. National Institute of Population Research and Training (NIPORT); 2007.

Mitra and Associate and Macro International. Bangladesh demographic and health survey.. National Institute of Population Research and Training (NIPORT);2011

Morris SS, Ruel MT, Cohen RJ, Dewey KG, de la Brière B, Hassan MN. Precision, accuracy, and reliability of hemoglobin assessment with use of capillary blood**.** Am J ClinNutr.1999; 69:1243–8.

National Rickets Survey, Bangladesh 2008. Health and Science Bulletin 2009; vol. 7 (1) icddr,b.

National Survey on Iodine Deficiency Disorder and Universal Salt Iiodization in Bangladesh 2004-5.

Nelson Textbook of Pediatrics. 18th Edition. 2008.

Novotny JA, Harrison DJ, Pawlosky R, Flanagan VP, Harrison EH, Kurilich AC. b-Carotene Conversion to Vitamin A Decreases as the dietary dose increases in humans. J Nutr 2010; 140(5): 915–918.

Nutritional Surveilance Project (NSP) 2001, HKI/IPHN.

Patro BK, Saboth P, Zodpey S, Shukla A, Karmarkar MG, Pandav CS. Tracking progress toward elimination of iodine deficiency disorders in jaarkhand, India. Ind J Comm Med 2008; 33(3):182-85.

Pettifor JM. Nutritional rickets: deficiency of vitamin D, calcium, or both? Am J Clin Nutr. 2004; 80(suppl):1725S–9S.

Ranganathan S. Karmarkar MG. Estimation of iodine in salt fortified with iodine & iron. Indian J Med Res. 2006 Apr; 123(4):531-40.

Roberts LC, Hug SJ, Dittmar J, Voegelin A, Saha GC, Ali MA. Spatial distribution and temporal variability of arsenic in irrigated rice fields in Bangladesh. 1. Irrigation water. Environ Sci Technol. 2007; 41:5960–6.

Ross AC, Taylor CL, Yaktine AL, Del Valle HB, Editors. Committee to Review Dietary Reference Intakes for Vitamin D and Calcium; Chapter 5. Dietary reference intakes for adequacy: Calcium and Vitamin D. Institute of Medicine, National Academy of Sciences (USA); 2011.

Solomons NW. Plant sources of provitamin A and human nutriture: How much is still too little? Nutrition Reviews 1999 Nov; 57(11):350-361.

Specker BL. Do North American women need supplemental vitamin D during pregnancy or lactation? Am J Clin Nutr. 1994; 59: S484 – S491.

Tang G, Qin J, Dolnikowski GG, Russell RM. Vitamin A equivalence of beta-carotene in a woman as determined by a stable isotope reference method. European Journal of Nutrition. 2002 Feb; 39(1):7-11.

Thurnham DI, McCabe LD, Haldar S, Wieringa FT, Northrop-Clewes CA, McCabe GP. Adjusting plasma ferritin concentrations to remove the effects of subclinical inflammation in the assessment of iron deficiency: a meta-analysis. Am J Clin Nutr. 2010; 92:546–55.

World Health Organization. Department of Nutrition for Health and Development. Assessment of iodine deficiency disorders and monitoring their elimination: A guide for programme managers. WHO Geneva, Switzerland; 2001.

World Health Organization. Iron deficiency anemia, Assessment, Prevention, and Control: A guide for programme managers; 2001 WHO/NHD/01.3.

Xiaoyan Z, Hong Y, Yuan X, Shaonong D, Bianba Z, Duolao W. Evaluation of a portable haemoglobin photometer in pregnant women in a high altitude area: a pilot study. BMC Public Health. 2009; 9:228.

7. Annexes

7. 1 Biochemical Assessment

7.1.1 Determination of Serum Retinol

A single aliquot of serum was assigned to retinol determination and kept at -70 °C until analysis. Serum retinol concentration was determined using high-performance liquid chromatography (HPLC) (Driskell, 1982). An aliquot of serum was de-proteinized with methanol containing 50% retinyl acetate as the internal standard, and retinol was then extracted into hexane. The hexane layer was transferred to a clean vial, evaporated under nitrogen, re-dissolved in a mobile phase (95% methanol), and injected into an HPLC column. Three plasma pool samples with assigned value set against standard serum from the National Institute of Science and Technology (NIST) were run with each set of samples, and the concentration of retinol was calculated based on known concentration of retinol in the pool samples.

Quality control (QC): For quality control, SRM 968c (Source: NIST) and a pooled serum sample was used. The Nutritional Biochemistry Laboratory participated in the latest Vital EQA Program of CDC for serum retinol.

Threshold for vitamin A deficiency: Serum retinol concentrations <0.7 µmol/L defining the subclinical deficiency and serum retinol concentrations <0.35 µmol/L defining the severe deficiency.

7.1.2 Anemia (Hemoglobin)

Hemoglobin was assessed by the HemoCue technique. HemoCue equipment was supplied by UNICEF. Hemoglobin was measured by the HemoCue machine (HemoCue, Angelholm, Sweden) directly from the gently mixed venous blood sample collected in the blood collection tube. A drop of the collected blood was placed onto a coverslip, and the microcuvette was held onto it, to allow for the capillary action to fill in the microcuvette. The HemoCue technique is based on an optical measuring cuvette of small volume and a short light path. The cuvette cavity contains reagents deposited on its inner walls; the blood sample is drawn into the cavity by capillary force and is spontaneously mixed with the reagents. The cuvette is then placed in a HemoCue photometer in which the absorbance is measured, and the hemoglobin level is calculated. Thus, the technique makes it possible to sample the blood, mix it and chemically react it with the reagents in the same cuvette. The reaction in the cuvette is a modified azide methemoglobin reaction. The erythrocyte membranes are disintegrated by sodium desoxycholate releasing the hemoglobin. Sodium nitrite converts the hemoglobin iron from the ferrous to the ferric state to form methemoglobin, which then combines with azide to form azide-methemoglobin. The survey team was adequately trained in this technique for appropriate application in the field. Hemoglobin readings were recorded directly in the field and shared with the survey participants.

The threshold for defining anemia was determined according to Table 100.

Table 100: Cut-off Values for Anemia according to the 2011 World Health Organization Recommendations

Population group	Anemia
Preschool children (6-59 months)	<110 g/L
School-aged children (5-11 years)	<115 g/L
School-aged children (12-14 years)	<120 g/L
NPNL women	<120 g/L

7.1.3 Ferritin (iron deficiency), and C-reactive protein (CRP), Alpha-1-Acid Glycoprotein (AGP) (inflammatory markers)

Serum ferritin was determined by electrochemiluminescence immunoassay (ECLIA) using automated immune chemistry analyzer cobas e601. It had been standardized against the Elecsys Ferritin assay. The Elecsys Ferritin assay had been standardized against the Enzymun-Test Ferritin method. This in turn had been standardized against the 1st International Standard (IS), National Institute for Biological Standards and Control (NIBSC) "Reagent for Ferritin (human liver)" 80/602. CRP and AGP in human serum was determined immunoturbidometrically on Roche-automated clinical chemistry, analyzer Hitachi 902 (Boehringer Mannheim, Germany). Human CRP agglutinates with latex particles coated with monoclonal anti-CRP antibodies. The precipitate is determined turbidmetrically at 570 nm. Anti-AGP antibodies react with AGP in the sample to form an antigen-antibody complex. Following agglutination, the precipitate was measured turbidimetrically. AGP concentration is proportional to the amount of turbidity formed. For quality control, commercially available QC materials were used (Precinorm Protein and Precipath Protein) from Roche Diagnostics.

Quality Control: For quality control, Precinorm Protein and Precipath Protein were used (Source: Roche Diagnostics GmbH D-68298 Mannheim, Germany). The Nutritional Biochemistry laboratory participated in the Vital EQA program of the U.S. Center for Disease Control and Prevention (CDC) for serum ferritin and CRP. Mean and SD were measured by analysing each QC material in ten replicates within same day and established a quality control chart by using mean±2SD. When the results of QC material during regular analysis fell outside ±2SD, corrective measures were taken.

Thresholds for iron deficiency: Iron deficiency was defined as a ferritin level of <12 ng/ml in children under 5 and <15 ng/ml in older children and adults (WHO 2001). Biochemical evidence of inflammation was defined as a CRP level of >10 mg/L and/or AGP >1 g/L (Looker, 1997).

7.1.4 Zinc

Principle: Serum zinc was estimated by atomic absorption spectrophotometry (AAS). Atomic absorption is a physical process involving the absorption of light by the free atoms at a wavelength specific to that element. Flame Atomic Absorption Spectrophotometry (Shimadzu-7000) was used.

Sample preparation: Samples were diluted with deionized water without deproteinization or adding any other reagents.

Precautions: Haemolyzed serum samples or any blood cells present in the serum was avoided.

Quality control: Bi-level serum trace element control was provided from the UTAK Laboratories Inc. USA. Normal and high was used as a check for both accuracy and precision. Pooled serum was also used in every day as internal quality control. One or more working standard solutions were run at intervals to check drifting. Duplication assays were also carried out to watch for precision.

7.1.5 Folate

The serum sample was analysed for folate using an electrochemiluminescence immunoassay (Roche kit). The analyzer was Cobas 6000. The serum was incubated with the folate pre.treatment reagents to release bound folate from endogenous folate binding proteins. Then, the pre-treated sample was incubated with the ruthenium labelled folate binding protein and a folate complex was formed, the amount of which was dependent upon the analyte concentration in the sample. Next, streptavidin-coated microparticles and folate labelled with biotin were added, and the unbound sites of the ruthenium-labelled folate-binding protein was occupied, with formation of a ruthenium-labelled folate-binding protein-folate biotin complex. The entire complex was bound to the solid phase via interaction of biotin and streptavidin. The reaction mixture was then aspirated into the measuring cell where the microparticles were magnetically captured onto the surface of the electrode. Unbound substances were washed away and application of a voltage to the electrode induced chemiluminescent emission, which was measured by a photomultiplier. Results were determined via a calibration curve.

Quality control: A pooled serum sample was used which was prepared in the nutritional biochemistry lab. Elecsys PreciControl anemia 1, 2 and 3 (Roche Diagnostics). Mean and SD were established by analysing each QC material in ten replicates within the same day and a quality control chart was established by using mean ± 2SD (Roche kits). The Nutritional Biochemistry laboratory participated in the Vital EQA Program of the CDC for serum folate.

Threshold for folate deficiency: <6.8 nmol/l (Lindstorm *et al.,* 2011).

7.1.6 Vitamin B_{12}

The serum sample was analysed for vitamin B_{12} using the Electrochemiluminescence immunoassay method (Roche kit). The analyzer was Cobas 6000. Serum was incubated with vitamin B_{12} pre-treatment reagent to release bound vitamin B_{12}. By incubating the pre-treated sample with the ruthenium labelled intrinsic factor, a vitamin B_{12}-binding protein complex was formed, the amount of which was dependent upon the analyte concentration in the sample. After addition of streptavidin-coated microparticles and vitamin B_{12} labelled with biotin, the still-vacant sites of the ruthenium labelled intrinsic factor became occupied, with formation of a ruthenium labelled intrinsic factor-vitamin B_{12} biotin complex. The entire complex became bound to the solid phase via interaction of biotin and streptavidin. The reaction mixture was aspirated into the measuring cell where the microparticles were magnetically captured onto the surface of the electrode. Unbound substances were then removed with ProCell. Application of a voltage to the electrode then induced a chemiluminescent emission, which was measured by a photomultiplier. Results were determined via a calibration curve which was instrument-specifically generated by 2-point calibration, and a master curve provided via the reagent barcode.

Quality control: Elecsys PreciControl anemia 1, 2 and 3 were used for QC. Additionally, pooled serum samples were used as internal quality control. The Nutritional Biochemistry laboratory participated in the CDC's Vital EQA Program for serum vitamin B_{12}.

Threshold for vitamin B_{12} deficiency: <200 pmol/l (Lindstorm *et al.,* 2011)

7.1.7 rinary Iodine

3-5 ml urine was collected and stored at -20 ˚C. The samples were transported to the nutritional biochemistry lab at icddr,b. Urinary iodine was measured by microplate method based on the Sandell–Kolthoff reaction. Urine was digested in a microplate at 110°C for 60 minutes using a specially designed sealing cassette to prevent loss of vapour and cross-contamination among wells. After the digestion, mixture was transferred to a transparent microplate and the Sandell–Kolthoff reaction was performed at 25 °C for 15 minutes; urinary iodine was measured by a microplate reader at 405 nm.

Quality control: The Nutritional Biochemistry Laboratory participated in Ensuring the Quality of Iodine Procedures (EQUIP), a standardization programme that addresses laboratory quality-assurance issues related to testing for iodine deficiency.

Threshold for iodine deficiency: Deficiency of a population will be defined as a median urinary iodine excretion level of < 100 µgram/L.

7.1.8 Estimation of Iodine Content in Salt

The iodine content in iodated salt was estimated by titrimetric procedure known as iodometric titration (Ranganathan, 2006). In this reaction, free iodine reacts with sodium thio-sulphate solution to give a light yellow colour complex. This colour complex combines with soluble chemical starch, which indicates the presence of sodium iodide.

Table 101: Definition of Iodization of Salt and Adequacy of Iodization

Type of salt	Iodized salt (ppm)	Adequately iodized salt (ppm)
Household	≥5*	≥15
Retailer	≥5	≥20
*Presence of iodine at < 5 ppm in salt (Patro, 2008)		

Annex 7.2: Sample size

Table 102: Hypothetical Sample Size Calculated to Detect Desired Changes in the Prevalence of Vitamin A*

Target group	Indicator	Survey 1 (%)	Survey 2 (%)	Minimum number of individuals in 1 cluster	Minimum number of individuals in all clusters	% of target popul-ation	Households in 1 cluster	House-holds in 3 clusters
Preschool children	Low serum retinol	25	20	2155	6465	10.5	4409	13227
NPNL women	Low serum retinol	5	2	1158	3474	25.8	965	2895
School-age children	Low serum retinol	25	20	2155	6465	26	1781	5343

*Notes: Sample size adjusting for the wesign effect of 2.0 and household response of 95%.

Table 103: Actual Sample Size Used for the Survey to Detect Changes in the Prevalence of Vitamin A Deficiency*

	Number of individuals with complete data				P value	
Target group	Indicator	% households target group recruited	1 cluster	All clusters	1 cluster	All clusters
Preschool children	Low serum retinol	100%	392	1 176	0.236	0.040
NPNL women	Low serum retinol	33%	318	954	0.146	0.012
School-age children	Low serum retinol	50%	485	1 455	0.187	0.022

*Notes: Number of households that were visited was limited to 3,000 or less; actual p values obtained for each target group for difference in the prevalence of vitamin A deficiency between the baseline and follow-up surveys.

Table 104: Hypothetical Sample Size for Other Indicators (Anemia, Iron, Folate and Vitamin B_{12} Deficiencies)*

Target group	Indicator	Estimated prevalence	Precision in 1 cluster (± x %)	Minimum sample in 1 cluster	Minimum sample in all clusters	% of target population	Number of households in 1 cluster	Number of households in 3 clusters
Preschool children	Anemia	50	±10	241	723	10.5	494	1482
	Iron deficiency	50	±10	241	723		494	1482
NPNL women	Anemia	50	±10	241	723	25.8	201	603
	Iron deficiency	50	±10	241	723		201	603
	Folate deficiency	25	±5	721	2 163		601	1 803
	B_{12} deficiency	50	±7	490	1 470		408	1 224
School-age children	Anemia	41	±7	475	1 425	26	393	1 092
	Iron deficiency	22	±7	337	1 011		279	837

*Notes: Sample size adjusting for the design effect of 2.0 and household response of 95%.

Table 105: Actual Sample Size for Other Indicators (Anemia, Iron, Folate and Vitamin B_{12} Deficiencies)*

Number of target group with data					Confidence intervals	
Target group	Indicator	% households target group recruited	1 cluster	All clusters	1 cluster	All clusters
Preschool children	Anemia Iron deficiency	50%	196	588	±9.9 ±9.9	±5.7 ±5.7
NPNL women	Anemia Iron deficency Folate deficiency B_{12} deficiency	33%	318	954	±7.8 ±7.8 ±6.7 ±7.8	±4.5 ±4.5 ±3.9 ±4.5
School-age children	Anemia Iron deficiency	50%	485	1,455	±6.2 ±5.2	±3.6 ±3.0

*Notes: Taking into consideration of limiting the number of households to visit under 3000; actual confidence intervals obtained for each target group.

Table 106: Actual Sample Size for the Prevalence of Zinc Deficiency*

Population	P	z	d	PQZ^2	Design effect	Adjustment for non-response	Population %	N=1 clusters	N=3 clusters	Adjusted sample in 3 clusters
Preschool children	0.22	1.96	0.07	0.659	2	1.2	0.10	323	969	1 050
NPNL women	0.73	1.96	0.06	0.757	2	1.2	0.25	505	1514	1 500
Total										2 550

*Notes: Sample size adjusted for a design effect of 2 and individual non-response of 20%; taking into consideration of limiting the number of households to visit under 3000.

Table 107: Actual Sample Size Required for Assessing Iodine Deficiency and Coverage of USI*

Target group	Indicator	Estimated prevalence	Precision in 1 cluster (± x%)	Minimum sample in 1 cluster	Minimum sample in all clusters	% of target population	No. of households in 1 clusters	No. of households in 3 clusters
NPNL women	UIE<100	39	±7	467	1,401	25.8	389	1,167
School-aged children	UIE<100	34	±7	440	1,320	26	364	1,092
Household	KAP on iodine "good health"	29.3	±6	NA	NA	NA	466	1,398
	KAP on iodine "prevents goiter"	24.6	±6	NA	NA	NA	417	1,251
	Purchase of iodized salt	69	±6	NA	NA	NA	481	1,443
	Adequacy of iodization in salt (≥15 ppm)	51	±6	NA	NA	NA	562	1,686
Retailer (assume 95% response)	KAP on iodine ("good health")	38.8	±8	301	903	NA	NA	NA
	KAP on iodine ("prevents goiter")	38.5	±8	300	900	NA	NA	NA
	Sale of iodized salt	41	±6	544	1,632	NA	NA	NA
	Adequacy of iodization in salt (≥20 ppm)	53.3	±10	202	606	NA	NA	NA

*Notes: Sample size adjusted for a design effect of 2, household response rate of 95% and individual response of 80%; taking into consideration of limiting the number of households to visit under 3000.

Annex 7.3 Standard Errors for Selected Variables Calculated from the Data Analysis

Table 108: Standard Errors for Selected Estimates

	Estimate	Value	Standard error (SE)
Number of household members			
National	Mean	4.67	0.07
Rural	Mean	4.70	0.08
Urban	Mean	4.58	0.11
Slum	Mean	4.47	0.10
Religion			
Islam	Percentage	0.89	0.028
Hinduism	Percentage	0.08	0.026
Buddhism	Percentage	0.004	0.003
Christianity	Percentage	0.012	0.008
Ethnic group			
Bangalee	Percentage	0.98	0.009
Chakma	Percentage	0.004	0.003
Marma	Percentage	0.007	0.007
Garo	Percentage	0.0004	0.0004
Saotal	Percentage	0.002	0.002
Other	Percentage	0.003	0.003
Has electricity	Percentage	0.687	0.046
Owns a mobile phone	Percentage	0.783	0.02
Monthly household expenses (*taka*)			
National	Mean	8943	369
Rural	Mean	8392	362
Urban	Mean	11005	1019
Slum	Mean	8778	333
Per capita oil consumption per day (gm)	Mean	24.4	1.16
Prevalence of anemia in preschool children			
National	Percentage	0.33	0.03
Rural	Percentage	0.37	0.04
Urban	Percentage	0.23	0.049
Slum	Percentage	0.22	0.039
Prevalence of iron deficiency in preschool children			
National	Percentage	0.107	0.024
Rural	Percentage	0.094	0.031
Urban	Percentage	0.123	0.039
Slum	Percentage	0.272	0.038
Prevalence of vitamin A deficiency in preschool children			
National	Percentage	0.204	0.022
Rural	Percentage	0.194	0.029
Urban	Percentage	0.212	0.028
Slum	Percentage	0.38	0.047

Prevalence of zinc deficiency in preschool children			
National	Percentage	0.446	0.052
Rural	Percentage	0.486	0.063
Urban	Percentage	0.295	0.058
Slum	Percentage	0.517	0.054
Prevalence of anemia in NPNL women			
National	Percentage	0.26	0.028
Rural	Percentage	0.27	0.034
Urban	Percentage	0.21	0.038
Slum	Percentage	0.20	0.035
Prevalence of iron deficiency in NPNL women			
National	Percentage	0.071	0.014
Rural	Percentage	0.066	0.017
Urban	Percentage	0.087	0.023
Slum	Percentage	0.074	0.018
Prevalence of zinc deficiency in NPNL women			
National	Percentage	0.572	0.031
Rural	Percentage	0.575	0.037
Urban	Percentage	0.545	0.044
Slum	Percentage	0.664	0.055
Prevalence of vitamin A deficiency in NPNL women			
National	Percentage	0.054	0.013
Rural	Percentage	0.054	0.016
Urban	Percentage	0.049	0.016
Slum	Percentage	0.068	0.019
Iodine Deficiency In NPNL Women			
National	Percentage	0.421	0.052
Rural	Percentage	0.447	0.066
Urban	Percentage	0.332	0.069
Slum	Percentage	0.334	0.049

Annex 7.4. Elevated Inflammatory Biomarkers

Table 109: Elevated Inflammatory Biomarkers

Elevated CRP (>10 mg/l)				Elevated AGP (>1 g/l)			
	n	%	95% CI		n	%	95% CI
Preschool children							
National	471	4.6	1.8-7.5	National	473	28.5	22.6-34.5
Rural	157	3.6	0.4-6.7	Rural	158	28.2	20.5-35.9
Urban	165	7.8	1.0-14.7	Urban	165	27.8	21.5-34.2
Slum	149	8.8	1.7-16.0	Slum	150	37.7	25.5-49.9
NPNL women							
National	896	1.9	0.7-3.2	National	896	12.8	9.0-16.6
Rural	317	1.0	-0.2-2.1	Rural	318	11.5	6.5-16.5
Urban	300	5.8	1.4-10.2	Urban	299	17.8	12.5-23.1
Slum	279	2.9	0.6-5.2	Slum	279	13.7	8.2-19.1
School-age children							
National	1 277	2.2	0.7-3.7	National	1 277	15.3	12.1-18.5
Rural	432	1.9	0.02-3.9	Rural	432	14.6	11.0-18.3
Urban	439	3.3	0.6-6.0	Urban	439	18.0	9.8-26.2
Slum	406	1.3	-0.2-2.9	Slum	406	14.1	8.1-19.9

Annex 7.5 Household Food Insecurity Questions

The generic occurrence questions, grouped by domain, are:

1) Anxiety and uncertainty about household food supply:

- Did you worry that your household would not have enough food?

2) Insufficient quality (includes variety and preferences of the type of food):

- Were you or any household member not able to eat the kinds of foods you preferred due to a lack of resources?
- Did you or any household member have to eat a limited variety of foods due to a lack of resources?
- Did you or any household member have to eat some foods that you really did not want to eat due to a lack of resources to obtain other types of food?

3) Insufficient food intake and its physical consequences:

- Did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food?
- Did you or any household member have to eat fewer meals in a day because there was not enough food?
- Was there ever no food to eat of any kind in your household because of a lack of resources to get food?
- Did you or any household member go to sleep at night hungry because there was not enough food?
- Did you or any household member go a whole day and night without eating anything because there was not enough food?(Coates *et al., 2007)*

Annex 7.6: List of Primary Sampling Units (PSU) for the National Micronutrient Survey 2011-12

Table 110: Primary Sampling Units (PSUs) for the Survey

	Cluster#	District	Upazilla	Union/ward	*Mauza*	Area	*Mauza* name
1	280	Barisal	Gaurnadi	Ward 08	352	2	Diasur
2	405	Barisal	Mhendiganj	Ward 06	563	2	Kharki
3	712	Jhalokati	Jhalokati Sadar	Ward 05	659	2	Mudi Patty
4	1 019	Patuakhali	Patuakhali Sadar	Ward 07	510	2	Power House
5	1 300	Bandarban	Bandarban Sadar	Ward 06	496	2	Keochin Para
6	1 711	Chandpur	Chandpur Sadar	Ward 01	426	2	Puran Bazar Uttar
7	2 018	Chittagong	Bakalia	Ward 35 (Part)	295	3	Chaktai
8	2 169	Chittagong	Kotwali	Ward 21	396	3	Jamal Khan
9	2 424	Comilla	Barura	Ward 04	516	2	Kamedda
10	2 913	Cox's Bazar	Cox's Bazar Sadar	Ward 09	381	2	Ghonar Para (Part)
11	3 324	Khagrachhari	Khagrachhari Sadar	Ward 05	395	2	Govt. High School Area
12	3 631	Lakshmipur	Ramganj	Ward 07	926	2	Sreepur
13	4 198	Rangamati	Rangamati Sadar	Ward 02	884	2	Reserve Bazar (Par
14	4 297	Dhaka	Dhanmondi	Ward 48 (Part)	820	3	Tinmazar (Jhigatala)
15	4 370	Dhaka	Khilkhet	Dhaka C.C./ Ward 17 (Part)	513	3	Khilkhet Kha Para
16	4 443	Dhaka	Motijheel	Ward 34	192	3	Dakshin Shahjahanpur
17	4 542	Dhaka	Shyampur	Shyampur	912	2	Shyampur
18	4 693	Faridpur	Faridpur Sadar	Ward 08	725	2	Uttar Alipur
19	5 000	Gopalganj	Gopalganj Sadar	Ward 07	640	2	Pacshim Tegharia
20	5 333	Jamalpur	Sarishabari	Ward 06	549	2	Katiar Bari
21	5 770	Madaripur	Madaripur Sadar	Ward 03	673	2	Mahisher Char(Part)
22	6 129	Munshiganj	Munshiganj Sadar	Ward 02	300	2	Gopalnagar
23	6 462	Mymensingh	Mymensingh Sadar	Ward 16	450	2	Ganginapar (Part)
24	6 821	Narsingdi	Narsingdi Sadar	Ward 01	088	2	Bhelanagar
25	7 180	Netrakona	Netrokona Sadar	Ward 07	533	2	Mukter Para
26	7 461	Shariatpur	Naria	Ward 05	160	2	Bitik Kuri
27	7 690	Sherpur	Sreebardi	Ward 04	927	2	Uttar Sreebardi
28	8 205	Bagerhat	Mongla	Ward 02	862	2	Selabunia
29	8 460	Jessore	Abhaynagar	Ward 02	718	2	Paschim Noapara
30	8 793	Jhenaidah	Kotchandpur	Ward 02	468	2	Kazi Para
31	9 022	Khulna	Khalishpur	Ward 14	043	3	Bara Boyra (Part 1-3)
32	9 095	Khulna	Paikgachha	Ward 08	107	2	Batikhali (Part)

	Cluster#	District	Upazilla	Union/ward	*Mauza*	Area	*Mauza* name
33	9 376	Kushtia	Mirpur	Ward 09	576	2	Khandakbaria
34	9 605	Meherpur	Meherpur Sadar	Ward 04	527	2	Kased Para
35	9 808	Satkhira	Kalaroa	Ward 04	280	2	Jikra Uttar
36	10 115	Bogra	Kahaloo	Ward 01	479	2	Sarai
37	10 708	Gaibandha	Gaibandha Sadar	Ward 05	675	2	Madha Gobindapur
38	10 963	Joypurhat	Kalai	Ward 09	588	2	Kalai Talukder Para
39	11 400	Lalmonirhat	Lalmonirhat Sadar	Ward 06	175	2	Baniar Dighi
40	11 681	Naogaon	Patnitala	Ward 07	458	2	North Harirampur
41	12 066	Chapai Nababgan	Chapai Nababganj Sad	Ward 06	937	2	Sankarbati
42	12 347	Pabna	Bera	Ward 03	620	2	Moytar Baidya
43	12 680	Panchagarh	Panchagarh Sadar	Ward 04	660	2	Jalashi Colony
44	12 857	Rajshahi	Durgapur	Ward 06	096	2	Baharampur
45	13 112	Rangpur	Kaunia	Ward 01	360	2	Jumma Para
46	13 471	Sirajganj	Sirajganj Sadar	Ward 06	814	2	Nutan Bhangabari
47	13 804	Habiganj	Chunarughat	Ward 08	079	2	Azimabad
48	14 085	Maulvibazar	Maulvibazar Sadar	Ward 08	875	2	Sabujbagh T&T Colony
49	14 652	Sylhet	Golapganj	Ward 04	915	2	Nij Sarashwati
50	14 803	Sylhet	Sylhet Sadar	Ward 21	800	3	Shaplabagh
51	97	Barguna	Barguna Sadar	Naltona	394	1	Gazi Mamud
52	422	Barisal	Mhendiganj	Char Ekkaria	978	1	Uttar Dadpur
53	725	Jhalokati	Jhalokati Sadar	Binoykati	382	1	Garanga
54	1 003	Patuakhali	Mirzaganj	Majidbari	687	1	Mazidbaria
55	1 319	Bandarban	Bandarban Sadar	Kuhalong	559	1	Kuhalang
56	1 602	Brahmanbaria	Kasba	Badair	066	1	Badair
57	1 881	Chandpur	Matlab Dakshin	Uttar Upadi	731	1	Naogaon
58	2 221	Chittagong	Mirsharai	Ichhakhali	660	1	Paschim Ichhakhali
59	2 500	Comilla	Burichang	Sholanal	111	1	Berajal Kadamtali
60	2 776	Comilla	Meghna	Gobindapur	164	1	Buriar Char
61	3 057	Cox's Bazar	Teknaf	Baharchhara	746	1	Shilkhali
62	3 350	Khagrachhari	Khagrachhari Sadar	Khagrachhari	459	1	Gamaridhala
63	3 641	Lakshmipur	Ramganj	Chandipur	192	1	Chandipur
64	3 921	Noakhali	Subarnachar	Purba Char Bata	393	1	Hajipur
65	4 183	Rangamati	Rajasthali	Ghila Chhari Unio	795	1	Kukya Chhari

	Cluster#	District	Upazilla	Union/ward	*Mauza*	Area	*Mauza* name
66	4 657	Faridpur	Char Bhadrasan	Char Harirampur	212	1	Char Harirampur
67	4 954	Gazipur	Kapasia	Singasree	898	1	Singasree
68	5 256	Jamalpur	Jamalpur Sadar	Meshta	156	1	Bir Fular Para
69	5 535	Kishoregonj	Katiadi	Achmita	041	1	Astagharia
70	5 822	Madaripur	Rajoir	Kadambari	267	1	Gazaria
71	6 107	Munshiganj	Lohajang	Gaodia	719	1	Pakhidia
72	6 395	Mymensingh	Gauripur	Sahanati	432	1	Jogir Danguri
73	6 674	Narayanganj	Bandar	Kalagachhia	379	1	Gokul Gobindabari
74	6 977	Netrakona	Barhatta	Asma	476	1	Hariatala
75	7 257	Rajbari	Baliakandi	Jangal	894	1	Sasapur
76	7 567	Sherpur	Jhenaigati	Hatibandha	703	1	Laykhan
77	7 854	Tangail	Ghatail	Sandhanpur	341	1	Gauri Jainabari
78	8 138	Bagerhat	Fakirhat	Mulghar	282	1	Faltita Baniakhali
79	8 437	Chuadanga	Jiban Nagar	Banka	071	1	Banka
80	8 720	Jhenaidah	Harinakunda	Raghunathpur	478	1	Kalaparia
81	9 071	Khulna	Koyra	Bagali	422	1	Ghugrakati
82	9 377	Kushtia	Mirpur	Ambaria	024	1	Ambaria Mirzapur
83	9 705	Narail	Lohagara	Lohagara	210	1	Char Baghjuri
84	10 013	Bogra	Bogra Sadar	Gokul	416	1	Gokul
85	10 276	Bogra	Shibganj	Saidpur	430	1	Gopiballabh
86	10 542	Dinajpur	Kaharole	Rasulpur	019	1	Baharpur
87	10 831	Gaibandha	Shaghata	Bonar Para	119	1	Bati
88	11 117	Kurigram	Chilmari	Raniganj	994	1	Uttar Uari
89	11 417	Lalmonirhat	Lalmonirhat Sadar	Harati	962	1	Taluk Harati
90	11 707	Naogaon	Patnitala	Shihara	020	1	Asanta
91	11 987	Chapai Nababgan	Bholahat	Gohalbari	420	1	Gohalbari
92	12 297	Nilphamari	Saidpur	Bothlagari	211	1	Bothlagari (Part)
93	12 577	Pabna	Sujanagar	Satbaria	537	1	Kandarpapur
94	12 899	Rajshahi	Godagari	Gogram	082	1	Baghdhara
95	13 217	Rangpur	Pirgachha	Annadanagar	040	1	Annadanagar
96	13 494	Sirajganj	Sirajganj Sadar	Ratankandi	377	1	Ekdala
97	13 782	Habiganj	Baniachong	Baraiuri	110	1	Bara Ujirpur
98	14 073	Maulvibazar	Kulaura	Sharifpur	212	1	Daudpur (Sonapur) Part
99	14 358	Sunamganj	Jagannathpur	Mirpur	675	1	Nabinagar

	Cluster#	District	Upazilla	Union/ward	*Mauza*	Area	*Mauza* name
100	14 626	Sylhet	Fenchuganj	Fenchuganj	331	1	Gayasi
101	14 868	Chittagong	Baezid Bostami	WARD 02	346	4	Kulgaon
102	14 870	Chittagong	Bakolia	Ward 17	721	4	Paschim Bakalia (Part 1)
103	14 871	Chittagong	Bakolia	Ward 18	111	4	Purba Bakalia (Part 2)
104	14 875	Chittagong	Chandgaon	Ward 06	721	4	Paschim Bakalia (Part)
105	14 880	Chittagong	Doubul Moring	Ward 29	479	4	Paschim Madrbari (Part)
106	14 881	Chittagong	Halishahar	Ward 24	640	4	Pangi Para
107	14 884	Chittagong	Kotowali	Ward 21	396	4	Jamal Khan
108	14 885	Chittagong	Kotowali	Ward 31	80	4	AL- Karan
109	14 886	Chittagong	Kotowali	Ward 34	895	4	Patharghata
110	14 891	Chittagong	Kulshi	Ward 14	810	4	Shah Garib Ullah
111	14 894	Chittagong	Kulshi	Ward 14	700	4	Railway Colony (Tiger Pass)
112	14 896	Chittagong	Pahartoli	Ward 11	236	4	Dakshin Kattali Part
113	14 897	Chittagong	Pahartoli	Ward 12	735	4	Sarai Para
114	14 898	Chittagong	Panchlaisn	Ward 03	999	4	Shohid Nagar
115	14 900	Chittagong	Panchlaisn	Ward 07	822	4	Paschim Shola Shahar (Part 2
116	14 911	Dhaka	Newmarket	Ward 52	370	4	Nilkhet Babupura
117	14 912	Dhaka	Gulshan	Ward 18	500	4	Kalachandpur (Madhya)
118	14 918	Dhaka	Hajaribag	Ward 58	574	4	Hazaribag Road, Nabipur Basti
119	14 919	Dhaka	Kufrul	Ward 04	145	4	Purba Baishtek
120	14 921	Dhaka	Kufrul	Ward 15	78	4	Bashan Tek 1 no. Basti
121	14 924	Dhaka	Kufrul	Ward 16	630	4	Paschim Kafrul, Nahar Bakery Basti
122	14 925	Dhaka	Khilgaon	Ward 22	257	4	257 Purba Rampura
123	14 928	Dhaka	Khilgaon	Ward 26	500	4	500 Meradia (Part 1)
124	14 929	Dhaka	Khilgaon	Ward 26	501	4	501 Meradia (Part 2)
125	14 936	Dhaka	Mirpur	Ward 10	225	4	Darussalam Society Basti
126	14 939	Dhaka	Muhammadpur	Ward 43	515	4	Baitul Aman Housing
127	14 941	Dhaka	Muhammadpur	Ward 46	500	4	Paschim Katashur Bottala Basti
128	14 942	Dhaka	Muhammadpur	Ward 47	208	4	Paschim Jafrabad Vandarir Basti

	Cluster#	District	Upazilla	Union/ward	*Mauza*	Area	*Mauza* name
129	14 943	Dhaka	Matijhil	Ward 31	226	4	Gopibag
130	14 946	Dhaka	Pallabi	Ward 02	148	4	Begun Tila Basti
131	14 947	Dhaka	Pallabi	Ward 03	410	4	Mirpur, Section-11, Block-C, Paris Road Basti
132	14 949	Dhaka	Pallabi	Ward 05	570	4	Mirpur, Section-11, Block-A, Bihari Camp Basti
133	14 950	Dhaka	Pallabi	Ward 06	212	4	Doari Para
134	14 954	Dhaka	Shampur	Ward 83	187	4	D.I.T Area, Gandaria Rail Line Basti
135	14 956	Dhaka	Shampur	Ward 87	654	4	Uttar Mirhazirbagh, Khetpar Basti
136	14 958	Dhaka	Shampur	Ward 90	705	4	Tula Bagicha
137	14 963	Dhaka	Tejgaon	Ward 38	960	4	Uttar Paschim Nakhalpara, Kebla bari Basti
138	14 964	Dhaka	Tejgaon	Ward 38	177	4	Purba Nakhal Para, Rashid Chairman Basti
139	14 969	Khulna	Khalishpur	Ward 07	995	4	Crisent Bazar
140	14 971	Khulna	Khalishpur	Ward 08	605	4	People Jute Mill Area
141	14 973	Khulna	Khalishpur	Ward 14	138	4	Goalkhali Bastuhara Colony
142	14 975	Khulna	Khalishpur	Ward 16	114	4	Dakshin Boyra Junction
143	14 978	Khulna	Khulna Sadar	Ward 22	628	4	Natun Bazar
144	14 980	Khulna	Khulna Sadar	Ward 24	669	4	Roy Para
145	14 983	Khulna	Khulna Sadar	Ward 31	430	4	Laban Chora (Madinabad)
146	14 985	Khulna	Sona Danga	Ward 17	713	4	Sonadanga Purba
147	14 991	Rajshahi	Boalia	Ward 25	919	4	Shekher Char
148	14 993	Rajshahi	Boalia	Ward 28	252	4	Jamalpur
149	14 997	Rajshahi	Raj Para	Ward 02	721	4	Harogram Ranidighi
150	14 998	Rajshahi	Raj Para	Ward 04	431	4	Keshabpur

Annex 7.7 Questionnaires

Annex 7.7.1 Household Questionnaire

Household # (50-household listing): ☐☐   Household # (Sl. 20-household list): ☐☐

Household Identification	
Cluster: 1=Rural; 2=Cities+Municipalities; 3= Urban (Slum)	☐
Division: 1=Dhaka, 2=Chittagong, 3= Rajshahi, 4=Khulna 5=Sylhet, 6=Barishal	Division: ☐ District: ☐☐
Upazilla/municipality ____________________	Union: ☐☐ Ward: ____________________ ☐☐ (............)
Mauza ____________________	Cluster No: ☐☐☐
Household Identification:	
Name of the household head ____________________	Date of data collection: DD/MM/YY ☐☐/☐☐/☐☐
Household landline /cell phone no.:	
Name of the Interviewer____________________	Signature: ____________________
Name of the Supervisor ____________________	Signature: ____________________
Name of the Quality Control Officer____________________	Signature: ____________________
Written informed consent: 1=Yes, 2=No ☐	
Result Code: ☐ Completed=1 Incomplete=2	
Reason for which the data collection was not completed	

General information on the Household

Now, I would like to ask you some questions about this household and its members.

1 What is your name? Respondent's Name ---

LINE NO.	USUAL RESIDENTS	RELATIONSHIP with household head	Male/ Female	RESIDENCE		AGE
	Please provide the names of the persons who usually live in your household starting with the head of the household	What is the relationship of (NAME) to the head of the household?*	Is (NAME) male or female?	Does (NAME) usually sleep here?	Does (NAME) usually eat here?	How old is (NAME)? If age is Less than 1 year, write '00'
(1)	(2)	(3)	(4)	(5a)	(5b)	(6)
01		☐☐	M ....1 F................2	YES..................1 NO 2	YES..................1 NO 2	IN YEARS ☐☐
02		☐☐	M ....1 F................2	YES..................1 NO 2	YES..................1 NO 2	IN YEARS ☐☐
03		☐☐	M ....1 F................2	YES..................1 NO 2	YES..................1 NO 2	IN YEARS ☐☐
04		☐☐	M ....1 F................2	YES..................1 NO 2	YES..................1 NO 2	IN YEARS ☐☐
05		☐☐	M ....1 F................2	YES..................1 NO 2	YES..................1 NO 2	IN YEARS ☐☐
06		☐☐	M ....1 F................2	YES..................1 NO 2	YES..................1 NO 2	IN YEARS ☐☐
07		☐☐	M ....1 F................2	YES..................1 NO 2	YES..................1 NO 2	IN YEARS ☐☐
08		☐☐	M ....1 F................2	YES..................1 NO 2	YES..................1 NO 2	IN YEARS ☐☐
09		☐☐	M ....1 F................2	YES..................1 NO 2	YES..................1 NO 2	IN YEARS ☐☐
10		☐☐	M ....1 F................2	YES..................1 NO 2	YES..................1 NO 2	IN YEARS ☐☐
11		☐☐	M ....1 F................2	YES..................1 NO 2	YES..................1 NO 2	IN YEARS ☐☐
12		☐☐	M ....1 F................2	YES..................1 NO 2	YES..................1 NO 2	IN YEARS ☐☐

If more than 12 household members, use continuation sheet

*CODES FOR Col. 3
RELATIONSHIP TO HEAD OF HOUSEHOLD:

Self.. 01	Grandson/granddaughter....................06
Husband/wife.................................. 02	Brother/sister 07
Son.. 03	Sister-in-law..08
Daughter.. 04	Nephew/niece 09
Daughter-in-law.................................. 05	Father/mother......................................10
	Father-in-law/mother-in-law................11
	OTHER (specify) 77

	QUESTIONS	CODING CATEGORIES	SKIP
4	What is the religion practised by most of the people who live in this household? *(Mark only one answer)*	Islam ....1 Hinduism ....2 Christianity ....3 Buddhism ....4 Other ....77 (Specify) Don't know.......................................99	

LINE NO.	USUAL RESIDENTS	RELATIONSHIP with household head	Male/ Female	RESIDENCE	AGE
	5	What ethnic group do you belong to?		Bangali ....1 Chakma. ....2 Marma ....3 Garo ....4 Saotal ....5 Other ....77 (Specify)	
	6	What is the main occupation of the head of the household?		Professional/technical ....01 Small business ....02 Large business ....03 Factory worker ....04 Service ....05 Skilled labour/service ....06 Unskilled labour ....07 Farmer/agricultural worker .... 08 Poultry/cattle raising ....09 Home manufacturing ....10 Domestic help ....11 Housewife ....12 Other ....77 (Specify)	
	7	What is the level of formal education of the (Household Head)?		No education ....1 Primary incomplete ....2 Primary complete ....3 Secondary incomplete ....4 Secondary complete or higher ....5 Don't know 99	
	8	What is the main source of drinking water for members of your household?		Piped into dwelling ....01 Piped to yard/plot ....02 Public tap ....03 Tube-well ....04 Protected well ....05 Unprotected well ....06 Unprotected spring well ....07 Protected spring well ....08 Rainwater ....09 Tanker truck ....10 Surface water (river/dam/lake/pond/ stream/canal/irrigation channel) ....11 Other ....77 (Specify)	
	9	Do you do anything to the water to make it safer to drink?		Yes ....1 No ....2 Don't know 9	→11
	10	What do you usually do to make water safer to drink?		Boil ....1 Add bleach/chlorine/purifying tablet . 2 Strain through a cloth ....3 Use water filter (ceramic/sand/ composite) ....4 Let it sand and settle ....5 Do nothing ....6 Other ....77 (Specify)	

	QUESTIONS	CODING CATEGORIES	SKIP
11	What kind of toilet facilities do members of your household usually use? (See for yourself)	Flushed to piped sewer system ....01 Flush to septic tank...02 Flush to pit latrine ....03 Flush to somewhere else....................................04 Pit latrine with slab...05 Pit latrine without slab/open pit ....06 Bucket toilet ....07 Hanging toilet ....08 No facility/bush/field...09 Others...77 (Specify)	
12	**Does your household or anyone of your household have:**		
	a. Electricity?	Yes ....1 No 2	
	b. A radio?	Yes ....1 No 2	
	c. A television?	Yes ....1 No 2	
	d. A mobile phone?	Yes ....1 No 2	
	e. A land line?	Yes ....1 No 2	
	f. A refrigerator?	Yes ....1 No 2	
	g. An *almirah*/wardrobe?	Yes ....1 No 2	
	h. Tables?	Yes ....1 No 2	
	i. Chairs?	Yes ....1 No 2	
	j. A watch?	Yes ....1 No 2	
	k. A bicycle?	Yes ....1 No 2	
	l. A motorcycle/scooter/tempo?	Yes ....1 No 2	
	m. An animal-drawn cart?	Yes ....1 No 2	
	n. A car or truck?	Yes ....1 No 2	
	o. A boat?	Yes ....1 No 2	
	p. A rickshaw/van?	Yes ....1 No 2	
13	What type of fuel does your household usually use for cooking?	Electricity...01 LPG ....02 Natural gas ....03 Biogas ....04 Kerosene..05 Coal..06 Wood ....07 Straw/shrubs/grass..08 Agricultural crop ....09 Animal dung ....10 Other ....77 (Specify)	

	QUESTIONS	CODING CATEGORIES	SKIP
14	What is the main material of the floor? (See for yourself)	Natural floor Earth/sand ....01 Rudimentary floor Wood/planks ....02 Palm/bamboo....03 Finished floor (parquet or polished) Wood ....04 Ceramic tiles/mosaic ....05 Cement ....06 Carpet....07 Other ....77 (Specify)	
15	What is the main material of the roof? (See for yourself)	Natural roofing No roof ....01 Thatch/palm leaf ....02 Rudimentary roofing Bamboo ....03 Wood planks....04 Cardboard....05 Finished roofing Tin....06 Wood ....07 Ceramic tiles ....08 Cement ....09 Other ....77 (Specify)	
16	What is the main material of the external wall? (See for yourself)	Natural walls No walls....01 Cane/palm/trunks ....02 Rudimentary walls Bamboo with mud....03 Stone with mud ....04 Plywood....05 Cardboard....06 Finished walls Tin....07 Cement ....08 Stone with lime/cement....09 Bricks ....10 Wood planks/shingles ....11 Other ....77 (Specify)	
17	How many rooms in the household are used for sleeping?	Number of bedrooms.... ☐☐	
18	Does the household own any homestead?	Yes ....1 No....2	→19
18A	Does the household own a homestead elsewhere?	Yes ....1 No....2	
19	Does the household own any land other than homestead land (cultivable/fallen land)?	Yes ....1 No....2	→21
20	How much land does the household own other than the homestead land (cultivable/fallen)?	Acres:.... ☐☐ Decimals:.... ☐☐	
21	Do you know the monthly expenditure of your family?	Yes ....1 No/don't know 2	→22
21A	What is the approximate monthly expenditure of your family (approximate collective expenditure of all the family members)?	*Taka* .... ☐☐☐☐☐☐	

	QUESTIONS	CODING CATEGORIES	SKIP
22	What type of cooking oil do you use in your household? (Multiple answers possible)	Soybean.....01 Mustard.....02 Supper/palm.....03 Coconut.....04 Others.....77 (Specify)	
22A	What kinds of cooking oil does your household buy?	"Brand" oil.....01 Open oil.....02 Both.....03 Others.....77 (Specify)	 →**23** →**23**
22B	(If you are using "brand" oil), what is the name of the "brand" oil you buy/use?	Brand name______________________________ ______________________________	
22C	Was the brand consumed by the household "fortified with vitamin A"? (Please check the oil container in the household for labelling, or check in shops whether the "brand" was fortified)	Yes.....1 No.....2	
23	How often do you buy cooking oil in a month?	Number of times..... ☐☐	
23A	How much cooking oil do you buy at a time?	Liters.....	
23B	How much does your household spend on cooking oil in a month?	Taka..... ☐☐☐☐	
24	Do you know which foods are rich in vitamin A?	Yes.....1 No.....2	→**24b**
24A	Please state the name of the foods that are rich in vitamin A?		
	a. Green leafy vegetables	Mentioned.....1 Did not mention.....2	
	b. Yellow/orange vegetables and fruits	Mentioned.....1 Did not mention.....2	
	c. Small fish species	Mentioned.....1 Did not mention.....2	
	d. Liver	Mentioned.....1 Did not mention.....2	
	e.Others(specify)______________________________ ______________________________	Mentioned.....1 Did not mention.....2	
24B	Do you know what the benefits are of eating foods rich in vitamin A, e.g. green leafy vegetables, yellow/orange vegetables and fruits and small fish species?	Yes.....1 No.....2	 →**25**
24C	If so, what are they? *(Do not prompt)*		
	a. Good for the eye sight	Mentioned.....1 Did not mention.....2	
	b. Healthy	Mentioned.....1 Did not mention.....2	
	c. Good for the skin	Mentioned.....1 Did not mention.....2	
	e. Prevents night blindness	Mentioned.....1 Did not mention.....2	
	f. Other (specify) ______________________________ ______________________________	Mentioned.....1 Did not mention.....2	
25	Do you know which foods are rich in iron?	Yes.....1 No.....2	→**25b**
25C	Please list the name of the foods that are rich in iron *(Do not prompt)*		
	a. Fish	Mentioned.....1 Did not mention.....2	
	b. Meat	Mentioned.....1 Did not mention.....2	

	QUESTIONS	CODING CATEGORIES	SKIP
	c. Eggs	Mentioned....1 Did not mention 2	
	d. Milk	Mentioned....1 Did not mention 2	
	e. Others (specify)________________ ________________	Mentioned....1 Did not mention 2	
25B	Do you know what the benefits are of eating iron-rich foods, e.g. fish, meat, eggs, milk?	Yes ....1 No 2	→26
25C	If so, what are they? *(Do not prompt)*		
	a. Provides energy	Mentioned....1 Did not mention 2	
	b. Provides iron	Mentioned....1 Did not mention 2	
	c. Healthy	Mentioned....1 Did not mention 2	
	d. Other (specify) ________________ ________________	Mentioned....1 Did not mention 2	
26	Did you know that oil fortified with vitamin A is available at the market?	Yes ....1 No....2	
	Household food insecurity (I would now like to ask you some questions about the amount of food available for members of your household.)		
27	In the past four weeks, did you worry that your household would not have enough food?	Yes ....1 No....2	→28
27A	How often did this occur?	Once or twice in the past four weeks (rarely)....1 Three to ten times in the past four weeks (Sometimes) ....2 More than ten times in the past four weeks (Often) 3	
28	In the past four weeks, were you or any household member unable to eat the kinds of foods you usually eat due to a lack of resources?	Yes ....1 No....2	→29
28A	How often did this occur?	Once or twice in the past four Weeks (rarely) ....1 Three to ten times in the past four weeks (sometimes) ....2 More than ten times in the past four weeks (often)....3	
29	In the past four weeks, did you or any household member have to eat a limited variety of foods due to a lack of resources?	Yes ....1 No....2	→30
29A	How often did this occur?	Once or twice in the past four weeks (rarely)....1 Three to ten times in the past four weeks (sometimes) ....2 More than ten times in the past four weeks (often)....3	
30	In the past four weeks, did you or any household member have to eat some foods that you really did not want to eat due to a lack of resources to obtain other types of food?	Yes ....1 No....2	→31
30A	How often did this occur?	Once or twice in the past four weeks (rarely)....1 Three to ten times in the past four weeks (sometimes) ....2 More than ten times in the past four weeks (often)....3	

	QUESTIONS	CODING CATEGORIES	SKIP
31	In the past four weeks, did you or any household member have to eat a smaller quantity of food at a meal than you felt you needed because there was not enough food?	Yes ....1 No 2	→**32**
31A	How often did this occur?	Once or twice in the past four weeks (rarely) ....1 Three to ten times in the past four weeks (sometimes) ....2 More than ten times in the past four weeks (often) 3	
32	In the past four weeks, did you or any other household member have to eat fewer meals in a day because there was not enough food?	Yes ....1 No 2	→**33**
32A	How often did this occur?	Once or twice in the past four weeks (rarely) ....1 Three to ten times in the past four weeks (sometimes) ....2 More than ten times in the past four weeks (often) 3	
33	In the past four weeks, was there ever no food to eat of any kind in your household due to a lack of resources?	Yes ....1 No 2	→**34**
33A	How often did this occur?	Once or twice in the past four weeks (rarely) ....1 Three to ten times in the past four weeks (sometimes) ....2 More than ten times in the past four weeks (often) 3	
34	In the past four weeks, did you or any household member go to sleep at night hungry because there was not enough food?	Yes ....1 No 2	→**35**
34A	35a. How often did this occur?	Once or twice in the past four weeks (rarely) ....1 Three to ten times in the past four weeks (Sometimes) ....2 More than ten times in the past four weeks (Often) 3	
35	In the past four weeks, did you or any household member go a whole day and night without eating anything because there was not enough food?	Yes ....1 No 2	→**36**
35A	How often did this occur?	Once or twice in the past four weeks (rarely) ....1 Three to ten times in the past four weeks (Sometimes) ....2 More than ten times in the past four weeks (Often) 3	
	Universal Salt Iodization (Now I would like to ask you some questions about the salt used in this household and about salt in general)		
36	Does your household usually use any of these types of salt? ***(****Read types and record yes or no for each type.****)***		
	1. Crude salt?	Yes ....1 No 2	
	2. Open?	Yes ....1 No 2	
	3. Packet?	Yes ....1 No 2	→**38**
37	If you do not consume salt packets at home, why not? *(Please read each question and indicate yes or no)*		

	QUESTIONS	CODING CATEGORIES	SKIP
	1.Don't like the taste	Yes ...1 No...2	
	2. Too expensive	Yes ...1 No...2	
	3. Not available	Yes ...1 No...2	
	4. Don't believe it is iodized	Yes ...1 No...2	
	5. Can't buy in small amounts	Yes ...1 No...2	
	6. Don't know ______________	Yes ...1 No...2	
	7. Other (specify) ______________	Yes ...1 No...2	
	Interviewers: In **Q.36** if the respondent mentions crude salt, then ask **Q.38.1**; if open salt, then ask **Q.38.2,** and packet, then **ask Q.38.3.**		
38	Where do you usually buy/obtain each of the following types of salt? ***[Please ask each type and indicate code for source]*?**		
	1. Crude salt?	City shop...1 Village/ local shop/*haa*...2 Others ...77 (Specify) N/A ...88	
	2. Open salt?	City shop...1 Village/ local shop/*haat* ...2 Others ...77 (Specify) N/A ...88	
	3. Salt packets?	City shop...1 Village/ local shop/*haat* ...2 Others ...77 (Specify) N/A ...88	
39	How do you store salt in your house?	Closed packet or container...1 Open packet or container (bamboo shell, pumpkin shell, earthen pot, etc.) ...2 Both...3	
40	While cooking, when do you usually add salt?	During cooking ...1 After cooking ...2 Both...3	
41	Do you add salt with meals?	Always ...1 Sometimes...2 No (Never) ...3	
42	Have you heard about iodized salt?	Yes ...1 No...2	→**51**
43	How do you know about iodized salt? *(Do not prompt)*		
	TV	Mentioned...1 Did not mention ...2	
	Radio	Mentioned...1 Did not mention ...2	
	Newspaper Poster/Leaflet	Mentioned...1 Did not mention ...2	
	Health care worker	Mentioned...1 Did not mention ...2	
	Friend/relative	Mentioned...1 Did not mention ...2	

	QUESTIONS	CODING CATEGORIES	SKIP
	School child	Mentioned....1 Did not mention....2	
	Teacher/school	Mentioned....1 Did not mention....2	
	Other ________ (Specify)	Mentioned....1 Did not mention....2	
44	Does crude salt contain iodine?	Yes....1 Yes, some....2 No....3 Don't know....9	
45	Does open salt contain iodine?	Yes....1 Yes, some....2 No....3 Don't know....9	
46	Does salt packets contain iodine?	Yes....1 Yes, some....2 No....3 Don't know....9	
47	Do you know benefits of iodized salt?	Yes....1 No....2	→49
48	If so, what are the benefits? *(Do not prompt)*		
	a. Prevents goiter	Mentioned....1 Did not mention....2	
	b. Prevents cretinism	Mentioned....1 Did not mention....2	
	c. Promotes mental development/intelligence	Mentioned....1 Did not mention....2	
	d. Promotes normal growth	Mentioned....1 Did not mention....2	
	e. Prevents abortion and stillbirths	Mentioned....1 Did not mention....2	
	f. Healthy	Mentioned....1 Did not mention....2	
	g. Other ________ (Specify)	Mentioned....1 Did not mention....2	
49	Do you test your salt for iodine using testing kit or home-made method?	Yes....1 No....2	→No
49A	Which method do you use to test salt for iodine?	Test kit....1 Home-made method....2 Both....3	
50	Do you know the ingredients to test salt for iodine? **(*Do not prompt)***		
	1. Salt?	Mentioned....1 Did not mention....2	
	2. Cooked rice?	Mentioned....1 Did not mention....2	
	3. Lemon juice?	Mentioned....1 Did not mention....2	
	Interviewers: In **Q.50** if the respondent mentions salt, then ask **Q.50a**; if cooked rice, then ask **Q.50b,** and if lemon juice, then **askQ.50c.**		
50A	How much salt? **(*Do not prompt)***	A pinch....1 A level teaspoon....2 Other amount....77 (Specify) Don't know....99 N/A....88	

	QUESTIONS	CODING CATEGORIES	SKIP
50B	How much rice? **(*Do not prompt*)**	A small amount ....1 5 grains ....2 Other amount....................77 (Specify) Don't know ....99 N/A 88	
50C	How much lemon juice? **(*Do not prompt*)**	A few drops ....1 Other amount....................77 (Specify) Don't know ....99 N/A 88	
50D	What colour does the salt turn when tested for iodine? **(*Do not prompt*)**	White....................1 Violet/bluish ....2 Other ....77 (Specify) Don't know 99	
50E	What colour does the salt turn to when test results are negative for iodine? **(*Do not prompt*)**	White....................1 Violet/bluish ....2 Other ....77 (Specify) Don't know 99	
51	Does your household have any livestock, e.g. cows/goats/chickens?	Yes ....1 No....................2	→**54**
52	Do you include salt in your feed?	Yes ....1 No....................2	→**54**
52A	What type of salt do you use?	Iodized ....1 Not iodized ....2 Don't know 99	
53	Do you test your livestock salt for iodine? *(Read all the options and code entry accordingly)*		
	a. Crude?	Yes ....1 No....................2	
	b. Open?	Yes ....1 No....................2	
	c. Packet?	Yes ....1 No....................2	
54	**(Was the household selected for salt collection?)**	Yes ....1 No....................2	
55	**(Was the salt sample collected?)**	Yes ....1 No....................2	**END**
56	**(Type of salt collected?)**	Crude ....1 Open....................2 Packet 3	→**58**
57	**Brand name of salt (packet)**	Brand	
58	**Sample coding**		
	a. Salt sample	a. Sample ID.................... □□□□□□□□	
Interviewer's comments:			
Supervisor's comments:			

Annex 7.7.2: Questionnaire: Preschool Children (6-59 months)

Instructions, Starte with the youngest children. In case of more than one mother with children in the household, ask about each under-5 child. Use a separate form for each child.

Household # (50-HH listing): ☐☐ Household# (Sl. In 20-HH list): ☐☐

Household Identification	
Cluster: 1=Rural; 2=Cities+Municipalities; 3= Urban (Slum).	☐
Division: 1=Dhaka, 2=Chittagong, 3= Rajshahi, 4=Khulna 5=Sylhet, 6=Barishal	Division: ☐☐ District: ☐☐
Upazilla/Municipality ________________	Union: ☐☐ Ward: ☐☐ (.................)
Mauza ________________	Cluster No: ☐☐☐
Household identification	
Name of the household head ________________	Date: DD/MM/YY ☐☐/☐☐/☐☐
Household landline/cell phone no.:	
Name of the Interviewer________________	Signature:________________
Name of the Supervisor ________________	Signature:________________
Name of the Quality Control Officer________________	Signature:________________
Written informed consent: 1=Yes, 2=No ☐	
Result Code: ☐ Completed=1 Incomplete=2	
Reason for which the data collection were not completed...	

Sl. No. of Children: ☐☐

Sl. No. of Mother/Primary Guardian: ☐☐

General Information about the Child

1.	What is the name of the child?	Name of the child
1a.	Child ID	□□□□□□□□ (P/Clusters/Division/Cluster/HH no/Sl. No. of the child)
2.	What is your name? (mother/primary guardian)	Name
2a.	What is your level of education?	No education ....1 Primary incomplete ....2 Primary complete ....3 Secondary incomplete ....4 Secondary complete or above 5
2b.	What is the date of birth of the child?	□□/□□/□□ (DD/MM/YY)
3.	What is the age of the child (completed months)?	....Months
4.	What is the sex of the child?	Male 1 Female 2

Child Morbidity (Children aged 6-59 months Preschool children)

Sl. No.	QUESTION	CODING CATEGORIES	SKIP
5.	Did the child (Name) have diarrhoea in the last 2 weeks? *(diarrhoea: 3 or more watery or loose/liquid stools in last 24 hrs)*	Yes ....1 No ....2 Don't know 99	
5a.	In case of diarrhoea in the last 2 weeks, what treatment did (child's name) receive?	ORS .... .1 ORS and zinc .... .2 Did not receive treatment .... .3 Other treatment (specify.... .4	
6.	"Has (Name) been ill with a fever at any time in the past 2 weeks?"	Yes .... .1 No .... .2 Don't know .... .99	
7.	In the past two weeks, has (Name) had an illness accompanied by a cough, and fast breathing or difficulty in breathing?	Yes .... .1 No .... .2 Don't know .... .99	
8.	Was the fast breathing or difficulty in breathing due to a problem in the chest or to a blocked or runny nose?	Yes .... .1 No .... .2 Don't know .... .99	
9.	Did (Name) have measles in the last 6 months?	Yes .... .1 No .... .2 Don't know .... .99	
10.	Does (Name) have a Expanded Programme on Immunization (EPI) card?	Yes .... .1 No .... .2 Don't know .... .99	→11
10a.	*Interviewer: If response is YES in Question no. 10, ask the respondent to show the card.*		
11.	Did the child (Name) at any time receive (.....)?		
11a.	Immunization from measles?	Yes .... 1 No .... 2 Don't know 99	
11b.	Vitamin A supplementation? *(Show the sample)*	Ye .... 1 No .... .2 Don't know 99	→ 11d
11c.	When did the child (Name) receive the last dose of vitamin A?	Month.... Year.... Don't know 99	

11d.	In the case of "No", what was the reason that (Name) has not received vitamin A supplementation?	....	
11e.	(Ask this question if the child is 2 years or over) Did the child (Name) receive antihelminthic tablet/ syrup in the last 6 months?	Yes ....1 No ....2 Don't know ....99 N/A 3	
Infant and Young Child Feeding [Check *Q3 and ask the following questions (12 -24), if the child (Name) is aged 6-23 months old]*			
12.	Has (Name) ever been breastfed?	Yes ....1 Nos ....2 Don't know 99	→14
13.	Was (Name) breastfed yesterday during the day or at night?	Yes ....1 Nos ....2 Don't know 99	
Now I would like to ask you around some medicines and vitamins that are sometimes given to infants.			
14. →	Was (Name) given any vitamin drops or other medicines as drops yesterday during the day or at night?	Yes ....1 Nos ....2 Don't know 99	
14a.	Was (Name)given [*LOCAL NAME FOR ORS*] yesterday during the day or at night?	Yes ....1 Nos ....2 Don't know 99	

Read the questions below.* Read the list *of* liquids *one by one and mark 'Yes, or 'No'* ACCORDINGLY. *After you have completed the list, continue by asking* question *16 (see far right hand column) for each of those* ITEMS *(15*B, *15*C, and*15F) where the respondent rep*lied *'Yes'.

15.	I would like to ask you about some liquids that ***(**NAME**)*** may have had yesterday during the day or at night. Did ***(**NAME**)*** have any **(**ITEM FROM the LIST***)***? *Read the list of liquids starting with 'plain water'.*		**Yes**	***No***	***Don't Know***	**16.** How many times yesterday during the day or at night did ***(**NAME**)*** consume any ***(I**TEM FROM LIST**)***? ***Read Question 16 for items B C, and F** if child consumed the item. Record '99' for Don't Know.*
	A. Plain water	A	1	2	99	
	B. Infant formula, such as lactogen, nido, my boy, complan	B	1	2	99	Times .... Don't know.......................... 99
	C. Milk such as packet, tinned, powdered or fresh animal milk	C	1	2	99	Times .... Don't know 99
	D. Juice or juice drinks	D	1	2	99	
	E. Clear broth	E	1	2	99	
	F. Yogurt	F	1	2	99	Times .... Don't know 99
	G. Thin porridge	G	1	2	99	
	H. Any other liquids Specify.......................... [Inquire about drinking any other liquids available in the locality, e.g. rice water, glucose water, etc.)	H	1	2	99	

16.	Please describe everything that ***(*NAME*)*** ate yesterday during the day or night, whether at home or outside the home. a) Think about when ***(*NAME*)*** first woke up yesterday. Did ***(*NAME*)*** eat anything at that time? *If so*, please tell me everything that ***(*NAME*)*** ate. *Probe: Did he or she eat* anything else? *Until respondent says nothing else.* I*f not, continue to Question b).* b) What did ***(*NAME*)*** do after that? Did ***(*NAME*)*** eat anything at that time? *If so,* tell me everything ***(*NAME*)*** ate at that time. *Probe:* Anything else? Un*til respondent says nothing more*. Repeat question *b) above until respondent says the child went to sleep until the next day.* I*f respondent mentions mixed dishes* such as PORRIDGE*, sauce or stew, probe:* c) What ingredients were in that ***(*MIXED DISH*)***? *Probe:* Anything else? *Until respondent says nothing more*. *As the respondent recalls foods, underline the corresponding food and circle '1' in the column next to the food group. If the food is not listed in any of the food groups below, write the food in the box labelled 'other foods'. If foods are used in small amounts for seasoning or as a condiment, include them under the condiments food group.* *Once the respondent finishes recalling foods eaten, read each food group where '1' was not circled, ask the following question and circle '1' if the respondent says yes, '2' if no, and '8' if don't know:* Yesterday during the day or night, did ***(*NAME*)*** drink/eat any ***(*FOOD GROUP ITEMS*)***?		
	A. Rice, bread, rice pudding, semolina, or other foods made from grains	Yes ....1 No.....................2 Don't know.....99	*Put in the box the maximum number of times any item of the group was eaten* ☐☐
	B. Pumpkin, carrots, squash, or sweet potatoes that are yellow or orange inside	Yes ....1 No.....................2 Don't know.....99	*Put in the box the maximum number of times any item of the group was eaten* ☐☐
	C. White potatoes, white yams, manioc, cassava, or any other foods made from roots	Yes ....1 No.....................2 Don't know.....99	*Put in the box the maximum number of times any item of the group was eaten* ☐☐
	D. Any dark green leafy vegetables, e.g. pui shak, kolmishak, mula shak, kochu shak, data shak, palong shak, paat shak, shorisha shak, etc.	Yes ....1 No.....................2 Don't know.....99	*Put in the box the maximum number of times any item of the group was eaten* ☐☐
	E. Ripe mangoes, ripe papayas, or inquire about other locally available vitamin A rich fruits, e.g. jack fruit)	Yes ....1 No.....................2 Don't know.....99	*Put in the box the maximum number of times any item of the group was eaten* ☐☐
	F. Any other fruits or vegetables	Yes ....1 No.....................2 Don't know.....99	*Put in the box the maximum number of times any item of the group was eaten* ☐☐
	G. Liver, kidney, heart, or other offal	Yes ....1 No.....................2 Don't know.....99	*Enter the maximum number of times that any item of the group was eaten* ☐☐
	H. Any meat, such as beef, pork, lamb, goat, chicken, or duck	Yes ....1 No.....................2 Don't know.....99	*Put in the box the maximum number of times any item of the group was eaten* ☐☐
	I. Eggs	Yes ....1 No.....................2 Don't know.....99	*Put in the box the maximum number of times the item of the group was eaten* ☐☐
	J. Fresh or dried fish, shellfish, or seafood	Yes ....1 No.....................2 Don't know.....99	*Put in the box the maximum number of times any item of the group was eaten* ☐☐
	K. Any foods made from beans, peas, lentils, nuts	Yes ....1 No.....................2 Don't know.....99	*Put in the box the maximum number of times any item of the group was eaten* ☐☐
	L. Seeds	Yes ....1 No.....................2 Don't know.....99	*Put in the box the maximum number of times any item of the group was eaten* ☐☐
	M. Cheese, yogurt, or other milk products	Yes ....1 No.....................2 Don't know.....99	*Put in the box the maximum number of times any item of the group was eaten* ☐☐

	N. Any oil, fats, or butter, or foods made with any of these	Yes ....1 No....................2 Don't know.....99	*Put in the box the maximum number of times any item of the group was eaten* ☐☐
	O. Any sugary foods such as chocolates, sweets, candies, pastries, cakes, or biscuits	Yes ....1 No....................2 Don't know.....99	*Put in the box the maximum number of times any item of the group was eaten* ☐☐
	P. Condiments such as chilies, spices, herbs, or fish powder	Yes ....1 No....................2 Don't know.....99	*Put in the box the maximum number of times any item of the group was eaten* ☐☐
	Q. Foods made with red palm oil	Yes ....1 No....................2 Don't know.....99	*Put in the box the maximum number of times any item of the group was eaten* ☐☐
	R. Other foods Specify.........................	Yes ....1 No....................2 Don't know.....99	*Put in the box the maximum number of times any item of the group was eaten* ☐☐

17.	Did (NAME) eat any solid, semi-solid, or soft foods yesterday during the day or at night? IF'YES' probe: What kind of solid, semi-solid, or soft foods did (NAME) eat?	**Yes** .... **1** **No**... **2** **Don't know** **99**	Q20 →	
	Interviewer's Note: If the response is YES in the Q. 18, return to Q. 17 and observe the record for verification. Then continue with Q. 19	**Yes** .... **1** **No**... **2** **Don't know** **99**	☐☐	
18.	How many times did (NAME) eat solid, semi-solid, or soft foods other than liquids yesterday during the day or at night?	**Number of times**.. **Don't know** **99**		
19.	Did (NAME) drink anything from a bottle with a nipple yesterday during the day or night?	**Yes** .... **1** **No**... **2** **Don't know** **99**		
Now I would like to ask you about some particular foods *(NAME)* may eat. I am interested in knowing if your child has eaten this particular food even if it was combined with other foods.				
20.	Yesterday, during the day or night, did (Name) consume any [ ] (Inquire about iron-fortified solid, semi-solid or soft foods specifically for infants and young children locally available)	**Yes** .... **1** **No**... **2** **Don't know** **99**		
21.	Yesterday, during the day or night, did (Name) consume any food to which you added Monimixor or something similar?	**Yes** .... **1** **No**... **2** **Don't know** **99**		
22	Yesterday, during the day or night, did (Name) consume any Plumpy'Nuts? (Ask to s*how common sample of plumpy' nut, if it is available)*	**Yes** .... **1** **No**... **2** **Don't know** **99**		
23	Yesterday, during the day or night, did (Name) consume any [iron-fortified infant/toddler formulas available in the local setting]? *[Inquire if there are any locally available)iron- fortified infant formulas, e.g. 'Nido', 'Mother's smile', 'Bio-milk', 'Lactogen', etc.*	**Yes** .... **1** **No**... **2** **Don't know** **99**		

Food consumption data

Interviewer: Check Q3 and ask Q 25 if the child is 24-59 months old?

Now I would like to ask you some questions around the food eaten by your child (24-59 months old). I know this is sometimes hard to remember, but please provide the best answer you can.

24. During the past 7 days, on how many days did your child (Name) eat the following foods?

Foods	Serving size	# of days in last 7 days	# of servings in last 7 days	gm/ml
1. Rice?	1 cup	☐	☐☐☐☐	☐☐☐☐☐☐
Breads				
2.Chapatti?	2 pieces	☐	☐☐☐☐	☐☐☐☐☐☐
3.Bread?	2 slices	☐	☐☐☐☐	☐☐☐☐☐☐
4.Parata?	1 piece	☐	☐☐☐☐	☐☐☐☐☐☐
Fish				
5. Small fish species(with bones)?	60 gram	☐	☐☐☐☐	☐☐☐☐☐☐
6. Big fish species (boneless)?	30 gram	☐	☐☐☐☐	☐☐☐☐☐☐
7. Egg?	One	☐	☐☐☐☐	☐☐☐☐☐☐
8. *Dal*?	½ cup	☐	☐☐☐☐	☐☐☐☐☐☐
Green Leafy Vegetables (*Shak*)				
9. Pui shak?	½ cup	☐	☐☐☐☐	☐☐☐☐☐☐
10. Palong shak?	½ cup	☐	☐☐☐☐	☐☐☐☐☐☐
11.Lal shak	½ cup	☐	☐☐☐☐	☐☐☐☐☐☐
12. Kalmi shak	½ cup	☐	☐☐☐☐	☐☐☐☐☐☐
13.Paat shak?	½ cup	☐	☐☐☐☐	☐☐☐☐☐☐
14.Kochu shak?	½ cup	☐	☐☐☐☐	☐☐☐☐☐☐
15.Shorisha shak?	½ cup	☐	☐☐☐☐	☐☐☐☐☐☐
16.Moola shak?	½ cup	☐	☐☐☐☐	☐☐☐☐☐☐
17.Others (specify........)	½ cup	☐	☐☐☐☐	☐☐☐☐☐☐
Yellow/orange vegetables/fruit				
18.Carrots	½ cup	☐	☐☐☐☐	☐☐☐☐☐☐
Record the amount..				
19.Ripe mango	½ cup	☐	☐☐☐☐	☐☐☐☐☐☐
Record the amount..				
20.Sweet Pumpkin	½ cup	☐	☐☐☐☐	☐☐☐☐☐☐
Record the amount..				
.21.Ripe jackfruit	½ cup	☐	☐☐☐☐	☐☐☐☐☐☐
Record the amount..				
22.Ripe papaya	½ cup	☐	☐☐☐☐	☐☐☐☐☐☐
Record the amount..				
23.Tomato	½ cup	☐	☐☐☐☐	☐☐☐☐☐☐
Record the amount..				
24.Sweet potato	½ cup	☐	☐☐☐☐	☐☐☐☐☐☐
Record the amount..				
25.Orange	½ cup	☐	☐☐☐☐	☐☐☐☐☐☐
Record the amount..				
26.Watermelon	½ cup	☐	☐☐☐☐	☐☐☐☐☐☐

	Record the amount..				
	27.Banana	½ cup	☐	☐☐☐☐	☐☐☐☐☐☐
	Record the amount				
	28.Others(Specify.........)		☐	☐☐☐☐	☐☐☐☐☐☐
	Meats				
	29.Chicken	60 gram	☐	☐☐☐☐	☐☐☐☐☐☐
	30.Beef	60 gram	☐	☐☐☐☐	☐☐☐☐☐☐
	31.Mutton	60 gram	☐	☐☐☐☐	☐☐☐☐☐☐
	32.Liver	60 gram	☐	☐☐☐☐	☐☐☐☐☐☐
	Milk and milk products				
	33.Milk	1 cup	☐	☐☐☐☐	☐☐☐☐☐☐
	34.Yogurt	½ cup	☐	☐☐☐☐	☐☐☐☐☐☐
	35.Cheese	Measure of a thumb	☐	☐☐☐☐	☐☐☐☐☐☐
	36.Sugar, honey, molasses	1 tbsf	☐	☐☐☐☐	☐☐☐☐☐☐
	37. Beans, nuts	½ cup	☐	☐☐☐☐	☐☐☐☐☐☐

25.	**Hand washing practice**		
	Activities	Do you wash your hands ....? Yes=1 No= 2	How do you wash your hands ....? Soap and water=01, Ash and water=02,=Mud and water=03, only water=04, Others=77,NA=8,
	25a. Before cooking?	☐	☐☐ If Others (77), specify)............................
	25b. Before feeding the child?	☐	☐☐ If Others (77), specify)............................
	25c. Before taking food?	☐	☐☐ If Others (77), specify)............................
	25d. After cleaning baby's bottom?	☐	☐☐ If Others (77), specify)............................
	25e. After defecation?	☐	☐☐ If Others (77), specify)............................
26.	Biological sample (Give tick mark in the middle and right columns against each of the parameters)		
	Name	Stipulated for collection	Actual collection
	S. Retinol	☐	☐
		Sample ID ☐☐☐☐☐☐☐☐☐	
	Hemoglobin	☐	☐ →
		Sample ID ☐☐☐☐☐☐☐☐☐	
	Hemoglobin%: ☐☐.☐		
	S. Ferritin	☐	☐
		Sample ID ☐☐☐☐☐☐☐☐☐	
	S. Zinc	☐	☐
		Sample ID ☐☐☐☐☐☐☐☐☐	→

Annex 7.7.3: School-aged Children's Form

(This form is for school-aged children, aged 6-14 years, who will provide the biological samples. Use separate form for each of the children)

Household # (50-HH listing): ☐☐ Household# (Sl. In 20-HH list): ☐☐

Household Identification	
Cluster: 1=Rural; 2=Cities+Municipalities; 3= Urban (Slums).	
Division: 1=Dhaka, 2=Chittagong, 3= Rajshahi, 4=Khulna 5=Sylhet, 6=Barishal	Division: ☐ District: ☐☐
Upazilla/municipality	Union: ☐☐ Ward: ☐☐ (...........)
Mauza	Cluster No: ☐☐☐
Household identification	
Name of the household head	Date: DD/MM/YY ☐☐/☐☐/☐☐
Household landline/Cell Phone No.:	
Name of the Interviewer	Signature:
Name of the Supervisor	Signature:
Name of the Quality control Officer	Signature:
Written informed consent: 1=Yes, 2=No ☐	
Result Code: ☐ Completed=1 Incomplete=2	
Reason for which the data collection was not completed:...	

Identification of the Child:		
1.	Sl. No of the child:	Sl. No .... ☐☐
2.	ID:	☐☐☐☐☐☐☐☐ (P/Clusters/Division/Cluster/HH no/Sl. No. of the child)
3.	What is the name of the child?	Name .... ☐☐
4.	What is (Name)'s age (Complete Years)?	Years ....
5.	What is (Name)'s Sex?	Male .... 1 Female 2

Child Morbidity (School-age children)

Q. No.	QUESTION	CODING CATEGORIES	SKIP
6.	Did (Name) have diarrhoea in last 2 weeks? *(diarrhoea: 3 or more watery or loose/liquid stool in last 24 hrs)*	Yes .... 1 No .... 2 Dont know .... .99	
7.	Did (Name) have diarhoea with blood in the last 2 weeks?	Yes .... 1 No .... 2 Dont know .... .99	
8.	Has (Name) been ill with a fever at any time in the last 2 weeks?	Yes .... 1 No .... 2 Dont know .... .99	
9.	Did (Name) have malaria in the last 3 months?	Yes .... 1 No .... 2 Dont know .... .99	

Food consumption data

Now I would like to ask you some questions around the food eaten by you/your child. I know this is sometimes hard to remember, but please give me the best answer you can.

10. During the past 7 days, on how many days did you/ your child (Name) eat the following foods?

	Foods	Serving size	# of days in last 7 days	# of servings in last 7 days	gm/ml
	1. Rice?	1 cup	☐	☐☐☐☐	☐☐☐☐☐☐
	Breads				
	2.Chapatti?	2 pieces	☐	☐☐☐☐	☐☐☐☐
	3.Bread?	2 slices	☐	☐☐☐☐	☐☐☐☐
	4.Parata?	1 piece	☐	☐☐☐☐	☐☐☐☐
	Fish				
	5. Small fish species (with bones)?	60 gram	☐	☐☐☐☐	☐☐☐☐
	6. Big fish species (boneless)?	30 gram	☐	☐☐☐☐	☐☐☐☐
	7. Egg?	One	☐	☐☐☐☐	☐☐☐☐
	8. Dal?	½ cup	☐	☐☐☐☐	☐☐☐☐
	Green Leafy Vegetables (Shak)				
	9. Pui shak?	½ cup	☐	☐☐☐☐	☐☐☐☐
	10. Palong shak?	½ cup	☐	☐☐☐☐	☐☐☐☐
	11.Lal skak	½ cup	☐	☐☐☐☐	☐☐☐☐
	12. Kalmi shak	½ cup	☐	☐☐☐☐	☐☐☐☐
	13.Paat shak?	½ cup	☐	☐☐☐☐	☐☐☐☐
	14.Kochu shak?	½ cup	☐	☐☐☐☐	☐☐☐☐
	15.Shorisha shak?	½ cup	☐	☐☐☐☐	☐☐☐☐
	16.Moola shak?	½ cup	☐	☐☐☐☐	☐☐☐☐
	17.Others (specify........)	½ cup	☐	☐☐☐☐	☐☐☐☐
	Yellow/orange vegetables/fruit				
	18.Carrots	½ cup	☐	☐☐☐☐	☐☐☐☐
	Record the amount...				
	19.Ripe mango	½ cup	☐	☐☐☐☐	☐☐☐☐
	Record the amount...				
	20.Sweet Pumpkin	½ cup	☐	☐☐☐☐	☐☐☐☐
	Record the amount...				
	21.Ripe jackfruit	½ cup	☐	☐☐☐☐	☐☐☐☐
	Record the amount...				
	22.Ripe papaya	½ cup	☐	☐☐☐☐	☐☐☐☐
	Record the amount...				
	23.Tomato	½ cup	☐	☐☐☐☐	☐☐☐☐
	Record the amount...				
	24.Sweet potato	½ cup	☐	☐☐☐☐	☐☐☐☐
	Record the amount...				
	25.Orange	½ cup	☐	☐☐☐☐	☐☐☐☐
	Record the amount...				

	26.Watermelon	½ cup	☐	☐☐☐☐	☐☐☐☐
	Record the amount..				
	27.Banana	½ cup	☐	☐☐☐☐	☐☐☐☐
	Record the amount				
	28.Others (Specify.........)		☐	☐☐☐☐	☐☐☐☐
	Meats				
	29.Chicken	60 gram	☐	☐☐☐☐	☐☐☐☐
	30.Beef	60 gram	☐	☐☐☐☐	☐☐☐☐
	31.Mutton	60 gram	☐	☐☐☐☐	☐☐☐☐
	32.Liver	60 gram	☐	☐☐☐☐	☐☐☐☐
	Milk and milk products				
	33.Milk	1 cup	☐	☐☐☐☐	☐☐☐☐
	34.Yogurt	½ cup	☐	☐☐☐☐	☐☐☐☐
	35.Cheese	Measure of a thumb	☐	☐☐☐☐	☐☐☐☐
	36.Sugar, honey, molasses	1 tbsf	☐	☐☐☐☐	☐☐☐☐
	37. Beans, nuts	½ cup	☐	☐☐☐☐	☐☐☐☐
11.	Biological Sample (Give tick mark in the middle and right columns against each of the parameters)				
	Name	Stipulated for collection		Actual collection	
	S. Retinol	☐		☐	
		Sample ID ☐☐☐☐☐☐☐☐☐			
	Hemoglobin	☐		☐	
		Sample ID ☐☐☐☐☐☐☐☐			
	Hemoglobin %: .				
	S. Ferritin	☐		☐	
		Sample ID ☐☐☐☐☐☐☐☐☐			
	Urinary Iodine	☐		☐	
		Sample ID ☐☐☐☐☐☐☐☐☐			

Annex 7.7.4: NPNL Women Form

(This form is for the non-pregnant, non-lactating (NPNL) women, who will provide the biological samples. Use separate form for each of the women)

Household # (50-HH listing): ☐☐ Household# (Sl. In 20-HH list): ☐☐

Household Identification	
Cluster: 1=Rural; 2=Cities+Municipalities; 3= Urban (Slums).	☐
Division: 1=Dhaka, 2=Chittagong, 3= Rajshahi, 4=Khulna 5=Sylhet, 6=Barishal	Division: ☐ District: ☐☐
Upazilla/Municipality	Union: ☐☐ Ward: ☐☐ (............)
Mauza	Cluster No: ☐☐☐

Household identification	
Name of the Household Head	Date: DD/MM/YY ☐☐/☐☐/☐☐
Household landline/cell phone No.:	
Name of the Interviewer	Signature:
Name of the Supervisor	Signature:
Name of the Quality Control Officer	Signature:
Written informed consent: 1=Yes, 2=No ☐	
Result Code: ☐ Completed=1 Incomplete=2	
Reason for which the data collection was not completed...	

General Information of the Woman

1.	Sl. No of women:	Sl. No .... ☐☐	
2.	Women ID:	☐☐☐☐☐☐☐☐ (W/Clusters/Division/Cluster/HH no/Sl. No.)	
3.	Name of the women:	Name .... ☐☐	
4.	Age (years) Consider the age in completed years	Years	
5.	What your level of formal education?	No education ....1 Primary incomplete .... 2 Primary complete ....3 Secondary incomplete ....4 Secondary complete or higher 5	
6.	What is your occupation?	Professional/technical ....01 Small Business ....02 Large Business ....03 Factory worker...04 Service ....05 Skilled labour/service ....06 Unskilled labour ....07 Farmer/agricultural worker ....08 Poultry/cattle raising ....09 Home manufacturing ....10 Domestic help..11 House wife..12 Other ....77 (Specify)	
7.	Are you married?	Yes ....1 No 2	→ 12
8.	How old were you at the time of marriage?	Years .... ☐☐	
9.	How many children have you given birth?(Live and dead)	Live .... ☐☐ Dead .... ☐☐	
10.	Did you suffer from malaria? (last 3 months)	Yes ....1 No ....2 Don't Know...99	
11.	Have you reached menopause? (Ask, if she is above 40)	Yes ....1 No ....2 Don't Know...99	

Food consumption data

Now I would like to ask you some questions around the foodn eaten by you. I know this is sometimes hard to remember, but please give me the best answer you can.

12. During the past 7 days, for how many days did you eat the following foods?

Foods	Serving size	# of days in last 7 days	# of servings in last 7 days	gm/ml
1. Rice	1 cup	☐	☐☐☐☐	☐☐☐☐
Breads				
2. Chapatti	2 pieces	☐	☐☐☐☐	☐☐☐☐
3. Bread	2 slices	☐	☐☐☐☐	☐☐☐☐
4. Parata	1 piece	☐	☐☐☐☐	☐☐☐☐
Fish				
5. Small fish species (with bones)	60 gram	☐	☐☐☐☐	☐☐☐☐
6. Big fish species (boneless)	30 gram	☐	☐☐☐☐	☐☐☐☐
7. Egg	One	☐	☐☐☐☐	☐☐☐☐
8. Dal	½ cup	☐	☐☐☐☐	☐☐☐☐
Green Leafy Vegetables (Shak)				
9. Pui shak	½ cup	☐	☐☐☐☐	☐☐☐☐
10. Palong shak	½ cup	☐	☐☐☐☐	☐☐☐☐
11. Pui shak	½ cup	☐	☐☐☐☐	☐☐☐☐
12. Palong shak	½ cup	☐	☐☐☐☐	☐☐☐☐
13. Paat shak	½ cup	☐	☐☐☐☐	☐☐☐☐
14. Kochu shak	½ cup	☐	☐☐☐☐	☐☐☐☐
15. Shorisha shak	½ cup	☐	☐☐☐☐	☐☐☐☐
16. Moola shak	½ cup	☐	☐☐☐☐	☐☐☐☐
17. Others (specify........)	½ cup	☐	☐☐☐☐	☐☐☐☐
Yellow/orange vegetables/fruit				
18. Carrots	½ cup	☐	☐☐☐☐	☐☐☐☐
Record the amount...				
19. Ripe mango	½ cup	☐	☐☐☐☐	☐☐☐☐
Record the amount...				
20. Sweet pumpkin	½ cup	☐	☐☐☐☐	☐☐☐☐
Record the amount...				
21. Ripe jackfruit	½ cup	☐	☐☐☐☐	☐☐☐☐
Record the amount...				
22. Ripe papaya	½ cup	☐	☐☐☐☐	☐☐☐☐
Record the amount...				
23. Tomato	½ cup	☐	☐☐☐☐	☐☐☐☐
Record the amount...				

	24. Sweet potato	½ cup	☐	☐☐☐☐	☐☐☐☐
	Record the amount..				
	25.Orange	½ cup	☐	☐☐☐☐	☐☐☐☐
	Record the amount..				
	26.Watermelon	½ cup	☐	☐☐☐☐	☐☐☐☐
	Record the amount..				
	27. Banana	½ cup	☐	☐☐☐☐	☐☐☐☐
	Record the amount				
	28.Others(Specify.........)		☐	☐☐☐☐	☐☐☐☐
	Meats				
	29.Chicken	60 gram	☐	☐☐☐☐	☐☐☐☐
	30.Beef	60 gram	☐	☐☐☐☐	☐☐☐☐
	31.Mutton	60 gram	☐	☐☐☐☐	☐☐☐☐
	32.Liver	60 gram	☐	☐☐☐☐	☐☐☐☐
	Milk and milk products				
	33. Milk	1 cup	☐	☐☐☐☐	☐☐☐☐
	34. Yogurt	½ cup	☐	☐☐☐☐	☐☐☐☐
	35. Cheese	Measure of a thumb	☐	☐☐☐☐	☐☐☐☐
	36. Sugar, honey, molasses	1 tbsf	☐	☐☐☐☐	☐☐☐☐
	37. Beans, nuts	½ cup	☐	☐☐☐☐	☐☐☐☐

Now I would like to collect 3-5 ml of your blood sample to assess level of vitamin A, A/ Hemoglobin/ Iron /Zinc/Folate and B_{12} in your body. I would like to request that you provide 30 ml of your urine sample for assessing level of iodine in your body.

13	Biological Sample (Tick offthe middle and right columns against each of the parameters)		
	Name	Stipulated for collection	Actual collection
	S. Retinol	☐	☐
		Sample ID ☐☐☐☐☐☐☐☐ ☐	
	Hemoglobin	☐	☐
		Sample ID ☐☐☐☐☐☐☐☐ ☐	
	Hemoglobin %: ☐☐.☐		
	S. Ferritin	☐	☐
		Sample ID ☐☐☐☐☐☐☐☐ ☐	
	S. Zinc	☐	
		Sample ID ☐☐☐☐☐☐☐☐ ☐	
	Urinary Iodine	☐	
		Sample ID ☐☐☐☐☐☐☐☐ ☐	
	S. Folate/B_{12}	☐	
		Sample ID ☐☐☐☐☐☐☐☐ ☐	

Annex 7.7.5: Retailer's Questionnaire

(This form will be used to collect information from retail shopkeepers.Use one form for each of the shop)

Section A: Retailer identification		
	Cluster: 1=Rural; 2=Cities+Municipalities; 3= Urban (Slums).	☐
	Division: 1=Dhaka, 2=Chittagong, 3= Rajshahi, 4=Khulna 5=Sylhet, 6=Barishal	Division: ☐ District: ☐☐
	Upazilla/Municipality	Union: ☐☐ Ward: ☐☐ (...........)
	Mauza	Cluster No: ☐☐☐
	Name of shop:	Shop number: ☐☐☐
	Name of shop owner:	Date: DD/MM/YY ☐☐☐☐☐☐
	Landline/cell phone no. of the shop:	
	Name of the interviewer:	Signature:
	Name of the Supervisor	Signature:
	Name of the Quality control Officer	Signature:
	Written informed consent: 1=Yes, 2=No	
	Result Code: Completed=1 Incomplete=2	
	Reason, the data collection was not completed...	

Section B: Data collection from retail shopkeeper

Q. No.	QUESTION	CODING CATEGORIES	SKIP
1.	What is the relationship of respondent to the owner of the retail shop?	None (Owner)....................1 Employee....................2 Others....................77	
2.	What is your Name?	Name	
3.	What is your level of education?	No education....................1 Primary incomplete....................2 Primary complete....................3 Secondary incomplete....................4 Secondary complete and higher....................5	
4.	Do you sell crude salt?	Yes....................1 No....................2	→ Q6
5.	Where do you usually buy crude salt from?	Factory....................1 Retailer....................2 Wholesaler....................3 Market....................4 Crude salt producer....................5 Other....................77 (Specify)	
6.	Do you sell open salt?	Yes....................1 No....................2	→ Q10
7.	Where do you usually buy open salt from?	Factory....................1 Retailer....................2 Wholesaler....................3 Market....................4 Other....................77 (Specify)	

8.	Do you seal the small packets made from the big sack?	Yes ..... 1 No 2	
9.	How do you store the open salt?	Open sunlight ..... 1 Damp place ..... 2 Ventilated places ..... 3 Cool, dry, dark place ..... 4 Other ..... 77 (Specify)	
10.	Do you sell salt packets?	Yes ..... 1 No 2	→ Q16
11.	Where do you buy salt packets from?	Factory ..... 1 Retailer ..... 2 Wholesaler ..... 3 Market ..... 4 Other ..... 77 (Specify)	
12.	Do you make smaller packets from ½ or 1 kg salt packets and sell them to customers?	Yes ..... 1 No ..... 2 (Put skip instruction)	→ Q16
13.	Is the opening of the 1- or .5-kg packet kept closed?	Yes ..... 1 No 2	
14.	Do you seal the small .5 or 1 kg packet?	Yes ..... 1 No 2	
15.		Open sunlight ..... 1 Damp place ..... 2 Ventilated places ..... 3 Cool, dry, dark place ..... 4 Other ..... 77 (Specify)	
16.		Yes ..... 1 No 2	→ Q32
17.			
		Mentioned ..... 1 Did not mention 2	
		Mentioned ..... 1 Did not mention 2	
		Mentioned ..... 1 Did not mention 2	
		Mentioned ..... 1 Did not mention 2	
		Mentioned ..... 1 Did not mention 2	
		Mentioned ..... 1 Did not mention 2	
		Mentioned ..... 1 Did not mention 2	
		Mentioned ..... 1 Did not mention 2	
		Mentioned ..... 1 Did not mention 2	
18.		Yes, all ..... 1 Yes, some ..... 2 No ..... 3 Don't know 99	

Q. No.	QUESTION	CODING CATEGORIES	SKIP
19.		Yes, all .... 1 Yes, some .... 2 No .... 3 Don't know 99	
20.		Yes, all .... 1 Yes, some .... 2 No .... 3 Don't know 99	
21.		Yes .... 1 No 2	→ Q23
22.	Please state the benefits? *(Do not prompt)*		
	a. Prevents goiter	Mentioned .... 1 Did not mention 2	
	b. Prevents cretinism	Mentioned .... 1 Did not mention 2	
	c. Promotes mental development/intelligence	Mentioned .... 1 Did not mention 2	
	d. Promotes normal growth	Mentioned .... 1 Did not mention 2	
	e. Prevents abortion and stillbirths	Mentioned .... 1 Did not mention 2	
	f. Healthy	Mentioned .... 1 Did not mention 2	
	g. Other (Specify ....)	Mentioned .... 1 Did not mention 2	
23.	Do you know how to test salt for iodine?	Know .... 1 Don't Know 2	→ Q32
23a.	Please explain how to test salt for iodine,	Test kit .... 1 Home-made .... 2 Both 3	
24.	Do you test your salt for iodine using testing kit or home-made method?	Yes .... 1 No 3	→ Q25
24a.	How do you test your salt for iodine?	Test kit .... 1 Home-made .... 2 Both 3	
25.	Do you know the ingredients to test salt for iodine?*(Do not prompt)*		
	1. Salt?	Mentioned .... 1 Did not mention 2	
	2. Cooked rice?	Mentioned .... 1 Did not mention 2	
	3. Lemon juice?	Mentioned .... 1 Did not mention 2	
	Interviewers: In **Q.25** if the respondent mentions salt then ask **Q.26**, if cooked rice, then ask **Q.27** and if lemon juice, then **ask Q.28.**		
26.	How much salt? (Do not prompt)	A pinch .... 1 A level teaspoon .... 2 Other .... 3 (Specify) Don't know .... 99 N/A 4	

Q. No.	QUESTION	CODING CATEGORIES	SKIP
27.	How much cooked rice? (Do not prompt)	A small amount .... 1 5 grains .... 2 Other amount .... 3 (Specify) Don't know .... 99 N/A 4	
28.	How much lemon juice? (Do not prompt)	A few drops .... 1 Other amount .... 2 (Specify) Don't know .... 99 N/A 4	
29.	What colour does the salt turn if it contains iodine? *(Do not prompt)*	White .... 1 Violet/bluish .... 2 Other .... 3 (Specify) Don't know 99	
30.	What colour does the salt turn if it has no iodine? *(Do not prompt)*	White .... 1 Violet/bluish .... 2 Other .... 3 (Specify) Don't know 99	
31.	How often do you test the salt you sell for iodine using the home-made method?	Never .... 1 Sometimes .... 2 Always 3	
32.	Do you know about a salt law?	Yes .... 1 No 2	→ Q35
33.	Is there any punishment for violating this salt law?	Yes .... 1 No .... 2 Don't know 99	 → Q35 → Q35
34.	If so, what is the punishment?	Imprisonment .... 1 Fine .... 2 Both 4	
35.	How many salt samples were collected (This question is not for the respondent, but for the records of the interviewer)?	Number	

36.	Sample identification:		
	Brand 1	Cluster no: Shop no:	Sample ID:
	Open salt or Brand 2	Cluster no Shop no:	Sample ID:

Q. No.	QUESTION	CODING CATEGORIES	SKIP
37.	Do you sell cooking oil?	Yes .... 1 No 2	→ Q37b
37a.	What kind of cooking oil do you sell?	Brand oil (Soybean oil) .... 1 Brand oil (Palm oil) .... 2 Brand oil (Mustard oil) .... 3 Open oil .... 4 Other .... 77 (Specify)	
37b.	Do you know about of vitamin A fortified cooking oil?	Yes .... 1 No 2	→ END
38c.	If so, do you sell vitamin A-fortified cooking oil? (Check the brand labels available in the shop for vitamin A-fortified oil)	Yes .... 1 No 2	

Annex 7.8: Biological Sample Collection Forms

Annex 7.8.1: Blood Sample Collection Form

Table 111: Blood Sample Collection Form

TYPE OF AREA: CLUSTER NO.: DIVISION: DISTRICT:

50 HH No	20 HH No	Participants' Name	P	S	W	Lab. ID (For laboratory use only)	Participant ID	Sample ID				Remarks
								R	F	B	Z	
TOTAL												

Collected by: Collection date: Time:

Assisted by: Carried by:

Date:

Received by:

Date: Time:

Annex 7.8.2: Household Salt Sample Collection Form

Table 112: Household Salt Sample Collection Form

TEAM: TYPE OF AREA: CLUSTER NO.: DIVISION: DISTRICT:

50-HH no.	20-HH no.	Name of the Household Head	Lab. ID (For laboratory use only)	Sample ID	Remarks

Collected by: Collection date: Time:

Assisted by: Carried by:

Date:

Received by:
Date: Time:

ANNEX 7.8.3: RETAILER'S SALT SAMPLE COLLECTION FORM

TABLE 113: RETAILER'S SALT SAMPLE COLLECTION FORM

TEAM: TYPE OF AREA: CLUSTER NO.: DIVISION: DISTRICT:

Shop no.	Name of Shop	Name of Shop Owner	Lab. ID (For laboratory use only)	Sample ID	Remarks
Total Retailer's salt sample					

Collected by: Collection date: Time:

Assisted by: Carried by:

Date:

Received by:

Date: Time:

Annex 7.8.4: Urine Sample Collection Form

Table 114: Urine Sample Collection Form

TEAM: TYPE OF AREA: CLUSTER NO.: DIVISION: DISTRICT:

50 HH No	20 HH No	Participants' Name	School-age Children	Women	Lab. ID (For laboratory use only)	Sample ID	Remarks
Total urine sample							

Collected by:

Time:

Collection date:

Assisted by:

Carried by:

Date:

Received by:

Date: Time:

Annex:7.9 Cluster Monitoring Form

Table 115: Cluster Monitoring Form

Cluster: Rural/urban/slum (Tick off as appropriate)			
Cluster#..................................		Date............ to	
Division.................................	District....................	Sub-district....................	Union........................
Ward	Mauza.....................		Mauza no..................

	Question	**Response** (Tick as appropriate)
1	Was the sampling of the households carried out **appropriately**?	Well Fair Unsatisfactory
2	Was the sampling of the biological specimen carried out **appropriately**?	Well Fair Unsatisfactory
3	Was the introduction, consent taking conducted **appropriatel**y?	Well Fair Unsatisfactory
4	Was the patient properly explained to about the procedure before drawing blood?	Well Fair Unsatisfactory
5	Was aseptic precaution taken?	Well Fair Unsatisfactory
6	Was the blood collection carried out **appropriately**?	Well Fair Unsatisfactory
7	Was the serum separation (centrifuge) conducted **appropriately**?	Well Fair Unsatisfactory
8	Was the aliquot preparation conducted **appropriately**	Well Fair Unsatisfactory
9	Was labelling done **appropriate**ly, including checking the sample ID in the forms?	Well Fair Unsatisfactory
10	Was the cold chain a**ppropriately** maintained at every stage from blood collection to sending back to the laboratory?	Well Fair Unsatisfactory
11	Were the used syringes, microcuvettes, cotton, etc. disposed **appropriately**?	Well Fair Unsatisfactory
12	Was the weight of the young children measured **appropriately**?	Well Fair Unsatisfactory

13	Was the length/height of the young children measured **appropriately**?	Well Fair Unsatisfactory
14	Was the mid-upper arm circumference (MUAC) of the young children measured **appropriately**?	Well Fair Unsatisfactory
15	Were the questions on young child feeding asked **appropriatel**y?	Well Fair Unsatisfactory
16	Were the questions on food consumption asked a**ppropriately**?	Well Fair Unsatisfactory
17	Were the questions on household food insecurity asked **appropriately**?	Well Fair Unsatisfactory
18	Was the question on household monthly expenses asked **appropriatel**y?	Well Fair Unsatisfactory
19	Was the coding done **appropriately**?	Well Fair Unsatisfactory
20	Did you conduct repeat interviews[2] in the cluster?	Yes No
21	If so, what is degree of agreement between the repeat interview[2] and the regular interview?	Well Fair Unsatisfactory

"Appropriately" means as per the training and/or operational guidelines.
[2]Do not ask the questions on infant feeding and food consumption questions in the repeat interviews. Try to administer the repeat interview after 24 hours and no later than 48 hours.
Score: The following score is accounted for the responses: Well=2, Fair=1, Unsatisfactory=0
Score obtained: Possible score: Result (%):
[Share the results and discuss with the field team in a supportive, supervisory manner]

Name, Signature of the Officer: Date:

Signature of the Supervisor/Principal Investigator: Date:

Annex:7.10 Bi-weekly Monitoring Report Form

Table 116: Bi-weekly Monitoring Report Form

Period covering: From…………………………………. to …………………………….			Date:
Name of the Officer:			
Division:	Districts:		Sub-district/sub-districts:
	Questions		Results
1	How many clusters did you visit over the fortnight?		Rural…………..………..(no.) Cluster Nos.................... Urban…….…..….…….(no.) Cluster Nos...................... Slum……….…..…..…..(no.) Cluster Nos...................... Total…………..………..(no.)
2	How many repeat interviews did you conduct over the fortnight?		
3	How many field interviews did you observe over the fortnight?		
4	How many field interviews did you observe conducted satisfactorily[1] over the fortnight?		
5	What was the percentage of the number of the field interviews you observed conducted satisfactorily[1] over the fortnight? Q5 (%) =Q4/ Q3 × 100		
6	How many episodes of length/height taking of young children did you observe over the fortnight?		
7	How many episodes of length/height taking of young children did you observe conducted correctly[2] over the fortnight?		
8	What was the percentage of the number of episodes of length/height taking of young children you observed conducted correctly[2] over the fortnight? Q8 (%) =Q7/Q6×100		
9	How many participants did you observe, with whom biological samples (blood, urine) were managed [3]over the fortnight?		
10	How many participants did you observe, with whom biological samples (blood, urine) were correctly[2] managed[3] over the fortnight?		
11	What was the percentage of participants you observed, with whom biological samples (blood, urine) were correctly[2] managed[3] over the fortnight: Q11(%) = Q10/ Q9 × 100		
12	How many feedback episodes did you take with the field data teams over the fortnight, in the cases of any inconsistencies observed?		
13	What was the average score (%) of the cluster performance over the fortnight?		
14	General comments:		
15	Specific comments:		

[1] "Satisfactorily": When the following questions, e.g. food consumption questions, household food insecurity questions, household monthly expense questions along with appropriate administration of other questions are satisfactorily administered, the interview will be termed "satisfactorily" conducted.
[2]"Correctly :As per training and operational guidelines
[3]"Manage": Blood collection, serum separation (ultra centrifuze), aliquot preparation, labeling, and maintenance of cold chain.

Signature of the officer: Date

Signature of the supervisor/PI: Date:

Annex 7.11 The Individuals Engaged in the National Micronutrient Survey 2011-12

7.11.1 The Survey Administrators:

Institute of Public Health Nutrition (IPHN)
Dr. Mohammad Hedayetul Islam, Director, Institute of Public Health Nutrition and Line Director of the National Nutrition Services, Co-Principal Investigator

Centre for Nutrition and Food Security, icddr,b
Dr. Sabuktgain Rahman, Principal Investigator/Survey Director
Dr.Tahmeed Ahmed, Co-Principal Investigator
Dr. Ahmed Shafiqur Rahman, Co-investigator
Dr. A.M. Shamsir Ahmed, Co-investigator
Dr. Nurul Alam, Co-investigator/statistician/demographer

UNICEF, Bangladesh
Dr. Ireen Akter Chowdhury, Co-investigator
Ms. Lilian Selenje, Co-investigator
Dr. Indrani Chakma, Co-investigator

7.11.2 The Technical Committee for the National Micronutrient Survey 2011-12

Institute of Public Health Nutrition (IPHN)
Dr. Mohammad Hedayetul Islam, Director, Institute of Public Health Nutrition and Line Director of the National Nutrition Services, Chairman
Dr. SM Mustafizur Rahman, Program Manager, NNS
Dr. Ashraf Hossain Sarkar, Deputy Director and Program Manager, NNS
Dr. Taherul Islam Khan, Program Manager, NNS

Institute of Epidemiology, Disease Control and Research (IEDCR)
Dr. M. Mushtuq Hussain, Principal Scientific Officer

Ministry of Industries
Khandakar Nuruzzaman, Joint Chief and Project Director, Fortification of Edible oil in Bangladesh Project
Abu Taher Khan, Director (Technology), BSCIC and Project Director, CIDD project, Bangladesh Small and Cottage Industries Corporation (BSCIC)
Mumtahenah Siddique, Assistant Director (Programme), Fortification of Edible Oil in Bangladesh-Project

Dhaka Medical College and Hospital
Dr. Mainuddin Ahmed, Associate Professor of Pediatrics

Shaheed Ziaur Rahman Medical College
Dr. Ferdousi Begum, Associate Professor, Obstetrics and Gynaecology

Bangladesh Council of Scientific and Industrial Research
Ms. Krishna Chowdhury, PSO & Section Chief, Oilseed and Lipid Technology Section, IFST

University of Dhaka
Dr. Md. Nazrul Islam Khan, Professor, Institute of Nutrition and Food Science
Dr. Sheikh Nazrul Islam, Professor, Institute of Nutrition and Food Science

Centre for Nutrition and Food Security, icddr,b
Dr. Tahmeed Ahmed, Senior Scientist and Director, Centre for Nutrition and Food Security
Dr. Ahmed Shafiqur Rahman, Associate Scientist, Centre for Nutrition and Food Security
Professor Dr. Md. Sohrab Ali, Member, Board of Trustees (BOT)
Dr. Sabuktagin Rahman, Assistant Scientist, Centre for Nutrition and Food Security

UNICEF, Bangladesh
Noreen Prendiville, Chief Nutrition Section
Dr. Md. Mohsin Ali, Nutrition Specialist
Dr. Ireen Akhter Chowdhury, Nutrition Specialist

Micronutrient Initiatives
Dr. Zeba Mahmud, Country Director

7.11.3 Monitoring and Supervision Teams

Centre for Nutrition and Food Security, icddr,b
Morad Hossain, Field Reseach Officer
Akul Chandra Halder, Field Reseach Officer
Kamruzzaman, Field Reseach Officer
Mostofa Mohsin, Field Reseach Officer
Khairul Islam Akanda, Field Reseach Officer
Kazi Alom, Field Reseach Officer
Dr. Sabuktagin Rahman, Assistant Scientist & Principal Investigator, National Micronutrients Survey
Dr. Tahmeed Ahmed; Director, CNFS, icddr,b

UNICEF, Bangladesh
Dr. Ireen Akhter Chowdhury, Nutrition Specialist
Dr. Mohsin Ali, Nutrition Specialist

Institute of Public Health Nutrition (IPHN)
A.K.M. Abdur Rob Khan; Field visitor
Md. Shafiqul Islam; Home visitor
Md. Sarwar Alam; Home visitor
Md. Jafrul Islam; Field assistant
Md. Abdus Salam; Home visitor

7.11.4. Staff Members from Mitra and Associates

S N Mitra	Executive Director
Siddique Mazumder	Director, Training
Fuad Pasha	Director, Administration
Jahangir Hossain Sharif	Assistant Director
Sittul Muna	Senior Research Officer
Sayed Abdullah Al Ahsan	Senior Research Officer
Mominul Haque	Quality. Control Officer
Bodruddoza	H. Technician
Bidyut Barai	H. Technician
Mitu Ballabhnth	Interviewer
Nurun Nahar	Interviewer
Shamim Sardar	Quality Control Officer
Faruk Hossain	Quality Control Officer
Shahidur Rahman(Sohel)	Quality Control Officer
Nazmul Islam	Quality Control Officer
Israt Jahan (Anth)	Quality Control Officer
Mitu Ballabhnth (Anth)	Quality Control Officer
Abdul Halim Khaddam	Supervisor
Soheb Hossen	Supervisor
Abdul Ahad	Supervisor
Biplab Kumar Roy	Supervisor
Aminul Islam (Khulna)	Supervisor

Tajul Islam	Supervisor
Meherul Islam	Supervisor
Abedul Haque	Supervisor
Amirul Islam Kabil	Supervisor
Shahidal Islam	Supervisor
Rayhanul Islam	H. Technician
Jugal Majumder	H. Technician
Zeaur Rahman	H. Technician
Tauhid Hossain	H. Technician
Anwara Begum Soma	H. Technician
Kamrul Islam	H. Technician
Bodruddoza	H. Technician
Younus Ali	H. Technician
Mominul Islam	H. Technician
Ayesha Khatun	H. Technician
Bidyt Barai	H. Technician
Thamina Akther	H. Technician
Aminul Islam (Patua)	Attendance
Hassan Selim	Attendance
Arifuzzman	Attendance
Anishur Rahman	Office
Debashis Bachar	Office
Eakub Ali Khan	Office
Jahirul Islam	Office
Mominuzzaman	Office
Zahidul Islam	Office
Anjuman Ara Begam (Anth-2)	Interviewer
Ashma Hossain	Interviewer
Asma Akhter (Anth)	Interviewer
Bulbuli Begum	Interviewer
Farzana Jakaria	Office
Ferdausi Akhter	Interviewer
Jahidha Khatun (Anth)	Interviewer
Lipi Begum	Interviewer
Lovely Rani Das	Interviewer
Mazeda Khatun	Office
Monira Pathan Lutfa	Office
Mousumi Akter (Lasmin)(Anth)	Interviewer
Nasrin Akter (Anth)	Interviewer

Nur Banu (Anth-3)	Interviewer
Nurun Nahar	Office
Parul Begum	Interviewer
Rina Aktar (Anth)	Interviewer
Rinky Khanam	Interviewer
Ripa Begum	Interviewer
Sahrima Khan (Anth-3)	Interviewer
Salma Akther (Anth)	Interviewer
Samsun Nahar	Interviewer
Sheuli Rani (Anth-2)	Interviewer
Suborna Parvin (Anth-3)	Interviewer
Suma Akhter	Interviewer
Sumina Liva (Sumi)	Interviewer
Taslima Akhter Lipi	Interviewer
Zohura Khatun (Anth-2)	Interviewer
Shishir Paul	Data Processor
Jharna Datta	Data Enty and Edit
Jayead	Data Enty and Edit
Rokshana	Data Enty and Edit
Sharif Hossain Talukdar	Data Enty and Edit
Arefin Hossain	Data Enty and Edit
Pronob Das	Data Enty and Edit
Ripon Barman	Data Enty and Edit
Amran Hossain	Data Enty and Edit
Songta Modok	Data Enty and Edit

Supported by: