National Micronutrient Survey Jordan 2010

(15 July 2011)

* Micronutrient status following flour fortification
* Household survey for fortified bread and iodized salt
* Anthropometric status of children

المملكة الأردنية الهاشمية

Jordan, Ministry of Health (MOH)

In collaboration with:

Global Alliance for Improved Nutrition (GAIN)
United States Center for Disease Control and Prevention (CDC)
United Nation Children's Fund (UNICEF) - Jordan

gain Global Alliance for Improved Nutrition

unicef

National Micronutrient Survey, Jordan 2010
(15 July 2011)

- *Micronutrient status following flour fortification*
- *Household surveys for fortified bread and iodized salt*
- *Anthropometric status of children*

Jordan, Ministry of Health (MOH)

In collaboration with:

Global Alliance for Improved Nutrition (GAIN)

United States Centers for Disease Control and Prevention (CDC)

United Nations Children's Fund (UNICEF)-Jordan

LIST OF ABBREVIATIONS

AGP	α-1-acid glycoprotein
BMI	Body mass index
CBC	Complete blood count
CDC	United States Centers for Disease Control and Prevention
CI	Confidence Interval
CPHL	Jordan Central Public Health Laboratory
CRP	C–reactive protein
DEFF	Design effect
DHS	Demographic and Health Survey
DOS	Department of Statistics
FDA	Food and Drug Administration
EDTA	Ethylenediaminetetraacetic acid
HIES	Household Income Expenditure Survey
HAZ	Height-for-age, Z-score
Hb	Hemoglobin
ICC	Inter-cluster correlation
ICCIDD	International Council for the Control of Iodine Deficiency Disorders
IMMPaCt	International Micronutrient Malnutrition Prevention and Control Program
IVACG	International Vitamin A Consultative Group
IDA	Iron deficiency anemia
JD	Jordanian Dinar
JUST	Jordan University of Science and Technology
LC-MS/MS	Liquid chromatography tandem mass spectrometry
MI	Micronutrient Initiative
MOH	Ministry of Health
MT	Metric ton
NCEH	National Center for Environmental Health
NTDs	Neural tube defects
PPM	Parts per million
PPS	Probability proportional to size
QC	Quality control
RBC	Red blood cells
RSS	Royal Scientific Society
SD	Standard deviation
SF	Serum ferritin
UNICEF	United Nations Children's Fund

VAD	Vitamin A Deficiency
VITAL-EQA	Vitamin A Laboratory External Quality Assurance program
WHO	World Health Organization
WHZ	Weight-for-height Z-score
WAZ	Weight-for-age Z-score

Investigators and Collaborators

The core members of the survey team are as follows:

Survey Personnel

- Hanan Masa'd (MOH) – Survey Director
- Aktham Haddadin (MOH-CPHL) – Laboratory Coordinator
- Ibrahim Khatib (JUST) – Laboratory Director
- Batoul Obaid (DOS) – Survey Design and Data Coordinator
- Tarek M. Al-Sanouri (MOH-CPHL) – Field Coordinator

Advisors

- Rawheih Barham (MOH)
- Adel M. Belbeisi (MOH)
- Basam Hijawi (MOH)
- Mohammed Tarawneh (MOH)
- Wissam Qarqash (Jordan Health Communication Partnership)
- Ahakmad Faqih (University of Jordan)
- Christine Clewes (GAIN)
- James Wirth (GAIN)
- Nancy Jennings Aburto (CDC)
- Bakary Drammeh (CDC)
- Erin Koers (CDC)
- Usha Mandava (CDC)
- Christine Pfeiffer (CDC)
- Rosemary Schliecher (CDC)
- Mary Serdula (CDC)
- Kevin Sullivan (CDC)

Acknowledgments

The current survey was funded through a grant agreement between GAIN and the Government of Jordan Ministry of Health (MOH) and a Memorandum of Understanding between GAIN and the CDC. Additional support was provided by the UNICEF regional office. We would especially like to acknowledge Nadera Al-Shareff and Ruba Nabulsi, for their oversight in the laboratory; lab technicians Gaia Alwahdan, Iman Aweda, Alena Georgy, and Maisun Matar, for their support of blood testing; Lamees Janineh and Shefa Saleh for their dedicated work processing bread and salt samples; Adie Saeed of the Royal Scientific Society for his work with the quantitative iron testing of bread; and field lab technicians Mahmoud Al Shouibe, Naim Daoud, Afif Farrash, Nabila Malkawi, and Musa Shoman, for their support during data collection. We would like also to thank Majd Ali for her secretarial support and Mohamad Khatib for creating the data entry platform and completing data entry. We are grateful to Khawla Al-Hiasat for her support in conducting the anthropometry training and input on maternal and child health strategy programs. We would like to acknowledge Adnan Ishaq and Mohammad Aneese for their work in designing the survey questionnaire and writing the survey proposal during the early stage of survey preparations. We would also like to acknowledge Joanna Galvez for her support in finalizing the analysis and formatting of the report and Joseph Nichols for assistance with graphics. We are also grateful to the Higher Committee for Nutrition in Jordan, especially Deyfallah Al Lawzy, Secretary General of MOH, Bassam Hijawi, and all of the Higher Committee members.

Finally, we are grateful to Nicolas Tsikhlakis and Barbara Macdonald, who conceived the idea for this survey evaluation and who have provided invaluable support throughout. We acknowledge Wissam Qarqash (Jordan Health Communication Partnership), who was the director of the 2002 survey, and to Henry Walke and Russell Gerber, of the Jordan Field Epidemiology Training Program, for their technical guidance during the 2002 and 2010 Micronutrient Surveys.

For their careful oversight, we are grateful to field supervisors Ibrahim Ablan, Methaq Al Sah dah, Marwan Al Zugal, Raja Badarneh, Sadeq Gabashneh, Revki Ismael, Basil Obaid, and Najib Thabet. We are also grateful to the interviewers and drivers for the many tireless hours they dedicated during data collection. Finally, we thank the citizens of Jordan for their hospitality and participation in the survey.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

This report summarizes the findings of the 2010 Micronutrient Survey in Jordan which was conducted in Jordanian households in March and April of 2010. An earlier micronutrient survey was conducted in 2002, four to five months after the start of a national flour fortification program.

The 2010 Micronutrient Survey was conducted by the Jordan Ministry of Health (MOH) in collaboration with the Global Alliance for Improved Nutrition (GAIN), the U.S. Centers for Disease Control and Prevention (CDC), and the United Nations Children's Fund (UNICEF)-Jordan. Additional support was provided by the Jordan University of Science and Technology (JUST) and the Jordan Department of Statistics (DOS), while funding was provided by GAIN and UNICEF. The survey collected data on micronutrient status of non-pregnant women of reproductive age (anemia, iron deficiency, iron deficiency anemia, vitamins A, D, and B_{12}, and folate) and children 12 – 59 months (anemia, iron deficiency, iron deficiency anemia, and vitamins A and D); assessed the prevalence of households with fortified bread and iodized salt; and assessed the anthropometric status of children.

Objectives

The objectives of the 2010 Micronutrient Survey Report are to measure:

1) The prevalence of anemia, iron deficiency, and iron deficiency anemia in women and children.
2) The prevalence of vitamin A deficiency in women and children.
3) The prevalence of vitamin D deficiency in women and children.
4) The prevalence of vitamin B_{12} deficiency in women.
5) The prevalence of folate deficiency in women.
6) The percentage of households that possess bread fortified with micronutrients.
7) The percentage of households that possess adequately iodized salt.
8) The anthropometric status of children.

Although one of the original intents of the 2010 survey was to describe the possible impact of the flour fortification program, the timing of the 2002 survey, in addition to other factors, preclude the ability to measure impact of the program as it was intended to be implemented (see Appendix II: Comparison of the 2002 and 2010 Surveys).

Methodology

Data for the 2010 Micronutrient Survey were collected from a nationally representative sample of Jordanian women (15 – 49 years), children (12 – 59 months), and households. Households for the survey were selected through a complex stratified multistage cluster sampling. A total of 30 strata were identified among urban, rural, and major city localities among the twelve governorates in Jordan. Probability proportionate to size sampling was used to randomly select a total of 166 clusters from the 30 strata. Twelve Jordanian households were systematically selected for participation within each cluster for a total of 1,992 households. For this study, households were defined as Jordanian if the head of household considered himself or herself Jordanian. All eligible women and children from eligible households were invited to participate.

The ethical committee for scientific research provided ethical approval for the survey, and interviewers obtained verbal consent from adult respondents for themselves and their children prior to participation. Survey teams conducted face-to-face interviews at participating households using a three-part household, woman, and child questionnaire. One representative of the household responded to the household questions pertaining to iron fortification and salt iodization knowledge, attitudes, and practices, while eligible women responded to the woman questions, and mothers or caregivers of eligible children responded to the child questions. At the end of the interviews, a phlebotomist collected a sample of blood from non-pregnant women and children. The supervisor, assisted by the phlebotomist or research assistant, took child height/length and weight measurements. In addition a sample of bread and salt was taken from all participating households (regardless of whether an eligible woman and/or child were present).

CDC reviewed internal quality control (QC) data from the CPHL and JUST laboratories. Both the CPHL and the JUST laboratories also participated in the CDC Vitamin A Laboratory External Quality Assurance (VITAL-EQA) program. For ferritin and 25(OH)D_3 (vitamin D), there was excellent precision and minimal bias for measuring the survey samples. For vitamin B_{12} and serum retinol, bias was below CDC target values for the external quality assurance exercise immediately preceding the survey sample testing. Thus vitamin B_{12} and serum retinol concentrations may be underestimated in the population and may show higher prevalence of deficiency than the actual prevalence.

Summary of Findings

Among the 1,992 households invited to participate, 87.4% (1,741) of households agreed to participate. Among households that agreed to participate, there were a total of 2,607 eligible women and 1,077 eligible children. A total of 95.0% (2,473) of eligible women completed the questionnaire, and 78.2% (2,039) completed the blood collection. Questionnaires were completed for 100.0% (1,077) of eligible children, and blood samples were collected from 87.9% (947).

Micronutrient Status

Prevalence of anemia, iron deficiency, and iron deficiency anemia for non-pregnant women was 30.6% (95% confidence intervals (CI): 28.1%, 33.2%), 35.1% (95% CI: 32.2%, 38.1%) and 19.8% (95% CI: 17.9%, 21.8%), respectively. Older women and married women were more likely than younger unmarried women to have anemia and iron deficiency anemia, and women living in South Jordan were more likely than women in North and Central Jordan to be anemic. Prevalence of anemia, iron deficiency, and iron deficiency anemia for children were 17.0% (95% CI: 14.4%, 20.1%), 13.7% (95% CI: 11.1%, 16.7%), and 4.8% (95% CI: 3.6%, 6.5%), respectively. Younger children were more likely than older children to have anemia, iron deficiency, and iron deficiency anemia. Children living in rural areas were more likely than children in urban areas to have anemia. Based on the WHO thresholds for defining the severity of anemia as a problem of public health importance, anemia is a public health problem of moderate severity in women and a public health problem of mild severity in children.

Vitamin A deficiency was prevalent in 4.8% (95% CI: 3.8%, 6.1%) of non-pregnant women. Deficiency was higher among younger women compared to older women, single women compared to married women, and women living in Central and North Jordan compared to women in South Jordan. Prevalence of vitamin A deficiency among children was 18.3% (95% CI: 15.4%, 21.6%). Deficiency was higher among males compared to females. Applying the IVACG and WHO thresholds for vitamin A deficiency (originally defined for children 6 – 71 months) to children, these findings suggest that vitamin A deficiency is a public health problem of moderate importance in children. (There are no WHO recommended cut-offs defining level of importance of vitamin A deficiency as a public health problem for non-pregnant women of reproductive age).

Vitamin D deficiency was prevalent in 60.3% (95% CI: 57.3%, 63.3%) of non-pregnant women. Deficiency was higher among urban women compared to rural women and higher among women living in Central Jordan compared to North and South Jordan. Deficiency was also higher among unmarried women (including single, separated, widowed) compared to married women, as well as among women who reported covering their head with a *Hijab*, scarf, or *Niqab* and among women who reported covering their hands when they leave the house or go outside compared to women who reported not covering. Prevalence of vitamin D deficiency among children was 19.8% (95% CI: 16.6%, 23.5%). Deficiency was higher among females compared to males, among children living in urban areas compared to rural areas, and among children living in the Central and South regions compared to children living in the North region.

Vitamin B_{12} deficiency was prevalent in 11.1% (95% CI: 9.3%, 13.1%) of non-pregnant women. Deficiency was higher among urban women compared to rural women and among women living in Central and South Jordan compared to women in North Jordan. Red blood cell folate deficiency was prevalent among 13.6% (95% CI: 10.2%, 17.8%) of non-pregnant women. No statistically significant differences in folate deficiency were detected among observed subgroups of age, region, residence, marital status, and education level.

In the presence of inflammation, serum ferritin concentration increases, while serum retinol concentration decreases. Serum α_1-acid glycoprotein (AGP), an acute phase indicator, was used to measure level of inflammation in the survey population to assess the influence of inflammation on serum ferritin and serum retinol concentrations (Correale, et al., 2008). AGP concentrations were measured on a subsample of 7% (n=146) of the women and 16% (n=153) of the child samples collected for the 2010 Micronutrient Survey. Among women, 44.1% (36.0%, 52.5%) had inflammation (AGP > 1.00 g/L), while 49.5% (95% CI: 41.5%, 57.5%) of children had inflammation. To the extent that inflammation affected biochemical measurements, the prevalence of iron deficiency is likely underestimated while the prevalence of vitamin A deficiency is likely overestimated.

Household Bread Fortification and Salt Iodization

Among bread samples, 44.1% (95% CI: 40.2%, 48.0%) tested positive for the presence of added iron (i.e. fortification). The prevalence was higher in South Jordan compared to Central and North Jordan. Nearly all households agreed with the government adding vitamins and minerals to bread: 74.3% (95% CI: 68.0%, 79.8%) strongly agreed and 20.7% (95% CI: 15.4%, 27.3%) agreed.

Tested salt samples yielded a mean of 23.3 parts per million (ppm) (standard deviation =15.9 ppm); 66.5% (95% CI: 63.6%, 69.3%) of households had salt that was adequately iodized (≥ 15.0 ppm). This percentage fell short of the international goal of > 90% of households using adequately iodized salt. The percentage of households with adequately iodized salt was higher in the North and Central regions compared to the South region and in urban areas compared to rural areas. Nearly all households agreed with the government adding iodine to salt: 74.7% (95% CI: 68.9%, 79.7%) strongly agreed, and 21.3% (95% CI: 15.8%, 28.1%) agreed.

Anthropometry

Anthropometric measurements, taken for children 12 to 59 months, showed that 3.5% (95% CI: 2.1%, 5.7%) of children were wasted (weight-for-height Z-score < -2), 2.5% (95% CI: 1.6%, 3.9%) were underweight (weight-for-age Z-score < -2), and 10.8% (95% CI: 8.6%, 13.6%) were stunted (height-for-age Z-score < -2). Anthropometric measurements also showed that 8.8% (95% CI: 6.6%, 11.6%) of the children were at risk for overweight (BMI-for-age Z-score > 2) and 1.8% (95% CI: 1.0%, 3.3%) at risk for obesity (BMI-for-age Z-score >3). A statistically significant difference was seen across subgroups of underweight, where a higher percentage of children in the North and South were underweight compared to the Central region, and a higher percentage of males were underweight compared to females. No statistically significant differences were observed across subgroups (including sex, age, region, and residence) of wasting, stunting, overweight, or obesity.

CHAPTER 1: INTRODUCTION

Overview on Micronutrient Deficiencies & Malnutrition in Jordan

Micronutrient malnutrition is a public health problem in Jordan, particularly with respect to vitamin A and iron deficiencies (Alwan, 2006). The first nationally representative survey on micronutrient status was conducted in 2002 --the 2002 National Survey on Iron Deficiency Anemia and Vitamin A Deficiency (hereafter referred to as the 2002 Micronutrient Survey). This survey was conducted in October of 2002 by the Ministry of Health (MOH) in collaboration with the World Health Organization (WHO), the United Nations Children's Fund (UNICEF), and the U.S. Centers for Disease Control and Prevention (CDC). The survey found that among Jordanian women 15-49 years of age (including non-pregnant and pregnant women), 32.3% were anemic, 40.6% had iron deficiency, and 22.5% had iron deficiency anemia (IDA) (Jordan MOH, 2002). Among children 12 – 59 months of age, 20.2% had anemia, 26.1% had iron deficiency, and 10.1% had IDA. The prevalence of vitamin A deficiency in children was 15.2%.

National Health Policy and Current Fortification Efforts

Micronutrient Supplementation Programs

Non-pregnant women are not routinely screened for anemia and are not routinely provided vitamin/mineral supplements. Pregnant women are routinely given folic acid (5 mg/day) from the first prenatal care visit through 16 weeks gestation. At 16 weeks pregnant women are routinely screened for anemia and given FeFolZ™ (ferrous sulfate 150 mg, folic acid 500 µg, and zinc). Women who are non-anemic are advised to take one tablet daily until delivery, and those who are anemic, two tablets daily.

As screening for anemia was introduced as a quality indicator for health center performance in 2007, routine screening for anemia among children attending public clinics for measles immunization (at about 10 months of age) has increased to approximately 47%. Since 2005, children attending this clinic visit have also been routinely given a vitamin A capsule (100,000 IU) (Dr. Khoula Al-Hisat, personal communication, February 2011).

Micronutrient Fortification Programs

To decrease micronutrient deficiency levels, Jordan has undertaken two national micronutrient fortification programs: a national salt iodization program initiated in 1995 and a wheat flour fortification program initiated in 2002. Jordan has participated in the Iodine Deficiency Disorders Control Program since 1996. The country initiated a monitoring and evaluation program in 2000 and has been successful in implementing an effective, functional national program for iodization of salt, including legislation, regulations, political commitment, a national program committee, regular monitoring procedures, mandatory reporting, public education, and social mobilization.
An iodine survey conducted in Jordan in 2010 showed a median iodine concentration of 203 µg/l (Massa'd and Barham, 2011), which is associated with a more than adequate iodine intake and risk of iodine-induced hyperthyroidism according to WHO/ICCIDD criteria (ICCIDD, UNICEF, WHO, 2001). The survey estimated that overall prevalence of goiter in Jordan is 4.9%

and that 96.4% of households are using salt with an iodine content of 15 to 40 ppm (Massa'd and Barham, 2011).

The Micronutrient Initiative (MI) Fund provided funds through the WHO to support consumer research, advocacy, social marketing, and to supply initial batches of vitamin and mineral premix for fortifying wheat flour in support of the national Flour Fortification Program. All wheat flour-producing mills in production were equipped with feeders for adding premix into the flour during the production process. The feeders were paid for by the WHO through the MI Fund, UNICEF, and the Ministry of Health (MOH). In addition, the millers were trained and guided on the use of the feeders, quality control procedures, and procurement of premix by technical consultants supported directly by the MI.

The flour fortification program was officially launched in April, 2002 (Alwan, 2006), and fortification of flour at the mills began in June, 2002. Flour was initially fortified with iron (dried ferrous sulfate) and folic acid (200 g of premix per metric ton added to yield 30 ppm of iron and 1.5 ppm of folic acid) (MOH, 2002). In March 2006, with the support of a small grant provided by the Global Alliance for Improved Nutrition (GAIN), the program was expanded to include the fortification of flour with zinc, niacin, and vitamins A, B_1, B_2, B_6, and B_{12}. The level of iron (dried ferrous sulfate) was increased slightly to 32 ppm, and folic acid was reduced to 1.0 ppm (personal communication Hanan Mas'd, March 2011). In June 2010, the MOH formally added vitamin D to the existing premix supplied to wheat flour millers. Since the inception of the flour fortification program, the Government of Jordan allocated an annual budget to provide premix at no cost to all wheat flour mills in Jordan in support of the government's mandate that all wheat flour mills fortify flour. The type of flour being fortified is the *Mowahad* wheat flour (73-78% extraction rate). *Mowahad* wheat flour is the only subsidized flour in Jordan and constitutes approximately 93% of Jordan's wheat flour production (2011 Ministry of Trade estimate). The total annual cost to the government for the procurement of premix distributed to millers is approximately 1.2 million Jordanian Dinar (JD) (2010).

The MOH set the level of micronutrients in the flour fortification program with input from fortification experts. Table 1-1 shows the amount of each micronutrient found in the milled flour when the premix is added at the recommended rate (250 g of premix per metric ton flour). The intake of *Mowahad* flour was estimated to be approximately 270 g per person per day. The estimated intake (g per person per day) was calculated by dividing the total amount of *Mowahad* wheat flour produced in Jordan by the total population.[1]

[1] Flour production figures are known to overestimate amount available for human consumption because the figures do not account for losses or use of flour for nonhuman consumption.

Table 1-1: Level of micronutrients in flour when premix added at 250 grams per metric ton of flour (2006).		
Nutrient	Ingredient	Amount of Nutrient in Flour (ppm)
Vitamin A	Vit A palmitate, SD	1.5
B_1	Thiamin monomitrate	3.575
B_2	Riboflavin	3.6
B_6	Pyridozine	4.4
B_{12}	Vitamin B_{12} 0.1% WS	0.007
Folic acid	Folic acid	1.00
Niacin	Niacin amide	35.0
Fe	Ferrous sulfate, dried	32.25
Zn	Zinc oxide	20.0
	Filling material	166.0

NOTE: SD=spray dried; WS=water soluble

As a cross check with flour production figures, the consumption of bread made from *Mowahad* flour was calculated from household data from the 2006 Jordan Household Income and Expenditure Survey (HIES), which was conducted by the Department of Statistics (DOS). According to HIES, the average per capita consumption of *Mowahad* bread was 112 kg *Mowahad* bread/ person/ year or 305 g *Mowahad* bread / person / day. This estimate is consistent with the above calculations for consumption of *Mowahad* flour.

<u>Mill Monitoring</u>

After initiating its fortification program, Jordan implemented a mill monitoring system with the following objectives:

1) To monitor the amount of fortification premix purchased each year to determine if the amount is sufficient to meet target premix addition rates;
2) To detect specific mills that are not meeting target addition rates;
3) To ensure proper maintenance of mill feeders and supplies and the proper storage and supply of fortification premix;
4) And lastly, to detect when end-product flour is not meeting target goals for micronutrient fortification.

The monitoring system includes two basic components: internal monitoring which is completed by the millers, and external monitoring which is completed by the Jordanian government. The internal monitoring component is designed to include the following:

1) Millers maintain records of the number of premix boxes used (25 kilograms per box) and production of fortified flour, in metric tons.

2) Millers conduct a check-weighing procedure to monitor the actual premix addition rate. This rate is measured in grams per metric ton. The target rate is 250 g per metric ton. The actual addition rate as a percentage of the target 250 g per metric ton is calculated.
3) Millers conduct a qualitative iron spot test on fortified flour samples (AACC, Method 40-40, 1999). In this test, chemicals are applied to a sample of flour. Red dots indicate the presence of iron. Tests should be run twice per shift.
4) Millers submit documentation from the first two steps to the MOH on a monthly basis. Ideally, problems detected during the internal monitoring process are corrected or reported by the millers as soon as the problem is detected.

For the external monitoring component, Jordanian government officials perform visits, ideally every one to two months, to check premix feed rates and collect flour samples for the quantitative spectrophotometric testing of the concentration of iron in the flour at the Jordan Food and Drug Administration (FDA). The target iron level for Jordan is 32 parts per million (ppm) of added iron (this does not include iron that is naturally contained in wheat flour). Documentation and results from the internal and external monitoring components are reviewed on a monthly basis.

The mill monitoring reports for the 16 months prior to and during the survey are included in Appendix I: Monthly Mill Monitoring Report. The mill monitoring indicates that the flour fortification program was incompletely implemented prior to the 2010 survey. Of the 13 mills producing *Mowahad* flour in Jordan, 11 did not fortify flour for five of the 16 months because no premix was distributed. Two mills did not participate because one mill lacked a feeder and the other mill was under construction until February 2010. Averages for production, addition rate, and iron level (as measured by spectrophotometry) can be found in Appendix I. Averages were calculated only during months when monitoring data were available and pre-mix was distributed. The calculations include averages by mill, monthly averages for all mills, and an overall average for all mills. Averages by mill indicate that eight mills fortified below 80% of the target 250 g per metric ton (range: 62%-93%). Average iron level by mill (measured in ppm) ranged from 24 to 52 ppm. The overall average for percent of target addition rate was 79%, and the overall average iron level was 34 ppm.

Survey Background

As mentioned above, in October, 2002, after the initiation of flour fortification at the mills, the MOH conducted a national survey to determine anemia levels and iron status in both women of childbearing age (15 – 49 years) and preschool children (12 – 59 months) and serum retinol (vitamin A) levels in preschool children. Because the 2002 Micronutrient Survey was conducted four to five months after the start of the flour fortification program, it is possible that some improvement in iron status may already have occurred in the population before the nutritional indicators were assessed in the 2002 Micronutrient Survey (Hurrell et al., 2010).

In 2008, Jordan requested and received funding from GAIN to undertake a subsequent survey which would measure the micronutrient status of the population and describe the possible impact of the flour fortification program. Initially, the subsequent survey was planned for October 2008. However, a review of the mill monitoring records in March 2008 showed that the fortification program was not implemented consistently across the country and over time. Because of concern that inconsistent implementation of the program would diminish impact, the decision was made to first improve mill compliance with the MOH prescribed fortification practices and postpone the survey until September 2009. However, because fortification had been interrupted in all mills approximately two months prior to the proposed September start date, the decision was made to postpone the survey for another six months (until March 2010). With technical assistance provided by CDC, the subsequent survey was conducted in March and April of 2010 and will hereafter be referred to as the 2010 Micronutrient Survey.

One of the original intents of the 2010 Micronutrient Survey was to measure the effectiveness of the flour fortification program by comparing the iron and vitamin A status of the population in the 2002 Micronutrient Survey with that in the 2010 Micronutrient Survey. However, the effectiveness of the flour fortification program, as it was originally designed, cannot be determined by comparison of the two surveys for several reasons: 1) the 2002 Micronutrient Survey cannot serve as a baseline (pre-fortification) survey because it was conducted four to five months after the start of the flour fortification program; 2) the flour fortification program was incompletely implemented prior to the 2010 Micronutrient Survey; and 3) during the eight-year time period between the 2002 and 2010 Micronutrient Surveys, secular changes occurred which could have led to differences in micronutrient status independent of the fortification program. For completeness, a comparison of the two surveys can be found in Appendix II; while the 2010 Micronutrient Survey results provide estimates of biologic and anthropometric indicators, observed changes in micronutrient status between 2002 and 2010 in some subgroups cannot be fully attributed to the flour fortification program and, likewise, the lack of change in iron or vitamin A status in some subgroups cannot be interpreted to be a lack of effectiveness of the flour fortification program.

Objectives

The objectives of the 2010 Micronutrient Survey Report are to measure:

1) The prevalence of anemia, iron deficiency, and iron deficiency anemia in women and children.
2) The prevalence of vitamin A deficiency in women and children.
3) The prevalence of vitamin D deficiency in women and children.
4) The prevalence of vitamin B_{12} deficiency in women.
5) The prevalence of folate deficiency in women.
6) The percentage of households that possess bread fortified with micronutrients.

7) The percentage of households that possess adequately iodized salt.

8) The anthropometric status of children.

CHAPTER 2: METHODS

Survey Design

The 2010 Micronutrient Survey is a nationally representative cross-sectional survey of Jordanian households. It assessed three groups:

1) preschool-aged children (12 – 59 months).

2) non-pregnant women of childbearing age (15 – 49 years).

3) Jordanian households.

At the time the 2010 Micronutrient Survey was planned, the objectives were to measure the change in micronutrient deficiency levels in 2002 compared to 2010 and to provide estimates of key biological indicators such as the prevalence of anemia and deficiency of iron, vitamin D, vitamin A, RBC folate, and B_{12} in women and/or children. The sample size calculations were based on the first objective. The target population for this survey was defined as the universe of all Jordanian households, with recruitment of all eligible preschool children (12-59.9 months) and women of childbearing age (15 – 49 years of age) within selected households.

To maintain consistency with the 2002 Micronutrient Survey, only Jordanian households were eligible for the survey. According to the standard definitions used by DOS, a household is defined as Jordanian if the head of the household identifies him or herself as Jordanian. The survey questionnaire consisted of a household, woman, and child interview questionnaire (Appendix III: 2010 Micronutrient Survey Questionnaire). The sample selection for the survey was designed to provide nationally representative estimates of anemia, iron deficiency anemia, and deficiency of vitamins A, D, and B_{12}; the survey was not designed to provide regional or other subgroup estimates because the benefit of potential regional variations did not justify the cost and logistical implications of stratification.

Field activities were managed by the MOH's Nutrition Department. Four functioning laboratories were involved with biological and food specimen testing: the CPHL, the metabolic laboratory of JUST, the Hematology Laboratory of St. James Hospital (Dublin, Ireland), and the laboratory of the Royal Scientific Society (RSS) of Jordan.

Sample Size Estimation

The primary objective of the 2010 Micronutrient Survey was to measure the change in micronutrient deficiencies between the 2002 and 2010 surveys. The estimated sample sizes needed to detect a meaningful reduction in prevalence of micronutrient deficiency from 2002 to 2010 with a power of 80% and an α=0.05 were calculated for children and non-pregnant women; a reduction in iron deficiency of 5% was considered as a reasonable expectation from the flour fortification program. The calculation took into account the average number of individuals or households sampled per clusters and the design effect. The modified formula for calculating power is shown below (Rosner, 2005):

Power =

where

= *prevalence/coverage in the 2002 Micronutrient Survey*

= *1-*

= *sample size in 2002 Micronutrient Survey*

= *the design effect in the 2002 Micronutrient Survey*

= *estimated prevalence/coverage in the 2010 Micronutrient Survey*

= *1-*

= *sample size in 2010 Micronutrient Survey*

= *the design effect in the 2010 Micronutrient Survey; this is estimated from the 2002 Micronutrient Survey by:*

1) *calculating the average number of observations per cluster in the 2002 Micronutrient Survey (k_1) as /m_1 where m_1=the number of clusters;*
2) *the ICC_1 (inter-cluster correlation) for the 2002 Micronutrient Survey calculated as (-1)/(k-1);*
3) *the average number of observations in the 2010 Micronutrient Survey calculated as $k_2=n_2/m_2$; finally,*
4) *the was calculated as $1+(k_2-1)xICC_1$*

= *a weighted average of the two prevalence/coverage values calculated as: $(p_1*n_1+p_2*n_2)/(n_1+n_2)$*

= *the weighted average of $DEFF_1$ and $DEFF_2$ calculated as $(DEFF_1*n_1+DEFF_2*n_2)/(n_1+n_2)$*

The above formula is based on a standard formula for determining power when comparing two proportions with two modifications; 1) the addition of DEFFs and 2) for the power calculation, using the *t* rather than *z* distribution. The *t* distribution is used with 1-alpha/2 and the degrees of freedom as the total number of clusters from both surveys-- 2. The value for n_2, the sample size for the 2010 National Micronutrient Survey, was chosen based on iterative process in which a power of at least 80% was achieved.

The 2002 report did not provide design effects and in some instances did not provide confidence limits. A reanalysis was performed to derive the 2002 estimates, which are presented in Table 2-1. Note that estimates vary slightly from those published in the 2002 report, as the 2002 report estimates include values for both pregnant and non-pregnant women, while the estimates presented below include only values for non-pregnant women.

Table 2-1: Prevalence estimates of biochemical major indicators from the 2002 Micronutrient Survey in Jordan.

Group	Indicator	Prevalence	95% CI Lower Bound	Upper Bound	n	DEFF	No. Clusters	Avg. cluster size	ICC[a]
12 – 59 m	VAD	15.2	12.4	18.4	1,027	1.814	163	6.30	0.154
	Anemic	20.2	17.3	23.3	1,059	1.502	163	6.50	0.091
	Iron Deficient	26.2	23.1	29.6	1,056	1.498	163	6.48	0.091
	IDA	10.1	8.1	12.5	1,050	1.457	163	6.44	0.084
15 – 49 y	Anemic	29.3	26.3	32.6	1,023	1.237	166	6.16	0.046
Non-preg	Iron Deficient	38.7	34.6	42.9	1,021	1.945	166	6.15	0.183
Women	IDA	20.0	17.3	22.9	1,021	1.280	166	6.15	0.054

NOTE: CI=confidence interval; DEFF=design effect; ICC=inter-cluster correlation; VAD=vitamin A deficiency; IDA=iron deficiency anemia. Average cluster size refers to the average number of target individuals per cluster.
[a] ICC = (DEFF-1)/(average cluster size - 1).

A response rate for blood collection of 85.3% for women and 79.8% for children was reported in the 2002 Micronutrient Survey. Accordingly, for sample size estimation for the 2010 Micronutrient Survey, an expected response rate of 80% was used. Data from the 2002 Micronutrient Survey showed an average number of children in the target age range (12 – 59 months) of 0.60 per household and an average number of women in the target age range (15 – 49 years) of 1.40 per household.

The 2010 survey was to have 166 clusters (same as 2002 survey). Taking into account the average household size, the proportion of the population 12 – 59 months or female 15 – 49 years and a response of 80%, it was decided that a survey with 166 clusters and 12 households per cluster (for a total of 1,992 households) would provide the ability to determine statistically significant differences if the prevalence estimates of iron deficiency differed from 2002 to 2010 by $\geq$5%.

Additional objectives of the 2010 Micronutrient Survey were to describe the nutritional status of the population based on a number of indicators including the prevalence of vitamins A and D deficiency in women and children, the prevalence of vitamin B_{12} deficiency in non-pregnant women and the distribution of RBC folate concentrations in women. With the exception of RBC folate, all other micronutrient indicators were measured on all participants in the 2010 survey. The sample size for the RBC folate measurement was based on the anticipated population average RBC folate value was calculated using the following equation (Rosner, 2005):

where:

n = sample size

z = standard normal deviate (a value of 1.96 was used for a level of confidence of 95%).

Variance = estimated variance (17.0 ng/ml) (based on anticipated population average RBC folate value if flour fortification reaches the population).

d = desired level of precision (0.6 ng/ml).

Based on this formula a sample size of 400 women was calculated; the test was to be performed on every fifth blood sample.

Both ferritin and retinol binding protein (RBP) are acute phase reactants. In the presence of inflammation, ferritin concentrations increase and RBP concentrations decrease. As RBP is the carrier protein for retinol, serum retinol concentrations also decrease. Serum α-1-acid glycoprotein (AGP) has been used to measure level of inflammation and its effect on ferritin and retinol values. Given the prohibitively high cost of measuring AGP in all participants, it was decided that serum AGP would be measured on approximately 150 women and 150 children, a subsample of 7% of the women samples and 17% of the child samples collected.

Sampling Design

Households

The sampling procedure used for the 2010 Micronutrient Survey was similar to that used for the 2002 Micronutrient Survey, with a few exceptions. For the 2002 Micronutrient Survey, a multistage cluster sampling technique was used. Household selection was based on a sampling frame developed for the 2002 Demographic Health Survey (DHS), which included 166 randomly chosen blocks (clusters) from approximately 10,000 blocks designated by the 1994 Jordan census. All eligible preschool children (12 – 59 months) in all 12 selected households were recruited for enrollment; eligible women aged (15 – 49 years) from six of the 12 selected households were recruited.

For the 2010 Micronutrient Survey, the national sample was again selected in collaboration with DOS. Participants were selected through a complex multistage cluster sampling (for full details, see Appendix IV: Description of 2010 Micronutrient Survey Sampling Design). The sampling frame was based on the frame of the 2004 Jordan Population and Housing Census conducted by the DOS, which consists of approximately 14,040 blocks. The DOS combined small blocks and created a total of about 13,000 clusters (each cluster contained one or more blocks). Each cluster had an average of 72 households. The sampling frame excluded the population living in remote areas (most of whom are nomads), as well as those living in collective dwellings, such as hotels, hospitals, work camps, and prisons.

A total of 30 strata were identified among urban, rural, and major city localities among the 12 governorates in Jordan. A sampling statistician from DOS used probability proportionate to size (PPS) sampling to randomly select a total of 166 clusters from the 30 strata (see Appendix IV: Description of 2010 Micronutrient Survey Sampling Design for selected strata and Appendix V: List and Characteristics of Selected Clusters for selected clusters). A DOS mapper enumerated and mapped the households in each selected cluster. (Only Jordanian private households were eligible for the survey)[2]. Based on the listing made by the mapper, the sampling statistician randomly selected 12 eligible households for participation in the survey using systematic selection. The survey included a questionnaire for participating women (15 – 49 years) and children (12 – 59 months), and blood samples for non-pregnant women and children in these households (unlike in the 2002 Micronutrient Survey, which included blood samples from both non-pregnant and pregnant women).

Micronutrient Subsamples

For folate and vitamins A and B_{12}, the laboratories identified the subsample for testing using systematic selection procedures. The selection interval appropriate for each analyte was calculated based on the total number of expected samples divided by the estimated subsample size necessary for each analyte (selection interval = number of samples expected/ necessary sample size) (see Table 2-2 above). If a sample selected for analysis was insufficient for testing, the subsequent sample was selected. This process was repeated for inadequate specimens until the next sample in the selection interval was reached. Every fourteenth sample for women and every sixth sample for children was selected for serum AGP testing. For vitamin D, laboratories tested all of the blood samples collected from women and children.

Identification and Recruitment of the Households

In the 2010 Micronutrient Survey the DOS provided to the survey director, a list of the 12 households in each cluster and a map to locate the households. If no adults from the household were present at the time of the visit, the survey team returned up to two additional times during different times of the day and/or other days of the week. If, after three attempts, no household member was contacted (the house was abandoned, had been destroyed, or no one was reached after three attempts), the interviewers recorded the final disposition as not available.

---

[2] According to the standard definitions used by the Jordanian Department of Statistics (DOS), a household is defined as Jordanian if the head of the household identifies him or herself as Jordanian.

Household: One person or more living in a separated housing unit or part of it.

Private Household: A household, consisting of one person or more, with a head, sharing with each other one separated housing unit or part of it; the members of household participate in expenditures from the income of head of household or from some household members. Some household members may not be related to each other, although it is commonly known that there is a relationship between them. It is also commonly (but not necessarily) known that the members share meals or some of these meals with each other. The household comprises all those who were temporarily absent from the household outside Jordan for a period less than one year, who will after that return to join the household (with the exception of students, army-men, and diplomats who are considered as usual members regardless of the period of their absence).

Collective Household: Every group of persons 6 or more residing in a conventional housing unit (apartment, *dar*, villa, etc.), with no relativities, where each person depends on himself for a living, even if he participates with the others in some meals, such as: the workers residing in work camps or those residing in an apartment or *dar*, etc.

Data Collection and Field Work

Data collection for the 2010 Micronutrient Survey was conducted between March and April of 2010.

Survey Teams and Overview of Data Collection Procedures

The fieldwork survey teams consisted of a phlebotomist, a DOS research assistant with experience in data collection and interviewing, a physician supervisor, and a driver. All fieldworkers including coordinators, supervisors, research assistants, nurses, and drivers wore identification badges with a photo and the insignia of the MOH at all times while conducting interviews.

The survey teams visited each identified (listed) household and conducted a face-to-face interview with a representative of the household, a household member that was at least 15 years old and could speak for the household. The survey team also interviewed all women 15 – 49 years of age and children 12 – 59 months of age. At the end of the interview, the phlebotomist collected a sample of blood from non-pregnant women (11.5 ml) and children (8 ml). The supervisor, assisted by the phlebotomist or research assistant, took child height/length and weight measurements. In addition a sample of bread and salt was taken from all households (regardless of whether an eligible women and/or child was present).

Survey Questionnaire

The questionnaire (Appendix III: 2010 Micronutrient Survey Questionnaire) includes three parts: a household, a woman, and a child questionnaire. The questionnaire was developed based on the 2002 Micronutrient Survey in Jordan, but additional questions were added on bread and salt use. The revised questionnaire was written in English, translated into Arabic, and back translated into English. The questionnaire was pre-tested in 50 households and subsequently revised.

One household questionnaire was completed each for selected households that agreed to participate; a woman questionnaire was completed for each eligible woman 15 – 49 years of age, and a child questionnaire was completed for each eligible child 12 – 59 months of age. One representative of the household (a male or female at least 15 years of age) responded to the household questions pertaining to iron fortification and salt iodization knowledge, attitudes, and practices, while eligible women responded to the woman questions, and mothers or caregivers of eligible children responded to the child questions.

Blood Collection

Blood collection and transportation was conducted according to the standard procedures (CDC/NCEH/IMMPaCt, 2009). A trained phlebotomist collected venous blood samples which were transported (4 to 10° C in a cold box containing frozen gel packs) to a central laboratory and processed within 24 hours.

Household Bread and Salt Collection

Approximately 200 g of bread (about the size of one Arabic loaf) and 100 g of salt were collected and stored in Ziploc bags from each household. Samples were taken to the CPHL for processing and analysis.

Child Anthropometry

The team supervisor, with assistance from the phlebotomist or research assistant, took height/length and weight measurements from all participating children. Barefoot height/length was taken using a portable wooden stadiometer. Length of children under two years was measured with the child lying down, while height of children two years and above was taken with the child standing up. Weight was taken using a Seca scale equipped with a mother/child-tare feature. Heavy clothing was removed from children prior to measuring weight.

Training and Pilot Study

Prior to data collection a five-day training workshop was conducted to prepare supervisors and field workers on various aspects of data collection (see Appendix VI: 2010 Micronutrient Survey Training Agenda). Supervisors attended an additional day of training. Practical training exercises including role-playing, interviews, biological specimen collection, labeling, handling, and shipping were carried out by the teams.

At the end of the training, a one-day pilot “dress-rehearsal” exercise was conducted in 50 households (in clusters that had not been selected for the survey). After the pilot exercise, the survey teams reconvened for one day to discuss logistics and make adjustments to the questionnaire and field procedures. All 50 questionnaires from the pilot study were entered into data base program templates to test data entry rules and consistency of questions.

General Laboratory Functions

Laboratory methods used to measure specific micronutrients are provided in subsequent chapters.

Laboratories

Four laboratories were identified to analyze the survey samples for various indicators. The test(s) conducted by each laboratory are listed below:

Central Public Health laboratory (CPHL, Amman, Jordan)

Hematologic tests

- Hemoglobin
- Hematocrit

Biological tests

- Serum ferritin
- Serum cobalamin (vitamin B_{12})

Food tests

- Iron spot tests for qualitative presence or absence of iron in bread samples

- Titration tests for quantification of iodine in salt samples

Jordan University of Science and Technology (JUST) Laboratory (Irbid, Jordan)
Biological tests

- Serum α-1-acid glycoprotein (AGP)
- Serum retinol (vitamin A)
- 25-hydroxyvitamin D_3 (25(OH)D_3, vitamin D)

Laboratory of the Royal Scientific Society (RSS) (Amman, Jordan)
Food tests

- Quantitative spectophotometric analysis of iron in bread

The Hematology Laboratory of St. James Hospital (Dublin, Ireland)

- RBC folate

Food Specimens

All salt samples were measured for iodine content at the CPHL using a quantitative titration method (ICCIDD/UNICEF/WHO, 2001). CPHL also conducted qualitative spot tests for the presence of iron on all bread samples using a modified version of AACC International's iron spot test for wheat flour (AACC International, Method 40-40, 1999). In addition, a subsample of bread samples was also measured using atomic absorption spectrophotometric analysis (AACC International, Method 40-70, 1999) at the Royal Scientific Society (RSS). Before testing at the CPHL, the subsample was selected from the first household which had a sufficient amount of bread (> 200 g) in every third cluster (i.e. one sample was taken from cluster 1, then cluster 4, cluster 7 and so forth). Approximately 100 g of the bread (half of the bread collected) was separated from the original sample and stored in a plastic bag labeled with the cluster and household ID. These samples were shipped to RSS for spectrophotometric analysis of iron.

Quality Control and Assurance

CDC reviewed internal quality control (QC) data from the CPHL and JUST laboratories and the Hematology Laboratory of St. James Hospital (Dublin, Ireland). All labs routinely run QC samples for all assays. The analytical coefficient of variation (CV) was 2.9% for serum ferritin, 2.4% for vitamin B_{12}, 2.0% for serum retinol and 25(OH)D_3, and 9.7% for RBC folate. This amount of imprecision is acceptable for microbiological assays.

Both the CPHL and the JUST laboratories also participated in the CDC Vitamin A Laboratory External Quality Assurance (VITAL-EQA) program, an external quality assurance program (http://www.cdc.gov/labstandards/vitaleqa.html). The CPHL and the JUST laboratories measured standard VITAL-EQA samples (ferritin and B_{12} for CPHL and vitamin A and 25(OH)D_3 for JUST). The results of their measurements were compared with the CDC reference values. For ferritin, there was excellent precision and minimal bias. For vitamin B_{12}, there was excellent precision, though bias was below CDC target values for the external quality assurance exercise immediately preceding the survey sample testing (-8%). Thus vitamin B_{12} concentrations may be underestimated in the population and may show higher prevalence of deficiency than the actual prevalence. For serum retinol concentrations, precision was optimal, though bias was below CDC target values (-14%). Thus, serum retinol concentrations may be underestimated in the population, prevalence of retinol deficiency may be overestimated. For 25(OH)D_3, there was excellent precision and minimal bias.

The Hematology Laboratory of St. James Hospital (Dublin, Ireland) did not participate in the CDC Vitamin A Laboratory External Quality Assurance (VITAL-EQA) program. The lab is well-established and has over 10 years of expertise in analyzing folate using a microbiological assay. A sample exchange with the CDC Nutritional Biomarkers Branch was conducted in 2000 and showed good agreement.

Data Management & Analysis

In the field, questionnaires were reviewed for completeness by the interviewer and the field team supervisor. All questionnaires were further reviewed by the survey director. A data entry programmer from the MOH designed the data entry template using Access software. The template included range and logic checks. MOH data entry operators carried out double data entry; all detected discrepancies were corrected based on the review of the original questionnaire. After all data were entered, the DOS performed frequency and distribution checks to identify and correct any remaining data entry errors. Laboratory values from each of the four participating laboratories were entered into separate files and merged to produce one master file that included all survey variables.

The DOS led the analysis of the data and construction of data tables using SPSS 14.0 and 17.0 (with the Complex Samples add-on module). Biochemical and anthropometric analysis was only conducted for age-eligible women (15 – 49 years) and children (12 – 59 months). While all women participants were in the target age range, 22 children were excluded from all analyses, including those with missing age (n=14) and those with out of the target age range (12 – 59 months of age) (n=8). Additional exclusions for hemoglobin and anemia analyses were defined for women and children with extremely high (> 18.0 g/dL, or > 180.0 g/L) or extremely low (< 4.0 g/dL) hemoglobin values. No women had extremely high or extremely low hemoglobin values in this survey; one child was excluded from hemoglobin and anemia analyses due to a hemoglobin > 18.0 g/dL.

The response rate for each cluster was calculated. Weights for analysis were calculated to account for sampling design and non-response for completion of the questionnaire and blood specimen collection for women and children and completion of the questionnaire and bread and salt specimen collection for households (see Appendix VII: Sampling Weights used in the 2010 Micronutrient Survey).

Prevalence and 95% confidence intervals were calculated for various nutrition and household indicators. Confidence intervals provide a range in which the true population prevalence or coverage is likely to be captured (for additional information on confidence intervals, see

Appendix VIII: Interpretation of Prevalence and Confidence Intervals). With the exception of Chapter 3, all effect estimates are weighted as described in Appendix VII: Sampling Weights used in the 2010 Micronutrient Survey. Confidence intervals and standard errors (SE) were adjusted for the complex survey design. Table 2-3 below shows the cut-off values which were used for defining nutritional deficiency in the population.

Results are provided by subgroups, including demographic characteristics, urban and rural domains, and the three regions in Jordan: North (consisting of Irbid, Mafraq, Jarash, and Ajloun, governorates), Central (consisting of Amman, Balqa, Zarqa, and Madaba governorates), and South (consisting of Karak, Tafielah, Ma'an, and Aqaba governorates), and demographic characteristics.

Table 2-3: Cut-off values for defining nutritional deficiencies for data analysis.

Nutrient (units)	Children (12 – 59 months)	Non-pregnant Women (15 – 49 years)
25-hydroxyvitamin D_3, ng/mL[a]		
Deficient	< 11.0	< 12.0
Vitamin B_{12}, pg/mL[b,c]		
Marginal status		200-300
Deficiency	-	< 200
Severe deficiency	-	< 100
Vitamin A (serum retinol)[d], µmol/L		
Deficiency	< 0.70	< 0.70
Severe deficiency	< 0.35	< 0.35
Hemoglobin (Hb), g/dL[e]		
Anemia	< 11.0	< 12.0
Severe anemia	< 7.0	< 7.0
Ferritin (iron deficiency), µg/L[f]		
Depleted iron stores	< 12.0	< 15.0
RBC folate, ng/mL[g]		
Deficient	-	< 151

[a] Institute of Medicine (IOM), 2011.
[b] Sehlub,2008
[c] IOM, 1998.
[d] WHO, 1996.
[e] DeMaeyer et al., 1989.
[f] WHO, 2001.
[g] WHO, 2008.

Ethical Considerations

Before the survey began, the protocol, informed consent, and questionnaires were reviewed and approved by the ethical committee for scientific research (see Appendix IX: Letter of Ethical Review and Approval). Before data collection from the household began, the purpose of the survey was explained, and verbal consent was obtained from the participating adults for their participation and the participation of the minor children (see questionnaire, Appendix III: 2010 Micronutrient Survey Questionnaire). Interviewers signed the consent form to confirm that verbal consent was received. Participants were informed that they would be notified by the laboratory if a participant was found to have a severe nutritional deficiency. In the case of a severe nutritional deficiency, the Director of the Jordan CPHL informed survey participants of their results via telephone and recommended the participant seek treatment at her respective health center. Severe deficiency levels below which participants were contacted are defined in Table 2-3. One exception to the table is for Hb, for which participants with Hb < 8.0 g/dL were contacted.

Confidentiality was strictly maintained. All questionnaires were kept in one office in the MOH and were stored in locked files. Only the senior staff had access to these files. Data entry only included the numeric identifiers for participants, which have no meaning to any outside observer. Data were released only in summary form, and the identity of participants was not made public.

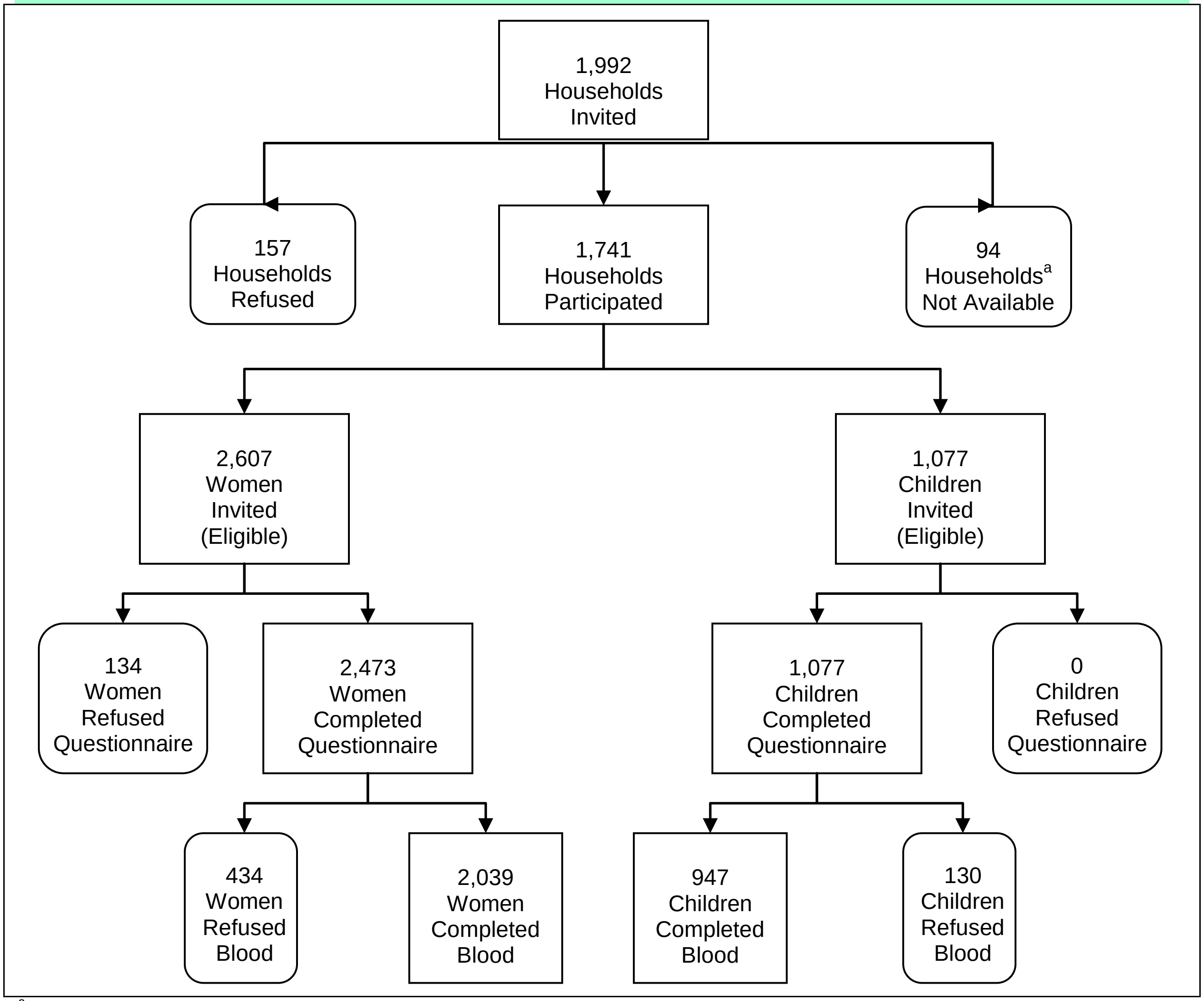
CHAPTER 3: RESPONSE RATES AND CHARACTERISTICS OF RESPONDENTS

Response Rates and Characteristics of Respondents

Response rates and weights to adjust for non-response were calculated using a target of 1,992 households (166 clusters x 12 households per cluster). Numbers and percentages presented throughout this chapter are unweighted to reflect the surveyed population. Figure 3-1 illustrates participation of households, women, and children. Among the 1,992 households invited to participate, 87.4% (1,741) households agreed to participate, 7.9% (157) refused, and 5.0% (94) were not available. Urban households were less likely to participate, with 85.6% of households agreeing to participate versus 96.1% among rural households. However, among households that agreed to participate, participation rates for women and children were comparable in urban versus rural areas (see Appendix X: Response and Participation Rates-2010 Micronutrient Survey). Among households that agreed to participate, there were a total of 2,607 eligible women and 1,077 eligible children. A total of 95.0% (2,473) of eligible women completed the questionnaire, and 78.2% (2,039) completed the blood collection. Questionnaires were completed for 100.0% (1,077) of eligible children, and blood samples were collected from 87.9% (947). Appendix X: Response and Participation Rates-2010 Micronutrient Survey shows response and participation rates by region and place of residence for the various components of the survey.

Design effects (DEFF) and inter-cluster correlation coefficients (ICC) for the major indicators measured in the 2010 Micronutrient Survey were calculated and are provided in Appendix XI: Design Effects and Inter-cluster Correlation Coefficients for Primary Indicators.

Figure 3-1: Flow chart of participation for households, women, and children, Jordan 2010.



[a] Not available: the house was abandoned (n= 33), house not found(n=1), or no one was reached after three attempts (n=1), house vacant (n=57), and other (n=2).

Household Characteristics

A total of 1,741 households participated in the survey. The characteristics (unweighted) of participant households are presented in Table 3-1 below. Among participating households, 90.3% of heads of household were male. Of the heads of household, 43.3% had completed basic education, 22.7% secondary education, and 24.0% higher education. A total of 29.6% of households were located in the North, 59.9% in the Central region, and 10.6% in the South. A total of 81.4% of households were located in urban areas, while 18.6% were located in rural areas. The mean number of people living in each household, not including non-Jordanian servants, was 5.4 (range 1 to 22), with an average of 1.5 women (15 – 49 years) per household and an average of 0.6 children (12 – 59 months) per household.

Table 3-1: Characteristics (unweighted) of participating households, Jordan 2010.

Characteristic	n	%
Head of Household Sex		
Male	1,572	90.3
Female	169	9.7
Head of Household Education		
Never enrolled in education	116	6.7
Illiterate	50	2.9
Basic[a]	753	43.2
Secondary	395	22.7
Higher[b]	417	23.9
Don't Know	10	0.6
Region		
North	515	29.6
Central	1,042	59.8
South	184	10.6
Residence		
Urban	1,418	81.4
Rural	323	18.6
Household Size		
Mean	5.4	-
TOTAL PARTICIPATING HOUSEHOLDS	1,741	100.0

[a] Basic Education: the elementary, preparatory in old system, and basic education in new system
[b] Higher Education: the intermediate diploma, bachelor, and higher education

Characteristics of Women and Children

Table 3-2 shows age, marital status, education, and place of residence characteristics of women who completed a questionnaire but refused to have blood collected compared to women who agreed to blood collection (among women from households that participated in the survey). Compared to women who agreed to blood collection, a higher proportion of women who completed the questionnaire only (refused blood collection) were between the ages of 20-29 (25.3% versus 40.8%) and had achieved a higher education level (34.1% versus 41.0%). The proportion that refused was similar across marital status and place of residence.

Children for whom a questionnaire and blood sample was completed tended to be slightly older compared to children who completed a questionnaire only; the percentage of male children who completed a questionnaire and blood was slightly lower compared to children who completed a questionnaire only (51.5% versus 56.2%). There was no apparent difference in participation by place of residence.

Table 3-2: Characteristics (unweighted) of women and children who completed blood collection compared to those who did not complete blood collection, among households that agreed to participate in survey, Jordan 2010.

Characteristic	Completed Questionnaire Only N	%	Completed Questionnaire & Blood n	%
Women				
Age Group (years)				
15 – 19	84	19.4	484	23.7
20 – 29	177	40.8	515	25.3
30 – 39	113	26.0	523	25.6
40 – 49	60	13.8	517	25.4
Marital Status				
Married	252	58.1	1,177	57.7
Single	179	41.2	797	39.1
Separated, divorced, or widowed	3	0.7	65	3.2
Education Level				
No formal education	11	2.5	97	4.8
Basic	180	41.5	1,011	49.6
Secondary	132	30.4	538	26.4
Higher	111	25.6	390	19.1
Don’t know	0	0.0	3	0.1
Place of Residence				
Urban	355	81.8	1,617	79.3
Rural	79	18.2	422	20.7
TOTAL	434	100.0	2,039	100.0
Children				
Age Group (months)				
12 – 23	35	26.9	228	24.1
24 – 35	39	30.0	222	23.4
36 – 47	26	20.0	228	24.1
48 – 59	30	23.1	269	28.4
Sex				
Male	73	56.2	488	51.5
Female	57	43.8	459	48.5
Residence				
Urban	102	78.5	744	78.6
Rural	28	21.5	203	21.4
TOTAL	130	100.0	947	100.0

CHAPTER 4: BIOLOGICAL INDICATORS FOR MICRONUTRIENT DEFICIENCY AND THE USE OF MICRONUTRIENT SUPPLEMENTS

Adequate intake of vitamins and minerals is essential for the health of children and adults. This chapter documents the prevalence of vitamin and mineral deficiencies based on the biochemical indicators measured in the survey.

CDC reviewed internal quality control (QC) data from the CPHL and JUST laboratories. The CDC provided both laboratories a format for electronically reporting internal QC results for all assays. Both labs routinely run QC samples for all assays. Both the CPHL and the JUST laboratories also participated in the CDC's Vitamin A Laboratory External Quality Assurance (VITAL-EQA) program, an external quality assurance program for a number of micronutrient including, but not limited to, vitamin A (http://www.cdc.gov/labstandards/vitaleqa.html). The CPHL and the JUST laboratories measured standard VITAL-EQA samples sent to Jordan by the CDc laboratories (ferritin and vitamin B_{12} for CPHL and vitamin A and 25(OH)D_3 for JUST). The results of their measurements were compared with the CDC reference values.

Concentrations of biochemical indicator distributions were checked for normality and for outlying values. When a distribution was normal, arithmetic means were presented (hemoglobin and serum retinol). When a distribution was skewed, a natural log transformation was used to achieve normality, and the log means and confidence intervals were calculated. The results were then back-transformed to the original scale, and the geometric mean was presented (serum ferritin, vitamin D, vitamin B_{12}, and folate).

Anemia and Iron Deficiency

Iron is an essential micronutrient and functions as a component of proteins and enzymes. It is a necessary component of hemoglobin in red blood cells and myoglobin in muscle tissue. A deficiency of iron leads to impaired work performance, fatigue, developmental delay, cognitive impairment and adverse pregnancy outcomes (WHO, 2001). Iron deficiency is one of the leading causes of anemia, yet not all cases of anemia are caused by iron deficiency, and, in populations not suffering from malaria, iron deficiency does not necessarily develop into anemia.

This section reports the detected prevalence of anemia, iron deficiency, and iron deficiency anemia in non-pregnant women (ages 15 – 49 years) and children (ages 12 – 59 months), as well as women's knowledge and awareness of anemia.

In the 2010 Micronutrient Survey, three markers of iron status were measured (see Table 4-1):

> (1) Anemia: Moderate anemia was defined as hemoglobin (Hb) concentration < 12.0 g/dL for non-pregnant women and < 11.0 g/dL for children; and severe anemia was defined as Hb concentration < 7.0 g/dL for non-pregnant women and children (WHO, 2001).

(2) Iron deficiency (ID): ID was defined as serum ferritin concentration < 15 µg/L for non-pregnant women and < 12 µg/L for children (WHO, 2001).

(3) Iron deficiency anemia (IDA): IDA was defined as having both Hb and serum ferritin values below the appropriate group-specific cut-off for anemia and ID.

The CPHL measured Hb values in a Complete Blood Count measurement, using a Beckman Coulter Cell Counter (Beckman Coulter Inc., 2003). The CPHL analyzed these measures in whole blood on the same day the samples arrived at the laboratory, within 24 hours of blood collection. The CPHL measured serum ferritin using electro-chemoluminescence in the C*obas e 411* automated analyser (Roche Diagnostics, Cobas, Switzerland). Internal quality control yielded an analytical coefficient of variation (CV) of 2.9% for serum ferritin. External quality assurance showed excellent precision and minimal bias for serum ferritin.

Table 4-1: Cut points for biological indicators classifying iron status among non-pregnant women aged 15-49 years and children aged 12 – 59 months, Jordan 2010.

Iron status	Indicators	Women	Children
Anemia[a]	Hemoglobin	< 12.0 g/dL	< 11.0 g/dL
Iron deficiency[b]	Serum ferritin	< 15.0 µg/L	< 12.0 µg/L
Iron deficiency anemia	Hemoglobin & Serum ferritin	< 12.0 g/dL < 15.0 µg/L	< 11.0 g/dL < 12.0 µg/L

[a] DeMaeyer,1989
[b] WHO, 2001

To accurately characterize the anemia status based on Hb concentration, the altitude of the place of residence must be taken into account (WHO, 2001). When living at an altitude of greater than 1000 meters, the body requires a higher concentration of Hb in the blood to meet the physiological requirements of health, growth, and development. This physiological adaptation is necessary due to the lower amount of oxygen in the atmosphere at higher altitudes. Therefore, to determine the prevalence of anemia in the population, adjustments for altitude were necessary. The adjustment for altitude was done using the following formula for all persons living at an altitude of 1000 meters above sea level or higher:

$$\text{Hb adjustment} = -0.032 \times [\text{altitude (m)} \times 0.0032808] + 0.022 \times [\text{altitude (m)} \times 0.0032808]^2$$

where the Hb adjustment was the value subtracted from each individual's observed hemoglobin concentration and then compared to the cut-off values for sea level (Sullivan et al., 2008). It was not possible to adjust hemoglobin values for smoking status of women.

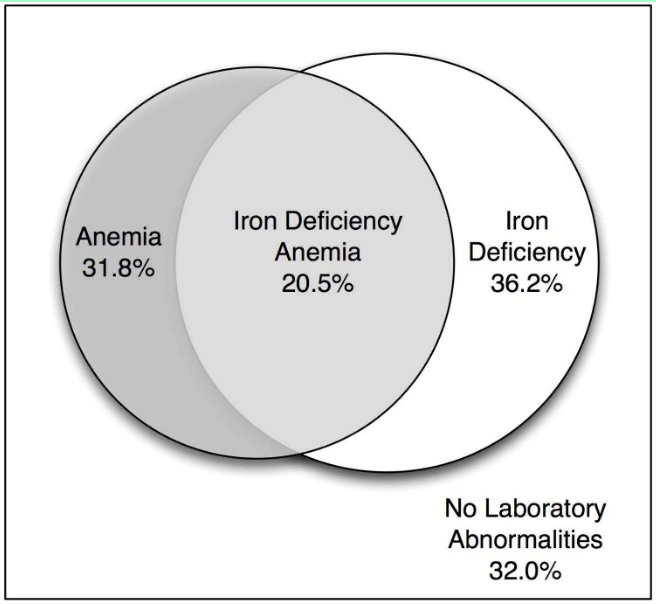
Anemia and Iron Deficiency in Non-pregnant Women

Iron status indicators were available for 2,035 non-pregnant women between the ages of 15 and 49 years. Altitude-adjusted hemoglobin values ranged from 5.3 to 17.1 g/dL with a mean (weighted) of 12.5 g/dL (95% CI: 12.4, 12.6; SE=0.5; SD=1.3, unadjusted for survey design).

No women were excluded from hemoglobin or anemia analyses due to extremely high (> 18.0 g/dL) or extremely low (< 4.0 g/dL) hemoglobin values. Serum ferritin values ranged from 0.0 to 363.1 µg/L with a geometric mean (weighted) of 31.8 µg/L (95% CI: 30.0, 33.7; SE=0.9).

Figure 4-1 below shows a Venn diagram of the percentage of women with anemia, iron deficiency, and iron deficiency anemia (among women that had both Hb and serum ferritin measures).

Figure 4-1: Venn diagram of anemia, iron deficiency, and iron deficiency anemia among non-pregnant women ages 15 – 49, Jordan 2010.



NOTE: This figure depicts total percentages for 2,026 women for whom Hb and serum ferritin information was available; thus, percentages vary slightly from those presented in Table 4-2.

Prevalence of anemia, iron deficiency, and iron deficiency anemia were 30.6% (95% CI: 28.1, 33.2), 35.1% (95% CI: 32.3, 38.1), and 19.8% (95% CI: 17.9, 21.8), respectively (Table 4-2) (*note: percentages are calculated from the total number of women who had a valid measurement available for each indicator and thus vary slightly from those presented in Figure 4-1*). Older women were more likely to be anemic and have iron deficiency anemia than younger women. Women in the South were also more likely to be anemic than in the North or Central region, while married women were more likely to be anemic, iron deficient, and have iron deficient anemia than unmarried women. A total of 5 (0.2%) women had severe anemia (Hb < 7.0 g/dL).

Table 4-2: Percent anemia, iron deficiency, and iron deficiency anemia in non-pregnant women ages 15 – 49 years according to selected characteristics, Jordan 2010.

Characteristic	n	Anemia %[a] (95% CI)[b,c]	n	ID %[a] (95% CI)[b,d]	n	IDA %[a] (95% CI)[b,e]
Age Group (years)						
15 – 19	481	25.3 (20.9, 30.2)	484	31.5 (26.3, 37.2)	481	15.4 (12.3, 19.0)
20 – 29	515	28.2 (24.5, 32.3)	514	36.9 (32.6, 41.3)	514	18.6 (15.3, 22.3)
30 – 39	521	33.8 (29.1, 39.0)	521	37.9 (33.2, 42.8)	519	21.5 (17.7, 25.8)
40 – 49	513	34.6 (28.1, 33.2)	516	33.8 (29.0, 39.0)	512	23.2 (19.3, 27.5)
		p = 0.006		*p* = 0.194		*p* = 0.024
Region						
North	684	31.7 (28.7, 34.9)	684	37.3 (33.5, 41.3)	684	20.6 (17.7, 23.9)
Central	1,131	28.6 (24.9, 32.5)	1,135	33.9 (29.8, 38.3)	1,127	18.5 (15.9, 21.3)
South	215	40.6 (34.4, 47.1)	216	33.9 (25.7, 43.1)	215	25.2 (19.7, 31.7)
		p = 0.008		*p* = 0.484		*p* = 0.100
Residence						
Urban	1,610	30.4 (27.5, 33.5)	1,613	34.2 (30.9, 37.7)	1,606	19.2 (17.0, 21.7)
Rural	420	31.4 (27.8, 35.3)	422	38.8 (33.8, 44.1)	420	22.0 (19.5, 24.8)
		p = 0.681		*p* = 0.141		*p* = 0.123
Marital Status						
Married	1,173	33.0 (29.8, 36.3)	1,174	37.5 (33.9, 41.3)	1,170	22.3 (19.7, 25.2)
Single	793	26.4 (23.1, 29.9)	796	31.6 (27.8, 35.6)	792	15.9 (13.5, 18.5)
Separated, divorced, or widowed	63	30.6 (28.1, 33.2)	64	33.5 (23.6, 45.0)	63	21.5 (12.5, 34.5)
		p = 0.002		*p* = 0.029		*p* = 0.003
Education Level						
No formal education	96	34.8 (25.9, 44.9)	97	34.6 (24.7, 46.1)	96	20.0 (12.2, 31.1)
Basic	1,006	29.2 (26.2, 32.4)	1,009	33.6 (30.1, 37.3)	1,004	18.4 (16.1, 20.9)
Secondary	535	31.7 (27.2, 36.6)	537	38.2 (33.8, 42.9)	534	21.7 (18.2, 25.7)
Higher	390	31.7 (26.7, 37.3)	390	34.0 (38.6, 39.8)	390	20.2 (16.4, 24.6)
		p = 0.695		*p* = 0.149		*p* = 0.602
TOTAL	2,030	30.6 (28.1, 33.2)	2,035	35.1 (32.2, 38.1)	2,026	19.8 (17.9, 21.8)

Note: The n's are un-weighted denominators for each subgroup; subgroups that do not sum to the total have missing data.
[a] Percentages weighted for non-response and survey design.
[b] CI=confidence interval, adjusted for cluster sampling design.
[c] Anemia, defined as Hb < 12.0 g/dL, adjusted for altitude.
[d] ID=iron deficiency, defined as serum ferritin < 15 µg/L.
[e] IDA=iron deficiency anemia, defined as low Hb (< 12.0 g/dL) with low serum ferritin (< 15 µg/L).

Results on knowledge of anemia are shown in Table 4-3. Among all women (pregnant and non-pregnant), 90.0% had ever heard of anemia (shortage of blood). 76.7% of women thought that lack of food caused anemia, followed by 38.3% who thought that lack of iron causes anemia, and 10.8% who thought that illness causes anemia. Among those who had ever heard of anemia, 59.8% of women thought that consuming vegetables prevents anemia followed by

43.2% of women who thought that consuming fruits prevents anemia, and 38.5% of women who thought that consuming meat prevents anemia.

Table 4-3: Knowledge of anemia among pregnant and non-pregnant women ages 15 – 49 years, Jordan 2010.

Indicator	Percentage[a]	(95 % CI)[b]
Have you ever heard about shortage of blood (anemia)? (n= 2,467)		
Yes	90.0	(86.9, 92.4)
No	9.3	(6.9, 12.4)
Don't know	0.7	(0.4, 1.2)
What do you think causes the shortage of blood? (*among those who have ever heard about shortage of blood*)[a, c] (n=2,204)		
Lack of food	76.7	(73.2, 79.9)
Lack of iron	38.3	(34.1, 42.6)
Illness	10.8	(8.8, 13.2)
Bleeding	6.9	(5.6, 8.5)
Heavy work	0.6	(0.3, 1.1)
Genetics	4.7	(3.2, 6.9)
Drink tea	3.4	(2.5, 4.6)
Don't know	8.1	(6.2, 10.5)
What are the kinds of food that prevent the shortage of blood (anemia)? (n=2,204), *among those who have ever heard about shortage of blood*)[c]		
Vegetables	59.8	(56.0, 63.4)
Fruits	43.2	(38.4, 48.2)
Meat	38.5	(34.8, 42.2)
Dark green leafy vegetables	31.0	(26.3, 36.3)
Cereals & legumes	24.3	(21.0, 28.0)
Milk	23.3	(20.4, 26.5)
Eggs	14.6	(12.5, 16.9)
Fish	13.0	(11.0, 15.3)
Chicken	10.8	(9.0, 3.0)
Other	10.8	(8.4, 13.7)
Don't know	3.9	(2.9, 5.2)
Bread / flour	1.9	(1.3, 2.9)
Rice	1.8	(1.2, 2.6)

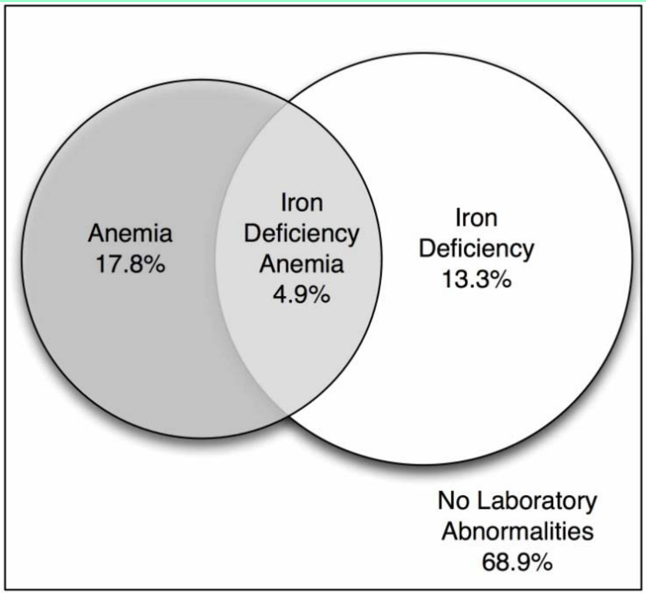
Note: The n's are un-weighted denominators for each subgroup.
[a] Percentages weighted for non-response and survey design.
[b] CI=confidence interval, adjusted for cluster sampling design.
[c] Column does not add to 100% because participants were allowed to select multiple answers.

Anemia and Iron Deficiency in Children

Iron status indicators were available for 940 children between the ages of 12 and 59 months, inclusive. Altitude-adjusted hemoglobin values ranged from 6.0 to 15.4 g/dL with a mean (weighted, altitude-adjusted) hemoglobin of 11.8 g/dL (95% CI: 11.8, 11.9; SE=0.4; SD=1.0, unadjusted for survey design). One child was excluded from hemoglobin and anemia analyses due to a hemoglobin > 18.0 g/dL. A total of 17.0% of children were anemic, and only 1 child had severe anemia (Hb < 7.0 g/dL, adjusted for altitude). Serum ferritin values ranged from 1.6 to 488.0 µg/L with a geometric mean (weighted) serum ferritin of 30.5 µg/L (95% CI: 28.4, 32.5; SE=1.0).

Figure 4-2 below shows a Venn diagram of the percentage of children ages 12 – 59 months with anemia, iron deficiency, and iron deficiency anemia.

Figure 4-2: Venn diagram of anemia, iron deficiency, and iron deficiency anemia among children ages 12 – 59 months, Jordan 2010.



NOTE: This figure depicts total percentages for 898 children for whom Hb and serum ferritin information was available; thus, percentages vary slightly from those presented in Table 4-4.

Prevalence of anemia, iron deficiency, and iron deficiency anemia were 17.0% (95% CI: 14.4, 20.1), 13.7% (95% CI: 11.1, 16.7), and 4.8% (95% CI: 3.6, 6.5), respectively (Table 4-4) (*note: percentages are calculated from the total number of children who had a valid measurement available for each indicator and thus vary slightly from those presented in Figure 4-2*). Younger children were more likely to be anemic and have iron deficiency and iron deficiency anemia compared to older children. Children living in rural areas were also more likely to be anemic compared to children in urban areas.

Table 4-4: Percent anemia and iron deficiency in children ages 12 – 59 months according to selected characteristics, Jordan 2010.

Characteristic	n	Anemia %[a] (95% CI)[b,c]	n	ID %[a] (95% CI)[b,d]	n	IDA %[a] (95% CI)[b,e]
Age Group (months)						
12 – 23	214	27.6 (22.4, 33.5)	226	19.1 (13.9, 25.7)	213	8.9 (5.8, 13.3)
24 – 35	214	21.8 (16.4, 28.2)	220	16.7 (11.7, 23.5)	213	6.7 (4.2, 10.4)
36 – 47	212	12.1 (8.5, 16.9)	227	9.6 (6.0, 15.0)	211	1.5 (0.5, 4.8)
48 – 59	262	8.6 (5.5, 13.2)	267	10.0 (6.8, 14.4)	261	2.7 (1.2, 5.8)
		$p < 0.001$		$p = 0.011$		$p = 0.001$
Sex						
Male	468	19.3 (15.7, 23.5)	485	14.7 (11.2, 18.9)	465	6.2 (4.0, 9.4)
Female	434	14.6 (11.3, 18.7)	455	12.6 (9.6, 16.4)	433	3.4 (2.1, 5.5)
		$p = 0.076$		$p = 0.389$		$p = 0.090$
Region						
North	310	18.1 (13.4, 24.1)	323	13.7 (10.3, 18.0)	310	6.7 (4.5, 9.9)
Central	508	16.0 (12.7, 19.9)	528	14.7 (10.9, 19.4)	504	3.6 (2.1, 5.9)
South	84	19.3 (13.3, 27.2)	89	6.1 (2.3, 15.2)	84	4.8 (1.7, 13.0)
		$p = 0.600$		$p = 0.213$		$p = 0.122$
Residence						
Urban	715	15.6 (12.5, 19.1)	739	14.3 (11.3, 18.0)	712	4.3 (3.0, 6.2)
Rural	187	23.1 (18.4, 28.4)	201	11.1 (7.7, 15.8)	186	6.8 (3.9, 11.6)
		$p = 0.011$		$p = 0.247$		$p = 0.178$
TOTAL	902	17.0 (14.4, 20.1)	940	13.7 (11.1, 16.7)	898	4.8 (3.6, 6.5)

Note: The n's are un-weighted denominators for each subgroup.
[a] Percentages weighted for non-response and survey design.
[b] CI=confidence interval, adjusted for cluster sampling design.
[c] Anemia, defined as Hb < 11.0 g/dL, adjusted for altitude.
[d] ID=iron deficiency, defined as serum ferritin < 12.0 µg/L.
[e] IDA=iron deficiency anemia, defined as low Hb (< 11.0 g/dL) with low serum ferritin (< 12.0 µg/L).

Public Health Significance of Anemia

WHO classifies the severity of the public health problem of anemia in a population based on prevalence of persons suffering anemia in a population (WHO, 2001). Table 4-5 presents the classifications of the severity of the public health problem of anemia in a population, as defined by the WHO.

Table 4-5: WHO classification of the severity of the public health problem of anemia in a population based on the population prevalence of anemia (WHO, 2001).

Category of the Severity of the Public Health Problem of Anemia	Prevalence of Anemia in the Population (%)
Severe	≥ 40.0
Moderate	20.0 – 39.9
Mild	5.0 – 19.9
Normal	≤ 4.9

NOTE: Anemia is defined as Hb<11.0 g/dL for children and Hb<12.0g/dL for non-pregnant women, adjusted for altitude.

A prevalence of 30.6% anemia suggests a moderate level of public health burden among women of reproductive age, while a prevalence of 17.0% suggests a mild level of public health burden among preschool children in Jordan.

Vitamin A Deficiency

Vitamin A is an essential nutrient required for the immune system, cell function and growth, and epithelial maintenance (WHO, 2009). When an individual is vitamin A deficient, a range of disorders can result affecting bone growth, vision, gene transcription, and skin health. Vitamin A deficiency (VAD) is the leading cause of preventable blindness globally. The groups most vulnerable to VAD are infants, young children, pregnant women, and lactating women (WHO, 2009).

One of the most common biological indicators to assess the prevalence of VAD in a population is serum retinol. A serum retinol concentration <0.70 µmol/L indicates VAD and a serum retinol value of < 0.35 µmol/L indicates severe VAD for both women and children (WHO, 1996). Serum retinol was measured for all participating non-pregnant women (n=2,032) and children (n=915). Additionally, serum retinol was tested on all participating women (n=2,032). The JUST laboratory analyzed serum retinol in blood specimens using the liquid chromatography-tandem mass spectrometry (LC-MS/MS) method (Roth et al., 2008). Internal quality control yielded an analytical coefficient of variation (CV) of 2.0%. External quality assurance showed optimal precision, though bias was below CDC target values (-14%). Thus, serum retinol concentrations may be underestimated in the population, and prevalence of retinol deficiency may be overestimated.

Vitamin A Deficiency in Non-pregnant Women

Serum retinol was analyzed for a total of 2,032 non-pregnant women. The overall prevalence of vitamin A deficiency was 4.8% (95% CI: 3.8, 6.1); no women were severely deficient. Serum retinol values ranged from 0.25 to 3.58 µmol/L with a mean (weighted) of 1.30 µmol/L (95% CI: 1.26, 1.33; SE=0.02). Younger women, women in North and Central Jordan, and single women were more likely to have vitamin A deficiency compared to older women, women in South Jordan, and married women, respectively (Table 4-6).

4-6: Percent women ages 15 – 49 years, according to selected characteristics, Jordan 2010. Table vitamin A deficiency (VAD) in non-pregnant

Characteristic	N	VAD %[a]	(95% CI)[b,c]
Age Group (years)			
15 – 19	482	6.3	(4.4, 8.9)
20 – 29	513	7.6	(5.4, 10.8)
30 – 39	521	3.2	(2.0, 5.0)
40 – 49	516	2.5	(1.4, 4.4)
		$p < 0.001$	
Region			
North	683	4.0	(2.5, 6.2)
Central	1,133	5.0	(4.5, 7.7)
South	216	1.0	(0.4, 2.5)
		$p = 0.011$	
Residence			
Urban	1,611	4.6	(3.6, 5.9)
Rural	421	5.8	(3.6, 9.4)
		$p = 0.394$	
Marital Status			
Married	1,173	3.3	(2.3, 4.8)
Single	794	7.3	(5.5, 9.7)
Separated, divorced, or widowed	64	0.7	(0.5, 0.9)
		$p < 0.001$	
Education Level			
No formal education	95	4.4	(1.6, 11.2)
Basic	1,008	4.7	(3.5, 6.4)
Secondary	537	4.5	(2.9, 6.9)
Higher	390	5.6	(3.3, 9.2)
		$p = 0.951$	
TOTAL	2,032	4.8	(3.8, 6.1)

Note: The n's are un-weighted denominators for each subgroup; subgroups that do not sum to the total have missing data.
[a] Percentages weighted for non-response and survey design.
[b] CI=confidence interval, adjusted for cluster sampling design.
[c] Vitamin A deficiency defined as serum retinol < 0.70 µmol/l.

Vitamin A Deficiency in Children

Serum retinol was analyzed for a total of 915 children. The overall prevalence of vitamin A deficiency was 18.3% (95% CI: 15.4, 21.6); the prevalence of severe deficiency was 0.3% (95% CI: 0.1, 0.8). Serum retinol values ranged from 0.28 to 2.13 µmol/L with a mean (weighted) serum retinol of 0.96 (95% CI: 0.93, 0.99; SE=0.01). Males were more likely to have vitamin A deficiency, compared to females. No other significant subgroup differences were observed.

Table 4-7: Percent vitamin A deficiency (VAD) in children ages 12 – 59 months, according to selected characteristics, Jordan 2010.

Characteristic	N	VAD %[a]	(95% CI)[b,c]
<u>Sex</u>			
Male	472	20.8	(17.0, 25.2)
Female	443	15.6	(12.2, 19.8)
		p = 0.043	
<u>Age Group (months)</u>			
12 – 23	219	19.7	(14.7, 26.0)
24 – 35	212	17.7	(13.4, 23.2)
36 – 47	221	16.5	(11.8, 22.5)
48 – 59	263	19.0	(14.2, 24.8)
		p = 0.813	
<u>Region</u>			
North	311	20.8	(15.9, 26.7)
Central	515	16.7	(13.1, 21.1)
South	89	17.5	(8.5, 32.5)
		p = 0.500	
<u>Residence</u>			
Urban	721	19.3	(15.9, 23.2)
Rural	194	14.3	(9.9, 20.2)
		p = 0.139	
TOTAL	915	18.3	(15.4, 21.6)

Note: The n's are un-weighted denominators for each subgroup.
[a] Percentages weighted for non-response and survey design.
[b] CI=confidence interval, adjusted for cluster sampling design.
[c] Vitamin A deficiency defined as serum retinol < 0.70 µmol/L (WHO, 1996).

Severity of the Public Health Problem of Vitamin A Deficiency

Criteria proposed by the International Vitamin A Consultative Group (IVACG) state that a prevalence of serum retinol concentration < 0.70 µmol/L among ≥ 15% of preschool children (aged 6 – 71 months) constitutes a public health problem (de Pee, 2002; Sommer, 2002). WHO defines level of severity of vitamin A deficiency as a public health problem based on the prevalence of low serum retinol in preschool children, aged 6 – 71 months (WHO, 1996) (Table 4-8). The prevalence of vitamin A deficiency of 18.3% in children in Jordan indicates that vitamin A deficiency is a public health problem of moderate severity in the country. There are no WHO recommended thresholds to define the severity of vitamin A deficiency as a public health problem for non-pregnant women of reproductive age .

Table 4-8: Prevalence defining level of severity of vitamin A deficiency as a public health problem based on serum retinol < 0.70 µmol/L in children 6 – 71 months (WHO, 1996).

Level of Severity	Prevalence of Vitamin A Deficiency (%)
Mild	≥ 2.0 to < 10.0
Moderate	≥ 10.0 to < 20.0
Severe	≥ 20.0

Vitamin D Deficiency

Vitamin D acts as a hormone in the human body, where its primary function is to supply sufficient serum calcium and phosphorus concentrations to the body by supporting the ability of the small intestine to absorb these minerals from the diet (DeLuca, 1988; Reichel, 1989). When calcium intake is low, vitamin D activates calcium stores in the bone. Vitamin D in turn increases calcium reabsorption in the kidney (Nagpal, 2005). When an individual is vitamin D deficient, a range of disorders can result including bone deformities, or rickets, in children, and bone loss and osteoporosis in adults (IOM, 2011).

Risk for vitamin D deficiency is particularly high among those living in urban areas where ozone-containing air pollution leads to a decrease in UV-B photons (Holick, 1995); among those with dark skin pigmentation that absorbs UV-B radiation (Clemens et al., 1982); and among other individuals, including the elderly, with limited exposure to the sun (Holick, 2007). This latter group of individuals includes women in countries where religious and/or cultural traditions encourage clothing habits that cover the majority of the skin, including the head, arms, and legs, and sometimes the face and hands.

Serum 25-hydroxyvitamin D_3 (vitamin D metabolite or 25(OH)D_3) was used to estimate prevalence of vitamin D deficiency in the population. A serum 25(OH)D_3 concentration <12.0 ng/mL for women and < 11.0 ng/mL for children indicates vitamin D deficiency (IOM, 2011). To estimate vitamin D status among women and children in 2010, serum 25(OH)D_3 was tested on blood specimens from all participating women (n=2,032) and all children who provided sufficient serum volume (n=916). In this investigation JUST applied, for the first time in Jordan, the liquid chromatography-tandem mass spectrometry (LC-MS/MS) method for measurement of 25(OH)D_3 status (Roth et al., 2008). Internal quality control yielded an analytical coefficient of variation (CV) of 2.0%. External quality assurance showed excellent precision and minimal bias for measuring the survey samples.

Vitamin D Deficiency in Non-pregnant Women

Serum 25(OH)D_3 was analyzed for a total of 2,032 women. Serum 25(OH)D_3 values ranged from 5.5 to 47.1 ng/ml with a geometric mean (weighted) of 11.9 ng/ml (95% CI: 11.6, 12.1, SE=0.1). The overall prevalence of vitamin D deficiency according to the IOM criteria of < 12 ng/mL of serum 25(OH)D_3 was found to be 60.3% (95% CI: 57.2, 63.3) among non-pregnant women aged 15 – 49 years (Table 4-9) (IOM, 2011). Deficiency was highest among women living in Central Jordan and among women living in urban areas. Single, separated, widowed, or divorced women had a higher prvalence of deficiency. The prevalence of vitamin D deficiency was highest among women who reported wearing a *Niqab* (68.0%), followed by women wearing *Hijab* or scarf (61.6%), and women wearing no cover (39.7%). Vitamin D deficiency among women who reported covering their hands was 72.9% compared to 59.8 % for women who reported not covering their hands (Table 4-9).

Table 4-9: Percent 25-hydroxyvitamin D_3 deficiency (VDD) in non-pregnant women ages 15 – 49 according to selected characteristics, Jordan 2010.

Characteristic	n	VDD%[a]	(95% CI)[b,c]
Age Group (years)			
15 – 19	482	57.9	(52.4, 63.3)
20 – 29	513	65.0	(60.2, 69.5)
30 – 39	521	59.8	(53.5, 65.7)
40 – 49	516	58.6	(52.1, 64.8)
		$p = 0.291$	
Region			
North	683	51.7	(47.9, 55.4)
Central	1,133	67.7	(62.7, 72.3)
South	216	43.5	(36.1, 51.3)
		$p < 0.001$	
Residence			
Urban	1,611	64.5	(60.7, 68.1)
Rural	421	42.1	(37.1, 47.2)
		$p < 0.001$	
Marital Status			
Married	1,173	57.5	(52.5, 62.2)
Single	784	63.6	(59.3, 67.7)
Separated, divorced, or widowed	64	73.8	(62.7, 82.6)
		$p = 0.037$	
Education Level			
No formal education	95	57.2	(45.8, 67.8)
Basic	1,008	56.9	(53.1, 60.7)
Secondary	537	64.1	(57.8, 69.9)
Higher	390	63.5	(55.2, 71.1)
		$p = 0.176$	
Cover Status			
Cover head			
No cover	98	39.7	(24.6, 57.0)
Hijab or Scarf	1,861	61.6	(58.9, 64.2)
Niqab	73	68.0	(57.4, 77.1)
		$p = 0.007$	
Cover arms			
No	445	56.8	(47.2, 65.9)
Yes	1,587	61.3	(58.3, 64.3)
		$p = 0.370$	
Cover hands			
No	1,948	59.8	(56.6, 62.9)
Yes	84	72.9	(62.0, 81.6)
		$p = 0.025$	
TOTAL	2,032	60.3	(57.2, 63.3)

Note: The n's are un-weighted denominators for each subgroup; subgroups that do not sum to the total have missing data.
[a] Percentages weighted for non-response and survey design.
[b] CI=confidence interval, adjusted for cluster sampling design.
[c] 25-hydroxyvitamin D_3 deficiency in women defined as serum 25-hydroxyvitamin $D_3 < 12$ ng/ml.

Vitamin D Deficiency in Children

Among the 915 children for whom 25(OH)D_3 was analyzed, serum 25(OH)D_3 values ranged from 2.6 to 83.9 with a geometric mean (weighted) of 19.4 ng/mL (95% CI: 18.4, 20.4, SE=0.5). The overall prevalence of vitamin D deficiency according to the IOM criteria of less than 11.0 ng/mL of 25(OH)D_3 was found to be 19.8% among children aged 12 – 59 months (Table 4-10) (IOM, 2011). Female children had a higher prevalence of deficiency, as well as 12 – 23 month old children, children living in Central and South Jordan, and children living in an urban residence.

Table 4-10: Percent 25-hydroxyvitamin D_3 deficiency (VDD) in children ages 12-59 months according to selected characteristics, Jordan 2010.

Characteristic	N	VDD%[a]	(95% CI)[b,c]
Sex			
Male	472	14.0	(10.9, 17.7)
Female	443	25.9	(20.8, 31.7)
		$p < 0.001$	
Age Group (months)			
12 – 23	219	24.1	(18.8, 30.3)
24 – 35	212	14.6	(10.4, 20.1)
36 – 47	221	20.3	(15.2, 26.5)
48 – 59	263	20.1	(14.8, 26.7)
		$p = 0.096$	
Region			
North	311	14.7	(10.4, 20.4)
Central	515	22.7	(18.2, 27.9)
South	89	23.2	(12.1, 39.9)
		$p = 0.099$	
Residence			
Urban	721	21.4	(17.5, 25.8)
Rural	194	13.6	(9.6, 19.0)
		$p = 0.022$	
TOTAL	915	19.8	(16.6, 23.5)

Note: The n's are un-weighted denominators for each subgroup.
[a] Percentages weighted for non-response and survey design.
[b] CI=confidence interval, adjusted for cluster sampling design.
[c] 25-hydroxyvitamin D_3 deficiency in children defined as serum 25-hydroxyvitamin D_3 < 11.0 ng/ml.

In June 2010, following the completion of data collection for the 2010 Micronutrient Survey, the MOH formally added vitamin D to the existing premix supplied to wheat flour millers.

Vitamin B_{12} Deficiency in Women

Vitamin B_{12} is a water-soluble vitamin. It is required for multiple physiological processes in the human body including normal red blood cell formation and proper neurological development and function (IOM, 1998). It is found naturally in many animal-source foods as well as dietary supplements and fortified foods including wheat flour. The most common causes of B_{12}

deficiency are low dietary intake (i.e. low intake of animal source foods) and malabsorption (Allen, 2008).

The CPHL measured the concentration of vitamin B_{12} in serum using electro-chemoluminescence in the *Cobas e 411* automated analyser (Roche Diagnostics, Cobas, Switzerland). Internal quality control yielded an analytical coefficient of variation (CV) of 2.4%. External quality assurance showed excellent precision, though bias was below CDC target values for the external quality assurance exercise immediately preceding the survey sample testing (-8%). Thus vitamin B_{12} concentrations may be underestimated in the population and may show higher prevalence of deficiency than the actual prevalence.

Among the 2,039 non-pregnant women for whom serum vitamin B_{12} concentrations were measured, values ranged between 39.5 and 1,970.0 pg/ml with a geometric mean (weighted) of 365.0 pg/ml (95% CI: 352.9, 377.2; SE=6.2). Among women, 0.3% were severely deficient (<100 pg/ml), 11.1% were deficient (<200 pg/ml), 32.0 % were marginally deficient (200-300 pg/ml), and 56.9% were normal (>300 pg/ml) (IOM, 1998; Selhub, 2008). Among women who were deficient, deficiency was higher in Central and South Jordan compared to women in the North and higher in urban areas compared to rural areas.

Table 4-11: Percent vitamin B_{12} deficiency (<200 pg/ml) in non-pregnant women ages 15 – 49 according to selected characteristics, Jordan 2010.			
Characteristic	N	%[a] (95% CI)[b,c]	
Age Group (years)			
15 – 19	484	8.3	(6.1, 11.3)
20 – 29	515	10.0	(7.6, 12.9)
30 – 39	523	14.0	(8.6, 22.1)
40 – 49	517	11.7	(8.7, 15.5)
			p = 0.255
Region			
North	684	8.5	(6.4, 11.1)
Central	1,139	12.1	(9.5, 15.2)
South	215	14.4	(11.1, 18.5)
			p = 0.035
Residence			
Urban	1,617	11.8	(9.8, 14.2)
Rural	422	7.9	(5.8, 10.8)
			p = 0.032
Marital Status			
Married	1,177	12.4	(9.6, 15.8)
Single	797	9.1	(7.1, 11.7)
Separated, divorced, or widowed	64	11.0	(5.6, 20.4)
			p = 0.177
Education Level			
No formal education	97	6.2	(2.7, 13.6)
Basic	1,011	10.0	(8.2, 12.2)
Secondary	538	14.5	(9.2, 22.2)
Higher	390	9.9	(7.5, 13.0)
			p = 0.216
TOTAL	2,039	11.1	(9.3, 13.1)

Note: The n's are un-weighted denominators for each subgroup; subgroups that do not sum to the total have missing data.
[a] Percentages weighted for non-response and survey design.
[b] CI=confidence interval, adjusted for cluster sampling design.
[c] Vitamin B_{12} deficiency defined as serum B_{12} < 200 pg/mL.

Folate Deficiency in Women

Folate is a water-soluble B vitamin found naturally in foods. Folic acid, or vitamin B_9, is the synthetic form of folate that is added to fortified foods and found in supplements (IOM, 1998). Folate is essential during periods of rapid cell division and growth especially during infancy and pregnancy. Both adults and children require folate or folic acid for proper health including the prevention of anemia, healthy red blood cells, proper energy metabolism, and neurological health and development (NIH, 2009; IOM, 1998). Adequate consumption of folate or folic acid before and during the early weeks of pregnancy is vital for proper development of the brain and neurological system of the fetus. Inadequate intake of folate or folic acid immediately before and during the early weeks of preganancy increases the risk of the fetus developing neural tube defects (NTDs) (Berry, 1999; Czeizel, 1992; MRC, 1991*)*. NTDs can lead to malformations of the spine or improper development of the brain and skull and can result in death or lifelong disability. In Jordan, it is recommended that women take folic acid supplements during the first trimester of pregnancy in order to prevent NTDs in their developing fetus.

Red blood cell (RBC) folate concentrations were measured in venous blood samples collected from non-pregnant women. RBC folate was measured from whole blood lysates for 20% of the participating women (n=393). The lysates were prepared by adding 0.1 mL (100 µL) of whole blood to 1 mL of 1% ascorbic acid. Determination of whole blood folate was done using microbiological assay at the Hematology Laboratory of St. James Hospital, Dublin Ireland (O'Broin et al., 1992). Internal quality control yielded an analytical coefficient of variation (CV) of 9.7%. While an external quality assurance exercise was not conducted with CDC's VITAL-EQA program for this survey, a sample exchange with the CDC Nutritional Biomarkers Branch was conducted in 2000 and showed good agreement.

RBC folate was calculated from whole blood folate concentration using the hematocrit value (O'Broin et al., 1997). Clinical folate deficiency, as measured by RBC folate, is defined as < 151 ng/mL by the WHO and < 140 ng/mL by the Institute of Medicine (WHO, 2008; IOM, 1998). Since both definitions are commonly used, we present prevalence of deficiency using both cut-offs.

In contrast to clinical folate deficiency, there is no defined RBC folate concentration established by international organizations for the prevention of folic-acid-sensitive NTDs in populations. There has been only one prospective study conducted with results regarding this topic (Daly, 1995). The study reported that the prevalence of neural tube defects, in an Irish population, was lowest when red blood cell folate concentrations were ≥ 400 ng/mL. Thus, we used RBC folate < 400 ng/mL to define folate insufficiency for the prevention of NTDs (Daly, 1995).

In the Jordanian population, among the 393 non-pregnant women for whom RBC folate concentrations were measured, values ranged between 48.0 and 1,024.0 ng/ml with a geometric mean (weighted) of 290.2 ng/ml (95% CI: 270.2, 310.2; SE=10.1). 13.6% of women were deficient according to the WHO criteria (< 151 ng/ml), and 9.8% were deficient according to the IOM criteria (< 140 ng/ml). No subgroups of women were significantly more likely to be folate deficient (Table 4-12) using WHO criteria. 82.9% (95% CI: 77.7, 87.1) of women were folate insufficient for the prevention of NTDs.

Table 4-12: Percent RBC folate deficiency in non-pregnant women ages 15 – 49 years according to selected characteristics, Jordan 2010.

Characteristic	n	RBC Folate Deficiency %[a]	(95% CI)[b,c]
Age Group (years)			
15 – 19	97	20.8	(12.4, 32.7)
20 – 29	91	10.2	(5.4, 18.4)
30 – 39	97	15.7	(10.0, 24.0)
40 – 49	108	7.3	(2.8, 17.6)
		p = 0.700	
Region			
North	136	19.0	(12.1, 28.5)
Central	215	11.6	(7.8, 16.8)
South	42	5.6	(3.6, 8.6)[d]
		p = 0.390	
Residence			
Urban	313	14.5	(10.6, 19.6)
Rural	80	9.3	(4.6, 17.7)
		p = 0.224	
Marital Status			
Married	230	11.7	(7.6, 17.5)
Single	149	16.7	(11.2, 24.2)
Separated, divorced, or widowed	14	-	-[e]
		p = 0.278	
Education Level			
No formal education	20	-	-[e]
Basic	195	17.4	(11.8, 25.0)
Secondary	106	8.9	(5.0, 15.1)
Higher	71	9.5	(4.6, 18.5)
		p = 0.249	
TOTAL	393	13.6	(10.2, 17.8)

Note: The n's are un-weighted denominators for each subgroup; subgroups that do not sum to the total have missing data.
[a] Percentages weighted for non-response and survey design.
[b] CI=confidence interval, adjusted for cluster sampling design.
[c] Folate deficiency defined as serum folate < 151 ng/ml (WHO, 2008).
[d] Prevalence estimate is based on 25-49 observations and therefore should be interpreted cautiously.
[e] Prevalence estimate is not reported because there are less than 25 observations.

Inflammation Status (AGP) in Non-pregnant Women and Children

Both ferritin and serum retinol are acute-phase proteins and thus, in the presence of inflammation, serum ferritin concentration increases and serum retinol concentration decreases. AGP, an acute phase protein, was used to measure level of inflammation in the survey population to assess the influence of inflammation on serum ferritin and serum retinol concentrations in a sub-sample (Correale, et al., 2008). AGP concentration was measured on

7% (n=146) of samples from women and 16% (n=153) of the child samples collected during the 2010 Micronutrient Survey. The JUST laboratory performed the analysis for the determination of serum AGP using the turbidimetric assay, which was applied on the Hitachi 912 autoanalyzer using Roche reagents kits (Lievins et al., 1996). Elevated AGP, indicating presence of inflammation or infection, was defined as serum AGP concentration ≥ 1.0 g/L (Thurnham et al., 2003). The analysis of a subsample of AGP for women and children, rather than the analysis of all samples, was undertaken due to budgetary restrictions.

In the sample of women in which AGP was measured, values ranged between 0.40 and 1.79 g/L with a mean AGP concentration of 0.99 g/L (95% CI: 0.94, 1.05; SE=0.03). The prevalence of elevated AGP was 44.1% (95% CI: 36.0, 52.5). There were no statistically significant differences across subgroups of age, region, residence, marital status, or education (Table 4-13).

Table 4-13: Percentage of non-pregnant women ages 15 – 49 years with elevated AGP[a] according to selected characteristics, Jordan 2010. (n=146)

Characteristic	n	Inflammation % AGP ≥ 1.00 g/L[b]	(95% CI)[c]
Age Group (years)			
15 – 19	32	36.4	(20.8, 55.4)[d]
20 – 29	33	38.9	(22.8, 57.7)[d]
30 – 39	35	48.9	(33.4, 64.5)[d]
40 – 49	46	50.2	(34.8, 65.2)[d]
			p = 0.591
Region			
North	48	39.4	(28.0, 52.0)[d]
Central	83	46.5	(34.8, 58.6)[d]
South	15	-	-[e]
			p = 0.657
Residence			
Urban	112	46.5	(36.8, 56.6)
Rural	34	34.9	(23.2, 48.6)[d]
			p = 0.169
Marital Status			
Married	95	44.5	(34.6, 54.8)
Single	45	38.6	(24.7, 54.6)[d]
Separated, divorced, or widowed	6	-	-[e]
			p = 0.124
Education Level			
No Formal Education	6	-	-[e]
Basic	75	41.7	(31.2, 52.9)
Secondary	37	47.6	(31.6, 64.0)[d]
Higher	28	48.3	(29.1, 68.0)[d]
			p = 0.770
TOTAL	146	44.1	(36.0, 52.5)

Note: The n's are un-weighted denominators for each subgroup; subgroups that do not sum to the total have missing data.
[a] AGP=serum α 1- glycoprotein acid
[b] Percentages weighted for non-response and survey design.
[c] CI=confidence interval, adjusted for cluster sampling design.
[d] Prevalence estimate is based on 25-49 observations and therefore should be interpreted cautiously.
[e] Prevalence estimate is not reported because there are less than 25 observations.

In the sample of children in which AGP was measured, values ranged from 0.52 to 3.26 g/L with a mean AGP concentration of 1.07 g/L (95% CI: 1.01, 1.13; SE=0.03). The prevalence of elevated AGP was 49.5% (95% CI: 41.5, 57.5). The percentage of children with inflammation was higher in urban areas compared to rural areas (Table 4-14).

Table 4-14: Percentage of children ages 12 – 59 months with elevated AGP[a] according to selected characteristics, Jordan 2010. (n=153)

Characteristic	N	Inflammation % AGP $\geq$ 1.00 g/L[b]	(95% CI)[c]
<u>Sex</u>			
Male	83	49.0	(38.3, 59.7)
Female	70	50.1	(38.5, 61.7)
		p = 0.884	
<u>Age Group (months)</u>			
12 – 23	35	44.1	(27.8, 61.8)[d]
24 – 35	41	44.6	(29.0, 61.4)[d]
36 – 47	39	58.5	(41.9, 73.3)[d]
48 – 59	38	50.7	(35.8, 65.5)[d]
		p = 0.592	
<u>Region</u>			
North	50	55.6	(41.1, 69.2)
Central	87	48.4	(38.0, 58.9)
South	16	-	-[e]
		p = 0.247	
<u>Residence</u>			
Urban	118	53.7	(44.1, 63.0)
Rural	35	34.6	(22.1, 49.6)[d]
		p = 0.033	
TOTAL	153	49.5	(41.5, 57.5)

Note: The n's are un-weighted denominators for each subgroup.
[a] Percentages weighted for non-response and survey design.
[b] CI=confidence interval, adjusted for cluster sampling design.
[c] Vitamin A deficiency defined as serum retinol < 0.70 µmol/L (WHO, 1996).
[d] Prevalence estimate is based on 25-49 observations and therefore should be interpreted cautiously.
[e] Prevalence estimate is not reported because there are less than 25 observations.

To the extent that inflammation affected biochemical measurements, the prevalence of iron deficiency is likely underestimated while the prevalence of vitamin A deficiency is likely overestimated in this survey.

Supplementation

Each respondent was asked if she or the eligible children for whom she was responding was currently taking any supplement that contains iron or any vitamins to improve the blood or make her/the child strong. For any respondent that answered "yes," the interviewer asked to see the package and indicated the contents of the package(s) on the questionnaire. Original response options included: iron, vitamins, other vitamins/minerals, vitamin B_{12}, herbs, and no label. On March 17th, the first day of data collection, it was noticed that these response options lacked folic acid. On day two of data collection, interviewers were instructed to record on the questionnaire by hand any packages that contained folic acid/folate. On day seven of data collection (March 24rd), response options on the questionnaire were revised to the following: iron, multivitamin, folic acid, vitamin B_{12}, herbs, no label, and other (specify). Packages that indicated a combination of iron and folic acid were coded as both iron and folic acid. The revised questionnaires were used during the survey beginning on approximately March 29th. Questionnaires for the 431 households visited before the revised questionnaire was used (when folic acid/folate was recorded by hand) were reviewed, and the hand recording was updated to match that of the revised response options.

Supplementation among Women

Information on current micronutrient supplementation use was available for a total of 121 pregnant women and 2,344 non-pregnant women. Results are shown in Table 4-15 below. Among the pregnant women who provided information on supplementation, 53.7% reported taking any supplement that contains iron or any vitamins; among these women, 66.1% reported taking iron, 24.7% reported taking a multi-vitamin, 53.8% reported taking folic acid, and 6.3% reported taking vitamin B_{12}. Additionally, 9.8% of pregnant women reported having ever had a B_{12} injection. Among the non-pregnant women who provided information on supplementation, 6.4% reported taking any supplement that contains iron or any vitamins; among these women, 48.0% reported taking iron, 37.9% reported taking a multi-vitamin, 34.1% reported taking folic acid, and 17.7% reported taking vitamin B_{12}. Additionally, 11.8% of non-pregnant women reported having ever had a B_{12} injection.

Table 4-15: Supplementation use among women 15 – 49 years, Jordan 2010		
	Pregnant (n=121)	Non-pregnant (n=2,351)
Supplement	% [a](95% CI)[b]	% [a] (95% CI) [b]
Are you currently taking any supplement that contains iron or any vitamins including tablets to improve your blood or make you strong? [c]		
	n=121	n=2,344
Yes[d]	53.7 (44.0, 63.2)	6.4 (5.1, 8.0)
Iron	66.1 (52.9, 77.2)	48.0 (37.1, 59.1)
Multivitamin	24.7 (12.9, 42.0)	37.9 (26.5, 50.8)
Folic acid	53.8 (40.0, 67.1)	34.1 (24.8, 44.6)
Vitamin B_{12}	6.3 (1.5, 22.3)	17.7 (8.5, 33.4)
Herbs	3.4 (0.5, 21.1)	4.3 (0.9, 18.5)
No label	0.0	0.3 (0.1, 2.5)
Other	27.3 (16.2, 42.1)	33.1 (22.5, 45.7)
No	46.3 (36.8, 56.0)	93.6 (92.0, 94.9)
Have you ever had a B_{12} injection?		
	n=121	n=2,345
Yes	9.8 (5.7, 16.6)	11.8 (9.8, 14.2)
No	90.2 (83.4, 94.3)	88.1 (85.7, 90.0)
Don't know	0.0	0.1 (0.1, 0.4)
When did you last have a B_{12} injection (among those who said yes)?		
	n=13[e]	n=245
Within 1 month	-	18.6 (12.9,26.0)
2-3 months	-	15.1 (10.5, 21.2)
4-11 months	-	18.1 (13.5, 23.7)
> 12 months	-	46.8 (38.9, 54.9)
Don't know	-	1.4 (0.3-4.9)

Note: The n's are un-weighted denominators for each subgroup; questions that do not add to the total have missing data.
[a] Percentages weighted for non-response and survey design.
[b] CI=confidence interval, adjusted for cluster sampling design.
[c] Calculated only for women who responded yes to taking supplements. Column does not add to 100% because multiple answers were permitted.
[d] Interviewers checked the package label to determine the contents.
[e] Prevalence estimate is not reported because there are less than 25 observations.

Supplementation among Children

Information on current micronutrient supplementation use was available for a total of 1,077 children. Results are shown in Table 4-16 below. Among children for whom information on supplementation was available, 3.1% were currently taking any supplement that contains iron or any vitamins. Additionally, 16.9% of children had ever received a vitamin A capsule. Of those who had received a capsule, it was reported in 22.5% that a capsule had been taken in the six months prior to the interview.

Table 4-16: Supplementation use among children 12 – 59 months, Jordan 2010.

Supplement	Prevalence [a] (%)	(95% CI)[b]
Is the child currently receiving iron or vitamin drops or tablets, including medicine given by the doctor to make the child stronger, improve the health, or increase the appetite? (n=1,077)		
Yes	3.1	(2.2, 4.5)
No	96.9	(95.5, 97.8)
Has the child ever received a Vitamin A capsule? Sometimes children receive vitamin A capsules when they are immunized at the health center. (Interviewers shows capsule).(n=1,077)		
Yes	16.9	(13.6, 20.8)
No	78.1	(73.7, 81.9)
Don't know	5.0	(3.4, 7.5)
Did the child receive a vitamin A capsule in the last 6 months from the interview date? (Among those who said yes) (n=186)		
Yes	22.6	(15.9, 31.2)
No	72.5	(63.5, 79.9)
Don’t know	4.9	(2.8, 8.5)

Note: The n’s are un-weighted denominators for each subgroup.
[a] Percentages weighted for non-response and survey design.
[b] CI=confidence interval, adjusted for cluster sampling design.

CHAPTER 5: FORTIFICATION

This chapter documents results from the survey related to fortified bread and iodized salt (salt containing iodine). The results presented in this chapter include: the prevalence of households which had fortified bread; the prevalence of households which had iodized salt; bread consumption practices; and flour, bread, and salt use; and knowledge, attitudes, and practices regarding flour fortification and salt iodization.

Flour Fortification

Fortification of wheat flour is a common strategy for reducing population prevalence of micronutrient deficiencies, including iron deficiency and preventing NTD-affected pregnancies (Baltussen et al., 2004; Gillespie et al., 1991; Hurrell, 1997; Berry, 2010). Benefits of flour fortification as a public health strategy for improving iron and folate status include its cost-effectiveness and minimal, if any, requirement for individual behavioral change (Layrisse, et al., 2004). Stability of folic acid and iron fortificants in wheat flour during processing and storage make wheat flour an ideal vehicle for fortification in populations where the consumption of wheat flour and products from wheat flour is relatively high. Prevention of NTDs (Berry, 2010) and decreases in prevalence of iron deficiency (Sadighi, et al., 2008) and/or anemia (Layrisse, et al., 2004) have been attributed to wheat flour fortified with folic acid and iron in multiple countries.

Methods

To estimate the amount of bread consumed by women and children, participants were asked how many loaves of Arabic bread they usually consume each day. Response options were recorded to the nearest 1/8 of a loaf for both small loaves (approximately 100 g) and large loaves (approximately 200 g). Total grams consumed per day were calculated for each participant.

To estimate the percentage of Jordanian households with fortified bread, a sample of approximately 200 g (about the size of one Arabic loaf) of bread was collected from each household. Participants were asked to provide a sample of the bread most commonly eaten. Bread samples were collected in a labeled, resealable plastic bag. A trained laboratory technician at the CPHL conducted the iron spot test for the qualitative determination of the presence of iron in the bread samples using a modified version of the AACC International's iron spot test for wheat flour (AACC International, Method 40-40, 1999). Five drops of a pre-prepared solution of 10% potassium thiocyanate and 2M hydrochloric acid were added directly to the inner portion of the bread sample with a dropper. Afterwards five drops of 3% of hydrogen peroxide were added and left to stand for one to two minutes. Red colored spots indicated the presence of iron added to the bread during fortification. The iron spot test only detects iron added to bread and not the iron intrinsically present in the bread. The presence of iron was a proxy for the fortification of the bread.

As the qualitative spot test for iron on samples of bread has not yet been validated, a small study was undertaken to assess the performance of the iron spot test as a qualitative method for detecting the presence of iron in bread made from wheat flour fortified with iron. A subsample of bread samples (n=50) was systematically selected to assess the performance of the iron spot test by comparing the outcome of the iron spot test to the quantitative measure of the iron measured by spectrophotometry which is considered as a gold standard for the measurement of iron. Additional details and the results of this performance assessment are presented in Appendix XII: Performance Assessment of the Iron Spot Test. The results show that a positive iron spot test result is an acceptable qualitative indicator of added ferrous sulfate in flat bread collected from Jordanian households. However, in this setting, the test is likely to produce false negative samples, where bread samples are identified as negative for added iron by the iron spot test yet positive by spectrophotometry. This means that the iron spot test in bread could lead to a lower prevalence of fortified bread compared to the true value. It is also important to note that the test is likely to perform better in Arabic bread that is mixed with a machine compared to other types of flat bread.

Bread Consumption, Flour and Bread Use, and Percentage of Households with Fortified Bread

A total of 94.4% of women (n=2,607) reported consuming bread with an average of 253.9 g per day, a median of 200.0 g, and an inter-quartile range of 200.0 to 400.0 g among women who consumed bread. A total of 94.8% (95% CI: 92.8, 96.2) of children (n=1,020) were reported to consume bread, with an average of 115.4 g per day, a median of 100.0 g, and an inter-quartile range of 50.0 to 100.0 g among children who consumed bread. Among the 1,741 households that completed the fortification section of the questionnaire (87.4% of all households recruited for participation), the majority (95.0%) reported that they did not usually bake bread, while 1.3% reported baking bread using both *Mowahad* (white flour, fortified) and *Baladi* (whole wheat flour, unfortified) flour, 1.2% reported baking bread with *Mowahad* flour only, and 1.2% reported baking bread with *Baladi* flour only (Table 5-1). Samples of bread were collected from 1,737 participating households (87.2% of all households recruited for participation). Among bread samples collected, 75.3% were *Kmahge*/Arabic, followed by 18.7% which were *Mashrooh*, and 3.5% which were *Taboon* (see Table 5-1). These types of bread are most often produced with 100% *Mowahad* wheat flour.

Table 5-1: Flour and bread types, Jordan 2010.

Item and Responses	Percent (95% CI)[a,b]	
If you usually bake the bread which the family uses at home, what type of flour do you use? (n=1,741)		
Do not bake	95.0	(92.7, 96.6)
Both (*Mowahad* and *Baladi*)	1.3	(0.8, 2.1)
Mowahad (white flour)	1.2	(0.7, 2.0)
Baladi (whole wheat)	1.2	(0.6, 2.6)
Other	0.6	(0.2, 2.2)
Don't know	0.6	(0.3, 1.2)
Type of bread sample collected from the household (n=1,737)[c]		
Kmahge/Arabic	75.3	(71.6, 78.7)
Mashrooh	18.7	(16.0, 21.7)
Taboon	3.5	(2.6, 4.7)
Mankosh	1.1	(0.5, 2.2)
Warda	0.8	(0.4, 1.6)
Other	0.5	(0.2, 1.1)
Don't know	0.2	(0.1, 0.5)

Note: The n's are un-weighted denominators for each subgroup.
[a] Percentages weighted for non-response and survey design.
[b] CI=confidence interval, adjusted for cluster sampling design.
[C] Participants were requested to provide a sample of the most commonly eaten bread in the household. If this was not available, participants were requested to provide a sample of the second most commonly eaten bread.

A total of 44.1% of bread samples collected from households tested positive for the presence of iron according to the iron spot test, indicating that the bread was fortified. Among these, 39.3% in North tested positive for iron, compared to 42.3% in Central, and 74.3% in the South. At the same time, 42.9% of urban samples tested positive, compared to 50.2% of rural samples (see Table 5-2).

Table 5-2: Percent of households with iron-fortified bread,[a] by region and place of residence, Jordan 2010.		
Characteristic	n	Households %[b] (95% CI)[c]
Region		
North	515	39.3 (31.7, 47.4)
Central	1,038	42.3 (37.4, 47.3)
South	184	74.3 (67.8, 80.0)
		$p < 0.001$
Residence		
Urban	1,414	42.9 (38.7, 47.1)
Rural	323	50.2 (39.8, 60.5)
		$p = 0.200$
Total	1,737	44.1 (40.2, 48.0)

Note: The n's are un-weighted denominators for each subgroup.
[a] Presence of iron determined by qualitative iron spot test.
[b] Percentages weighted for non-response and survey design.
[c] CI=confidence interval, adjusted for cluster sampling design.

Iron Fortification: Knowledge, Attitudes, and Practices

A total of 1,741 respondents completed the iron fortification knowledge, attitudes, and practices section of the household questionnaire. Of household respondents, 82.3% stated that they would prefer a loaf of bread with added iron or vitamins over a loaf without added iron or vitamins. When asked about how they felt about the government adding iron or vitamins to their bread and flour, 74.3% strongly agreed, while only 0.6% strongly disagreed. The majority of respondents (81.3%) said they did not know whether their bread was fortified (Table 5-3).

Table 5-3: Iron fortification knowledge, attitudes, and practices of household responders, Jordan 2010.

Item and Responses	Percent (95% CI)[a,b]
If you were given the choice of two loaves of bread of the same size and cost, but one had added iron and vitamins and the other did not, which would you prefer? (n=1,741)	
Loaf with added iron or vitamins	82.3 (77.3, 86.3)
Loaf without added iron or vitamins	2.0 (1.3, 3.0)
Don't care	1.3 (0.8, 2.3)
Don't know	14.4 (10.6, 19.3)
How do you feel about the government adding iron or vitamins to your bread and flour? (n=1,741)	
Strongly agree	74.3 (68.0, 79.8)
Agree	20.7 (15.4, 27.3)
Neutral / don't have an opinion	2.3 (1.5, 3.5)
Disagree	2.0 (0.8, 5.4)
Strongly disagree	0.6 (0.3, 1.4)
Does the bread you eat most often in this household have added iron or other vitamins and minerals (also known as fortified)? (n=1,741)	
Yes	14.1 (11.7, 16.8)
No	4.6 (2.9, 7.3)
Don't know	81.3 (77.8, 84.3)
Does the flour you purchase have added iron and other vitamins and minerals? (n=1,741)	
Yes	6.2 (4.7, 8.2)
No	3.4 (2.5, 4.6)
I don’t purchase	43.1 (36.3, 50.2)
Don't know	47.2 (41.0, 53.5)

Note: The n’s are un-weighted denominators for each subgroup.
[a] Percentages weighted for non-response and survey design.
[b] CI=confidence interval, adjusted for cluster sampling design.

Salt Iodization

Iodine is an essential nutrient required for the proper development of the brain and mental functioning. Worldwide, iodine deficiency is the most prevalent preventable cause of brain damage. Iodine deficiency, to which pregnant women and young children are most susceptible, negatively impacts child learning, the health of women, quality of life, and economic productivity. Prophylactic iodization of salt is recommended by WHO as a public health measure for the prevention of iodine deficiency and the disorders is causes (ICCIDD, UNICEF, WHO, 2001). Measuring iodine content of salt is an important tool in the monitoring and evaluation of salt iodization programs around the world. At a population level, the percentage of houses with adequately iodized salt (> 15 ppm) is an indicator to measure the coverage of salt iodization programs.

In order to measure the household coverage of iodized salt in Jordan, each participating household was asked for a 100 g sample of table salt. For each salt sample collected, field workers noted if the package of salt indicated “iodized,” the type of salt, and the expiration date on the package (if available).

Quantitative Iodine Test

A trained technician at the CPHL facilities quantified the concentration of iodine (as KIO_3) in a total of 1,716 salt samples using a quantitative titration method (ICCIDD/UNICEF/WHO, 2001). The Jordan MOH target level for iodization of salt is 40 to 60 ppm. In accordance with ICCIDD/UNICEF/WHO guidelines, a cutoff of ≥ 15 ppm was used to indicate adequately iodized salt in this report (ICCIDD/UNICEF/WHO, 2001). While it is possible that imported salt may contain iodine as potassium iodide, quantitative determination of potassium iodide was not done because the laboratory equipment was not able to measure it. Thus, if salt was fortified with potassium iodide, it was not measured, and levels of iodized salt in this report may be underestimated.

A total of 1,731 household salt samples were measured for the concentration of iodine. The mean concentration of iodine in the salt samples was 23.3 ppm (SD=15.9 ppm), ranging from 0.0 to 126.0 ppm. 2.2% of samples from households were found to be iodized with > 60 ppm, 14.3% with 40 to 60 ppm, 50.0% with 15 to < 40 ppm, 25.4% with > 0 to < 15 ppm, and 8.1% with 0 ppm. By region, 64.9% of samples in the North region were adequately iodized (≥ 15 ppm), compared to 68.7% in the Central and 55.9% in the South regions. At the same time, 67.8% of urban samples tested positive, compared to 60.1% of rural samples (see Table 5-4).

Table 5-4: Percent of households with adequately iodized salt[a], by region and place of residence, Jordan 2010. (n=1,731)

Characteristic	Households %[b]	(95% CI)[c]
Region		
North	64.9	(59.5,70.0)
Central	68.7	(64.8,72.3)
South	55.9	(50.8,60.9)
		p = 0.017
Residence		
Urban	67.8	(64.5,70.9)
Rural	60.1	(54.5, 65.4)
		p = 0.016
Total	66.5	(63.6, 69.3)

[a] Presence of adequately iodized salt determined by the titration method (≥ 15 ppm).
[b] Percentages weighted for non-response and survey design.
[c] CI=confidence interval, adjusted for cluster sampling design.

Types of Salt Used and Percentage of Households with Adequately Iodized Salt

A total of 1,741 respondents completed the salt iodization knowledge, attitudes, and practices section of the questionnaire. Overall, households reported consuming a mean of 1.7 bags of table salt (750 g) each month (SD=1.2 bags), ranging from 0.1 to 20.0 bags. Among salt samples collected, the majority of samples (66.9%) were taken from brand or labeled packages. 44.4 % of packages indicated that the salt was "iodized." At the same time, 2.7% of packages indicated that the expiration date had passed (as of the period of data collection) (see Table 5-5).

Table 5-5: Types, indication of iodization, and expiration date of household salt samples, Jordan 2010.

Item and Responses	Percent (95% CI) [a,b]	
Type of table salt sampled (n=1,716)		
Brand or labeled	66.9	(62.6, 70.9)
Brandless salt	14.6	(11.0, 19.2)
Other labeled type	0.1	(0.1, 0.1)
Don't know	18.3	(15.1, 22.0)
Does the package of table food salt say "iodized"? (n=1,741)		
Yes	44.4	(39.1, 49.8)
No, has a label but it does not say "iodized"	3.5	(2.4, 5.1)
There is no label on the salt	26.5	(20.9, 33.1)
There is no package	25.4	(21.0, 30.3)
No salt in the household	0.2	(0.1, 0.6)
Status of expiration of salt sampled (n=1,716)		
Expiration date not yet passed	27.8	(24.0, 32.0)
Expiration date passed	2.7	(1.9, 3.8)
No expiration date	69.4	(65.3, 73.3)

Note: The n's are un-weighted denominators for each subgroup.
[a] Percentages weighted for non-response and survey design.
[b] CI=confidence interval, adjusted for cluster sampling design.

Salt Iodization: Knowledge, Attitudes, and Practices

Among household respondents, 83.4% stated that they would prefer a package of salt with added iodine over a package without added iodine. When asked about how they felt about the government adding iodine to their salt, 74.7% strongly agreed, while only 0.3% strongly disagreed. 68.8% of respondents reported that the salt they purchase most often in the household has added iodine, while 57.7% reported that they look/ask for salt with iodine added when they purchase it for the home (see Table 5-6).

Table 5-6: Salt iodization knowledge, attitudes, and practices of household responders, Jordan 2010.

Item and Responses	n=1,741	Percent (95% CI)[a,b]
If you were given the choice of two packages of salt of the same size and cost, but one had added iodine and the other did not, which would you prefer?		
Package with added iodine		83.4 (78.7, 87.3)
Package without added iodine		1.8 (1.2, 2.6)
Don't care		1.3 (0.7, 2.3)
Don't know		13.5 (10.0, 18.0)
How do you feel about the government adding iodine to your salt?		
Strongly agree		74.3 (68.9, 79.7)
Agree		21.3 (15.8, 28.1)
Neutral / don't have an opinion		2.7 (1.8, 4.1)
Disagree		1.4 (0.8, 2.2)
Strongly disagree		0.3 (0.1, 0.8)
Do you know if the salt that you purchase most often has added iodine?		
Yes		68.8 (65.0, 72.3)
No		2.0 (1.4, 2.9)
Don't know		29.2 (25.7, 33.0)
Do you look/ask for salt with iodine added (iodized salt) when you purchase it for your home?		
Yes		57.7 (53.9, 62.3)
No		28.4 (23.7, 33.6)
I don’t purchase		0.9 (0.6, 1.5)
Don't know		13.0 (10.1, 16.4)

[a] Percentages weighted for non-response and survey design.
[b] CI=confidence interval, adjusted for cluster sampling design.

The internationally accepted goal for national elimination of iodine deficiency disorders (IDD) is to achieve at least a 90% household coverage of adequately iodized (≥ 15 ppm) salt (ICCIDD, UNICEF, WHO, 2001). With 66.5% of households with adequately iodized salt in this survey, household coverage falls below the accepted goal.

CHAPTER 6: ANTHROPOMETRY

Adequate nutrition is important for child development. The window between birth and 59 months of age is a critical time for optimal growth and healthy development of a child. Often this period is marked by sub-optimal growth due to malnutrition, micronutrient deficiencies, and disease. This chapter documents the anthropometric measurements of children and compares them to international standards for growth.

Complete information for anthropometric indicators of height-for-age, weight-for-age, weight-for-height, and body mass index (BMI)-for-age was available for a total of 1,023 children in the 2010 Micronutrient Survey. The age of the child was calculated based on the difference between the child's birth date and the date of the measurement. For children older than 24 months of age, height was measured to the nearest 0.1 cm using a field appropriate Shorr stadiometer (Olney, Maryland, USA). For children ≤ 24 months of age, recumbent length was measured using the Shorr stadiometer. All subjects were measured without shoes and hair adornments. UNICEF Seca Uniscales were used to measure body weight. The weight of children who could not stand on their own was assessed using the mother-child tare function on the scale. During data collection, the quality of the anthropometric data was reviewed by CDC using Emergency Nutrition Assessment (ENA)/EpiInfo software, which checks the plausibility of entered data and flags potential problems associated with digit preference and high standard deviations (which can be caused by inaccurate measurements). Retraining was conducted as necessary.

Pediatric anthropometric data were interpreted using the most recent World Health Organization (WHO) international growth reference/standard (WHO, 2006). This reference/standard is based on growth curves for children receiving optimal nutrition in six different countries around the world. Healthy, well-nourished children from most countries exhibit a pattern of growth that is similar to that of the reference/standard.

Anthropometric indices were interpreted using classifications based on Z-scores (standard deviation units from the reference/standard median). The WHO recommends that a Z-score cut-off point of < -2.0 be used to classify low height-for-age, low weight-for-age, and low weight-for-height for estimating the prevalence of malnutrition. The WHO reference/standard Z-score distribution for each index has a mean of 0.0 and a standard deviation of 1.0. A Z-score cut-off of +2.0 was used to classify high weight-for-height for estimating the prevalence of overweight or obesity (also a form of malnutrition). A Z-score of -2.0 corresponds to the 2.3rd percentile of the reference/standard distribution, while a Z-score of +2.0 corresponds to the 97.7th percentile of the reference/standard distribution. With any of the indicators, a population prevalence of malnutrition less than 2.3% is regarded as the surveyed population being similar to the WHO reference/standard population and thus free from malnutrition based on that indicator.

- Height-for-Age

A low height-for-age indicates shortness, or growth stunting, which reflects a long term deficit of adequate nutrition and/or a history of illness and disease such as diarrhea and acute respiratory infection. On a population level, a high prevalence of stunting is usually associated with poor socioeconomic conditions and a greater risk for frequent and/or early exposure to adverse environmental conditions such as illness and inadequate nutrition (WHO, 1995). A decrease in the prevalence of stunting usually parallels improvements in economic conditions. Countries with < 20% prevalence in low height-for-age (Z-score < -2.0) are classified as countries with low prevalence of stunting by WHO.

- Weight-for-Age

Low weight-for-age, or underweight, can serve as an indication of malnutrition caused by both acute and chronic conditions. In addition, underweight can be used on an individual basis, for children under two years of age, to assess growth faltering by comparing a child's growth progression in comparison to a reference group (Cogill, 2001). On a cross-sectional basis, however, weight-for-age is less useful than height-for-age or weight-for-height in defining nutritional status. In most populations where there are few children with low weight-for-height, the weight-for-age status provides essentially the same information as height-for-age.

- Weight-for-Height

Low weight-for-height, or wasting, is an indicator of thinness or acute under-nutrition and is often the result of severe food shortages and/or prolonged severe illness. Unlike the wide variation in stunting rates observed in developing countries, the prevalence of wasting is usually less than 5% in most countries provided there is no severe food shortage. Therefore, a wasting prevalence of more than 5% is of concern; a prevalence of 10% to 14% is considered serious; a prevalence of 15% or higher is considered critical (WHO, 1995).

- BMI-for-Age

Body mass index, or BMI, is a number that indicates a person's weight in proportion to height, calculated as kilograms per meters squared (kg/m^2). BMI-for-age is a growth indicator that relates BMI to age. High BMI-for-age is used as an indicator of overweight (BMI-age Z-score > 2) and obesity (BMI-age Z-score > 3).

- Data Quality

The observed SD value of the Z-score distribution is very useful for assessing data quality. With accurate age assessment and anthropometric measurements, the SDs of the observed length-for-age, weight-for-age, and weight-for-length Z-score distributions should be relatively constant and close to the expected value of 1.0 for the reference distribution. An SD that is significantly lower than 0.9 describes a distribution that is more homogenous, or one that has a narrower spread, compared to the distribution of the reference population. Any standard deviation of the Z-scores above 1.3 suggests inaccurate data due to measurement error or incorrect age reporting. The expected ranges of standard deviations of the Z-score distributions for the three anthropometric indicators are as follows (WHO, 1995):

- Height-for-age Z-score: 1.10 to 1.30
- Weight-for-age Z-score: 1.00 to 1.20
- Weight-for-height Z-score: 0.85 to 1.10

During data cleaning, 12 observations with potentially erroneous data were excluded from analysis based on the following standard Z-score cutoffs developed by WHO (WHO, 1995 for HAZ, WAZ, and WHZ; WHO, 2010 for BAZ):

- Height-for-age Z-score (HAZ) < -6.0 or > +6.0
- Weight-for-age Z-score (WAZ) < -6.0 or > 5.0
- Weight-for-height Z-score (WHZ) < -5.0 or > 5.0
- BMI-for-age Z-score (BAZ) < -5.0 or > 5.0

A total of 12 unique observations were excluded, including 10 for extreme HAZ values, three for extreme WHZ values, and four for extreme BAZ values (note some observations had extreme values for multiple measures).

2010 Anthropometric Status of Children

Valid anthropometric data were available for 1,013 children to calculate height-for-age (stunting), 1,023 children to calculate weight-for-age (underweight), 1,011 children to calculate weight-for-height (wasting/overweight), and 1,019 children to calculate BMI-for-age (obesity) Z-scores. Mean Z-scores, standard deviations, and z-score range are provided for the indicators in Table 6-1. The standard deviations for height-for-age and weight-for-height indicators suggest that measurements (most likely height measurements or age information) may be slightly inaccurate because they fall outside of the acceptable range (see section on Data Quality above). However, although the standard deviations are wider than expected based on WHO guidelines, Mei and Grummer-Strawn (2007) have demonstrated that higher standard deviations are to be expected when using the WHO 2006 growth reference.

Table 6-1: Mean and standard deviation of Z-scores[a] for anthropometric measures of children ages 12 – 59 months, Jordan 2010.

Indicator	N	Mean Z-score (95% CI)[b]	Standard Deviation[c]	Z-score Range
Height-for-age (stunting)	1,013	-0.3 (-0.5, -0.1)	1.6	(-5.5, 5.4)
Weight-for-age (underweight)	1,023	0.1 (0.0, 0.2)	1.1	(-4.4, 4.7)
Weight-for-height (wasting)	1,011	0.4 (0.3, 0.5)	1.2	(-4.6, 4.2)
BMI-for-age (overweight, obesity)	1,019	0.5 (0.3, 0.6)	1.3	(-4.8, 5.0)

[a] Using 2006 WHO Child Growth Standards.
[b] CI=confidence interval, adjusted for cluster sampling design. Means are weighted for non-response.
[c] Standard deviations are not adjusted for cluster sampling design.

Figure 6-1 below shows the distributions of z-scores for stunting (HAZ), underweight (WAZ), wasting/overweight (WHZ), and obesity (BAZ) for Jordanian children ages 12 – 59 months compared to the 2006 WHO Child Growth Standard. Compared to the standard, Jordanian children were generally shorter and heavier.

Figure 6-1: Anthropometric Z-score distributions for Jordanian children ages 12 – 59 months compared to the 2006 WHO Child Growth Standard, Jordan 2010.

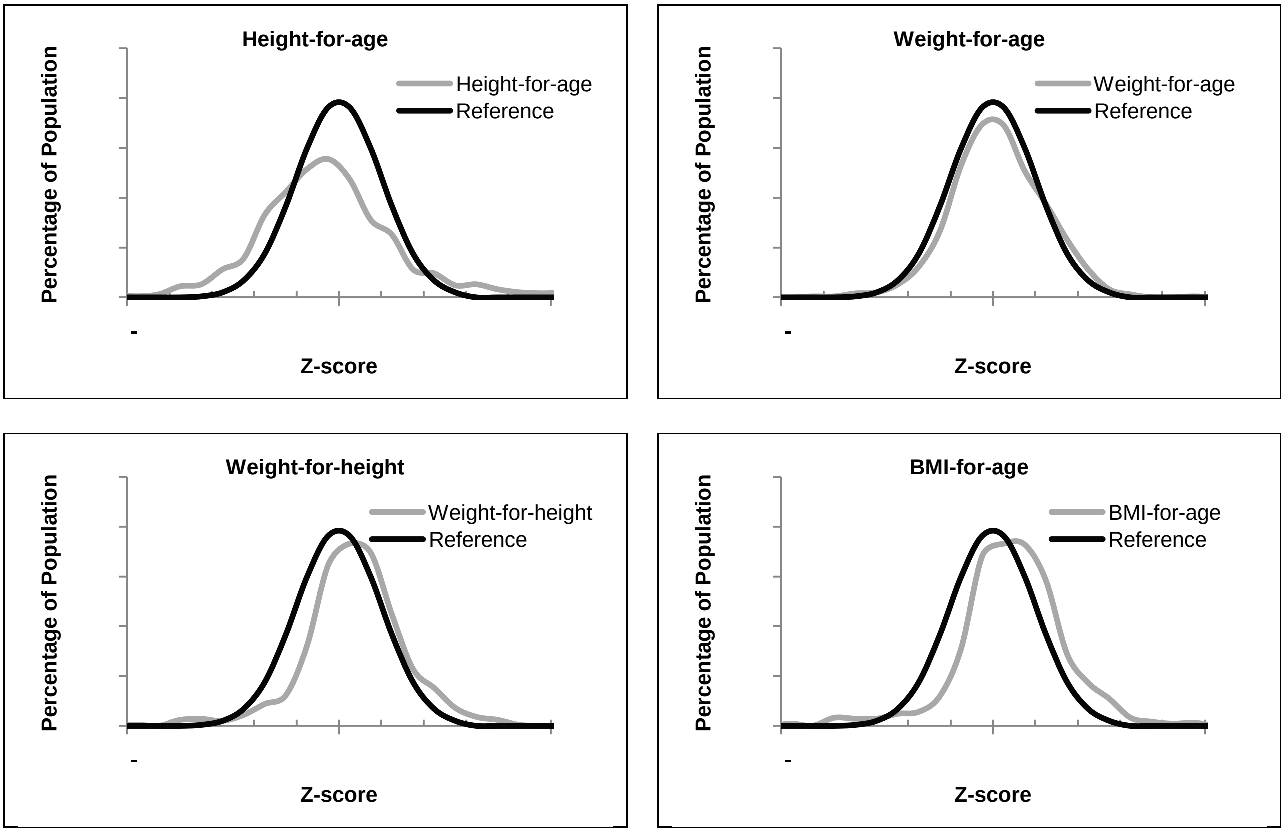


Table 6-2 shows prevalence of stunting, underweight, wasting, overweight, and obesity for children by sex, age group, region, and place of residence. Stunting was identified in a total of 10.8% of children aged 12 – 59 months. No statistically significant differences were observed across subgroups of stunting including sex, age, region, and residence. While 2.5% of children were underweight, 3.5% were wasted, 8.8% of the children were overweight, and 1.8% obese. A statistically significant difference was seen across subgroups of underweight, where a higher percentage of children in the North and South were underweight compared to the Central region (p=0.011), and a higher percentage of males were underweight compared to females (p=0.051).

Table 6-2: Prevalence of malnutrition for various indicators[a], according to selected characteristics for children ages 12 – 59 months, Jordan 2010.

Characteristic	Height-for-age (stunting, z < -2) % (95% CI[b])		Weight-for-age (underweight, z < -2) % (95% CI[b])		Weight-for-height (wasting, z < -2) % (95% CI[b])		BMI-for-age[c] (overweight, z > 2) % (95% CI[b])		BMI-for-age[c] (obesity, z > 3) % (95% CI[b])	
<u>Sex</u>										
Male	12.1	(9.1, 15.7)	3.4	(2.1, 5.5)	3.9	(2.3, 6.5)	9.2	(6.4, 12.9)	2.5	(1.2, 4.9)
Female	9.6	(6.8, 13.2)	1.5	(0.6, 3.3)	3.0	(1.6, 5.8)	8.4	(5.9, 11.7)	1.1	(0.4, 2.7)
	p = 0.235		*p* = 0.051		*p* = 0.501		*p* = 0.651		*p* = 0.103	
<u>Age Group (months)</u>										
12 – 23	7.9	(5.1, 12.2)	1.7	(0.6, 4.5)	2.6	(1.0, 6.6)	10.4	(6.9, 15.4)	1.5	(0.5, 4.1)
24 – 35	14.0	(10.1, 19.2)	2.1	(0.9, 4.8)	3.9	(1.7, 8.8)	10.3	(6.9, 15.2)	3.7	(1.8, 7.4)
36 – 47	12.4	(8.4, 17.8)	2.8	(1.3, 5.6)	3.2	(1.5, 6.9)	9.1	(5.3, 15.3)	1.2	(0.3, 5.6)
48 – 59	9.3	(6.1, 14.0)	3.2	(1.7, 5.9)	4.1	(1.9, 6.6)	5.7	(3.4, 9.5)	0.9	(0.2, 3.8)
	p = 0.113		*p* = 0.620		*p* = 0.093		*p* = 0.216		*p* = 0.131	
<u>Region</u>										
North	12.0	(8.7, 16.3)	4.3	(2.4, 7.8)	4.9	(2.0, 11.2)	8.1	(4.8, 13.4)	1.9	(0.8, 4.3)
Central	9.8	(6.8, 14.0)	1.2	(0.5, 2.7)	2.6	(1.5, 4.6)	8.5	(5.7, 12.4)	1.7	(0.6, 4.3)
South	13.7	(7.5, 23.8)	3.3	(1.2, 8.4)	3.5	(1.2, 10.0)	14.4	(8.1, 24.3)	2.5	(0.7, 8.8)
	p = 0.515		*p* = 0.011		*p* = 0.635		*p* = 0.362		*p* = 0.879	
<u>Residence</u>										
Urban	9.6	(7.5, 12.3)	2.6	(1.6, 4.3)	3.8	(2.2, 6.6)	8.3	(6.3, 11.0)	1.3	(0.7, 2.3)
Rural	15.7	(9.3, 25.4)	1.8	(0.6, 5.1)	2.1	(0.9, 5.2)	10.6	(4.8, 21.7)	4.0	(1.3, 11.8)
	p = 0.090		*p* = 0.530		*p* = 0.716		*p* = 0.567		*p* = 0.063	
TOTAL	10.8	(8.6, 13.6)	2.5	(1.6, 3.9)	3.5	(2.1, 5.7)	8.8	(6.6, 11.6)	1.8	(1.0, 3.3)

[a] Using 2006 WHO Child Growth Standards.
[b] CI=confidence interval, adjusted for cluster sampling design.
[c] BMI=body mass index; kg/m^2

Complete WHO Global Database on Child Growth and Malnutrition tables with anthropometric results for children measured in the 2010 Micronutrient Survey are included in Appendix XIII: Jordan 2010 Micronutrient Survey Anthropometry Results for the WHO Global Database on Child Growth and Malnutrition.

Public Health Burden of Low Anthropometric Indicators

Certain cut-off values are used to measure the severity of growth faltering in a population. The prevalence of low anthropometric indicators in the 2010 Micronutrient Survey were interpreted using the WHO classification presented in Table 6-3. According to this classification, Jordan's children fall into the low public health significance category for all indicators. (Note: there is currently no classification for BMI-for-age).

Table 6-3: WHO classification for low anthropometric indicators according to public health significance for children < 5 years of age (WHO, 1995).

Anthropometric Index	Low	Medium	High	Very High
Low HAZ (stunting)	< 20.0%	20.0 – 29.9%	30.0 – 39.9%	≥ 40.0%
Low WAZ (underweight)	< 10.0%	10.0 – 19.9%	20.0 – 29.9%	≥ 30.0%
Low WHZ (wasting)	< 5.0%	5.0 – 9.9%	10.0 – 14.9%	≥ 15.0%

NOTE: This WHO classification is based on children < 5 years of age (< 59 months), while the survey population includes children 12 and 59 months; classifications are not yet available for BMI-for-age.

REFERENCES

AACC International. Approved Methods of Analysis, Method 40-70. Elements by atomic absorption spectrophotometry. AACC International, St. Paul, MN, U.S.A. Final approval 16 October, 1991; Reapproval 3 Nov., 1999.

AACC International. Approved Methods of Analysis, Method 40-40. Iron-qualitative method. AACC International, St. Paul, MN, U.S.A. 2002. Final approval 5 May, 1960; Reapproval 3 Nov., 1999.

Allen LH. Causes of B_{12} and folate deficiency. Food Nutr Bull. 2008;29:S20-34.

Alvarez, JC and De Mazancourt, P. Rapid and sensitive high-performance liquid chromatographic method for simultaneous determination of retinol, α-tocopherol, 25-hydroxyvitamin D_3, and 25-hydroxyvitamin D_2 in human plasma with photodiode-array ultraviolet detection. Journal of Chromatography B. 2001;755:129–135.

Alwan A, Kharabsheh, S. Nutrition in Jordan: a review of the current nutritional trends and major strategic directions of the national food and nutrition policy. Amman, Jordan. 2006.

Beckman Coulter, Inc. COULTER HmX hematology analyzer with autoloader. Fullerton, CA. June, 2003. PN 4237523.

Berry RJ, Bailey L, Mulinare J, Bower C. Fortification of flour with folic acid. Food and Nutrition Bulletin. 2010;31(1) supplement:S22-S35.

Berry, R.J., et al., Prevention of neural-tube defects with folic acid in China. China-U.S. Collaborative Project for Neural Tube Defect Prevention. N Engl J Med. 1999;341(20):1485-90.

Baltussen R, Knai C, Sharan M. Iron fortification and iron supplementation are cost-effective interventions to reduce iron deficiency in four subregions of the world. J Nutr. 2004;134:2678-84.

Catignani GL and Bieri JG. Simultaneous determination of retinol and α-tocopherol in serum or plasma by liquid chromatography. Clin Chem. 1983;29(4):708-12.

Centers for Disease Control and Prevention (CDC). National report on biochemical indicators of diet and nutrition in the U.S. population 1999-2002. Chapter 2. Fat-Soluble Vitamins & Micronutrients: Vitamin D. 2008;61-9.

CDC/NCEH/IMMPaCt. Venous Blood Collection. In Survey Toolkit: Field and laboratory module. Centers for Disease Control and Prevention, National Center for Environmental Health and International Micronutrient Malnutrition Prevention and Control Program. 2009.

Clemens TL, Adams JS, Henderson SL, Holick MF. Increased skin pigment reduces the capacity of skin to synthesise vitamin D_3. Lancet. 1982;319(8263):74-6.

Cobas. Cobas e 411. Version 10. May, 2010. Ref: 03737551 190.

Cobas. Cobas e 411. Version 4. August, 2008. Ref: 04745736 190.

Cogill, B. Anthropometric indicators measurement guide. Food and Nutrition Technical Assistance Project (FANTA). Academy for Educational Development. Washington, DC. U.S.A. 2001.

Correale M., et al., Acute phase proteins in atherosclerosis (acute coronary syndrome). Cardiovasc Hematol Agents Med Chem. 2008;6(4):272-7.

Czeizel, AE, Dudas, I. Prevention of the first occurrence of neural-tube defects by periconceptional Vitamin supplementation. N Engl J Med. 1992;327(26):1832-5.

Daly LE, et al. Folate levels and neural tube defects: implications for prevention. JAMA. 1995;274:1698-702.

DeLuca HF. The Vitamin D story: a collaborative effort of basic science and clinical medicine. FASEB J. 1988;2:224-36.

de Pee S, Dary O. Biochemical indicators of vitamin A deficiency: serum retinol and serum retinol binding protein. J Nutr. 2002;Sep.132(9 Suppl):2895S-2901S.

Gabay C, Kushner I. Acute-phase proteins and other systemic responses to inflammation. N Engl J Med. 1999;340(6):448-454.

Gillespie S, Kevany J, Mason J. Controlling iron deficiency. United Nations: Administrative Committee on Coordination/Subcommittee on Nutrition, 1991.

Holick MF. Environmental factors that influence the cutaneous production of vitamin D. Am J Clin Nutr 1995;61:638-45.

Holick MF. Vitamin D deficiency. N Engl J Med. 2007;357:266-81.

Hurrell RF. Preventing iron deficiency through food fortification. Nutr Rev. 1997;55:210-22.

Hurrell RF, et al. Revised recommendations for iron fortification of wheat flour and an evaluation of the expected impact of current national wheat flour fortification programs. Food Nutr Bull. 2010:31(no.1 Supplement): S7-S21.

International Council on the Control of Iodine Deficiency Disorders (ICCIDD), United Nations Children's Fund (UNICEF), World Health Organization (WHO). Assessment of iodine deficiency disorders and monitoring their elimination: A guide for program managers. 2nd ed. 2001. WHO/NHD/01.1.

Institute of Medicine (IOM). Dietary reference intakes for thiamine, riboflavin, niacin, vitamin $B_{6,}$ folate, vitamin B_{12}, panthtenic acid, biotine and choline. Washington DC: National Academies Press, 1998.

Institute of Medicine (IOM). Dietary reference intakes for calcium and vitamin D. Washington, DC: National Academy Press. 2011.

Jordan Ministry of Health. A national survey on iron deficiency anemia and vitamin A deficiency. Jordan, 2002.

Jordan Ministry of Health. Recommendations of the Higher National Committee. 2002.

Layrisse M, et al. Impact of fortification of flours with iron to reduce the prevalence of anemia and iron deficiency among schoolchildren in Caracas, Venezuela: a follow-up. Food Nutr Bull. 2002;23:384-9.

Lievins M, et al. Evaluation of four new Tina-quant assays for determination of α1-acid glycoprotein, α1-antitrypsin, hapatoglobin, and prealbumin. Clin Lab. 1996;42:515-520.

Massa'd H, Barham R. National survey to assess iodine deficiency disorders (IDD) among Jordanian children—2010. Jordan Ministry of Health Nutrition Department, World Health Organization Non-Communicable Disease Department. Amman, Jordan. 2011.

Mei Z, Grummer-Strawn LM. Standard deviation of anthropometric Z-scores as a data quality assessment tool using the 2006 WHO growth standards: a cross country analysis. Bull World Health Organ. 2007;85:441-8.

MRC Vitamin Study Research Group. Prevention of neural tube defects: results of the Medical Research Council vitamin study. Lancet. 1991;338(8760):131-7.

National Institutes of Health (NIH). Dietary supplement fact sheet: Folate. [07/15/2009]; Available from: http://ods.od.nih.gov/factsheets/folate.asp#en10.

Nagpal S, Na S, Rathnachalam R. Noncalcemic actions of vitamin D receptor ligands. Endocr Rev. 2005;25:662-87.

O'Broin SD, Kelleher BP, Davoren A, Gunter EW. Field-study screening of blood folate concentrations: specimen stability and finger-stick sampling. Am J Clin Nutr. Dec. 1997:66(6);1398-1405.

O'Broin S, Kelleher B. Microbiological assay on microtitre plates of folate in serum and red cells. J Clin Pathol. 1992;45;344-7.

Reichel H, Koeffler HP, Norman AW. The role of vitamin D endocrine system in health and disease. N Engl J Med. 1989;320:980-91.

Roth HJ, Schmidt-Gayk H, Weber H, Niederau C. Accuracy and clinical implications of seven 25-hydroxyvitamin D methods compared with liquid chromatography-tandem mass spectrometry as a reference. Ann Clin Biochem. 2008;45:153–159.

Rosner B. Fundamentals of Biostatistics, 6th ed. Duxbury Press, 2005.

Sadighi J, et al. Flour fortification with iron: a mid-term evaluation. Public Health. 2008;122:313-21.

Selhub J, et al. The use of blood concentrations of vitamins and their respective functional indicators to define folate and vitamin B_{12} status. Food Nutr Bull. 2008;29:S67-73.

Sommer A, Davidson FR. Assessment and control of vitamin A deficiency: the Annecy Accords. J Nutr. 2002;132(9 Suppl):2845S-2850S.

Sullivan KM, Mei Z, Grummer-Strawn L, Parvanta I. Haemoglobin adjustments to define anaemia. Trop Med Int Health. 2008;13(10):1267-71.

Thurnham DI, McCabe GP, Northrop-Clewes CA, Nestel P. Effect of subclinical infection on plasma retinol concentrations and assessment of prevalence of vitamin A deficiency: meta-analysis. Lancet. 2003;362:2052–8.

U.S. Department of Health and Human Services (HHS), U.S. Department of Agriculture (USDA). Dietary guidelines for Americans, 2005. 6th ed. Washington, D.C.: U.S. Government Printing Office. January 2005.

World Health Organization (WHO) Technical Consultation. Conclusions of a WHO Technical Consultation on folate and vitamin B_{12} deficiencies. Food and Nutrition Bulletin. 2008:29(2):S238-44.

World Health Organization (WHO). WHO Anthro for Personal Computers Manual: Software for assessing growth and development of the world's children. Geneva: WHO. 2010;14.

World Health Organization (WHO). Global prevalence of vitamin A deficiency in populations at risk 1995-2005. WHO Global Database on vitamin A Deficiency. Geneva: World Health Organization. 2009.

World Health Organization (WHO). WHO Child Growth Standards: Length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: Methods and development. Multicentre Growth Reference Study Group. Geneva: WHO. 2006.

World Health Organization (WHO). Iron deficiency anemia – Assessment, prevention, and control: A guide for programme managers. Geneva: World Health Organization. 2001; (WHO/NHD/01.3).

World Health Organization (WHO). Indicators for assessing vitamin A Deficiency and their application in monitoring and evaluating intervention programmes. Geneva: World Health Organization. 1996; (WHO/NUT/96.10).

World Health Organization (WHO). Physical status: the use and interpretation of anthropometry. WHO Technical Report Series 854. Geneva: World Health Organization. 1995;217-9.

APPENDIX

Appendix I: Monthly Mill Monitoring Report
Jordan flour fortification program monthly mill monitoring results for January 2009 – April 2010.

Mill Name	Indicator	Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09	Aug-09[a]	Sep-09	Oct-09	Nov-09	Dec-09	Jan-10	Feb-10	Mar-10	Apr-10	Mill Avg.[a]
Modern Flour	Mowhad flour prod. (MT)	1,336	2,413	2,990	260	2,402	2,402	2,518	2,395	1,817	6,194	2,393	2,275	1,959	1,962	3,206	2,056	2,411
	Add. rate, % target 250g	97%	*PSO*	43%	100%	*PSO*	100%	*NRC*	*PSO*	*PSO*	*PSO*	88%	97%	107%	92%	84%	92%	90%
	Iron level, PPM	38		36	45		47					36	39	39	60	49	128	52
Rghadan Flour	Mowhad flour prod. (MT)	5,988	5,102	5,756	6,486	5,933	5,647	5,705	4,631	3,810	5,319	5,397	5,009	5,725	5,116	5,792	4,765	5,386
	Add. rate, % target 250g	95%	*PSO*	38%	94%	84%	78%	*NRC*	*PSO*	*PSO*	*PSO*	96%	98%	66%	59%	52%	38%	73%
	Iron level, PPM	38		35	38	29	30					39	40	15	32	31	*missing*	33
ZarKa	Mowhad flour prod. (MT)	2,170	1,995	2,150	2,188	1,935	1,935	2,140	2,310	2,185	2,205	2,240	2,100	2,100	1,970	2,065	1,980	2,104
	Add. rate, % target 250g	83%	*PSO*	33%	91%	*PSO*	78%	84%	59%	*PSO*	*PSO*	58%	85%	110%	91%	82%	81%	78%
	Iron level, PPM	29		39	35		29	9	20			26	30	45	45	42	40	32
South Amman	Mowhad flour prod. (MT)	3,861	3,802	4,211	2,777	4,536	4,536	4,381	4,415	3,536	4,915	5,021	4,832	5,000	3,000	5,000	4,500	4,270
	Add. rate, % target 250g	96%	*PSO*	38%	94%	*PSO*	88%	*NRC*	*PSO*	*PSO*	*PSO*	98%	87%	92%	90%	28%	100%	81%
	Iron level, PPM	35		40	39		35					39	34	23	41	40	43	37
Al Juweida	Mowhad flour prod. (MT)	7,150	6,333	6,898	5,404	5,167	5,168	5,809	5,375	4,097	4,907	5,532	4,481	5,211	4,694	4,682	5,210	5,382
	Add. rate, % target 250g	96%	*PSO*	30%	98%	48%	48%	72%	93%	*PSO*	*PSO*	81%	85%	77%	87%	64%	69%	73%
	Iron level, PPM	39		34	42	*missing*	32	*missing*	*missing*			34	31	32	36	11	15	31
Abu Nsier	Mowhad flour prod. (MT)	2,297	2,181	2,508	2,349	2,139	2,139	2,265	2,340	2,312	2,995	3,163	3,072	2,792	2,576	2,836	2,757	2,545
	Add. rate, % target 250g	91%	*PSO*	32%	85%	*PSO*	79%	*NRC*	*PSO*	*PSO*	*PSO*	76%	72%	46%	39%	35%	62%	62%
	Iron level, PPM	30		28	28		27					29	27	14	13	*missing*	*16*	24
Irbid	Mowhad flour prod. (MT)	6,699	6,470	6,801	6,606	6,656	6,656	6,095	4,618	3,542	3,991	4,253	3,742	4,492	3,496	4,214	3,972	5,144
	Add. rate, % target 250g	90%	*PSO*	41%	95%	*PSO*	77%	*NRC*	*PSO*	*PSO*	*PSO*	85%	91%	98%	92%	95%	100%	86%
	Iron level, PPM	30		32	40		34					35	37	19	22	62	25	34
Al Daqiq	Mowhad flour prod. (MT)	6,602	6,044	6,474	6,323	6,595	6,595	6,320	6,049	5,289	6,561	6,873	6,536	6,485	5,982	6,604	6,348	6,355
	Add. rate, % target 250g	97%	*PSO*	43%	98%	88%	84%	*NRC*	*PSO*	*PSO*	*PSO*	97%	99%	86%	47%	45%	50%	76%
	Iron level, PPM	40		39	40	*missing*	42					40	42	22	21	12	14	31
Amman Grand	Mowhad flour prod. (MT)	6,674	6,018	6,727	6,563	6,631	6,631	6,538	5,989	4,751	6,194	6,447	6,175	5,733	5,734	6,380	5,960	6,197
	Add. rate, % target 250g	100%	*PSO*	37%	91%	60%	80%	72%	*PSO*	*PSO*	*PSO*	93%	86%	91%	78%	63%	67%	77%
	Iron level, PPM	42		38	37	*18*	36	72				42	33	63	25	19	34	38
Al Nameesh	Mowhad flour prod. (MT)	20	*2,295*	2,233	1,989	2,285	2,285	1,906	2,481	2,270	3,058	3,312	3,167	3,291	*missing*	*missing*	*2,818*	2,386
	Add. rate, % target 250g	74%	*PSO*	40%	80%	*PSO*	83%	*NRC*	*PSO*	*PSO*	*PSO*	81%	73%	97%	*NRC*	*NRC*	103%	79%
	Iron level, PPM	26		37	26		31					37	29	45	28	28	27	31

Mill Name	Indicator	Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09	Aug-09[a]	Sep-09[a]	Oct-09[a]	Nov-09	Dec-09	Jan-10	Feb-10	Mar-10	Apr-10	Mill Avg.[a]
Al Hadef	Mowhad flour prod. (MT)	758	476	543	573	653	652	708	650	619	756	579	772	1,200	800	1,200	931	742
	Add. rate, % target 250g	99%	*PSO*	37%	100%	83%	92%	100%	*PSO*	*PSO*	*PSO*	86%	90%	100%	100%	100%	129%	93%
	Iron level, PPM	35		33	44	40	40	*missing*				36	41	*missing*	28	32	46	37
Al Faker	Mowhad flour prod. (MT)	0	0	0	0	0	0	0	0	0	0	1,026	1,153	1	571	1,102	1,386	-
	Add. rate, % target 250g	*NFM*	*NFM*	*NFM*	*NFM*	*NFM*	*NFM*	*NFM*	*NFM*	*NFM*	*NFM*	*NFM*	*NFM*	*NFM*	*NFM*	*NFM*	*NFM*	-
	Iron level, PPM																	-
Al Hashmieh	Mowhad flour prod. (MT)													2,970	2,544	2,780	2,820	2,779
	Add. rate, % target 250g	*MUC*	*MUC*	*MUC*	*MUC*	*MUC*	*MUC*	*MUC*	*MUC*	*MUC*	*MUC*	*MUC*	*MUC*	64%	79%	86%	57%	71%
	Iron level, PPM													*missing*	25	25	27	25
																		TOTAL AVG.[a]
Monthly Average[a]	Mowhad flour prod. (MT)	3,630	3,594	3,941	3,460	3,744	3,720	3,699	3,438	-	-	3,853	3,610	3,612	3,204	3,822	3,500	3,600
	Add. rate, % target 250g	93%	-	38%	93%	73%	81%	82%	76%	-	-	85%	87%	86%	78%	67%	79%	79%
	Iron level, PPM	35	-	36	38	29	35	41	20	-	-	36	35	32	31	32	38	34

NOTE: Source of data from mill monitoring reports except underlined figures, which are from the Ministry of Trade; MT=metric tons; g/MT=grams of premix per metric ton; PPM=parts per million; PSO=premix stock out; NRC=no report collected; NFM=no feeder in mill; MUC=mill under construction.

[a] Calculations include only months for which data are available and for months in which premix was added.

Appendix II: COMPARISON OF THE 2002 AND 2010 SURVEYS

Background

To decrease the prevalence of micronutrient deficiency, the government of Jordan initiated a national wheat flour fortification program. The program was officially launched in April, 2002 (Alwan, 2006), and the fortification of wheat flour at mills began in June, 2002. Since the inception of the program, the government of Jordan has provided premix at no cost to all wheat flour mills in Jordan in support of the government's mandate that all wheat flour mills fortify flour. The type of flour being fortified is the *Mowahad* wheat flour (73-78% extraction rate). *Mowahad* wheat flour is the only subsidized flour in Jordan and constitutes 92.5% of Jordan's wheat flour production (2011 Ministry of Trade estimate).

At the start of the program in 2002, flour was fortified with iron (ferrous sulfate, 32 ppm) and folic acid (1.5 ppm). In March 2006, the program was expanded to include the fortification of wheat flour with zinc, niacin, and vitamins A, B_1, B_2, B_6, and B_{12}, in addition to iron and folic acid; folic acid was decreased to 1.0 ppm. Micronutrient levels for Jordan's fortification program subsequent to 2006 are included in Table A-1. (In June 2010, vitamin D was also added to the premix).

Table A-1: Level of micronutrients in flour when premix added at 250 grams per metric ton of flour.

Nutrient	Ingredient	Amount of Nutrient in Flour (ppm)
Vitamin A	Vit A palmitate, SD	1.5
B_1	Thiamin monomitrate	3.575
B_2	Riboflavin	3.6
B_6	Pyridozine	4.4
B_{12}	Vitamin B_{12} 0.1% WS	0.007
Folic acid	Folic acid	1.00
Niacin	Niacin amide	35.0
Fe	Ferrous sulfate, dried	32.25
Zn	Zinc oxide	20.0
	Filling material	166.0

NOTE: SD=spray dried; WS=water soluble

In October, 2002, the Jordan Ministry of Health (MOH) conducted a national survey to evaluate the prevalence of anemia and iron deficiency in pregnant and non-pregnant women of childbearing age (15 – 49 years) and preschool children (12 – 59 months) and the prevalence of retinol (vitamin A) deficiency in preschool children. These values could be used as baseline values for fortification deficiency prevalence. (Although it should be noted that the 2002 survey was conducted 4-5 months after the fortification program began). In 2010 (March-April), the Jordan MOH conducted a second national micronutrient survey to measure the micronutrient status of the population. This survey could be referred to as a "follow-up" survey post-fortification. The original intent of the 2010 survey was to determine the effectiveness of the program by comparing the micronutrient status of the population in the 2002 survey with that in the 2010 survey. However, limitations in the implementation of the program and variations in the methodologies of the two surveys impede the ability to assess the effectiveness of the program as it was designed to be implemented (see discussion).

Method

The 2002 and 2010 Micronutrient Surveys used a similar methodology for sample selection and measurement of hemoglobin and other biochemical indicators. The 2002 survey was conducted in October. The 2010 survey was conducted in March and April, 2010. Both surveys used a similar survey design (three-stage stratified, probability proportionate to size (PPS), cluster design). There were 29 strata in the 2002 survey and 30 strata in the 2010 survey. In each survey, 166 clusters were independently selected and enumerated from which 12 households were randomly selected for participation. In the 2002 survey, children (12 – 59 months) from all 12 households were invited to participate; eligible women (15 – 49 years) from six of the 12 households were invited to participate (the six households were chosen randomly). In the 2010 survey, all eligible children and women from all 12 households were invited to participate. Detailed methods for the 2010 survey are described in Chapter 2 of the present report; detailed methods for the 2002 report have been previously described (Jordan MOH, 2002).

Blood collection and laboratory methods for determining measurement of hemoglobin and ferritin were identical in both surveys. Briefly, hemoglobin was measured using a Beckman Coulter Cell Counter and the Coulter method (Beckman Coulter Inc., 2003). Serum ferritin was measured using the electro-chemoluminescence (Cobas, 2010) method. Moderate anemia was defined as hemoglobin (Hb) concentration < 12.0 g/dL for non-pregnant women and < 11.0 g/dL for children; severe anemia was defined as Hb concentration < 7.0 g/dL for non-pregnant women and children (WHO, 2001). Iron deficiency (ID) was defined as serum ferritin (SF) concentration < 15.0 µg/L for non-pregnant women and < 12.0 µg/L for children (WHO, 2001). Iron deficiency anemia (IDA) was defined as having both an Hb and SF value below the appropriate group-specific cut-off point for anemia and ID. Because it was not possible to determine altitude for the clusters selected for the 2002 survey, anemia and iron deficiency anemia were not adjusted for altitude in the comparison between the 2002 and 2010 surveys. For the 2002 survey, serum retinol was measured using high performance liquid chromatography (HPLC) (Catignani and Bieri, 1983), while liquid chromatograph-tandem mass spectrometry (LC-MS/MS) was used in 2010 (Roth et al., 2008).[3] Vitamin A deficiency was defined as serum retinol concentration < 0.70 µmol/L (WHO, 1996).

[3] Throughout the survey, approximately 75 blood specimens with sufficient serum were selected to compare serum retinol values measured using HPLC versus LC-MS/MS. Both methods produced excellent agreement on concentrations and similar levels of accuracy and precision; inter-method differences were all less than 5%.

During both surveys, households were asked to provide a sample of bread that was usually consumed in the home. The bread sample was tested qualitatively for presence of added iron by the iron spot test using a modified version of the AACC International's iron spot test for wheat flour (AACC International, Method 40-40, 1999).

No information on inflammatory markers was collected in 2002, thus the effect of inflammation is not accounted for in this 2002 – 2010 comparison. In the 2002 survey blood was collected from both pregnant and non-pregnant women. For the statistical analysis presented here, 101 women identified as pregnant in 2002 were excluded. Additional women excluded from the analysis were women whose age was outside the target age range of 15 to 49 years (n=1). For the hemoglobin and anemia analysis, women with extremely high hemoglobin values (> 18.0 g/dL) were also excluded (n=1). No women had extremely low hemoglobin values (< 4.0 g/dL). In the 2010 survey, blood was not collected from any pregnant women. Among the non-pregnant participants in the 2010 survey, there were no women whose age was out of the target range. No women had extremely high (> 18.0 g/dL) or extremely low (< 4.0 g/dL) hemoglobin values. Among 2002 child survey participants, 11 children were excluded, including those with missing age (n=10). Children with extremely high hemoglobin values (> 18.0 g/dL) (n=1) were excluded for the hemoglobin and anemia analysis. No children had extremely low hemoglobin values (< 4.0 g/dL). In the 2010 survey, 22 children were excluded, including those with missing age (n=14) and those with out of the target age range (12 – 59 months of age) (n=8). One child had an extremely high (> 18.0 g/dL) hemoglobin value and was excluded from hemoglobin and anemia analyses; no children had extremely low (< 4.0 g/dL) hemoglobin values. Due to these exclusions, the percentages in the current report vary slightly from those in the 2002 Micronutrient Survey Report.

SPSS (v 14.0) was used for statistical analyses. The analyses were performed treating both surveys as multi-stage stratified cluster surveys. The sample weights for the 2002 survey were calculated using the original analyses (Jordan MOH, 2002). The exact way in which these analyses were calculated was not provided, but the same weight was applied to all participants in a stratum, and therefore weighting for non-response is unlikely to have been performed. The weights for the 2010 survey were calculated based on stratification and non-response. The difference in weighting procedures used in 2002 and 2010 is not likely to have a significant effect on the results. The distributions of concentrations of biochemical indicators were checked for normality and for outlying values. Where a distribution was normal, means are presented (hemoglobin and serum retinol). Where a distribution was skewed, a natural log transformation was used to achieve normality. The log means and confidence intervals were calculated. The results were then back-transformed to the original scale, and the geometric means are presented (serum ferritin). Weighted *t*-tests were used to compare means and geometric means. Chi square analysis was used to compare prevalence values between surveys. Comparisons were considered statistically significant at an alpha = 0.05.

Results: Comparison of the 2002 and 2010 Surveys

Women Ages 15 – 49 Years

Among women, serum ferritin was statistically significantly ($p < 0.01$) higher in 2010 compared with 2002 (21.3 versus 18.3 µg/L, respectively). There were no differences observed in mean hemoglobin or prevalence of anemia, iron deficiency or iron deficiency anemia (Tables A-2 and A-3).

Table A-2: Comparison of hemoglobin (means) and ferritin (geometric means) in non-pregnant women ages 15 – 49 years, Jordan 2002 and 2010.

	2002		2010		
Indicator	n	Mean (95% CI)[a]	n	Mean (95% CI)[a]	*p*-value[b]
Hemoglobin (g/dL) (mean)	1,023	2.4 (12.4, 12.5)	2,030	12.5 (12.4, 12.6)	0.692
Ferritin (µg/L) (geometric mean)	1,021	8.33 (16.96, 19.80)	2,035	21.34 (20.07, 22.68)	0.005

Note: The n's are un-weighted denominators for each subgroup. Hemoglobin is not adjusted for altitude because the 2002 survey did not make this adjustment.
[a] Means are weighted. CI=confidence interval, adjusted for cluster sampling design.
[b] 2002 and 2010 means for each indicator compared using weighted t-tests.

Table A-3: Comparison of percent iron deficiency in non-pregnant women ages 15 – 49 years, Jordan 2002 and 2010.

	2002		2010		
Indicator	N	% (95% CI)[a]	n	% (95% CI)[a]	*p*-value[e]
Anemia[b]	1,023	29.3 (26.3, 32.6)	2,030	29.2 (26.8, 31.7)	0.961
ID[c]	1,021	38.7 (34.6, 42.9)	2,035	35.1 (32.2, 38.1)	0.166
IDA[d]	1,021	20.0 (17.3, 22.9)	2,026	19.1 (17.3, 21.2)	0.605

Note: The n's are un-weighted denominators for each subgroup.
[a] Percentages are weighted. CI=confidence interval, adjusted for cluster sampling design.
[b] Anemia, defined as Hb < 12.0 g/dL not adjusted for altitude because the 2002 Survey did not make this adjustment; accordingly, numbers vary slightly from those presented in Chapter 4.
[c] ID=iron deficiency, defined as serum ferritin < 15 µg/L.
[d] IDA=iron deficiency anemia, defined as low Hb (< 12.0 g/dL) with low serum ferritin (< 15 µg/L)); anemia was not adjusted for altitude because the 2002 survey did not make this adjustment; accordingly, numbers vary slightly from those presented in Chapter 4.
[e] 2002 and 2010 percentages for each indicator compared using the Wald statistic for the difference between prevalence estimates in 2002 and 2010.

Among non-pregnant women, no differences in prevalence of anemia or iron deficiency anemia by survey year were observed across the demographic categories of age, sex, or residence. However, a significant decline in prevalence of anemia and iron deficiency anemia was observed among women living in the North, but not the Central or South regions (Table A-4). Significant declines ($p < 0.05$) in the prevalence of iron deficiency were observed in the following categories: 15 – 19 years of age, the North region, and single marital status (Table A-5).

Table A-4: Comparison of the prevalence of anemia[a] among non-pregnant women (15 – 49 years) by demographic category, Jordan 2002 and 2010.

Characteristic	2002 n	2002 % (95% CI)[b]	2010 n	2010 % (95% CI)[b]	*p-value*[c]
Age (years)					
15 – 19	232	26.4 (20.3, 33.4)	481	23.4 (19.2, 28.3)	0.461
20 – 29	340	25.8 (21.2, 31.1)	515	27.8 (24.0, 32.0)	0.538
30 – 39	285	30.8 (24.5, 37.9)	521	31.7 (27.1, 36.7)	0.831
40 – 49	166	38.4 (30.2, 47.2)	513	33.2 (29.1, 37.6)	
Region					
North	306	39.2 (33.0, 45.9)	684	31.2 (28.3, 34.2)	0.027
Central	469	24.8 (21.4, 28.4)	1,131	27.9 (24.3, 31.7)	0.232
South	248	31.0 (25.3, 37.4)	215	30.2 (24.6, 36.4)	0.853
Residence					
Urban	701	29.3 (26.1, 32.6)	1,6100	29.3 (26.5, 32.3)	0.999
Rural	322	29.7 (24.8, 35.1)	420	28.4 (25.0, 32.1)	0.684
Marital status					
Married	559	33.0 (29.1, 37.2)	1,1733	31.5 (28.5, 34.7)	0.564
Single	439	24.5 (19.8, 29.9)	793	24.9 (21.6, 28.5)	0.898
Other	24	- -[d]	63	40.6 (29.0, 53.2)	-
Overall	1,023	29.3 (26.6, 32.2)	2,030	29.2 (26.8, 31.7)	0.961

Note: The n's are un-weighted denominators for each subgroup; subgroups that do not sum to the total have missing data.
[a] Anemia, defined as Hb < 12.0 g/dL; anemia was not adjusted for altitude because the 2002 Survey did not make this adjustment; accordingly, numbers vary slightly from those presented in Chapter 4.
[b] CI=confidence interval, adjusted for cluster sampling design.
[c] 2002 and 2010 percentages for each indicator compared using the chi square test.
[d] Prevalence estimate is not reported because there are less than 25 observations.

Table A-5: Comparison of the prevalence of iron deficiency[a] among non-pregnant women (15 – 49 years) by demographic category, Jordan, 2002 and 2010.

	2002		2010		
Characteristic	n	% (95% CI)[b]	n	% (95% CI)[b]	*p-value*[c]
Age (years)					
15 – 19	231	43.1 (34.8, 51.7)	484	31.5 (26.3, 37.2)	0.024
20 – 29	340	36.6 (30.7, 43.1)	514	36.9 (32.6, 41.3)	0.938
30 – 39	285	38.9 (32.6, 45.5)	521	37.9 (33.2, 42.8)	0.807
40 – 49	165	36.7 (27.9, 46.5)	516	33.8 (29.0, 39.0)	0.590
Region					
North	306	44.7 (39.0, 50.5)	684	37.3 (33.5, 41.3)	0.037
Central	469	35.2 (29.6, 41.1)	1,135	33.9 (29.8, 38.3)	0.722
South	246	44.0 (36.3, 52.0)	216	33.9 (25.7, 43.1)	0.088
Residence					
Urban	699	37.1 (32.9, 41.5)	1,613	34.2 (30.9, 37.7)	0.300
Rural	322	44.3 (35.0, 54.1)	422	38.8 (33.8, 44.1)	0.320
Marital status					
Married	558	37.1 (32.7, 41.7)	1,174	37.5 (33.9, 41.3)	0.893
Single	438	40.7 (34.4, 47.3)	796	31.6 (27.8, 35.6)	0.018
Other	24	- -[d]	64	33.5 (23.6, 45.0)	-
Overall	1,021	38.7 (34.8, 42.7)	2,035	35.1 (32.2, 38.1)	0.166

Note: The n's are un-weighted denominators for each subgroup; subgroups that do not sum to the total have missing data.
[a] ID=iron deficiency, defined as serum ferritin < 15.0 µg/L.
[b] CI=confidence interval, adjusted for cluster sampling design.
[c] 2002 and 2010 percentages for each indicator compared using the chi square test.
[d] Prevalence estimate is not reported because there are less than 25 observations.

Table A-6: Comparison of the prevalence of iron deficiency anemia[a] among non-pregnant women (15 – 49 years), Jordan 2002 and 2010.

Characteristic	2002 n	2002 % (95% CI)[b]	2010 n	2010 % (95% CI)[b]	*p-value*[c]
Age (years)					
15 – 19	231	18.3 (12.9, 25.4)	481	14.7 (11.6, 18.4)	0.321
20 – 29	340	16.8 (12.9, 21.6)	514	18.3 (15.1, 22.1)	0.599
30 – 39	285	21.9 (16.1, 29.0)	519	20.5 (16.7, 24.8)	0.719
40 – 49	165	25.6 (18.9, 33.7)	512	22.6 (18.8, 27.0)	0.487
Region					
North	306	27.2 (22.4, 32.6)	684	20.3 (17.3, 23.5)	0.024
Central	469	16.5 (13.2, 20.4)	1,127	18.2 (15.7, 21.1)	0.459
South	246	21.7 (17.2, 27.0)	215	21.0 (15.8, 27.3)	0.856
Residence					
Urban	699	19.6 (16.7, 22.8)	1,606	18.8 (16.6, 21.7)	0.693
Rural	322	21.3 (16.5, 27.1)	420	20.4 (18.0, 23.1)	0.764
Marital status					
Married	558	21.3 (17.9, 25.1)	1,170	21.8 (19.2, 24.6)	0.828
Single	438	17.6 (13.7, 22.5)	792	15.1 (12.8, 17.7)	0.331
Other	24	- -[d]	63	21.5 (12.5, 34.5)	
Overall	1,021	20.0 (17.5, 22.7)	2,026	19.1 (17.3, 21.1)	0.605

Note: The n's are un-weighted denominators for each subgroup; subgroups that do not sum to the total have missing data.
[a] IDA=iron deficiency anemia, defined as low Hb (< 12.0 g/dL) with low serum ferritin (< 15.0 µg/L); anemia was not adjusted for altitude because the 2002 survey did not make this adjustment; accordingly, numbers vary slightly from those presented in Chapter 4.
[b] CI=confidence interval, adjusted for cluster sampling design.
[c] 2002 and 2010 percentages for each indicator compared using the chi square test.
[d] Prevalence estimate is not reported because there are less than 25 observations.

Children 12 – 59 Months

Among children, mean serum ferritin was significantly ($p < 0.01$) higher in 2010 compared with 2002 (24.4 versus 18.1 µg/L, respectively). There were no significant declines observed in mean hemoglobin or prevalence of anemia; however, significant declines ($p < 0.05$) were observed in the prevalence of iron deficiency (26.2% vs. 13.7%) and iron deficiency anemia (10.1% vs 4.8%) (Tables A-7 and A-8). No difference was observed in either mean serum retinol or prevalence of vitamin A deficiency.

Table A-7: Comparison of means for hemoglobin and retinol and geometric means for ferritin in children ages 12 – 59 months, Jordan 2002 and 2010.

	2002		2010		
Indicator	N	Mean (95% CI)[a]	n	Mean (95% CI)[a]	*p*-value[b]
Hemoglobin (g/dL)	1,059	11.7 (11.6, 11.8)	902	11.8 (11.8, 11.9)	0.066
Ferritin (µg/L) (geometric mean)	1,056	18.1 (17.1, 19.2)	940	24.4 (23.0, 25.9)	< 0.001
Retinol (µmol/L)[c]	1,027	0.96 (0.94, 0.99)	915	0.96 (0.93, 0.99)	0.999

Note: The n's are un-weighted denominators for each subgroup; hemoglobin is not adjusted for altitude because the 2002 survey did not make this adjustment.

[a] Means are weighted. CI=confidence interval, adjusted for cluster sampling design.

[b] 2002 and 2010 means for each indicator compared using weighted t-tests.

[c] Serum retinol was measured using LC-MS/MS in 2010 and HPLC in 2002.

Table A-8: Comparison of percent anemia, iron deficiency, and vitamin A deficiency in children ages 12 – 59 months, Jordan 2002 and 2010.

	2002		2010		
Indicator	N	% (95% CI)[a]	n	% (95% CI)[a]	*p*-value[b]
Anemia[c]	1,059	20.2 (17.3, 23.3)	902	16.6 (13.9, 19.6)	0.088
ID[d]	1,056	26.2 (23.1, 29.6)	940	13.7 (11.1, 16.7)	< 0.001
IDA	1,050	10.1 (8.1, 12.5)	898	4.8 (3.6, 6.5)	< 0.001
VAD[f]	1,027	15.2 (12.4, 18.4)	915	18.3 (15.4, 21.6)	0.159

Note: The n's are un-weighted denominators for each subgroup.

[a] Percentages are weighted. CI=confidence interval, adjusted for cluster sampling design.

[b] 2002 and 2010 percentages for each indicator compared using the Wald statistic for the difference between prevalence estimates in 2002 and 2010.

[c] Anemia, defined as Hb < 11.0 g/dL not adjusted for altitude because the 2002 Survey did not make this adjustment; accordingly, numbers vary slightly from those presented in Chapter 4.

[d] ID=iron deficiency, defined as serum ferritin < 12.0 µg/L.

[e] IDA=iron deficiency anemia, defined as low Hb (< 11.0 g/dL) with low serum ferritin (< 12.0 µg/L), again anemia does not adjust for altitude because the 2002 survey did not make this adjustment; accordingly, numbers vary slightly from those presented in Chapter 4.

[f] VAD=Vitamin A deficiency defined as serum retinol < 0.70 µmol/L; serum retinol was measured using LC-MS/MS in 2010 and HPLC in 2002.

Among children, no differences in anemia prevalence by survey year were observed across the demographic categories of age, sex, or residence. However, a significant decline in anemia prevalence was observed among children living in the North, but not the Central or South regions (Table A-9). Significant declines in the prevalence of iron deficiency were seen across all demographic categories (Table A-10). In regard to prevalence of iron deficiency anemia, significant declines were observed in the following categories: children 12 – 23 months of age, both males and females, those living in the North and Central regions and those living in urban areas (Table A-11). No difference in prevalence of vitamin A deficiency was observed across any demographic category (Table A-12).

Table A-9: Comparison of the prevalence of anemia[a] among children (12 – 59 months) by demographic characteristics, Jordan, 2002 and 2010.

Characteristic	2002 n	2002 % (95% CI)[b]	2010 n	2010 % (95% CI)[b]	*p*-value[c]
Age (months)					
12 – 23	245	34.4 (27.9, 41.5)	214	27.2 (22.2, 32.8)	0.102
24 – 35	257	23.4 (17.9, 30.0)	214	21.3 (16.0, 27.8)	0.626
36 – 47	281	13.2 (10.0, 17.3)	212	11.4 (7.9, 16.2)	0.523
48 – 59	276	10.6 (7.0, 15.8)	262	8.3 (5.3, 12.9)	0.438
Sex					
Male	529	22.1 (18.1, 26.7)	468	18.7 (15.1, 22.9)	0.251
Female	530	18.2 (14.5, 22.7)	434	14.3 (11.0, 18.4)	0.166
Region					
North	315	30.1 (24.5, 26.3)	310	17.9 (13.1, 23.9)	<0.001
Central	463	14.9 (11.8, 18.8)	508	16.0 (12.7, 19.9)	0.668
South	281	23.4 (16.3, 32.5)	84	14.3 (9.1, 21.7)	0.082
Residence					
Urban	694	19.5 (16.2, 23.2)	715	15.2 (12.2, 18.8)	0.080
Rural	365	22.5 (17.3, 28.7)	187	22.0 (17.3, 27.5)	0.898
Overall	1,059	20.2 (17.3, 23.3)	902	16.6 (13.9, 19.6)	0.088

Note: The n's are un-weighted denominators for each subgroup.
[a] Anemia, defined as Hb < 11.0 g/dL, not adjusted for altitude because the 2002 Survey did not make this adjustment; accordingly, numbers vary slightly from those presented in Chapter 4.
[b] Percentages are weighted. CI=confidence interval, adjusted for cluster sampling design.
[c] 2002 and 2010 percentages for each indicator compared using the chi square test.

Table A-10: Comparison of the prevalence of iron deficiency[a] among children (12 – 59 months) by demographic characteristics, Jordan 2002 and 2010.

Characteristic	2002 N	2002 % (95% CI)[b]	2010 n	2010 % (95% CI)[b]	*p*-value[c]
Age (months)					
12 – 23	246	45.9 (38.8, 53.3)	226	19.1 (13.9, 25.7)	<0.001
24 – 35	257	26.8 (20.8, 33.7)	220	16.7 (11.7, 23.5)	0.024
36 – 47	279	16.9 (11.7, 23.6)	227	9.6 (6.0, 15.0)	0.055
48 – 59	274	16.2 (11.6, 22.1)	267	10.0 (6.8, 14.4)	0.066
Sex					
Male	530	29.1 (24.7, 33.9)	485	14.7 (11.2, 18.9)	<0.001
Female	526	23.3 (19.1, 28.2)	455	12.6 (9.6, 16.4)	<0.001
Region					
North	314	26.0 (20.8, 32.0)	323	13.7 (10.3, 18.0)	<0.001
Central	461	27.1 (22.7, 32.0)	528	14.7 (10.9, 19.4)	<0.001
South	281	22.1 (17.5, 27.4)	89	6.1 (2.3, 15.2)	<0.001
Residence					
Urban	692	26.6 (22.8, 30.8)	739	14.3 (11.3, 18.0)	<0.001
Rural	364	24.8 (20.2, 30.1)	201	11.1 (7.7, 15.8)	<0.001
Overall	1,056	26.2 (23.1, 29.6)	940	13.7 (11.1, 16.7)	<0.001

Note: The n's are un-weighted denominators for each subgroup.
[a] ID=iron deficiency, defined as low serum ferritin (< 12.0 µg/L).
[b]CI=confidence interval, adjusted for cluster sampling design.
[c] 2002 and 2010 percentages for each indicator compared using the chi square test.

Table A-11: Comparison of the prevalence of iron deficiency anemia[a] among children (12 – 59 months) by demographic characteristics, Jordan 2002 and 2010.

Characteristic	2002 N	2002 % (95% CI)[b]	2010 n	2010 % (95% CI)[b]	*p-value*[c]
Age (months)					
12 – 23	243	21.3 (15.9, 27.9)	213	8.9 (5.8, 13.3)	<0.001
24 – 35	255	10.9 (7.4, 15.9)	213	6.7 (4.2, 10.4)	0.118
36 – 47	279	3.8 (2.0, 6.9)	211	1.5 (0.5, 4.8)	0.167
48 – 59	273	5.1 (2.6, 9.7)	261	2.7 (1.2, 5.8)	0.266
Sex					
Male	526	10.6 (7.6, 14.5)	465	6.2 (4.0, 9.4)	0.049
Female	524	9.6 (6.7, 13.6)	433	3.4 (2.1, 5.5)	0.002
Region					
North	313	13.7 (9.9, 18.6)	310	6.7 (4.5, 9.9)	0.007
Central	457	8.2 (5.7, 11.6)	504	3.6 (2.1, 5.9)	0.010
South	280	11.2 (8.0, 15.5)	84	4.8 (1.7, 13.0)	0.064
Residence					
Urban	687	9.9 (7.5, 13.0)	712	4.3 (3.0, 6.2)	<0.001
Rural	363	10.7 (8.0, 14.1)	186	6.8 (3.9, 11.6)	0.120
Overall	1,050	10.1 (8.1, 12.5)	898	4.8 (3.6, 6.5)	<0.001

Note: The n's are un-weighted denominators for each subgroup.
[a] CI=confidence interval, adjusted for cluster sampling design.
[b] IDA=iron deficiency anemia, defined as low Hb (< 11.0 g/dL) with low serum ferritin (< 12.0 µg/L); anemia not adjusted for altitude because the 2002 Survey did not make this adjustment; accordingly, numbers vary slightly from those presented in Chapter 4.
[c] 2002 and 2010 percentages for each indicator compared using the chi square test.

Table A-12: Comparison of the prevalence of Vitamin A deficiency[a] among children (12 – 59 months), Jordan 2002 and 2010.

Characteristic	2002 n	2002 % (95% CI)[b]	2010 n	2010 % (95% CI)[b]	*p*-value[c]
Age (months)					
12 – 23	240	20.1 (15.2, 26.0)	219	19.7 (14.7, 26.0)	0.920
24 – 35	250	18.1 (12.9, 24.8)	212	17.7 (13.4, 23.2)	0.919
36 – 47	267	13.3 (9.3, 18.6)	221	16.5 (11.8, 22.5)	0.376
48 – 59	270	9.7 (6.4, 14.4)	263	19.0 (14.2, 24.8)	0.006
Sex					
Male	514	16.0 (12.2, 20.7)	472	20.8 (17.0, 25.2)	0.111
Female	513	14.4 (11.2, 18.3)	443	15.6 (12.2, 19.8)	0.655
Region					
North	309	18.3 (12.5, 26.1)	311	20.8 (15.9, 26.7)	0.573
Central	446	12.4 (9.3, 16.2)	515	16.7 (13.1, 21.1)	0.111
South	272	21.8 (15.0, 30.7)	89	17.5 (8.5, 32.5)	0.557
Residence					
Urban	670	14.6 (11.5, 18.4)	721	19.3 (15.9, 23.2)	0.067
Rural	357	17.1 (12.0, 23.7)	194	14.3 (9.9, 20.2)	0.481
Overall	1,027	15.2 (12.4, 18.4)	915	18.3 (15.4, 21.6)	0.159

Note: The n's are un-weighted denominators for each subgroup.
[a] Vitamin A deficiency defined as serum retinol < 0.70 µmol/L; serum retinol measured using LC-MS/MS in 2010 and HPLC in 2002.
[a] CI=confidence interval, adjusted for cluster sampling design.
[c] 2002 and 2010 percentages for each indicator compared using the chi square test.

Discussion

Among children, there was a 4.6% lower prevalence of anemia in 2010 compared to 2002; however, this was not statistically significant (p=0.09). Iron status generally improved with an increase in mean serum ferritin and a decline in iron deficiency; furthermore, iron deficiency anemia was cut in half. Among children, declines were greatest for the youngest children: the decline in the prevalence of iron deficiency was significant for children < 24 months, and the decline in iron deficiency anemia was significant only for children 12 – 23 months of age. No statistically significant change was observed for vitamin A deficiency.

The primary target group for the flour fortification program was women of childbearing age because of their higher prevalence of iron deficiency and anemia (compared to other demographic groups) and also because they consume a sufficient quantity of bread. However, it would be expected that all individuals in the population, including children, would benefit from the four fortification program to some extent. Contrary to our expectations, except for a slight increase in serum ferritin, no overall change was observed in anemia or iron deficiency among women. While household fortification testing was only conducted on a single day during data collection, the percentage of households with bread that tested positive for iron was lower in the North compared with the Central and South regions (36.7%, 42.6% and 76.3%, respectively). Thus, an unexpected finding was that significant declines in anemia, iron deficiency, and iron deficiency anemia were observed only among women in the North region.

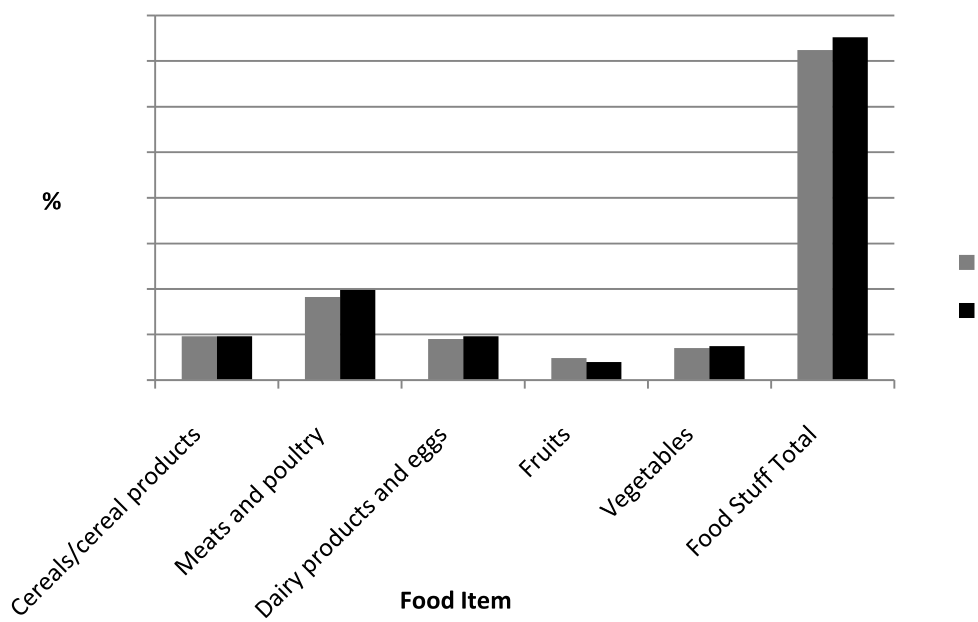
Several factors should be considered in comparing estimates from the 2002 with the 2010 survey. These factors include: the lack of a true baseline survey, seasonal differences in surveys, limitations of the evaluation design, and the incomplete implementation of the fortification program. First, the 2002 survey was conducted approximately four to five months after the initiation of the fortification of wheat flour. The timing of the 2002 survey meant that it is possible that some improvement in iron status may already have occurred in the population before the nutritional indicators were assessed in the 2002 Micronutrient Survey (Hurrell et al., 2010). In fact, the percentage of households which had bread which tested positive for the presence of added iron by the iron spot test was higher in the 2002 survey than in the 2010 survey (60% versus 44%). Second, to adjust for seasonal factors it would have been ideal for the surveys to be conducted during the same season. While the 2002 survey was conducted in October, the 2010 survey was conducted in March and April. However, as bread is a staple in the Jordanian diet year-round, intake is not expected to vary by season.

Third, comparison of two cross-sectional surveys precludes causal inferences in regard to the effectiveness of the flour fortification program. During the eight years between surveys, important secular changes occurred including changes in the MOH programs and the global economic crisis. These secular changes could lead to differences in micronutrient status independent of the fortification program. Specifically, the MOH began a vitamin A capsule distribution campaign (100,000 IU) in 2005 and also instituted a routine screening and treatment program for anemia for 10-month old children attending public clinics for measles immunization. Coverage for this program is estimated at 47% of children attending the clinics (Dr. Khoula Al-

Hisat, personal communication, February 2011). In addition to these changes in the MOH program, there have been changes in the economy and food availability over the time period between surveys.

A comparison of HIES data from 2002 and 2008 suggests that while in 2008, people did not spend less on food compared to 2002 (Figure 1), consumption of white flour and fruits and vegetables decreased from 2002 to 2008 (Figure 2). At the same time, total meat/fish consumption remained relatively similar, and consumption of white flour bread increased from 2002 to 2008. These results imply that in 2008 Jordanian households may have been more likely to purchase white bread rather than baking white bread at home.

Figure 1. Percentage annual household member expenditure on food items



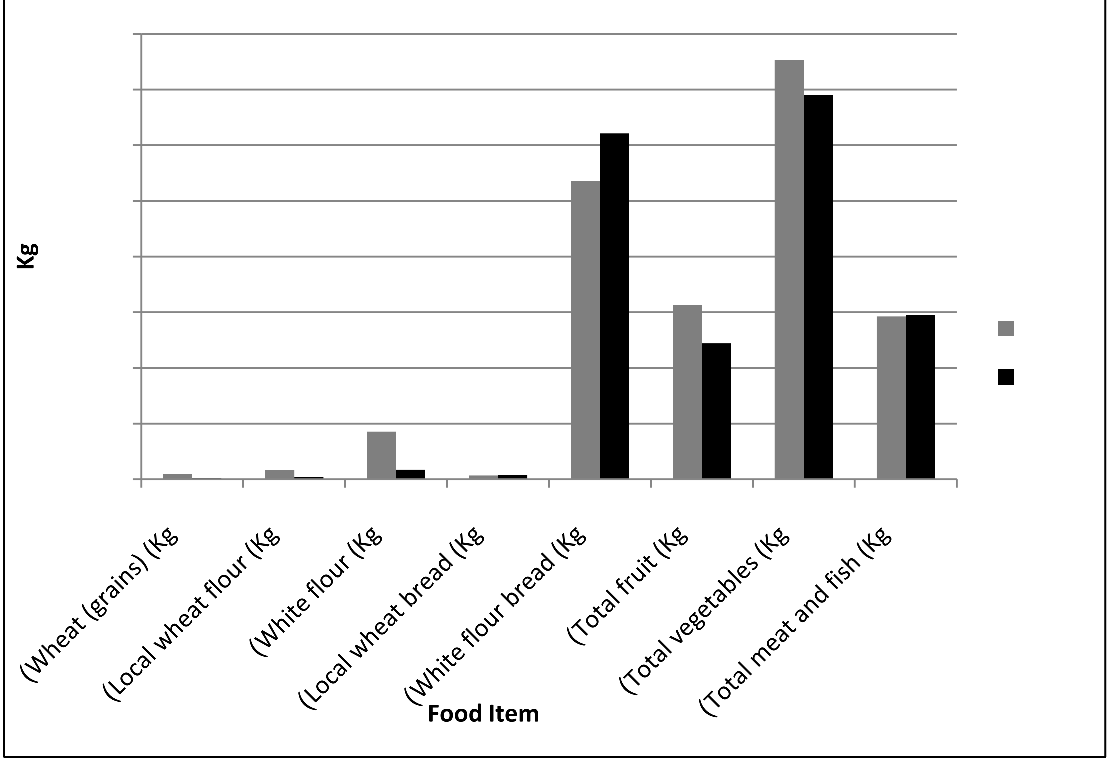


Figure 2. Average annual consumption of food items by household member

Fourth, adherence to the fortification program by wheat flour mills has not been complete. In the 2010 survey, the percentage of households which had bread made from *Mowahad* flour that tested positive for iron by the iron spot test was only 44. These data suggest that less than half of households were purchasing and consuming fortified bread at the time of the survey. Consistent with the iron spot test data, external monitoring of fortification at the mills reported less than optimal fortification during the 16 months prior to and during the 2010 survey (see Mill Monitoring Report, Appendix I). Of the 13 mills producing *Mowahad* flour, only 11 participated in the program. Therefore two mills did not fortify any of the *Mowahad* flour they produced. For five of the 16 months prior to the 2010 survey (February, May, August, September, and October 2009), there was no premix available for fortification of flour. During months that mills had premix, premix addition rates averaged 79% of the target 250 g per metric ton (197.5 g per metric ton).

In summary, comparison of the 2002 and 2010 surveys showed a dramatic improvement in the iron status in children, but little change in the iron status of women. While the flour fortification program had reached 44% of the households during the 2010 survey, efforts are needed to increase coverage. This would require assuring a consistent supply of premix, adequate pre-mix addition rates and participation by all mills. The level of fortification (including type of iron) and amount of bread consumed should be sufficient to have made an impact on iron deficiency (Hurrell, 2010). The fortification program is well-designed and when fully implemented would be expected to make a positive impact on the reduction of micronutrient deficiencies.

Survey Appendix III: 2002 and 2010 Questionnaires (Arabic and English versions)

2010 Micronutrient Survey Questionnaire (English)

The Hashemite Kingdom of Jordan

NATIONAL MICRONUTRIENT SURVEY IN JORDAN

Q	IDENTIFICATION				
12	CLUSTER SERIAL NO. IN SAMPLE...	☐☐☐	06	SUB-AREA......................	☐☐
13	HOUSEHOLD NO.....................	☐☐	07	BLOCK NO.....................	☐☐☐
01	GOVERNORATE..............	☐☐	08	CLUSTER NO.................	☐☐☐☐
02	DISTRICT...........................	☐☐	09	STRATUM NO.................	☐
03	SUB-DISTRICT.................	☐	10	BUILDING NO........................	☐☐☐
04	LOCALITY.........................	☐☐☐	11	HOUSING UNIT NO.....................	☐☐
05	AREA................................	☐☐	14	TELEPHONE/MOBILE NO.........................	

INTERVIEWER VISITS

	1	2	3	FINAL VISIT
	D M	D M	D M	D M Y
DATE				1 0
INTERVIEWER NAME	....	....	....	INTERVIEWER CODE ☐☐
RESULT*	....	....	....	15 Final VISIT ☐
NEXT VISIT DATE	....	....		16 TOTAL VISIT ☐
NEXT VISIT TIME	....	....		

VISIT RESULT*

1. Fully Complete
2. Paratially Complete

Continue

3. No household member at home or no competent respondent at home at time of visit
4. Entire household absent for extended period of time
5. Refused
6. Housing unit vacant or address no more a dwelling
7. Housing unit destoyed
8. Housing unit not found
9. Other (Specify: ______________________________)

Finsh the interview & put the label in the next page

17 Total NO. of elegiable women aged (15-49 year) ☐☐

18 Total NO. of children aged (12-59 month) ☐☐

SUPERVISOR NAME .... SUPERVISOR CODE ☐☐

REMARK FOR INTERVEWER: IF YOU USED EXTRA QUESTINARE, PUT X ☐

1										
101	102	103		104	105			106	107	108
HH MEMBER NO.	USUAL RESIDENTS AND VISITORS	RELATIONSHIP TO HEAD OF HH		SEX	DATE OF BIRTH			AGE IN COMPLETE YEAR	ELIGIBILITY FOR INDIVDUAL INTERVEW	
	NAMES Please give me the names of the persons who usually live in your household starting with the head of the household. [After listing the names and recording the relationship and sex for each person, ask questions to be sure that the listing is complete. Then ask appropriate questions for each person]	Wife/Husband 1 Son/Daughter 2 Grandchild 3 Father/Mother 4 Brother/Sister 5 Other Relative 6 Not Relative 7 Servent 8		Is (Name) male or female? Male=1 Female=2	In what day, month, and year was (NAME) born? [If don't know day, record 98 for day] [If don't know month, record 98 for month] [If don't know year, record 9998 for year] [Verify dates with the family book]			How old is (Name)? [If age= 95+, record 95.] [Compare and correct date of birth and/or age if inconsistent] [If unknown, recod 98]	[Circle women 15-49 *years]	[Circle children 12-59 *months]
					dd	mm	yy			
xx			x	x	xx	xx	xxxx	xx	xx	xx
01		Head	0						01	01
02									02	02
03									03	03
04									04	04
05									05	05
06									06	06
07									07	07
08									08	08
09									09	09
10									10	10
11									11	11
12									12	12
13									13	13
14									14	14
15									15	15
16									16	16
17									17	17
18									18	18
19									19	19
20									20	20
21									21	21
22									22	22
23									23	23
24									24	24
25									25	25

[* If the servent is non Jordanion, do not ciricle]

Cluster Serl No. in Sample [| |] **Household No.** [|]

INTORDUCTION AND CONSENT

Hello, my name is ____________ and I am working with the Ministry of Health. We are conducting a national survey about various nutritional issues. We would very much appreciate your participation in this survey. The interview usually takes between 20 and 30 minutes to complete.

As part of the survey we would first like to ask some questions about the household and take a bread and salt sample. We would also like to ask questions regarding all women 15-49 years of age and all children 12-59 months of age who belong to this household. After asking questions, our trained and experienced nurse would like to take a sample of blood from all women 15-49 years and all children 12-59 months of age. This information will be collected from approximately 2000 women and children in Jordan to help the Ministry of Health understand the health and nutritional status of the population. All of the answers given to our questions will be confidential unless we need to contact a physician regarding a deficiency. Participation in the survey is completely voluntary. If we come to any point at which the mother or child does not want to answer, just let me know and I will go on to the next question; or the interview can be stopped at any time.

At this time, do you want to ask me anything about the survey? May I begin the interview now?

Oral Consent given [ ] YES [ ] NO

Signature of interviewer:______________________________ Name of person giving permission ________________________

Date ____________________________

In addition, please provide an Post address is avaialble or name of the nearest health clinic

[INTERVIEWER: Please list all members of the household on next page. (See defenition below)]

Household: a household, consisting of one person or more, with a head, sharing with each other one separated housing unit or part of it, the members of household participate in expenditures from the income of head of household or from some household members. Some of household members may not be related to each other, although it is commonly known that there is a relationship between them. it is also commonly (but not necessarily) known that the members share meals or some of these meals with each other. The household comprises all those who were temporarily absent from the household outside Jordan for a period less than one year, who will after that return ti join the household (with the exception of students, army-men and diplomats are considered as usual members regardless of the period of their absence).

[Affix pre printed household lable here.]

[Note: For the household listing, request to see the family book to verify dates]

[Interviewer: Conduct Household Questionnaire with the eligible person which is aged 15+]

Cluster Serl No. in Sample | | | | **Household No.** | | |

2 HOUSEHOLD CHARACTERISTICS

No.	Question	Response	Code	Skip
210	Have the head of the household (Name—) ever attended or do you corrently attend school?	Yes, currently attend	1	
		Yes, attended previvsly	2	
		No	0	301
		Don't Know	8	301
211	What is the highest level of education that the head of household completed successfully? (Old elementary, old preparatory, old secondary, new basic, new secondary, intermediate diploma, bachelor, or higher?)	**OLD SYSTEM**		
		Elementary	1	
		Preparatory	2	
		Secondary	3	
		NEW SYSTEM		
		Basic	4	
		Secondary	5	
		Intermediate Diploma	6	
		Bachelor	7	
		Higher	8	
		Don't know	98	

Now we would like to ask question about bread and salt that the family purchases, May I speak to the member of the family who can best answer these questions?

Respondent member line number | | |

3 OPINION MODULE

We would like to ask you questions about your opinion on iron and vitamins in your food

No.	Question	Response	Code
301	If you were given the choice of two loaves of bread of the same size and cost, but one had added iron and vitamins and the other did not; which would you prefer?	Loaf with added iron or vitamins	1
		Loaf without added iron or vitamins	2
		Don't care	3
		Don't know	8
302	How do you feel about the government adding iron or vitamins to your bread and flour? I am going to read you some options, please tell me which option best describes how you feel about the government adding iron or vitamins to your bread and flour. [INTERVIEWER: Read choices]	Strongly agree	1
		Agree	2
		Neutral/ don't have an opinion	3
		Disagree	4
		Strongly disagree	5
303	If you were given the choice of two packages of salt of the same size and cost, but one had added iodine and the other did not; which would you prefer?	Package with added iodine	1
		Package without added iodine	2
		Don't care	3
		Don't know	8
304	How do you feel about the government adding iodine to your salt? I am going to read you some options, please tell me which option best describes how you feel about the government adding iodine to your salt. [INTERVIEWER: Read choices]	Strongly agree	1
		Agree	2
		Neutral/ don't have an opinion	3
		Disagree	4
		Strongly disagree	5

Cluster Serl No. in Sample [| |] Household No. [|]

4	**KNOWLEDGE, ATTITUDE, AND BELLEFS**			
401	Does the bread you eat most often in this household have added iron or other vitamins and minerals (also known as fortified)?	Yes No Don't know	1 0 8	[ ]
403	Does the flour you purchase have added iron and other vitamins and minerals?	Yes No I don't purchase Don't know	1 0 7 8	[ ]
405	Do you know if the salt that you purchase most often has added iodine?	Yes No Don't know	1 0 8	[ ]
406	Do you look/ask for salt with iodine added (iodized salt) when you purchase it for your home?	Yes No I don't purchase Don't know	1 0 7 8	[ ]
5	**FLOUR FORTIFICATION MODULE**			
506	If you usually bake the bread which the family used at home, what type of flour do you use?	Mowahad (white flour) Baladi (whole wheat) Both (Mowahad and Baladi) Other *(specify)* ____________ Do not Bake Don't know	1 2 3 4 7 8	[ ]
507	Do you have a sample of bread most commonly eaten in the household now? (Interviewer: ask to see package of bread)	Yes No Don't know	1 0 8	[ ]
5	**FLOUR FORTIFICATION MODULE**			
510	How many Kg of bread does your family eat daily?	<1 1-<2 2-<3 3-<4 4+ Don't know	1 2 3 4 5 8	[ ]
Interviewer: "We would like to take a sample of your bread for testing for added iron in our laboratory". Collect a 200 g sample (about the size of one Arabic loaf) of the bread.				
511	Was a sample collected? [Affix pre printed lable here and on sample collcted]	Yes No, no bread in household No, refused to give sample	1 2 3	2, 3 → 601 [ ]

Cluster Serl No. in Sample [| |] **Household No.** [|]

512	[What is the name of this bread (sampled bread)?]	Komaj/Arabic.. Tabon.. Mashrooh.. Mankosh.. Warda.. Other (specify)________________ Don't know..	1 2 3 4 5 6 8	[ ]
6	**SALT MODULE**			
"Now I would like to ask you some questions about the salt that you use"				
601	What brand of food salt do you purchase most often?	Brand (specify) ________________ Brandless salt.. Not applicable (No one purceses salt).................... Don't know..	1 2 7 8	[ ] → 603
602	Where do you purchase your food salt?	From the supermarket.. From cars/retail seller.. Other (specify)________________ Don't know..	1 2 3 8	[ ]
603	How many bags of food salt (750 g) do you consume monthly?	Num________________ Don't know..	[|] . [ ] 98.0	
Interviewer: Ask to see the package of salt.				
604	Does the package of table food salt say "iodized"?	Yes.. No, has a label but it does not say iodized................ There is no label on the salt.............................. There is no package.. No salt in the household..	1 0 2 3 4	[ ]
Interviewer: "We would like to collect a sample of table salt to be tested for iodine in the Ministry of Health laboratory. May we collect a sample?"[Collect a 100 g salt sample (provide an example amount) (glass of tea)]				
605	[Was a sample collected?] [Affix pre printed lable here and on sample collcted]	Yes.. No, no salt in household.. No, refused to give sample..	1 2 3	[ ] } 700
606	[What is the type of tables salt sampled?]	Brand (specify)________________ Brandless salt.. Other labeled type.. Don't know..	1 2 3 8	[ ]
607	[What is the expiration date on the package?] [if day unknown =98] [if month unknown =98] [if year unknown =9998]	D D M M YEAR [|] [|] [| | |]		

Cluster Serl No. in Sample | | | | Household No. | | | Woman No. | | |

Woman Qyuestionnaire (aged 15-49 years)

Now we would like to ask questions regarding the eating patterns of (Name of Woman) [INTERVIEWER: If this woman is not home ask]: Who is the person in the household who could best answer questions regarding Name of Womn)?

Now we would like to ask some questions about the eating patterns of (Name of woman). [INTERVIEWER: If this woman is not home, go to other participants and return to this questionnaire when the woman returns. If she does not return before you are finished with all other eligible participants. Ask:] Who is the person in the household who could best answer questions regarding (Name of woman)?
[INTERVIEWER: Have this person answer questions about this woman.]

Participation in the survey is completely voluntary. If we should come to any question that you do not want to answer, just let me know and will go on to the next question; or the interview can be stopped at any time. All of the answers given to our questions will be confidential unless we need to contact a physician regarding a deficiency.

[INTERVIEWER: Only read this below if the eligible woman is being interviewed]

After asking questions our trained and experienced nurse would like to take a sample of blood from you. The collection of the blood sample might cause a slight bruise but should not have other consequences. The blood will be sent to the laboratory where trained technicians can determine your anemia status and other vitamin and mineral levels. If you are found to have a severe nutritional deficiency, the Ministry of Health will notify you. If you do not want your blood drawn you have the right to decline. However, we hope that you will participate in the survey because your praticipation will help the Ministry of Health understand the health and nutritional status of the population of Jordan. At this time, do you want to ask me anything about the survey? May I begin the interviw now.

700	Oral Consent recevied?	Yes with blood test	1	
		Yes without blood test................	2	
		No.......................................	0	→ Record Why and STOP INTERVIEW__________________

Signature of interviewer ....

7 WOMAN QUESTIONNAIRE (AGED 15-49 YEARS)

	Affix pre-printed label of woman here →			
701	[Is the eligible woman at home]	Yes... No..	1 0	→ 703
702	[If No, why not?]	Working out of home.. Shopping/errands.. Visiting family/friends....................................... Living outside of household.................................. Sick... Other (specify:________________________) In School.. Don't know..	1 2 3 4 5 6 7 8	
703	What is your birthdate? [if day unknown =98] [if month unknown =98] [if year unknown =9998]	DD |__|__| MM |__|__| YYYY |__|__|__|__|		
704	How many years old are you?	|__|__|		

Cluster Serl No. in Sample [ ][ ][ ] **Household No.** [ ][ ] **Woman No.** [ ][ ]

705	What is your marital status?	Single........	1 → 707
		Married........	2
		Divorced........	3
		Widow........	4
		Separated........	5
		Don't know........	8
706	How many live births have you had? [If Don't Know =98]		[ ][ ]
	Need to find out if she is considered Jordainan i.e is her husband Jordainan's. If she is not Jordainan, Neither she or her children should be intervitwed.		
707	Have you ever attended or do you corrently attend school?	Yes, currently attend........	1
		Yes, attended previvsly........	2
		No........	0 → 709
		Don't Know........	8 → 709
708	What is the highest level of education that you completed successfully? (Old elementary, old preparatory, old secondary, new basic, new secondary, intermediate diploma, bachelor, or higher?)	Ilittrate/read and write	01
		OLD SYSTEM	
		Elementary........	02
		Preparatory........	03
		Secondary........	04
		NEW SYSTEM	
		Basic........	05
		Secondary........	06
		Intermeduate Diploma........	07
		Bachelor........	08
		Higher........	09
		Don't know........	98
	[INTERVIEWER: If woman not in home: STOP INTERVIEW and go to next eligible participent]		
	Now I would like to ask some questions about bread that you use		
709	How many of loaves of bread do you usually eat daily?	Small........	[ ][ ] . [ ][ ]
	1/8=0.12 2/3=0.66	Big........	[ ][ ] . [ ][ ]
	1/4=0.25 1/2=0.50	Don't know........	98.00
	1/3=0.33 3/4=0.75	Don't eat bread........	00.00

Cluster Serl No. in Sample | | | Household No. | | Woman No. | |

8	ANEMIA FOR WOMAN					
801	Have you ever heard about shortage of blood (anemia)?		Yes	1		
			No	0	→ 804	
			Don't Know	8	→ 804	
				Yes	No	
802	What do you think caused the shortage of blood (anemia)?	1.	Lack of food	1	0	
		2.	Lack of iron	1	0	
		3.	Illness	1	0	
		4.	Bleeding	1	0	
	Multi answers	5.	Heavy work	1	0	
		6.	Genetics	1	0	
		7.	Drink tea	1	0	
		8.	Other (specify:______________________)	1	0	
		9.	Don't know	1	0	
				Yes	No	
803	What are the kinds of food that prevent the shortage of blood (anemia)?	1.	Eggs	1	0	
		2.	Milk	1	0	
		3.	Cereals & Legumes	1	0	
		4.	Vegetables	1	0	
	Multi answers	5.	Fruits	1	0	
		6.	Rice	1	0	
		7.	Dark green leafy vegetables	1	0	
		8.	Meat	1	0	
		9.	Fish	1	0	
		10	Chicken	1	0	
		11	bread/ flour	1	0	
		12	Other (specify:______________________)	1	0	
		13	Don't know	1	0	
804	Are you currently taking any medicine that contain iron or any vitamins including tablets to improve your blood or make you strong?		Yes	1		
			No	0	→ 809	
			Don't Know	8	→ 809	
805	How often do you take these tablets?		Irregular (less than one a week)	1		
			Weekly	2		
			Daily or almost daily	3		
			Other (specify:______________________)	4		
			Don't know	8		
806	Can we see the package?		Yes	1		
			No	0	→ 809	

Cluster Serl No. in Sample | | | Household No. | | Woman No. | |

No.	Question	Response	Code	Skip
807	[INTERVIEWER: check if the package have lable?]	Yes	1	
		No	0	→ 809
808	[INTERVIEWER: Check the package and note contents]		Yes / No	
		1. Iron	1 / 0	
		2. MultiVitamin	1 / 0	
		3. Folic acid/folate	1 / 0	
		4. Vit B12	1 / 0	
		5. Herbs	1 / 0	
		6. No label	1 / 0	
		7. Other (specifiy) ______	1 / 0	
809	Have you ever taken B12 injections?	Yes	1	
		No	0	→ 901
		Don't know/ Don't remmber	8	→ 901
810	When did you last take a B12 injection?	within 1 month	1	
		2 - 3 months	2	
		4 - 11 months	3	
		12 months or more	4	
		Don't know/don't remmber	8	
9	**WOMAN ATTITUDE, BEHAVIOR MODULE**			
901	When you leave your house or go outside, how do you usualy cover your head?	No cover	0	
		Scarf	1	
		Hijab	2	
		Niqab	3	
902	When you leave your house or go outside, do you usually cover your arms?	Yes	1	
		No	0	
903	When you leave your house or go outside, do you usually cover your hands?	Yes	1	
		No	0	
904	Do you usualy drink tea during or shortly after your meals?	Yes	1	
		No	0	→ 906
905	How often do you usualy drink tea daily after your meals?	Once aday	1	
		2-3 times	2	
		3 <	3	
		Don't know	8	
	[INSTRUCTIONS not to ask Q906 if the woman is single] → Go to Q907			
906	Are you currently pregnant? [INTERVIEWER: If the woman answers Yes, Do not collect blood]	Yes	1	→ STOP AND PROCCED TO NEXT ELIGIBLE RESPONDENT
		No	0	
		Don't Know	8	

Cluster Serl No. in Sample | | | | Household No. | | | Woman No. | |

907	Do you have fever today or have you had a fever in the last week?	Yes...... No...... Don't Know......	1 0 8	
908	About how long ago did you eat?	<1 hour...... 1 to 2 hours...... More than 2 hours......	1 2 3	
	[INSTRUCTIONS Now will take blood sample			
909	[Nurse/Phlebotomist: Write down current time]	H h M m		
910	[Nurse/Phlebotomist: Was blood drawn?]	No, refused...... No, unsuccessful...... Yes, incomplete...... Yes, complete......	0 1 2 3	
911	[Nurse/Phlebotomist: Describe purple top sample]	No sample...... Partial sample...... Complete......	0 1 2	
912	[Nurse/Phlebotomist: Describe red top sample]	No sample...... Partial sample...... Complete......	0 1 2	
	[INTERVIEWER: Finish woman questionnaire and go to thenext eligiable respondent]			

Cluster Serl No. in Sample | | | | **Household No.** | | |

Number of child from line list | | | **Number of child mother from line list** | | |

If the child's mother not being in the household, put 99

Child Qyuestionnaire (aged 12-59 Month)

Now we would like to ask some questions about (Name of Child). [INTERVIEWER: If the mother is not at home, ask] who is the person in the household who can answer questions about the eating patrens of child?

Participation in the survey is completely voluntary. If we should come to any question that you do not want to answer, just let me know and will go on to the next question; or the interview can be stopped at any time. All of the answers given to our questions will be confidential unless we need to contact a physician regarding a deficiency.

[INTERVIEWER: Only read this if the eligible child is being interviewed present.]

After asking questions our trained and experienced nurse would like to take a sample of blood from child. The collection of the blood sample might cause a slight bruise but should not have other consequences. The blood will be sent to the laboratory where trained technicians can determine your anemia status and other vitamin and mineral levels. In addition, the INTERIEVIEWER will weight the child and measure the childs length. I the child found to have a severe nutritional deficiency, the Ministry of Health will notify you. If you do not want your child blood drawn. you have the right to decline. However, we hope that you will participate in the survey because your praticipation will help the Ministry of Health understand the health and nutritional status of the population of Jordan. At this time, do you want to ask me anything about the survey? May I begin the interviw now.

1000	Oral Consent recevied?	Yes with blood test	1	
		Yes without blood test................	2	
		No.......................................	0	→ Record Why and STOP INTERVIEW__________________

Signature of interviewer ....

10 CHILD QUESTIONNAIRE (AGED 12-59 MONTHS)

	Affix pre-printed ID label →			
1001	What is the child's birthdate? [Check date with the family book or immunization card] [if the day or month or year do not know, put 98]	DD MM YYYY		
1002	What is your relationship with child?	Mother .... Grandmother........................ Other relative........................ Other (specify:________________)	1 2 3 4	
1003	What is the gender of this child?	Male........................ Female........................	1 0	
1004	Was the child ever breastfed?	Yes........................ No........................ Don't Know........................	1 0 8	}→ 1006 (No, Don't Know)
1005	Is the child breastfeeding now?	Yes........................ No........................ Don't Know........................	1 0 8	

Cluster Serl No. in Sample | | | | Household No. | | |

Number of child from line list | | | Number of child mother from line list | | |

If the child's mother not being in the household, put 99

1006	At what age in months was the child first given something other than breast milk (including water, tea, formula, juice or solid food) [Enter 97 if exclusively breastfeeding that is only cansuming breast milk witout other pluds or foods, Enter 00 if less give something other than breast milk at < 1 month, Enter 98 for Don't know]	Age in months Less than month Breastfed Don't Know	 00 97 → 1009 98
1007	How old was the child when breastfeeding stopped? [Enter 00 if less than 1 month, Enter 97 if still breastfeeding, Enter 98 for Don't know]	Age in months Less than month Still Breastfeeding Don't Know	 00 97 98
1008	How many loaves of bread the child does eat daily? 1/8=0.12 2/3=0.66 1/4=0.25 1/2=0.50 1/3=0.33 3/4=0.75	Small Big Don't know Don't eat	 98.00 00.00
1009	Is the child currently receiving iron or vitamins drops or tablets? Including medicine given by the doctor to make the child stronger, improve the health or increase the appetite?	Yes No Don't Know	1 0 } 1013 8 } 1013
1010	Can we see the package?	Yes No	1 0 → 1013
1011	[check is the package have lable?]	Yes No	1 0 → 1013
1012	[INERVIEWER: Check the package and note contents] [Multi answer]		Yes / No
		1. Iron	1 / 0
		2. MultiVitamin	1 / 0
		3. Folic acid/folate	1 / 0
		4. Vit B12	1 / 0
		5. Herbs	1 / 0
		6. No label	1 / 0
		7. Other (specifiy) ____	1 / 0
1013	Has this child ever received a vitamin A capsule? Sometimes children receive Vit A capsules when they are immunized at the health center. [INVESTIGATOR: Show capsule. (have blue and red).]	Yes No Don't Know	1 0 } 1015 8 } 1015
1014	Did the child has recived a vitamin A capsule in the last 6 months from the intreview date?	Yes No Don't Know	1 0 8
1015	Does the child ever drink tea?	Yes No Don't Know	1 0 } 1018 8 } 1018

Cluster Serl No. in Sample [| |] **Household No.** [|]

Number of child from line list [|] **Number of child mother from line list** [|]
If the child's mother not being in the household, put 99

1016	Does the child drink tea during or shortly after his/her meals?	Yes No Don't Know	1 0 8	[ ] 0, 8 → 1018
1017	How often does this child drink tea daily after his/her meals?	Once a day 2-3 times 3 < Don't know	1 2 3 8	[ ]
1018	Is this child in the house now or can the child be called home?	Yes No	1 0	→ 1020 [ ]
1019	If no, why not?	With adult shopping/errands At school or daycare Visiting family Playing with friends Other (specify:______________) Don't know	1 2 3 4 5 8	[ ]
Ask about the child and tell them that will take a blood sample and **[If the eligible child is NOT in the house, stop interview and go to next eligible participant]**				
1020	About how long ago did the child eat? Please include breastfeeding	<1 hour 1 to 2 hours > 2 hours	1 2 3	[ ]
1021	[Nurse/Phlebotomist: Write down current time]	H h [|] M m [|]		
1022	[Nurse/Phlebotomist: Was blood drawn?]	No, refused No, unsuccessful Yes, incomplete Yes, complete	0 1 2 3	[ ]
1023	[Nurse/Phlebotomist: Describe purple top sample]	No sample Partial sample Complete	0 1 2	[ ]
1024	[Nurse/Phlebotomist: Describe red top sample]	No sample Partial sample Complete	0 1 2	[ ]
[INVESTIGATOR: Continue to anthropomety section]				

Cluster Serl No. in Sample | | | | **Household No.** | | |

Number of child from line list | | | **Number of child mother from line list** | | |

If the child's mother not being in the household, put 99

Anthropomety	
Now I am going to measure the hight and weight of the child.	
AM1. Were anthropometrics taken from the child? 1= Yes 0= No	[ ] 1 → AM3
AM2. Why not? 1= Refused (cried, kicked, etc) 3= Not present 2= Mother/guardian refused 4=Other (specify)	[ ]
AM3. Child's weight (Kg)	[ ][ ] . [ ]
AM4. Child's hieght (cm)	[ ][ ][ ] . [ ]
INTERIEVEIER: measure child lying dowan if < 24 month; measure the child standing if ≥ 24 months	
AM5. Measured lying down or standing up? 1= Lying down 2= Standing up	[ ]

2010 Micronutrient Survey Questionnaire (Arabic)

1

رقم العنقود في العينة | _ | _ | _ | رقم الأسرة | _ | _ |

مقدمة وتعريف

مرحبا، أسمي --------- أعمل في وزارة الصحة، ونحن نقوم الان بتنفيذ مسح وطني يتعلق بدراسة الوضع الصحي والتغذوي للسيدات ممن اعمارهن 15-49 سنة والأطفال في عمر 12 - 59 شهر. ونحن نقدر مشاركتم في هذا المسح، وسوف اخذ من وقتك من 20-30 دقيقة لتعبئة الاستمارة. وكل المعلومات التي تدلين بها ستعامل بسرية تامة ولن يطلع عليها اشخاص اخرون.

تهدف الدراسة إلى مساعدة الحكومة على تطوير البرامج الوقائية والعلاجية وتشمل الدراسة جمع معلومات عن الأسرة، واخذ عينة دم من الأطفال والسيدات ضمن الفئات العمرية المطلوبة بالاضافة إلى اخذ عينات من الخبز والملح المستخدم في الأسرة.

سيقوم فني من وزارة الصحة مدرب وعلى درجة كبيرة من الخبرة والكفاءة بسحب عينة الدم من السيدات والاطفال الذين تنطبق عليهم الشروط، وعند اخذ العينة ستستخدم حقن ولمرة واحدة نظيفة وامنة جداً وقد تسبب الماً بسيطاً وسيتم تحليل الدم في مختبرات وزارة الصحة باجهزة حديثة وسيتم اعلامكم حال ظهور نتائج غير مرضية لتوجيهكم للعلاج، علماً بأن الفحص مجاني.

كما أود أن اعلمك بان المشاركة في هذه الدراسة طوعية ولديكم مطلق الحرية بالمشاركة او عدم المشاركة في الدراسة، واذا ما وصلنا الى سؤال لا تريدين الاجابة عليه اعلميني فقط وسوف انتقل الى السؤال التالي. كما يمكنك وقف المقابلة في اي وقت، وعلى اية حال فاننا نأمل ان ان تشاركي في هذه الدراسة حيث ان المعلومات التي سنحصل عليها من قبلك مهمة جداً.

والان، هل ترغبين ان تسألي أي شئ حول هذه الدراسة؟

هل يمكنني أن ابدأ المقابلة الان؟

الموافقة الشفوية   نعم ☐   لا ☐

توقيع الباحث ____________________   اسم الشخص الموافق على المشاركة ____________________

التاريخ ____________________

العنوان البريدي المتوفر أو أسم أقرب مركز صحي ____________________

[الباحث: سجل جميع أفراد الأسرة في الصفحة التالية(انظر التعريف ادناه)]

الأسرة: تتكون من فرد أو أكثر لها رئيس أو رب أسرة يشتركون معاً في وحدة سكنية مستقلة أو جزءاً من وحدة سكنية ويساهمون معاً في الانفاق من دخل رب الأسرة أو بعض أفرادها، ومن الشائع وجود صلة قربى تربط معظم أفراد الأسرة الواحدة بعضهم ببعض، وقد يكون من بين أفراد الأسرة من لا ينتمون بصلة القرابة لباقي أفرادها، ومن الشائع (وليس من الضروري) أن يشترك أفراد الأسرة في وجبات الطعام أو في بعضها. وأعتبر من أفراد الأسرة كل من تغيب عن مسكن الأسرة بصفة مؤقتة خارج البلاد لفترة لا تزيد عن ستة أشهر يعود بعدها للاقامة معها. بإستثناء الطلبة والمرضى والعسكريين والدبلوماسيين فيعتبرون ضمن أفراد الأسرة بغض النظر عن فترة وجودهم خارج البلاد.

[ضع لاصق الأسرة هنا]

[ملاحظة: لتعبئة افراد الاسرة اطلبي دفتر العائلة والوثائق الرسمية]

رقم العنقود في العينة ☐☐☐ رقم الأسرة ☐☐

الباحث: عبأ استمارة الأسرة من فرد مؤهل ممن أعمارهم 15 سنة فأكثر وقادرين على الاجابة

2	القسم الثاني: خصائص الأسرة		
210	هل سبق ان التحق رب الأسرة بالمدرسة أو ملتحق حالياً؟	نعم ملتحق حالياً ---------- 1 نعم سبق له الالتحاقً ---------- 2 لا ---------- 0 لا أعرف ---------- 8	☐ (0، 8 ← 301)
211	ماهو أعلى مستوى تعليمي انهاه بنجاح؟	امي / ملم ---------- 01 **النظام القديم** ابتدائي ---------- 02 اعدادي ---------- 03 ثانوي ---------- 04 **النظام الجديد** اساسي ---------- 05 ثانوي ---------- 06 دبلوم متوسط ---------- 07 بكالوريوس ---------- 08 تعليم عالي ---------- 09 لا أعرف ---------- 98	☐☐

والان أود أن أسأل عن رأيك بالحديد والفيتامينات في طعامك

رقم الفرد المستجيب ☐☐

3	القسم الثالث: بيان الرأي		
301	أذا أعطيت الخيار بين رغيفين بنفس الحجم والثمن، أحدهما مضاف له الحديد وفيتامينات والأخر لا فأيهما تختار ؟	الرغيف المضاف له حديد وفيتامينات ---------- 1 الرغيف غير المضاف له حديد وفيتامينات ---------- 2 لا أهتم ---------- 3 لا أعرف ---------- 8	☐
302	ما رايك بإضافة الحديد والفيتامينات للخبز والطحين من قبل الحكومة؟ (تقرأ الخيارات)	موافق بشدة ---------- 1 موافق ---------- 2 محايد/ لا رأي ---------- 3 غير موافق ---------- 4 غير موافق بشدة ---------- 5	☐
303	إذا أعطيت الخيار بين عبوتي ملح أحدهما مضاف له يود والاخر لا. فأيهما تختار؟	ملح مضاف له يود ---------- 1 ملح غير مضاف له يود ---------- 2 لا أهتم ---------- 3 لا أعرف ---------- 8	☐
304	ما رايك بإضافة اليود للملح من قبل الحكومة؟ (تقرأ الخيارات)	موافق بشدة ---------- 1 موافق ---------- 2 محايد/ لا رأي ---------- 3 غير موافق ---------- 4 غير موافق بشدة ---------- 5	☐

رقم العنقود في العينة ☐☐☐ رقم الأسرة ☐☐

4	**القسم الرابع: المعرفة والاتجاهات والمعتقدات**		
401	هل الخبز الذي تستهلكه الأسرة يومياً في المسكن مضاف له حديد وفيتامينات؟	نعم ---------- 1 لا ---------- 0 لا أعرف ---------- 8	☐
403	هل الطحين الذي تشتريه مدعم بالحديد والفيتامينات والمعادن؟	نعم ---------- 1 لا ---------- 0 لا أشترى طحين ---------- 7 لا أعرف ---------- 8	☐
405	هل تعلم بأن الملح الذي تشتريه وتتناوله هو ملح مضاف له اليود؟	نعم ---------- 1 لا ---------- 0 لا أعرف ---------- 8	☐
406	هل تطلب ملح مدعم باليود عند شرائك الملح من السوق؟	نعم ---------- 1 لا ---------- 0 لا أشترى ---------- 7 لا أعرف ---------- 8	☐
5	**القسم الخامس: برنامج تدعيم الطحين**		
506	إذا كنت تخبزين الخبز الذي تتناوله الأسرة في البيت، ما نوع الطحين المستخدم؟	موحد (الطحين الأبيض) ---------- 1 بلدي (طحين قمح) ---------- 2 خليط (موحد + بلدي) ---------- 3 أخرى (حدد)__________ 4 لا أخبز ---------- 7 لا أعرف ---------- 8	☐
507	هل يوجد خبز من النوع الذي تتناول عادة الأسرة؟ الباحث: أطلب أن ترى كيس الخبز.	نعم ---------- 1 لا ---------- 0 لا أعرف ---------- 8	☐
510	كم كيلو غرام من الخبز تستهلك الأسرة يومياً؟	أقل من 1 كغم ---------- 1 1-<2 ---------- 2 2-<3 ---------- 3 3-<4 ---------- 4 4+ ---------- 5 لا أعرف ---------- 8	☐
	الباحث: أستاذن لاخذ عينة خبز من الذي تستعمله الأسرة لفحصها بالمختبر. أجمع حوالي 200 غرام (ما يساوي رغيف عربي واحد).		
511	هل تم اخذ العينة؟ ثبت لاصق المعلومات هنا وعلى العينة	نعم ---------- 1 لا (لا يوجد خبز بالبيت) ---------- 2 لا (رفض اعطاء عينة) ---------- 3	☐ (2، 3) ← 601

رقم العنقود في العينة ☐☐☐ رقم الأسرة ☐☐

512	ما نوع هذا الخبز؟ (العينة التي اخذت من الأسرة لاخذها للمختبر)	كماج ---- 1 طابون ---- 2 مشروح ---- 3 منقوش ---- 4 وردة ---- 5 أخرى (حدد)____ 6 لا أعرف ---- 8	☐

6 القسم السادس: برنامج الملح

الان اود ان اسال بعض الاسئلة عن الملح المستخدم في الأسرة.

601	مانوع ملح الطعام الذي تشتريه الأسرة غالبا؟	حدد الماركة ---- 1 لا يوجد ماركة ---- 0 لا أحد يشتري الملح ---- 7 ← 603 لا أعرف ---- 8	☐
602	من أين تشتري ملح الطعام؟	السوبرماركت أو البقالة ---- 1 السيارات / الباعة المتجولين ---- 2 أخرى (حدد) ---- 3 لا أعرف ---- 8	☐
603	ما هي كمية ملح الطعام المستهلكة من قبل الأسرة خلال الشهر الواحد؟ (اكياس او علب وزن 750 غرام)	العدد ---- لا أعرف ---- 98.0	☐☐ . ☐
	الباحث: اطلب رؤية كيس الملح او العلبة.		
604	هل ذكر على علبة ملح الطعام (ملح ميودن أو ملح باليود)؟	لا/ هناك بطاقة بيان لا يوجد عليها أي معلومات ---- 0 نعم ---- 1 لا يوجد بطاقة بيان اصلاً ---- 2 لا يوجد مغلف أصلاً (ملح بلا غلاف) ---- 3 لا يوجد ملح بالبيت ---- 9	☐
	الباحث: نود اخذ عينة من الملح الذي تستخدمه الأسرة لفحصه في مختبرات وزارة الصحة (حوالي 100 غرام) وتقدر ملئ كأس شاي		
605	هل اخذت العينة؟ شت لاصق المعلومات هنا وعلى العينة	نعم ---- 1 لا /لا يوجد ملح في البيت ---- 2 لا /رفض اعطاء عينة ---- 3 (2، 3 ← 700)	☐
606	ما نوع ملح الطعام الذي اخذت منه العينة؟	اسم الماركة ---- 1 لا يوجد ماركة ---- 2 انواع اخرى من الملح غير ملح الطعام ---- 3 لا أعرف ---- 8	☐
607	ما تاريخ الانتهاء على بطاقة البيان لعلبة ملح الطعام؟ اذا كان اليوم غير معروف ضع 98 اذا كان الشهر غير معروف ضع 98 اذا كانت السنة غير معروف ضع 9998	يوم ☐☐ شهر ☐☐ سنة ☐☐☐☐	

رقم العنقود في العينة | رقم الأسرة | رقم سطر السيدة المؤهلة

7 القسم السابع: استمارة السيدة المؤهلة (15-49 سنة)

السيدة / الانسة -------------- نرغب بسؤالك بعض الاسئلة المتعلقة بأسلوب التغذية المتبع لديك ولك الخيار بالمشاركة أو الرفض وعدم الاجابة عن أي سؤال لا ترغبين فيه علماً بأن المعلومات ستعامل بدرجة كبيرة من السرية التامة علما ان مشاركتك ستساعد الحكومة في تقييم الوضع الصحي والتغذوي للسكان في المملكة.

الباحث: أقرائي هذه المعلومات في حال موافقة السيدة على المشاركة

الباحث: اذا كانت السيدة غير موجودة في المسكن وقت الزيارة، اجري المقابلة مع الافراد المؤهلين في الأسرة وعند الانتهاء استكمل بيانات الجزء الخاص بالسيدة الغائبة واذا لم تعد لحين ذاك الوقت اسأل عن فرد من أفراد الأسرة ممن يستطيعون الاجابة عن هذه السيدة.

سيقوم فني من وزارة الصحة مدرب وعلى درجة كبيرة من الخبرة والكفاءة بسحب عينة دم بعد اجابتك على الاسئلة وسيتم استخدام حقن ولمرة واحدة نظيفة وامنة جداً وقد تسبب الماً بسيطاً وسيتم تحليل الدم في مختبرات وزارة الصحة باجهزة حديثة وسيتم اعلامك حال ظهور نتائج غير مرضية لتوجيهك للعلاج، علماً بأن الفحص مجاني.

والان، هل ترغبين ان تسألي أي شئ حول هذه الدراسة؟

رقم	السؤال	الإجابات	الرمز / الانتقال
700	الموافقة الشفوية	نعم مع فحص الدم .... 1 نعم بدون فحص الدم 2 0	← أسألي عن السبب ثم توقفي ________ توقيع الباحث ________
	ضع لاصق معلومات السيدة المؤهلة هنا ←		
701	هل السيدة المؤهلة موجودة في المسكن؟	نعم ---- 1 لا ---- 0	1 ← 703
702	اذا لا، أين هي؟ الباحث: تأكد من عدم وجودها في المسكن.	تعمل خارج المسكن ---- 1 في السوق ---- 2 في زيارة ---- 3 تعيش خارج المسكن ---- 4 مريضة ---- 5 أخرى (حدد) ---- 6 في المرسة ---- 7 لا أعرف ---- 8	
703	ما تاريخ ميلادك اذا كان اليوم غير معروف ضع 98 اذا كان الشهر غير معروف ضع 98 اذا كانت السنة غير معروف ضع 9998	يوم شهر سنة	
704	العمر بالسنوات الكاملة؟	العمر ----	
705	ما هي حالتك الزواجية الان؟	عزباء ---- 1 متزوجة ---- 2 مطلقة ---- 3 ارملة ---- 4 منفصلة ---- 5	1 ← 707
706	كم عدد الابناء الذين ولدوا احياء لك؟ اذا اجابة بلا اعرف ضع 98	عدد الابناء ----	

الباحث: تاكد ان السيدة اردنية، وفي حال كانت لا تاكد ان الزوج اردني وعليه يتم استيفاء بيانات السيدة واطفالها

رقم العنقود في العينة | رقم الأسرة | رقم سطر السيدة المؤهلة

707	هل سبق ان التحقت بالمدرسة أو ملتحق حالياً؟	نعم ملتحق حالياً ---------- 1 نعم سبق له الالتحاقً ---------- 2 لا ---------- 0 لا أعرف ---------- 8	0، 8 ← 709
708	ماهو أعلى مستوى تعليمي انهيته بنجاح؟	امي / ملم ---------- 01 النظام القديم ابتدائي ---------- 02 اعدادي ---------- 03 ثانوي ---------- 04 النظام الجديد اساسي ---------- 05 ثانوي ---------- 06 دبلوم متوسط ---------- 07 بكالوريوس ---------- 08 تعليم عالي ---------- 09 لا أعرف ---------- 98	
الباحثة: اذا كانت السيدة غير موجودة في المسكن، انهي المقابلة وانتقلي الى السيدة المؤهلة الاخرى ان وجد			
اود ان اسأل عن الخبز الذي تستخدمينه			
709	كم رغيف خبز تاكلين خلال اليوم؟ 2/3=0.66 1/8=0.12 1/2=0.50 1/4=0.25 3/4=0.75 1/3=0.33	رغيف صغير ---------- رغيف كبير ---------- لا أعرف ---------- 98.00 لا أكل خبز ---------- 00.00	.

8 القسم الثامن: فقر الدم للمرأة

801	هل سبق وسمعت بمرض فقر الدم (الانيميا)؟	نعم ---------- 1 لا ---------- 0 لا أعرف ---------- 8		0، 8 ← 804
802	ما هو سبب الاصابة بفقر الدم (الأنيميا). الباحثة: ضع الرمز 1 اذا اجابة بالسبب والرمز 0 اذا لم تذكر السبب. لا تقرأ الخيارات		نعم	لا
		1. نقص الغذاء ----------	1	0
		2. نقص الحديد ----------	1	0
		3. المرض ----------	1	0
		4. النزيف ----------	1	0
		5. الأعمال الشاقة ----------	1	0
		6. وراثة ----------	1	0
		7. شرب الشاي ----------	1	0
		8. أخرى (حدد) ----------	1	0
		9. لا أعرف ----------	1	0

رقم العنقود في العينة ☐☐☐ رقم الأسرة ☐☐ رقم سطر السيدة المؤهلة ☐☐

رقم	السؤال	الخيارات	نعم	لا	انتقل إلى	
803	ما هي الاطعمة التي تحمي من الاصابة بفقر الدم؟ الباحثة: ضع الرمز 1 اذا اجابة بالسبب والرمز 0 اذا لم تذكر السبب. لا تقرأ الخيارات	1. البيض --------------------------------------	1	0		☐
		2. الحليب --------------------------------------	1	0		☐
		3. الحبوب والبقوليات ----------------------------	1	0		☐
		4. الخضار --------------------------------------	1	0		☐
		5. الفواكه --------------------------------------	1	0		☐
		6. الرز --------------------------------------	1	0		☐
		7. الخضار الورقية ------------------------------	1	0		☐
		8. اللحم --------------------------------------	1	0		☐
		9. السمك --------------------------------------	1	0		☐
		10. الدجاج --------------------------------------	1	0		☐
		11. الخبز / الطحين ------------------------------	1	0		☐
		12. أخرى (حدد) ----------------------------------	1	0		☐
		13. لا أعرف --------------------------------------	1	0		☐

رقم	السؤال	الخيارات	الرمز	انتقل إلى	
804	هل تتناولين أقراص حديد او فيتامينات لتحسين صحتك حديثاً؟	نعم --------------------------------------	1		☐
		لا --------------------------------------	0	809	
		لا أعرف --------------------------------------	8	809	
805	كم مرة تتناولين هذه الأقراص؟	غير منتظم (أقل من حبة خلال اسبوع) -----------	1		☐
		أسبوعي --------------------------------------	2		
		يومياً أو على الاغلب يومياً ------------------	3		
		أخرى (حدد) --------------------------------------	4		
		لا أعرف --------------------------------------	8		
806	هل يمكن رؤية العبوة؟	نعم --------------------------------------	1		☐
		لا --------------------------------------	0	809	
807	هل يوجد سجل المكونات على العبوة؟	نعم --------------------------------------	1		☐
		لا --------------------------------------	0	809	

رقم	السؤال	الخيارات	نعم	لا	
808	الباحث: انظر لعلبة الدواء وسجل المكونات الباحثة: ضع الرمز 1 اذا كانت نعم والرمز 0 اذا لم كانت لا.	1. حديد --------------------------------------	1	0	☐
		2. فيتامين متعددة --------------------------	1	0	☐
		3. حامض الفوليك --------------------------	1	0	☐
		4. فيتامين B12 --------------------------	1	0	☐
		5. أعشاب --------------------------------------	1	0	☐
		6. لا يوجد بطاقة بيان على العبوة ----------------	1	0	☐
		7. أخرى (حدد) ______________________	1	0	☐

رقم العنقود في العينة ☐☐☐ رقم الأسرة ☐☐ رقم سطر السيدة المؤهلة ☐☐

الرقم	السؤال	الإجابة	الرمز	انتقل إلى
809	هل سبق واخذت أبر فيتامين B12؟	نعم ----------	1	☐
		لا ----------	0	901
		لا أعرف ----------	8	901
810	متى كانت أخر أبرة B12 تم اخذها؟	خلال 1 شهر ----------	1	☐
		2-3 شهر ----------	2	
		4-11 شهر ----------	3	
		12 شهراً أو أكثر ----------	4	
		لا أعرف / لا أذكر ----------	8	
9	**القسم التاسع: اتجاهات وسلوكيات السيدة المؤهلة**			
901	عند مغادرتك للمسكن ما نوع غطاء الراس المستخدم؟	بدون غطاء ----------	0	☐
		أشارب ----------	1	
		حجاب ----------	2	
		نقاب ----------	3	
902	عند مغادرتك للمسكن هل تغطي ساعداك بالعادة؟	نعم ----------	1	☐
		لا ----------	0	
903	عند مغادرتك المسكن هل تلبسين قفازات؟	نعم ----------	1	☐
		لا ----------	0	
904	هل تتناولين الشاي أثناء وجبة الطعام أو بعدها بفترة قصيرة؟	نعم ----------	1	☐
		لا ----------	0	906
905	كم مرة تتناولين الشاي يومياً اثناء وجبة الطعام او بعدها بفترة قصيرة؟	مرة في اليوم ----------	1	☐
		2-3 مرة ----------	2	
		أكثر من 3 ----------	3	
		لا أعرف ----------	8	
	الباحثة: اذا كانت السيدة عزباء لا تسألي عن الحمل السؤال 906 وانما انتقلي الى سؤال 907			
906	هل انت حامل ؟ الباحث: اذا اجابت السيدة بنعم فلا تاخذ عينة دم.	نعم ----------	1	أنهي المقابلة وأنتقلي الى السيدة المؤهلة التالية أن وجد
		لا ----------	0	☐
		لا أعرف ----------	8	
907	هل تعانين أو عانيتِ من ارتفاع درجة الحرارة هذا اليوم أو خلال الأسبوع الماضي؟	نعم ----------	1	☐
		لا ----------	0	
		لا أعرف ----------	8	
908	منذ متى تناولت أخر وجبة طعام لك اليوم؟	أقل من ساعة ----------	1	☐
		ساعة 1-2 ----------	2	
		أكثر من ساعتين ----------	3	

رقم العنقود في العينة ☐☐☐ رقم الأسرة ☐☐ رقم سطر السيدة المؤهلة ☐☐

الباحثة: الان اذا كنت لا تمانعين سناخذ عينة دم من قبل فني المختبر

910	فني المختبر : هل تم سحب الدم؟	لا / رفضت اعطاء عينة ---------- 0 لا / السحب غير ناجح ---------- 1 نعم / كمية غير كافية ---------- 2 نعم /كمية كافية ---------- 3	☐
911	فني المختبر: وصف لأنبوب السحب الحاوي على مادة مانعة للتخثر (غطاء بنفسجي)؟	لا يوجد عينة ---------- 0 كمية غير كافية ---------- 1 كمية كافية ---------- 2	☐
912	فني المختبر: وصف لأنبوب السحب المفرغ والذي لا يحتوي أي اضافة (غطاء احمر)؟	لا يوجد عينة ---------- 0 كمية غير كافية ---------- 1 كمية كافية ---------- 2	☐
909	فني المختبر: سجل الوقت لسحب الدم.	دقيقة ☐☐ ساعة ☐☐	

الباحثة: اشكري المستجيبة وانهي استمارة السيدة المؤهلة وانتقلي الى السيدة المؤهلة التالية ان وجد في الأسرة.

رقم العنقود في العينة ☐☐☐ رقم الأسرة ☐☐

رقم سطر الطفل ☐☐☐ رقم سطر ام الطفل ☐☐

ضعي 99 في حالة كان الام ليست من افراد الاسرة

10 القسم العاشر: استمارة الطفل (12-59 شهر)

سيدتي أود أن أسألك عن طفلك (اسم الطفل) بعض الاسئلة المتعلقة بأسلوب التغذية له ولك الخيار باشراك طفلك بالدراسة والاجابة عن الاسئلة المتعلقة به أو الرفض علماً بان المعلومات ستعامل بدرجة كبيرة من السرية التامة، علماً ان مشاركة طفلك ستساعد الحكومة لتقييم الوضع الصحي والتغذوي لدى الاطفال في المملكة.

الباحث: اقرأ هذه المعلومات في حال موافقة ولي الامر على مشاركة الطفل وتأكد من وجود الطفل في المسكن وكذلك تأكد ان كان **الطفل** اردنياً.

سيقوم فني من وزارة الصحة مدرب وعلى درجة كبيرة من الخبرة والكفاءة بسحب عينة دم بعد اجابتك على الاسئلة المتعلقة بالطفل وسيتم استخدام حقن ولمرة واحدة نظيفة وامنة جداً وقد تسبب الماً بسيطاً وسيتم تحليل الدم في مختبرات وزارة الصحة باجهزة حديثة وسيتم اعلامك حال ظهور نتائج غير مرضية لتوجيهك للعلاج، علماً بأن الفحص مجاني، اضافة الى انه سيتم قياس وزن وطول الطفل بعد الاجابة على الاسئلة.

والان، هل ترغبين ان تسألي أي شئ حول هذه الدراسة؟

1000	الموافقة الشفوية	نعم مع فحص الدم .... 1 نعم بدون فحص الدم 2 0	☐ أسألي عن السبب ثم توقفي ← ____________ توقيع الباحث ____________
		ضع هنا لاصق معلومات الطفل ←	☐
1001	تاريخ ميلاد الطفل اذا كان اليوم أو الشهر غير معروف ضع 98 اذا كانت السنة غير معروف ضع 9998 تأكدي من تاريخ الميلاد من دفتر العائلة أو بطاقة الطفل	اليوم ☐☐ الشهر ☐☐ السنة ☐☐☐☐	
1002	ما علاقتك بالطفل؟	أم ---------- 1 جدة ---------- 2 أقرباء أخرون ---------- 3 أخرى (حدد) ---------- 4	☐
1003	جنس الطفل؟	ذكر ---------- 1 أنثى ---------- 2	☐
1004	هل تم (اسم الطفل) ارضاعه رضاعة طبيعية؟	نعم ---------- 1 لا ---------- 0 لا أعرف ---------- 8	☐ 1006 ← (0، 8)
1005	هل مازلت ترضعين (اسم الطفل)؟	نعم ---------- 1 لا ---------- 0 لا أعرف ---------- 8	☐
1006	في أي عمر (بالاشهر) أعطي (اسم الطفل) غذاء مساند غير الرضاعة الطبيعية بما في ذلك (الماء، الاغذية الاضافية، الرضاعة الصناعية، العصير والطعام و الطعام الصلب) ؟	العمر بالاشهر ---------- أقل من شهر ---------- 00 الرضاعة الطبيعية ---------- 97 لا أعرف ---------- 98	☐☐ 1009 ← 97

12

رقم العنقود في العينة | رقم الأسرة

رقم سطر الطفل | رقم سطر ام الطفل

ضعي 99 في حالة كان الام ليست من افراد الاسرة

1007	في أي عمر توقف (اسم الطفل) عن الرضاعة الطبيعية؟	العمر بالاشهر --- أقل من شهر --- 00 لا يزال يرضع --- 97 لا أعرف --- 98	
1008	كم رغيف خبز يتناول (اسم الطفل) يومياً ؟ 1/8=0.12 2/3=0.66 1/4=0.25 1/2=0.50 1/3=0.33 3/4=0.75	رغيف صغير --- رغيف كبير --- لا أعرف --- 98.0 لا يأكل --- 00.0	. .
1009	هل يتناول (اسم الطفل) أي نقط أو أقراص من الحديد والفيتامينات بما في ذلك ما أعطي له من قبل الطبيب لتحسين صحته وشهيته؟	نعم --- 1 لا --- 0 لا أعرف --- 8	1013 (0، 8)
1010	الباحث: استأذن ان كان بالامكان رؤية عبوة الدواء؟	نعم --- 1 لا --- 0	1013 ← (0)
1011	هل يوجد سجل مكونات على عبوة الدواء؟	نعم --- 1 لا --- 0	1013 ← (0)
1012	الباحث: تأكد من العبوة وسجل المكونات؟	(نعم / لا) 1. حديد --- 1 0 2. فيتامين متعددة --- 1 0 3. حامض الفوليك --- 1 0 4. فيتامين B12 --- 1 0 5. أعشاب --- 1 0 6. لا يوجد بطاقة بيان على العبوة --- 1 0 7. أخرى (حدد) ___ 1 0	
1013	هل اعطي (اسم الطفل) كبسولة فيتامين أ مع المطعوم في المركز الصحي؟ الباحث: اعرض حبة الفيتامين (الزرقاء أو الحمراء).	نعم --- 1 لا --- 0 لا أعرف --- 8	1015 (0، 8)
1014	هل أعطي (اسم الطفل) كبسولة فيتامين A خلال ال ستة الشهور الاخيرة من يوم المقابلة؟	نعم --- 1 لا --- 0 لا أعرف --- 8	
1015	هل سبق وشرب (اسم الطفل) الشاي؟	نعم --- 1 لا --- 0 لا أعرف --- 8	1018 (0، 8)
1016	هل يشرب (اسم الطفل) الشاي أثناء وجبة الطعام أو بعدها بقليل؟	نعم --- 1 لا --- 0 لا أعرف --- 8	1018 (0، 8)

رقم العنقود في العينة ☐☐☐ رقم الأسرة ☐☐

رقم سطر الطفل ☐☐☐ رقم سطر ام الطفل ☐☐

ضعي 99 في حالة كان الام ليست من افراد الاسرة

1017	كم مرة يشرب (اسم الطفل) الشاي اثناء وجبة الطعام أو بعدها بقليل؟	مرة في اليوم ---------- 1 2-3 مرة ---------- 2 أكثر من 3 ---------- 3 لا أعرف ---------- 8	☐
1018	هل (اسم الطفل) موجود في المسكن؟ هل يمكن استدعاء الطفل للبيت؟	نعم ---------- 1 لا ---------- 0	1020 ← ☐
1019	اذا كان (اسم الطفل) غير موجود في المسكن، لماذا؟	مع اخوته في السوق ---------- 1 في المدرسة أو الحضانة ---------- 2 يزور العائلة ---------- 3 يلعب مع اصدقائه خارجاً ---------- 4 أخرى (حدد) ---------- 5 لا أعرف ---------- 8	☐
الباحثة: أسألي عن (اسم الطفل) وانه سيتم اخذ عينة دم منه من قبل فني المختبر واذا كان غير موجوداً في المسكن انتقل للطفل التالي في الأسرة			
1020	متى تناول (اسم الطفل) اخر وجبة طعام له هذا اليوم بما فيها اخر رضعة؟	أقل من ساعة ---------- 1 ساعة 2-1 ---------- 2 أكثر من ساعتين ---------- 3	☐
1022	فني المختبر: هل تم سحب عينة دم؟	لا / رفضت اعطاء عينة ---------- 1 لا / السحب غير ناجح ---------- 2 نعم / كمية غير كافية ---------- 3 نعم /كمية كافية ---------- 4	☐
1023	فني المختبر: وصف لأنبوب السحب الحاوي على مادة مانعة للتخثر (غطاء بنفسجي)؟	لا يوجد عينة ---------- 1 كمية غير كافية ---------- 2 كمية كافية ---------- 3	☐
1024	فني المختبر: وصف لأنبوب السحب المفرغ والذي لا يحتوي أي اضافة (غطاء احمر)؟	لا يوجد عينة ---------- 1 كمية غير كافية ---------- 2 كمية كافية ---------- 3	☐
1021	فني المختبر: سجل وقت سحب العينة؟	دقيقة ☐☐ ساعة ☐☐	
انتقلي الى القياسات الجسمانية			

رقم العنقود في العينة | | رقم الأسرة | |
رقم سطر الطفل | | رقم سطر ام الطفل | |

ضعي 99 في حالة كان الام ليست من افراد الاسرة

القسم الحادي عشر: قياسات الوزن والطول

الان سوف نقوم باخذ قياسات الوزن والطول لـ (اسم الطفل)			
AM1	هل اخذت قياسات الوزن والطول لـ (اسم الطفل)؟	نعم ---------- 1 لا ---------- 0	AM3 ←
AM2	لماذا لم يتم اخذ قياسات الوزن والطول لـ (اسم الطفل)؟	رفض الطفل (يبكي، يرفس، ... أسباب أخرى) ---- 1 رفض الأم أو الوصي على الطفل ---------- 2 الطفل غير موجود ---------- 3 أخرى (حدد) ---------- 4	
AM3	وزن الطفل بالكيلو غرام	الوزن (كغم) ----------	__ __ . __
AM4	طول الطفل بالسنتمتر	الطول (سم) ----------	__ __ __ . __
الباحث: قم بقياس الطفل مستلقياً اذا كان عمره < 24 شهر وقياس الطفل واقفاً اذا كان عمر ه ≥ 24 شهر			
AM5	هل تم قياس الطفل مستلقياً ام واقفاً؟	مستلقياً.................... 1 واقفاً.................... 2	

2002 Micronutrient Survey Questionnaire (English)

NATIONAL MICRONUTRIENT SURVEY IN JORDAN
MOH & WHO & UNICEF & CDC
WOMAN &CHILD'S QUESTIONAIRE

Questionnaire: # ☐☐☐☐

Governorate	☐☐	Block #	☐☐☐☐☐
District	☐☐	Building # ( )	
Sub-district	☐	Household # ( )	
Population	☐☐☐	Cluster #	☐☐☐
Area	☐	Family #	☐☐
Urban (1) / Rural (2)	☐	Telephone # ( )	
No. of women in the family	☐	No. of children in the family	☐

Investigator Visit

	1	2	3	Final visit
Date: Name of Investigator: Result*:				Day: ☐☐ Month: ☐☐ Year: ☐☐☐☐ Investigator code: ☐☐ Result: * ☐
Next visit: Date Time				Total # of visits: ☐

Visit's result* :

1. Done
2. Postponed
3. Refused
4. Home closed
5. Home empty
6. Others (specify) ______________________________

Field Auditor	Officer Auditor	Data Entry
Name: -------------------- ☐☐ Date: --------------------	Name: ------------- ☐☐ Date: --------------	Name: ------------- ☐☐ Date: --------------

Section 1: Family Members

1	2	3		4		5	6	7
No.	Name	Gender		Date of Birth M/Y		Age	Illegable Women and Children for interview	
							Women(15-49 year)	Children(0-59 months)
		M	F	Month	Year	xx	xx	xx
1		1	2				1	1
2		1	2				2	2
3		1	2				3	3
4		1	2				4	4
5		1	2				5	5
6		1	2				6	6
7		1	2				7	7
8		1	2				8	8
9		1	2				9	9
10		1	2				10	10
11		1	2				11	11
12		1	2				12	12
13		1	2				13	13
14		1	2				14	14
15		1	2				15	15
16		1	2				16	16
17		1	2				17	17
18		1	2				18	18
19		1	2				19	19
20		1	2				20	20

Investigator Note: kindly continue the questionnaire if you have Illegable family members who are entitled for the interview, otherwise stop the interview.

Section 1: General Background for Women aged between 15-49 year

No.	Woman sequency/order	1st woman	2nd woman
101	Name & Number of registered woman from quest. 2+6	Name: Registered #: ☐☐	Name: Registered #: ☐☐
102	Age / whole year?	Age ________ ☐☐	Age ________ ☐☐
103	What is your Marital Status?	Single .... 1 → 108 Married .... 2 Divorce .... 3 → 105 Widow .... 4 Separated 5	Single .... 1 → 108 Married .... 2 Divorce .... 3 → 105 Widow .... 4 Separated 5
104	Are you currently pregnant?	Yes .... 1 → 106 No .... 2 Not sure 3	Yes .... 1 → 106 No .... 2 Not sure 3
105	Were you enrolled previously in school?	Yes .... 1 No 2	Yes .... 1 No 2
106	The educational background/status you reached successfully?	Illiterate .... 1 Semi-literate .... 2 Elementary ....3 Preparatory .... 4 Old Secondary ... . 5 Basic .... 6 Modern Secondary ...... 7 Diploma .... 8 Bachelor .... 9 High Diploma 10	Illiterate .... 1 Semi-literate .... 2 Elementary ....3 Preparatory .... 4 Old Secondary ... . 5 Basic .... 6 Modern Secondary ...... 7 Diploma .... 8 Bachelor .... 9 High Diploma 10
107	What is your monthly average income in Jordanian Dinar from all resources?	Less than JD 150 .... 1 150-299 .... 2 300 – 499 .... 3 More than 500 .... 4 Don't know 8	Less than JD 150 .... 1 150-299 .... 2 300 – 499 .... 3 More than 500 .... 4 Don't know 8

Section 2: Knowledge & Attitude Questions

No.	Woman sequency/order	1st woman	2nd woman
	Name & Number of registered woman from quest. 2+6	Name: Registered #: ☐☐	Name: Registered #: ☐☐
201	Have you ever heard about shortage of blood (Anemia)	Yes .... 1 No .... 2 } 204 Don't know 88	Yes .... 1 No .... 2 } 204 Don't know 8
202	Reason that caused shortage of blood (Anemia) Interviwer: circle all anwsers from respondent.	Lack of food .... 1 Illness .... 2 Bleeding .... 3 Heavy work .... 4 Genetics .... 5 Drink tea...............6 Others (specify) ..... 7 Don't know 88	Lack of food .... 1 Illness .... 2 Bleeding .... 3 Heavy work .... 4 Genetics .... 5 Drink tea...............6 Others (specify) ..... 7 Don't know 88
203	What are the kinds of food that prevent the shortage of blood (Anemia) Interviwer: circle all anwsers from respondent.	Eggs .... 1 Milk .... 2 Cereals & Legumas 3 Vegetables .... 4 Fruits .... 5 Rice .... 6 Dark Green leafy vegetables .... 7 Meat .... 8 Fish....................... 9 Chickens .... 10 Others (specify)........ 11 Don't know 88	Eggs .... 1 Milk .... 2 Cereals & Legumas 3 Vegetables ....4 Fruits ....5 Rice .... 6 Dark Green leafy vegetables 7 Meat .... 8 Fish....................... 9 Chickens .... 10 Others (specify)........ 11 Don't know 98
204	Are you currently taking any medicine that contain iron or any vitamins?	Yes .... 1 No .... 2 →209 Don't know 88	Yes .... 1 No .... 2 →209 Don't know 88
205	How often do you take these tablets?	Daily .... 1 Weekly .... 2 Irregular .... 3 Others (specify) ... 6	Daily .... 1 Weekly .... 2 Irregular .... 3 Others (specify) ... 6
206	Did you have fever today or in the past week?	Yes .... 1 No .... 2 Don't know 88	Yes .... 1 No .... 2 Don't know 88
207	**Bread sample:** For investigator: Ask for a piece of bread and salt that are usually available at home.	Sample was taken .... 1 Not available 2	
208	Blood test	Sample was taken .... 1 Refused 2	Sample was taken .... 1 Refused 2
209	Visit result	Done .... 1 Not available .... 2 Postponed .... 3 Refused .... 4 Particially done .... 5 Can't answer .... 6 Others (specify) 7	Done .... 1 Not available .... 2 Postponed .... 3 Refused .... 4 Particially done .... 5 Can't answer .... 6 Others (specify) 7

Section 3: Children

No.	Children in order	1st child	2nd child	3rd child
	Name & Number of registered child from quest. 2 + 7	Name: Registered #: ☐☐ (child)	Name: Registered #: ☐☐ (child)	Name: Registered #: ☐☐ (child)
300	Name of person responding on behalf of the child	Name: Registered #: ☐☐ (responsible for child)	Name: Registered #: ☐☐ (responsible for child)	Name: Registered #: ☐☐ (responsible for child)
301	Was the child ever breast feed?	Yes ………….. 1 No …….. 2 → 305 Don't know 88 → 305	Yes ………….. 1 No …….. 2 → 305 Don't know 88 → 305	Yes ………….. 1 No …….. 2 → 305 Don't know 88 → 305
302	Is the child breast feed now?	Yes …… 1 → 304 No …….. 2	Yes …… 1 → 304 No …….. 2	Yes …… 1 → 304 No …….. 2
303	For how many months did you breast feed?	Time in months ……… ☐☐	Time in months ……… ☐☐	Time in months ……… ☐☐
304	At what age in months was the child given something other than breast milk (including water , formula, juice or solid food)	Age by month ☐☐ Nothing was given -------96	Age by month ☐☐ Nothing was given -------96	Age by month ☐☐ Nothing was given -------96
305	Is the child currently receiving iron drops or tablets?	Yes ………….. 1 No …….. 2 → 307	Yes ………….. 1 No …….. 2 → 307	Yes ………….. 1 No …….. 2 → 307
306	Can we see the vial?	With Iron …. 1 No iron …..... 2 With vitamin….3 No vitamin……4 Not shown … 5	With Iron …. 1 No iron …..... 2 With vitamin….3 No vitamin……4 Not shown … 5	With Iron …. 1 No iron …..... 2 With vitamin….3 No vitamin……4 Not shown … 5
307	Is the child currently receiving vitamins drops or tablets?	Yes ………….. 1 No …….. 2 → 309	Yes ………….. 1 No …….. 2 → 309	Yes ………….. 1 No …….. 2 → 309
308	Has the child had fever today or in the past 7 days?	Yes ………….. 1 No …………….. 2 Don't know …. 88	Yes ………….. 1 No …………….. 2 Don't know …. 88	Yes ………….. 1 No …………….. 2 Don't know …. 88
309	Blood test	Sample was taken. 1 Refused ……….. 2 Child not available…3	Sample was taken. 1 Refused ……….. 2 Child not available…3	Sample was taken. 1 Refused ……….. 2 Child not available…3
310	Visit result	Done ………… 1 Postponed….. 2 Refused ………. 3 ☐ Particially done 4 Others (specify) 5	Done ………… 1 Postponed….. 2 Refused ………. 3 ☐ Particially done 4 Others (specify) 5	Done ………… 1 Postponed….. 2 Refused ………. 3 ☐ Particially done 4 Others (specify) 5

2002 Micronutrient Survey Questionnaire (Arabic)

The Arabic version of the 2002 Micronutrient Survey Questionnaire can be found in the 2002 Micronutrient Survey Report:

Jordan Ministry of Health. A national survey on iron deficiency anemia and vitamin A deficiency. Jordan, 2002.

Appendix IV: Description of 2010 Micronutrient Survey Sampling Design

Sample Frame

Administratively, Jordan is divided into 12 governorates. Each governorate is subdivided into district units; in turn, each district is divided into sub districts, which are divided into localities, and each locality into areas and then sub-areas. In addition to these administrative units, during the 2004 Jordan Population and Housing Census, each sub-area was subdivided into convenient area units called blocks. The list of census blocks contains census information on households and population, grouped by each administrative unit. The sample frame for the 2010 Micronutrient Survey consisted of 14,040 blocks. The DOS combined small blocks and created about 13,000 clusters (each cluster contained one or more blocks). Each cluster had an average of 72 households. The sampling frame excluded the population living in remote areas (most of whom are nomads), as well as those living in collective dwellings, such as hotels, hospitals, work camps, and prisons.

Stratification

For the purposes of sample design, each of the 12 governorates in Jordan was considered an independent stratum. The population localities in each governorate were divided into urban (a locality with population of 5,000 or more) and rural (except for the five major cities, namely: Amman, Marka, Wadi Essier, Zarqa, Russeifa, and Irbid, each of which formed an independent stratum), with a resultant 30 strata. The localities in each governorate were divided into categories according to the population size in the locality; then they were ordered according to their geographical succession.

Sample Selection

The sample was selected in three stages. In the first stage a total of 166 clusters were allocated to the 30 stratum, proportional to the number of households in the stratum. Then the selection of clusters was done by sorting the clusters within each stratum according to the administrative levels (*i.e.* by governorate and then by urban, rural, and major city localities) and then by their socio-economic characteristics (see Table).

Table. Distribution of clusters by strata, region and urban-rural, Jordan 2010.

Region	Governorate	Urban/Rural/City	Census (2004)		Final Allocation of Clusters	
			No. of Households in Stratum	**Percent**	**No. of Clusters**	**Percent**
North	Irbid	Urban	89,313	9.5	16	9.6
		Rural	27,668	3.0	5	3.0
		City (Irbid)	48,237	5.2	8	4.8
	Mafraq	Urban	16,234	1.7	3	1.8
		Rural	22,150	2.4	4	2.4
	Jarash	Urban	16,352	1.7	3	1.8
		Rural	9,351	1.0	2	1.2
	Ajloun	Urban	15,733	1.7	3	1.8
		Rural	4,698	0.5	1	0.6
Central	Amman	Urban	137,022	14.7	24	14.5
		Rural	19,980	2.1	4	2.4
		City (Amman)	110,793	11.8	18	10.8
		City (Marka)	83,612	8.9	15	9.0
		City (Wadi Essier)	26,550	2.8	5	3.0
	Balqa	Urban	44,805	4.8	8	4.8
		Rural	16,827	1.8	3	1.8
	Zarga	Urban	17,353	1.9	3	1.8
		Rural	6,578	0.7	1	0.6
		City (Zarqa)	75,939	8.1	13	7.8
		City (Russeifa)	42,078	4.5	7	4.2
	Madaba	Urban	16,344	1.7	3	1.8
		Rural	6,245	0.7	1	0.6
South						
	Karak	Urban	11,541	1.2	2	1.2
		Rural	23,993	2.6	4	2.4
	Tafielah	Urban	9,566	1.0	2	1.2
		Rural	3,477	0.4	1	0.6
	Ma’an	Urban	8,529	0.9	2	1.2
		Rural	6,631	0.7	1	0.6
	Aqaba	Urban	15,510	1.7	3	1.8
		Rural	2,173	0.2	1	0.6
Total			935,282	100.0	166	100.0

In the second stage, clusters were identified and selected independently in each stratum. By using a probability proportional to size selection for the Primary Sampling Units (PSU's) (clusters) during the first sampling stage, an implicit stratification and proportional allocation was achieved at each of the lower administrative levels. This was done by sorting the clusters within each sampling stratum according to the administrative levels (*i.e.* by governorate and then by urban, rural, and major city localities) and then by their socio-economic characteristics.

For the second stage, a household listing operation was carried out in all of the selected clusters. A DOS mapper visited each cluster, enumerated the households, determined the nationality of the household, determined if the household was private or collective, and mapped the households in the cluster. (Only Jordanian private households were eligible for the survey)[4]. Household selection was an equal probability systematic selection of fixed size: 12 households per cluster. Twelve households were selected in each of the 166 clusters for a total of 1,992 households.

For the final stage, all women aged 15 – 49 years and children aged 12 – 59 months were interviewed in participating households.

---

[4] According to the standard definitions used by the Jordanian Department of Statistics (DOS), a household is defined as Jordanian if the head of the household identifies him or herself as Jordanian.

Household: One person or more living in a separated housing unit or part of it.

Private Household: A household, consisting of one person or more, with a head, sharing with each other one separated housing unit or part of it; the members of household participate in expenditures from the income of head of household or from some household members. Some household members may not be related to each other, although it is commonly known that there is a relationship between them. It is also commonly (but not necessarily) known that the members share meals or some of these meals with each other. The household comprises all those who were temporarily absent from the household outside Jordan for a period less than one year, who will after that return to join the household (with the exception of students, army-men, and diplomats who are considered as usual members regardless of the period of their absence).

Collective Household: Every group of persons six or more residing in a conventional housing unit (apartment, *dar*, villa, etc.), with no relativities, where each person depends on himself for a living, even if he participates with the others in some meals, such as: the workers residing in work camps or those residing in an apartment or *dar*, etc.

Appendix V: List and Characteristics of Selected Clusters – 2010 Micronutrient Survey

2010 Survey Cluster #	2004 Pop. & Housing Cluster #	# HH Participated	Region	Urban/ Rural	2010 Survey Cluster #	2004 Pop. & Housing Cluster #	# HH Participated	Region	Urban/ Rural
1	26	6	Central	Urban	47	11	7	Central	Urban
2	122	12	Central	Urban	48	69	9	Central	Urban
3	209	12	Central	Urban	49	129	8	Central	Urban
4	290	5	Central	Urban	50	197	11	Central	Urban
5	367	4	Central	Urban	51	272	8	Central	Urban
6	442	12	Central	Urban	52	336	11	Central	Urban
7	517	5	Central	Urban	53	401	11	Central	Urban
8	594	10	Central	Urban	54	468	9	Central	Urban
9	668	4	Central	Urban	55	533	9	Central	Urban
10	746	6	Central	Urban	56	595	4	Central	Urban
11	815	6	Central	Urban	57	655	11	Central	Urban
12	904	7	Central	Urban	58	718	10	Central	Urban
13	994	12	Central	Urban	59	789	10	Central	Urban
14	1,066	10	Central	Urban	60	855	11	Central	Urban
15	1,134	10	Central	Urban	61	921	10	Central	Urban
16	1,200	10	Central	Urban	62	2	12	Central	Urban
17	1,274	12	Central	Urban	63	69	10	Central	Urban
18	1,338	11	Central	Urban	64	141	1	Central	Urban
19	1,399	12	Central	Urban	65	212	10	Central	Urban
20	1,465	12	Central	Urban	66	296	1	Central	Urban
21	1,526	12	Central	Urban	67	54	11	Central	Urban
22	1,603	10	Central	Urban	68	125	11	Central	Urban
23	1,698	11	Central	Urban	69	196	12	Central	Urban
24	1,772	9	Central	Urban	70	275	11	Central	Urban
25	71	12	Central	Rural	71	355	12	Central	Urban
26	154	11	Central	Rural	72	414	12	Central	Urban
27	238	11	Central	Rural	73	476	12	Central	Urban
28	317	10	Central	Rural	74	530	12	Central	Urban
29	86	4	Central	Urban	75	13	12	Central	Rural
30	190	12	Central	Urban	76	94	12	Central	Rural
31	274	8	Central	Urban	77	183	12	Central	Rural
32	365	11	Central	Urban	78	36	11	Central	Urban
33	456	6	Central	Urban	79	122	12	Central	Urban
34	554	6	Central	Urban	80	192	12	Central	Urban
35	635	6	Central	Urban	81	100	11	Central	Urban
36	703	6	Central	Urban	82	56	12	Central	Urban
37	769	7	Central	Urban	83	131	12	Central	Urban
38	840	11	Central	Urban	84	213	12	Central	Urban
39	918	12	Central	Urban	85	291	12	Central	Urban
40	1,000	10	Central	Urban	86	366	12	Central	Urban
41	1,072	7	Central	Urban	87	448	11	Central	Urban
42	1,144	11	Central	Urban	88	527	11	Central	Urban
43	1,218	8	Central	Urban	89	604	12	Central	Urban
44	1,302	9	Central	Urban	90	683	11	Central	Urban
45	1,382	8	Central	Urban	91	769	12	Central	Urban
46	1,447	12	Central	Urban	92	953	11	Central	Urban

continued

List and Characteristics of Selected Clusters – 2010 Micronutrient Survey *(continued)*

2010 Survey Cluster #	2004 Pop. & Housing Cluster #	# HH Participated	Region	Urban/ Rural	2010 Survey Cluster #	2004 Pop. & Housing Cluster#	# HH Participated	Region	Urban/ Rural
93	1,035	11	Central	Urban	139	135	10	North	Rural
94	1,118	11	Central	Urban	140	223	12	North	Rural
95	42	12	Central	Urban	141	317	12	North	Rural
96	123	12	Central	Urban	142	60	11	North	Urban
97	200	12	Central	Urban	143	130	12	North	Urban
98	269	12	Central	Urban	144	203	12	North	Urban
99	361	12	Central	Urban	145	57	11	North	Urban
100	450	12	Central	Urban	146	128	12	North	Urban
101	553	9	Central	Urban	147	31	8	North	Urban
102	78	9	Central	Urban	148	106	12	North	Urban
103	155	12	Central	Urban	149	180	9	North	Urban
104	230	12	Central	Urban	150	25	12	North	Rural
105	10	12	Central	Rural	151	66	12	South	Urban
106	44	12	North	Urban	152	157	11	South	Urban
107	118	12	North	Urban	153	44	12	South	Rural
108	198	12	North	Urban	154	134	9	South	Rural
109	282	12	North	Urban	155	226	12	South	Rural
110	373	12	North	Urban	156	323	12	South	Rural
111	462	12	North	Urban	157	52	12	South	Urban
112	558	12	North	Urban	158	135	12	South	Urban
113	653	12	North	Urban	159	58	12	South	Rural
114	732	12	North	Urban	160	59	10	South	Urban
115	807	12	North	Urban	161	125	12	South	Urban
116	890	11	North	Urban	162	51	11	South	Rural
117	965	12	North	Urban	163	24	12	South	Urban
118	1,036	12	North	Urban	164	108	11	South	Urban
119	1,118	12	North	Urban	165	192	12	South	Urban
120	1,196	11	North	Urban	166	33	12	South	Rural
121	1,264	12	North	Urban					
122	14	12	North	Rural					
123	97	12	North	Rural					
124	179	11	North	Rural					
125	263	12	North	Rural					
126	353	12	North	Rural					
127	50	12	North	Urban					
128	134	11	North	Urban					
129	218	10	North	Urban					
130	293	10	North	Urban					
131	373	10	North	Urban					
132	460	11	North	Urban					
133	530	12	North	Urban					
134	601	9	North	Urban					
135	48	12	North	Urban					
136	121	12	North	Urban					
137	191	12	North	Urban					
138	51	12	North	Rural					

Appendix VI: 2010 Micronutrient Survey Training Agenda

Training Schedule
Jordan Survey 2010

Day 1: Anthropometry measurements

Day & date	Subject	Instructors	Time
Wednesday 10/3/2010	Introduction and survey overview	Eng. Hanan Masa`d	9 – 9:30
	Introduction & overview of anthropometric measurement in children	Dr. Khawla Hiasat	9:30 –10:30
	Coffee break		10:30 – 11
	Demonstration of measurements in clinic		11:15 – 13

Day 2: Introduction, field work, logistics, and questionnaire training

Day & date	Subject	Instructors	Time
Thursday 11/3/2010	Opening	Dr. Adel Belbeisi Dr. Mohammed Tarawneh	9 – 9:15
	Introduction and survey overview Overview of responsibilities	Eng. Hanan Masa`d	9:15 – 9:30 9:30 –10:30
	Coffee break		10:30 – 11
	Labeling of blood & food samples in the field & at the CPHL. (Attachment of labels)	Dr. Nadera	11 – 11:30
	Questionnaire Completion of cover page & completion of house hold page Survey methods & Principles Review answers & check for mistakes	Ms. Batoul	11:30 – 13

Day 3: Laboratory part of the survey

Sunday 14 / 3/2010	Procedures for collecting blood & food samples Supplies for collecting , preserving & chipping blood & food samples Bio safety measure & management of post-exposure to needle stick Management & analysis of blood & food samples	Dr. Aktham	9 – 11
	Coffee break		11 – 11:30
	Quality assurance & CDC EQAS Reporting of results	Dr. Nadera	11:30 – 12:30
	Discussion with Supervisors & all team members	All	12:30 – 2

Day 4: Field pilot

Day & date	Subject	Instructors	Time
Monday 15/ 3/2010	Each team will visit field site, interview at least 5 families, collect blood & ship to headquarters where the blood will be processed (at least for CBC).	All staff	9 – 14

Day 5: Discussion of day 4 & final field preparation

Tuesday 16/3/2010	Discussion of day 5 & final field preparation	All instructors	9-13

Appendix VII: Sampling Weights used in the 2010 Micronutrient Survey

Sampling probability was calculated separately for each sampling stage and for each cluster. The following notations are used:

Where,

P_{1hi} = First stage sampling probability of the i^{th} cluster in stratum *h*.

P_{2hi} = Second stage sampling probability within the i^{th} cluster (household selection).

Let $\boldsymbol{a_h}$ be the number of cluster selected in stratum *h*, $\boldsymbol{M_{hi}}$ the number of households according to the sampling frame in the i^{th} cluster, and $\sum \boldsymbol{M_{hi}}$ the total number of households in the stratum.

The probability of selecting the i^{th} cluster in the 2010 Micronutrient Survey sample is calculated as follows:

Let $\boldsymbol{L_{hi}}$ be the number of households listed in the household listing operation in cluster *i* in stratum *h*, and let g_{hi} be the number of households selected in the cluster. The second stage's selection probability for each household in the cluster is calculated as follows:

The overall selection probability of each household in cluster *i* in stratum *h*, is therefore the product of the two stages selection probabilities:

The sampling weight for each household in cluster *i* of stratum *h* is the inverse of its overall selection probability:

A spreadsheet containing all sampling parameters and selection probabilities was prepared to facilitate the calculation of sampling weights. Sampling weights were adjusted for household non-response and for individual non-response. Therefore, three sets of weights were calculated; one set for the households, one set for the women, and one set for the children. The difference of the household weight and the individual weight was introduced by the women non-response and child non-response. The final weights were normalized in order to give the total number of unweighted cases equal to the total number of weighted cases at the national level, for both household weights and individual weights. A table of the weights used in the 2010 Micronutrient Survey is included below.

Weights of household, woman, and child by cluster

2010 Survey Cluster #	HH weight	Woman weight	Child weight	2010 Survey Cluster #	HH weight	Woman weight	Child weight
1	1.318576	3.15576834	0	84	0.90858	1.35908	0.96819
2	1.019836	1.79469821	1.08674	85	0.76990	1.15164	0.82041
3	0.820794	1.22776135	0.87463	86	0.84368	1.26200	0.89903
4	5.767559	28.7574618	6.14592	87	0.81222	1.21493	0.86550
5	2.797266	11.1578952	2.98077	88	0.90499	1.45784	0.96436
6	2.048503	3.53560927	2.18288	89	0.95401	1.55112	1.01659
7	2.003551	3.42509179	0	90	0.88843	1.39539	1.01954
8	1.394356	2.43332538	1.48582	91	0.75526	1.12973	0.80480
9	1.759287	3.50877207	1.87469	92	0.84152	1.25877	0.89673
10	1.932045	3.46799445	0	93	0.91684	1.37143	0.97699
11	1.695313	2.53588527	1.80652	94	1.03675	1.67009	1.10476
12	1.723805	2.57850519	0	95	0.88227	1.39303	0.94014
13	0.956330	1.43049938	1.01906	96	0.74570	1.11544	0.79462
14	0.932422	1.50202435	1.13553	97	0.99595	1.71896	1.06129
15	0.688557	1.17709663	0.73372	98	0.83908	1.25511	0.89412
16	1.107828	1.65711315	1.18050	99	0.73829	1.10435	0.78672
17	0.592836	0.88677716	0.63172	100	0.99217	1.48410	1.05725
18	1.222202	1.93573732	1.30238	101	1.51396	2.53104	1.61328
19	0.885633	1.32475010	0.94373	102	0.92997	1.39106	0.99097
20	1.070232	1.73428369	1.14044	103	0.75793	1.13374	0.80766
21	1.054976	1.57805597	1.31154	104	0.59065	1.17802	0.62940
22	1.308398	2.51631104	1.39423	105	0.84993	1.27134	0.90569
23	1.056818	1.73889276	1.12614	106	0.92250	1.37989	0.98302
24	1.142074	1.70833916	1.21699	107	0.96591	1.51051	1.02928
25	0.508068	0.7599801	0.54139	108	0.80516	1.25674	0.85798
26	0.421370	0.72726263	0.44901	109	0.81174	1.21422	0.86499
27	0.834312	1.24798268	0.88904	110	0.90079	1.34743	0.95989
28	1.041183	1.55742400	1.10948	111	0.85087	1.27275	0.90669
29	2.010496	7.51835887	0	112	0.92250	1.45252	0.98302
30	0.837706	1.42013445	0.89266	113	0.89183	1.33402	0.95033
31	1.217896	1.82175618	1.29779	114	0.84334	1.26149	0.89867
32	0.878713	1.64299800	0.93635	115	1.33524	1.99728	1.42284
33	2.258166	5.40450145	0	116	1.07740	1.61160	1.14808
34	1.514316	2.26514658	0	117	0.89377	1.33692	0.95240
35	1.796820	3.13567624	2.29763	118	0.81496	1.21903	0.86842
36	1.675413	2.50611962	1.78532	119	1.05323	1.57544	1.12232
37	1.311609	1.96193364	1.39765	120	1.54323	2.41832	1.64447
38	0.861341	1.88967180	0.91784	121	0.86237	1.28995	0.91894
39	0.726012	1.48088886	0.77364	122	0.84171	1.25905	0.89693
40	0.710606	1.06294039	0.75722	123	0.85581	1.28013	0.91195
41	2.054683	3.75642546	2.18947	124	0.85979	1.28609	0.91619
42	0.718904	1.07535314	0.76606	125	0.78449	1.17346	0.83595
43	1.108729	1.65846151	1.18146	126	0.85352	1.27672	0.90952
44	0.647826	0.96903292	0.69032	127	0.83268	1.24555	0.88731
45	1.276665	1.90966315	0	128	1.08081	1.61671	1.15172

Weights of household, woman, and child by cluster (continued)

2010 Survey Cluster #	HH weight	Woman weight	Child weight	2010 Survey Cluster #	HH weight	Woman weight	Child weight
46	0.845839	1.26522544	0.90132	129	1.12698	2.08242	0
47	2.901131	4.33957490	3.09145	130	1.12542	1.68343	1.19925
48	1.025955	1.53464660	1.09326	131	1.22158	1.82726	1.30172
49	1.180483	1.76579302	1.25792	132	0.95962	1.43543	1.02258
50	0.592599	0.95460907	0.63147	133	0.87923	1.31518	0.93691
51	1.593121	2.38302518	1.69763	134	1.17139	1.94688	1.24824
52	0.711441	1.17060886	0	135	1.00285	1.50009	1.17551
53	0.809204	1.21042549	0.86229	136	0.85921	1.28523	0.91558
54	0.848734	1.26955547	0.90441	137	1.02428	2.04287	1.09148
55	1.011505	1.89128983	1.07786	138	1.10534	1.65339	1.17785
56	2.219461	5.21701246	0	139	1.47223	2.20219	1.56881
57	0.967650	1.44743188	1.03113	140	1.08859	1.71880	1.16001
58	0.926187	1.38541091	0.98694	141	1.28670	1.92468	1.37111
59	1.153116	1.72485632	1.22876	142	0.94414	1.41226	1.07315
60	0.794044	1.18774860	0.84613	143	0.97007	1.45106	1.03371
61	0.910355	1.36172867	0.97007	144	0.91731	1.37213	0.97748
62	0.752178	1.12512455	0.80152	145	0.92556	1.38448	0.98628
63	0.964779	1.64930022	1.02807	146	0.87149	1.38506	0.92866
64	12.37230	0	0	147	1.18957	1.77938	1.26761
65	0.899738	1.61501701	0.95876	148	0.67409	1.00832	0.71831
66	17.01080	0	0	149	1.17966	1.76456	1.25704
67	0.492129	0.73613752	0.52441	150	0.82694	1.32531	0.88119
68	0.910722	1.58932374	0.97046	151	0.76995	1.15171	0.82046
69	0.718138	1.14582075	0.84177	152	0.72914	1.30881	0.77698
70	0.923920	1.38202064	1.47679	153	0.87608	1.31046	0.93355
71	0.571676	0.85512527	0.60917	154	1.18741	1.91279	1.26531
72	0.649773	0.97194566	0.69240	155	0.88326	1.32120	0.94120
73	1.301662	2.19043628	1.38705	156	0.95404	1.52222	1.01663
74	0.886016	1.32532236	0.94414	157	0.76209	1.23908	0.81209
75	0.820771	1.22772704	0.87461	158	0.64094	1.01199	0.68298
76	1.030095	1.54083932	1.09767	159	0.95994	1.52565	1.02292
77	0.956411	1.43062124	1.01915	160	0.86034	1.28692	0.91678
78	1.326375	1.98402046	1.41338	161	0.57446	0.85930	0.61215
79	1.124624	3.17755933	1.19840	162	1.11703	1.67089	1.19031
80	0.512328	0.95794068	0.54593	163	0.41212	0.61646	0.43916
81	0.778001	1.16375152	0.82904	164	0.86859	1.29925	0.92557
82	0.820657	1.22755734	0.87449	165	0.69190	1.03495	0.73729
83	0.891602	1.33367796	0.95009	166	0.38105	0.61382	0.40604

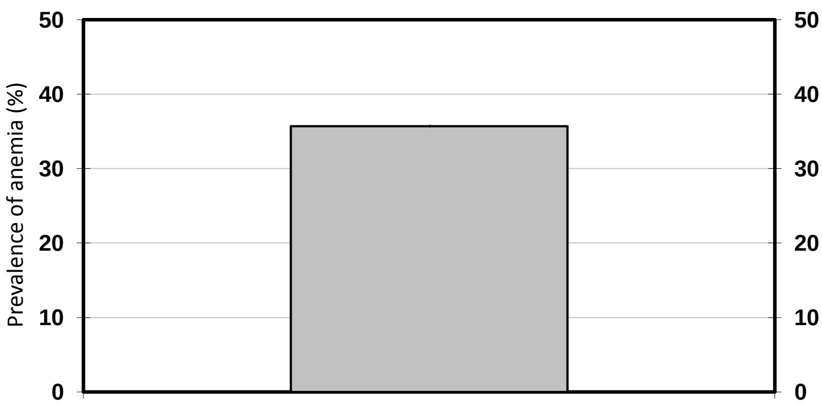
Appendix VIII: Interpretation of Prevalence and Confidence Intervals

Single prevalence or coverage estimate and confidence interval

Surveys are usually performed to estimate prevalence or coverage in a population based on a representative sample. It is known that if the sampling procedures were to be repeated in a population again and again, each survey would provide a different estimate. Therefore, when reviewing the prevalence and coverage estimates in this report, these are *estimates* and unlikely to be the exact true prevalence or coverage in the population.

Example: Based on survey results, the prevalence of anemia among non-pregnant women 15 – 49 years of age is estimated to be 35.7% (see Fig 1).

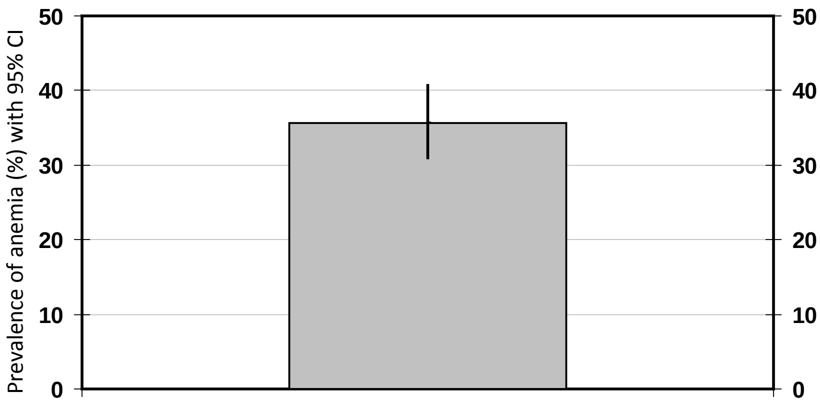
Figure 1. Prevalence of anemia among non-pregnant women of childbearing age (15-49 years of age), Country Z, 2005



What is the true prevalence? This is unknown, but hopefully the true prevalence is somewhere around 35.7%, perhaps it is higher or lower. Confidence intervals provide a range in which the true population prevalence or coverage is likely to be captured. Frequently 95% confidence intervals are provided.

Example: Based on survey results, the prevalence of anemia among non-pregnant women 15 – 49 years of age is estimated to be 35.7% (95% CI: 31.0, 40.7) (see Fig 2).

Figure 2. Prevalence of anemia (with 95% confidence interval) among non-pregnant women of childbearing age (15-49 years of age), Country Z, 2005



The confidence intervals mean that we are 95% confident that the true prevalence of anemia in this population is somewhere from 31.0% to 40.7%. There is a small chance that the true prevalence is less than 31.0% or greater than 40.7%.

What are the factors that affect the width of the confidence interval in surveys? The main factors are: 1) Sample size - in general, the bigger the sample size, the narrower the confidence interval; 2) the design effect - a measure of how much clusters differ from one another in terms of prevalence – the more they differ from each other, the larger the design effect and therefore the wider the confidence interval; and 3) the point estimate - in general, estimates near 50% tend to have a wider confidence interval than estimates closer to 100% or 0%.

Comparing two or more prevalence or coverage estimates with confidence intervals

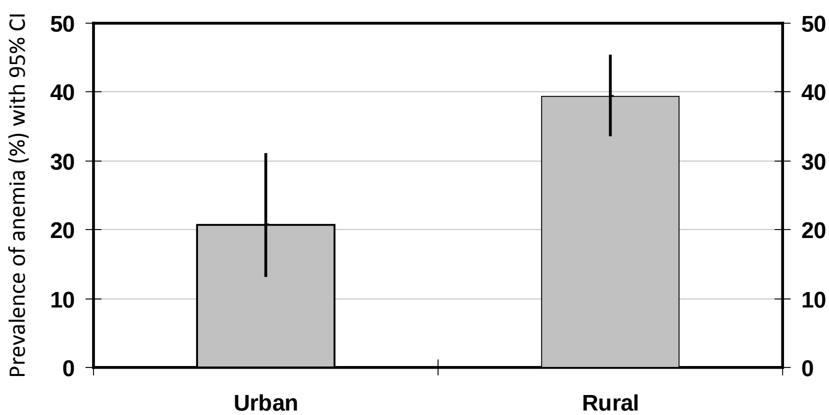
Frequently estimates and confidence intervals are provided in subgroup analyses, such as the prevalence of anemia by urban/rural status, by age groups, etc. How should these be interpreted?

Example: The prevalence of anemia among women in urban areas was 20.7% (95% CI: 13.3, 30.9) and in rural areas, 39.4% (95% CI: 33.8, 45.2) (see Fig 3).

The prevalence of anemia is much lower in women from urban areas (~21%) compared to those living in rural areas (~39%). Note that the confidence interval for women from urban areas is

wider compared to those from rural areas. In this example the primary reason for the wider confidence interval for women from urban areas is that the sample size (n=182 women) is much smaller than the sample size for women from rural areas (n=578 women).
Is there an ***important*** difference between these two prevalence estimates? This requires the investigator to determine what difference is important.

Figure 3. Prevalence of anemia (with 95% confidence interval) among non-pregnant women of childbearing age (15-49 years of age), by urban/rural status, Country Z, 2005



Is there a ***statistically significant*** difference between the prevalence estimates? Determining statistical significance can be tricky when visually comparing two or more estimates with confidence intervals. Here are some rules of thumb:

- If there is no overlap in confidence intervals, then there is a statistically significant difference between the two estimates and the *p*-value will be ≤ 0.01.
- If there is approximately 1/3rd overlap in confidence intervals, the *p*-value will be around 0.05.
- If the point estimate from one group is captured within the confidence interval for the other group, the *p*-value will be ≥ 0.18.

Of course it is possible to calculate the *p*-value using the same statistical software that calculated the confidence intervals; in Fig. 3 the *p*-value is < 0.001.

Note that statistical significance does not necessarily mean public health significance.

Appendix IX: Letter of Ethical Review and Approval

بسم الله الرحمن الرحيم

وزارة الصحة

Translated From Arabic Version

الرقم Dev. Train. 4857

التاريخ 13-8-2009

الموافق

Human Resources Development Director

Dear Sir,,

In reference to your letter no / development /training 4857 dated July 9/2009 concerning the Nutritional National Survey which planned to be conducted by Non-communicable diseases Directorate , underthe title " Evaluation of Women Nutritional Status during reproduction period from age 15- 49 years and for children during the age from 12-59 months , after the implementation of flour fortification program since 2002.

The survey will be funded by the Global Alliance for Improved Nutrition (GAIN) and the (CDC) .

Kindly be informed that the mentioned subject have been approved by the Ethical Committee .

Your co-operation is highly appreciated.

Yours sincerely

(Signed by)
Chairman of Ethical committee

Dr . Abdel hadi Braizat

Jordan
Ministry of Health
Non - Communicable Diseases Directorate

المملكة الأردنية الهاشمية
هاتف ٥٢٠٠٢٣٠ ٦ ٩٦٢+ فاكس ٥٦٨٨٣٧٣ ٦ ٩٦٢+ ص.ب ٨٦ عمان ١١١١٨ الأردن. الموقع الإلكتروني: www.moh.gov.jo

Appendix X: Response and Participation Rates – 2010 Micronutrient Survey

Response and participation rates (unweighted) for the various components of the National Micronutrient Survey in Jordan, 2010.

	North		Central		South		Urban		Rural		Total	
Survey Component	Eligible n	Participated (%)	Eligible n	Participated (%)	Eligible n	Participated (%)	Eligible n	Participated (%)	Eligible n	Participated (%)	Eligible n	Participated (%)
Household[a]												
Questionnaire	540	95.4	1,260	82.7	192	95.8	1,656	85.6	336	96.1	1,992	87.4
Bread Sample[b]	515	100.0	1,042	99.6	184	100.0	1,418	99.7	323	100.0	1,741	99.8
Salt Sample[b]	515	97.7	1,042	98.8	184	99.5	1,418	98.4	323	99.4	1,741	98.6
Women[c]												
Questionnaire	830	98.0	1,496	92.8	282	96.5	2,096	94.1	511	98.0	2,607	94.9
Blood sample[d]	813	84.1	1,388	82.1	272	79.4	1,972	82.0	501	84.2	2,473	82.5
Children[c]												
Questionnaire	360	100.0	645	100.0	107	100.0	846	100.0	231	100.0	1,077	100.0
Blood sample[d]	360	90.0	645	82.8	107	83.2	846	87.9	231	87.9	1,077	87.9

NOTE: Response rate=total number completed out of the total number eligible; Participation rate=total number completed out of the number of eligible respondents successfully contacted.
[a] Eligible households calculated using a target of 1,992 households (166 clusters x 12 households per cluster).
[b] Among households that agreed to complete a questionnaire.
[c] Eligible women and children calculated using the total number of eligible women and children from participating households only.
[d] Among those who completed a questionnaire.

Appendix XI: Design Effects and Inter-cluster Correlation Coefficients for Primary Indicators—Jordan 2010 Micronutrient Survey

Indicator[a]	Target Group	Sample Size	Prevalence (%)[b]	95% Confidence Interval[c]	DEFF[d]	Number of Clusters	Average Cluster Size	ICC[e]
Anemia								
Hb < 12.0 g/dL	Non-pregnant women (15 – 49 y)	2,030	30.6	(28.1, 33.2)	1.577	165	12.303	0.051
Hb < 11.0 g/dL	Children (12 – 59 m)	902	17.0	(14.4, 20.1)	1.316	147	6.130	0.061
Serum Ferritin (sf, Iron Deficiency)								
< 15 µg/L	Non-pregnant women (15 – 49 y)	2,035	35.1	(32.1, 38.0)	1.988	165	12.333	0.087
< 12 µg/L	Children (12 – 59 m)	940	13.7	(11.1, 16.7)	1.562	147	6.395	0.104
Iron Deficiency Anemia (IDA)								
Hb < 12.0 g/dL and sf < 15 µg/L	Non-pregnant women (15 – 49 y)	2,026	19.8	(17.9, 21.8)	1.272	165	12.278	0.024
Hb < 11.0 g/dL and sf < 12 µg/L	Children (12 – 59 m)	898	4.8	(3.6, 6.5)	1.058	147	6.109	0.011
Serum Retinol								
< 0.70 µmol/L	Non-pregnant women (15 – 49 y)	2,032	4.8	(3.8, 6.1)	1.362	165	12.315	0.032
< 0.70 µmol/L	Children (12 – 59 m)	915	18.3	(15.4, 21.6)	1.498	147	6.224	0.095
AGP								
> 1.0 g/L	Non-pregnant women (15 – 49 y)	146	44.1	(36.0, 52.5)	1.052	125	1.168	0.310
> 1.0 g/L	Children (12 – 59 m)	153	49.5	(41.5, 57.5)	1.015	112	1.366	0.041
25-hydroxyvitamin D_3								
< 12.0 ng/mL	Non-pregnant women (15 – 49 y)	2,032	60.3	(57.2, 63.3)	2.037	165	12.315	0.092
< 11.0 ng/mL	Children (12 – 59 m)	915	19.8	(16.6, 23.5)	1.748	147	6.224	0.143
Vitamin B_{12}								
< 100 pg/mL	Non-pregnant women (15 – 49 y)	2,039	0.3	(0.1, 0.6)	0.933	165	1.000	-0.006
100-200 pg/mL	Non-pregnant women (15 – 49 y)	2,039	10.8	(9.1, 12.9)	1.916	165	1.714	0.081
RBC Folate								
< 151 ng/mL	Non-pregnant women (15 – 49 y)	393	13.6	(10.2, 17.8)	1.237	152	1.111	0.150

Continued

Confidence Intervals and Design Effects for Primary Indicators - Jordan 2010 Micronutrient Survey (*continued*).

Indicator[a]	Target Group	Sample Size	Prevalence (%)[b]	95% Confidence Interval[c]	DEFF[d]	Number of Clusters	Average Cluster Size	ICC[e]
Stunting								
Height-for-age z-score (HAZ) < -2 SD	Children (12 – 59 m)	1,013	10.8	(8.6, 13.6)	1.695	150	6.753	0.121
Underweight								
Weight-for-age z-score (WAZ) < -2 SD	Children (12 – 59 m)	1,023	2.5	(1.6, 3.9)	1.350	150	6.820	0.060
Wasting								
Weight-for-height z-score (WHZ) < -2 SD	Children (12 – 59 m)	1,011	3.5	(2.1, 5.7)	2.314	150	6.740	0.229
Overweight								
BMI-for-age z-score (BAZ) > 2 SD	Children (12 – 59 m)	1,019	8.8	(6.6, 11.6)	1.987	150	6.793	0.170
Ever Received a vitamin A Capsule	Children (12 – 59 m)	1,077	16.9	(13.6, 20.8)	2.571	154	6.994	0.262
Fortified Bread in Household	Household	1,737	44.1	(40.2, 48.0)	2.756	167	10.401	0.187
Iodized Salt in Household	Household	1,731	66.5	(63.6, 69.3)	1.600	167	10.365	0.064

Note: DEFF=design effect; ICC=inter-cluster correlation coefficient; Hb=hemoglobin; AGP=α_1-acid glycoprotein; RBC=red blood cell.
[a] Cut-offs for micronutrient deficiencies as described in Chapter 2.
[b] Percentages weighted for non-response.
[c] Confidence intervals adjusted for cluster sampling design
[d] The design effect or DEFF is the ratio of the actual variance to the variance computed under the assumption of simple random sampling, thus calculating the loss of effectiveness by the use of cluster sampling, instead of simple random sampling; the larger the DEFF, the greater the variance.
[e] ICC=(DEFF-1)/(average cluster size - 1).

Appendix XII: Performance Assessment of the Iron Spot Test for Bread

Iron spot tests (IST) are used extensively in the flour industry for internal quality control for flour fortification. While use of the IST on flour has been validated, this test has not been validated for use on bread. Therefore, a small study was undertaken to assess the performance of the IST as a qualitative method for assessing the presence of iron in bread made from iron-fortified wheat flour commonly consumed in Jordan.

CPHL performed the IST on all collected bread samples. For this assessment, a subsample of bread was selected from the first household which provided a sufficient amount of bread (> 200 g) in every third cluster (50 samples). Approximately 100 g of the bread (half of the bread collected) was separated from the original sample and shipped to the Royal Scientific Society (RSS) for quantitative spectrophotometric analysis of iron. The RSS used the AACC atomic absorption spectrophotometric method 40-70 for the quantification of iron in cereals and cereal products in the 50 bread samples (AACC, Method 40-70, 1999). Both the CPHL and RSS laboratories were blinded to the results of the other laboratory tests.

While the spectrophotometric test measures natural and added iron, the IST only measures added iron. Arabic bread from white flour contains approximately 15.0 ppm iron (Quail, 1996). Thus, performance measures were calculated for a cut-point of 15.0 ppm, where spectrophotometric results greater than 15.0 parts per million (ppm) suggest the presence of added iron while results 15.0 ppm or below suggest that no iron was added.

For the 50 bread samples selected for the performance assessment, the IST resulted in 66% positive (n=33, iron present) and 34% negative (n=17, iron absent) samples. Spectrophotometric testing yielded a range of 10.4 to 41.0 parts per million (ppm) (mean=23.3, SD=7.7) iron. The IST showed a sensitivity of 76.6% (95% CI: 62.3%, 86.9%), a specificity of 100.0% (95% CI: 64.6%, 100.0%), a positive predictive value (PPV) of 100.0% (95% CI: 89.6%, 100.0%), and a negative predictive value (NPV) of 41.2% (95% CI: 21.6%, 64.0%). Calculations are shown in the table below.

These results suggest that of the bread samples with iron content ≥ 15.0 ppm per the spectrophotometric method, almost 77% tested positive per the IST method (sensitivity). Alternatively, of the bread samples that showed an iron content < 15.0 ppm per the spectrophotometric method, 100% tested negative for added iron per the IST method (specificity). At the same time, of the bread samples that tested positive for added iron per the IST method, 100.0% showed iron content ≥ 15.0 ppm per the spectrophotometric method (PPV). Lastly, of the bread samples that tested negative for added iron per the IST method, only 41.2% showed iron content < 15.0 ppm per spectrophotometry (NPV).

Performance measures of the iron spot test compared to the spectrophotometric method for detecting iron in bread.

Iron Spot Test	**Spectrophotometric Method** Iron ≥ 15.0	Iron < 15.0	
Added iron present (positive)	33	0	Positive Predictive Value (PPV) 33/(33+0)*100 = 100.0% (95% CI: 91.3%, 100.0%)
Added iron not present (negative)	10	7	Negative Predictive Value (NPV) 7/(10+7)*100 = 41.2% (95% CI: 20.1%, 65.0%)
	Sensitivity 33/(33+10)*100 = 76.7% (95% CI: 62.5%, 87.5%)	Specificity 7/(0+7)*100 = 100.0% (95% CI: 65.2%, 100.0%)	N= 50

Note: Confidence intervals were calculated using the Mid-P Exact method for a single proportion in Open Epi (http://openepi.com/OE2.3/Menu/OpenEpiMenu.htm).

The measurement by both the IST and the spectrophotometric methods on the 50 bread samples allowed for the comparison of the methods and assessment of the performance of the spot method for determining the presence of iron in bread samples. The results of the assessment show that the IST generally performs well as a qualitative indicator of added ferrous sulfate in Jordanian bread. However, the low NPV warrants concern over the potential of the IST to produce false negatives in bread.

References

Quail KJ. Arabic Bread Production. Bread Research Institute of Australia, North Ryde. AACC. St. Paul Minnesota: 1996;135.

Appendix XIII: Jordan 2010 Micronutrient Survey Anthropometry Results for the WHO Global Database on Child Growth and Malnutrition

GLOBAL DATABASE ON CHILD GROWTH AND MALNUTRITION	
	Ref. No.:
Country:	Jordan
Author:	Ministry of Health, Jordan / Global Alliance for Improved Nutrition (GAIN) / US Centers for Disease Control and Prevention (CDC)
Reference:	
Administrative level:	National
Month and year survey:	March – April, 2010

AGE GROUPS	N	WEIGHT/AGE (%)				HEIGHT/AGE (%)				WEIGHT/HEIGHT (%)							BMI/AGE (%)							NOTES
(Months)		< -3 SD	< -2 SD [1]	Mean z-score	SD z-score	< -3 SD	< -2 SD [1]	Mean z-score	SD z-score	< -3 SD	< -2 SD [1]	> + 1 SD [1]	> + 2 SD [1]	> + 3 SD	Mean z-score	SD z-score	< -3 SD	< -2 SD [1]	> + 1 SD [1]	> + 2 SD [1]	> + 3 SD	Mean z-score	SD z-score	Standard deviations are not adjusted for survey design.
TOTAL (12-59)	1,023	0.6	2.6	0.13	1.08	3.3	10.8	-0.30	1.57	1.7	3.6	27.4	7.9	1.6	0.39	1.18	2.0	3.9	30.5	8.8	1.8	0.45	1.25	10 missing HAZ 12 missing WHZ 4 missing BAZ
0-5																								
6-11																								
12-23	250	0.4	1.7	0.35	1.11	2.4	7.9	-0.16	1.53	0.0	2.6	31.6	10.3	1.5	0.55	1.10	0.8	4.2	37.0	10.4	1.5	0.60	1.21	7 missing HAZ 1 missing WHZ 1 missing BAZ
24-35	246	0.2	2.1	0.10	1.01	5.7	14.0	-0.50	1.64	2.1	3.9	29.6	8.7	2.0	0.46	1.24	3.2	3.9	34.1	10.3	3.7	0.56	1.40	2 missing HAZ
36-47	243	1.3	2.8	-0.05	1.05	3.2	12.4	-0.47	1.60	2.4	3.2	24.9	8.5	0.7	0.35	1.20	1.5	3.3	26.1	9.1	1.2	0.42	1.21	1 missing HAZ 2 missing WHZ 2 missing BAZ
48-59	284	0.6	3.2	0.10	1.12	2.2	9.3	-0.11	1.48	2.2	4.1	23.7	4.5	2.2	0.23	1.17	2.4	4.2	25.5	5.7	0.9	0.25	1.17	9 missing WHZ 1 missing BAZ

AGE GROUPS	N	WEIGHT/AGE (%)				HEIGHT/AGE (%)				WEIGHT/HEIGHT (%)							BMI/AGE (%)							NOTES
(Months)		< -3 SD	< -2 SD [1]	Mean z-score	SD z-score	< -3 SD	< -2 SD [1]	Mean z-score	SD z-score	< -3 SD	< -2 SD [1]	> + 1 SD [1]	> + 2 SD [1]	> + 3 SD	Mean z-score	SD z-score	< -3 SD	< -2 SD [1]	> + 1 SD [1]	> + 2 SD [1]	> + 3 SD	Mean z-score	SD z-score	
Male (12-59)	529	0.8	3.4	0.10	1.11	4.1	12.1	-0.36	1.56	2.1	3.9	29.0	8.4	1.6	0.40	1.22	2.0	4.1	33.5	9.2	2.5	0.48	1.29	4 missing HAZ 7 missing WHZ 4 missing BAZ
0-5																								
6-11																								
12-23	126	0.0	2.4	0.41	1.18	2.1	8.7	-0.10	1.58	0.0	2.5	37.2	13.1	2.0	0.66	1.12	0.0	3.8	43.0	11.4	2.0	0.72	1.21	2 missing HAZ 1 missing WHZ 1 missing BAZ
24-35	139	0.3	3.1	0.00	1.03	8.0	17.2	-0.64	1.71	2.8	4.5	31.2	0.0	2.8	0.45	1.34	3.9	4.5	36.7	11.0	5.1	0.56	1.53	1 missing HAZ
36-47	119	1.2	3.9	-0.04	1.07	5.0	13.7	-0.61	1.59	2.7	2.7	29.3	10.7	1.0	0.49	1.21	0.7	2.1	33.6	10.9	1.9	0.62	1.16	1 missing HAZ 1 missing WHZ 2 missing BAZ
48-59	145	1.7	4.1	0.01	1.10	1.5	8.7	-0.10	1.30	3.0	5.6	18.8	1.5	0.7	0.04	1.14	2.9	5.4	21.6	3.9	0.7	0.08	1.16	5 missing WHZ 1 missing BAZ

AGE GROUPS	N	WEIGHT/AGE (%)				HEIGHT/AGE (%)				WEIGHT/HEIGHT (%)							BMI/AGE (%)							NOTES
(Months)		< -3 SD	< -2 SD [1]	Mean z-score	SD z-score	< -3 SD	< -2 SD [1]	Mean z-score	SD z-score	< -3 SD	< -2 SD [1]	> + 1 SD [1]	> + 2 SD [1]	> + 3 SD	Mean z-score	SD z-score	< -3 SD	< -2 SD [1]	> + 1 SD [1]	> + 2 SD [1]	> + 3 SD	Mean z-score	SD z-score	
Female (12-59)	494	0.4	1.5	0.16	1.56	2.5	9.6	-0.24	1.57	1.2	3.0	25.6	7.4	1.6	0.38	1.14	2.1	3.8	27.4	8.4	1.1	0.42	1.21	6 missing HAZ 5 missing WHZ
0-5																								
6-11																								
12-23	124	0.9	0.9	0.28	1.03	2.7	7.0	-0.22	1.48	0.0	2.7	25.6	7.4	0.9	0.43	1.10	1.7	4.6	30.6	9.3	0.9	0.48	1.20	5 missing HAZ
24-35	107	0.0	0.9	0.22	0.97	2.8	9.9	-0.33	1.53	1.2	3.1	27.5	8.3	0.9	0.47	1.10	2.4	3.1	30.8	9.4	1.9	0.56	1.22	1 missing HAZ
36-47	124	0.0	1.7	-0.05	1.03	1.7	11.2	-0.34	1.61	2.2	3.7	20.9	6.5	0.6	0.22	1.18	2.2	4.3	19.4	7.5	0.5	0.24	1.24	1 missing WHZ
48-59	139	0.9	2.2	0.19	1.13	2.9	10.0	-0.11	1.65	1.5	2.6	28.4	7.4	3.6	0.41	1.19	2.0	3.1	29.3	7.6	1.2	0.41	1.17	4 missing WHZ

	N	WEIGHT/AGE (%)				HEIGHT/AGE (%)				WEIGHT/HEIGHT (%)							BMI/AGE (%)							NOTES
		< -3 SD	< -2 SD [1]	Mean z-score	SD z-score	< -3 SD	< -2 SD [1]	Mean z-score	SD z-score	< -3 SD	< -2 SD [1]	> + 1 SD [1]	> + 2 SD [1]	> + 3 SD	Mean z-score	SD z-score	< -3 SD	< -2 SD [1]	> + 1 SD [1]	> + 2 SD [1]	> + 3 SD	Mean z-score	SD z-score	
RESIDENCE																								
Urban	806	0.7	2.6	0.14	1.10	2.9	9.6	-0.22	1.56	2.1	3.8	26.6	7.6	1.4	0.35	1.20	2.5	4.3	29.3	8.3	1.3	0.40	1.26	7 missing HAZ 10 missing WHZ 4 missing BAZ
Rural	217	0.2	1.8	0.06	1.03	4.9	15.7	-0.61	1.56	0.0	2.1	30.4	9.1	2.4	0.57	1.10	0.0	2.4	35.6	10.6	4.0	0.65	1.21	3 missing HAZ 2 missing WHZ
REGIONS																								
North	336	1.3	4.3	-0.05	1.12	4.6	12.0	-0.47	1.44	3.4	4.9	23.8	6.7	2.1	0.25	1.25	3.2	4.5	25.3	8.1	1.9	0.34	1.29	4 missing HAZ 4 missing WHZ 3 missing BAZ
Central	593	0.2	1.2	0.23	1.03	2.7	9.8	-0.21	1.61	0.7	2.6	29.0	8.7	1.3	0.48	1.13	1.4	3.5	33.4	8.5	1.7	0.51	1.22	6 missing HAZ 8 missing WHZ 1 missing BAZ
South	94	0.5	3.3	0.18	1.15	2.2	13.7	-0.25	1.67	1.1	3.6	31.4	7.8	1.4	0.41	1.25	1.7	4.1	33.2	14.4	2.5	0.50	1.32	

NOTES

[1] % < -2SD includes %< -3SD; %> + 2SD includes > + 3SD; %> + 1SD includes %> + 2SD and %> + 3SD.