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CONTENTS

ABBREVIATIONS 4
EXECUTIVE SUMMARY 5
BACKGROUND 9
I. OBJECTIVES AND METHODOLOGY 10
A. Objectives 10
B. Methodology 11
II. RESULTS 14
A. Anemia rate: haemoglobin level in whole capillary blood samples 14
B. Ferritin level in blood serum and iron depletion 17
C. Folic acid level in blood plasma and folic acid deficiency 19
D. Urine iodine excretion 21
E. Awareness and knowledge of women about IDA/FF and IDD/SI, and use of fortified food 25
III. DISCUSSION 27
RECOMMENDATIONS 29

ABBREVIATIONS

ACT	Asian countries in transition
ADB	Asian Development Bank
AZER	Azerbaijan
CAR	Central Asian Republics
CARK	Central Asian Republics and Kazakhstan
FSU	Former Soviet Union
ID	Iron deficiency
IDA	Iron deficiency anemia
IDD	Iodine deficiency disorders
JFPR	Japan Fund for Poverty Reduction
FF	Fortified flour
Fn	Ferritin
FAD	Folic acid deficiency
Hb	Haemoglobin
KAN	Kazakh Academy of Nutrition
KAZ	Kazakhstan
KYR	The Kyrgyz Republic
MoH	Ministry of Health
MON	Mongolia
RCAO	Regional Coordination and Administration Office
TAJ	Tajikistan
UNICEF	United Nations Children's Fund
UNICEF CARK	Regional Office of United Nations Children's Fund for CARK
USI	Universal Salt Iodization
UI	Urine iodine
UZB	Uzbekistan
WHO	World Health Organization
WFF	Wheat Flour Fortification

EXECUTIVE SUMMARY

1. The Almaty 2001 Forum on JFPR 9005 Project recommended carrying out the Sentinel Study (SS) in order to evaluate the effectiveness of the Project implementation in pilot regions in all six countries (Azerbaijan, Kazakhstan, The Kyrgyz Republic, Mongolia, Tajikistan and Uzbekistan) which were involved in the Project. The first round of SS was carried out in December 2002 – April 2003 to collect the baseline data on IDA/IDD, and Iron/Iodine/Folic acid status in pilot regions before implementation of food fortification program in the countries. The second round of SS was carried out in May–August 2004 with the same people in households of pilot regions of each country 12 months after the beginning of a wide range of food fortification, and the same data on IDA/IDD, and Iron/Iodine/Folic acid status were collected. The SS was carried out jointly by the Country Teams and Kazakh Academy of Nutrition. The Asian Development Bank and UNICEF supported the study.

2. The main objective of the SS was to evaluate the overall effectiveness of the implementation of the food fortification program (salt iodization and wheat flour fortification) in terms of improving the micronutrient status of selected families in pilot regions of six countries. The sub-objectives of the study were the following:

a) To record the baseline data on iron, folic acid, and iodine status of selected groups of families in which the population was expected to have access to iodized salt and fortified wheat flour within twelve months of the initial survey, and in which improvement in fortified salt and flour distribution is expected. The initial round of SS for obtaining baseline data was to be completed before the first improvements in salt iodization and flour fortification in a country.

b) To obtain data on the iron, folic acid, and iodine status of the same selected group of families in each of the six participating countries 12 months after the beginning of a wide range of food fortification and the initial round of the survey.

c) To evaluate the impact of salt iodization and wheat flour fortification program on iron, folic acid, and iodine status of a selected group of families in each of the six countries, by comparing the data received in two different rounds of SS.

3. The sample was designed to give estimates of iron, iodine and folic acid status of children ranging from 2 to15 years of age, and women in reproductive age, living in selected households in pilot regions. 80 children between 2-15 years old, and 40 women in reproductive age, living in 40 households, were sampled in each country (women were included only in the second round of the study). So, the SS was not a population-based study, and it was restricted to 40 households and 120 individuals in a selected community in a pilot region in each country. A total of 720 subjects (480 children aged 2-15 and 240 women in childbearing age) in six countries were targeted. Among all children and women the following analyses were performed (i) haemoglobin levels in capillary blood; (ii) ferritin levels in venous blood serum; (iii) folic acid levels in venous blood plasma; and (iv) urine iodine excretion. In households, edible salt was tested for iodine by iodine checker; flour samples were collected and analyzed for iron by spot test; women were interviewed for us to find what what their knowledge is on fortified food products, availability and use of iodized salt and fortified wheat flour.

4. According to the results obtained after interviewing women in households in the second round of SS, 92,3% of women in Uzbekistan, 48,8% - in The Kyrgyz Republic, 46,2% - in Tajikistan, 2,5% - in Mongolia, and none of the women in Azerbaijan and Kazakhstan answered that they used fortified flour products in their home. The duration of using fortified flour products was different in all countries: 12 months in Tajikistan, 11,5 months in Uzbekistan, 8,1 months in the The Kyrgyz Republic, and 6 months in Mongolia. The results of spot testing of flour for iron reveal that flour was fortified in 80% of households in Azerbaijan, 79% - in Uzbekistan, 10% - in Mongolia, 2,5 % in Kazakhstan and Tajikistan (flour in the The Kyrgyz Republic was not tested).

5. Baseline data on anemia prevalence among children with significant differences in the countries were collected in the first round of SS: 70% in Tajikistan, 50% in Kazakhstan, 31,4% in Uzbekistan, 20,9% in Azerbaijan, 15% in the The Kyrgyz Republic, and 12,5% in Mongolia. The prevalence of anemia among children in 2004 was the following: 37,5% in Kazakhstan, 25% in Azerbaijan, 24,1% in Tajikistan, 10,5% in Uzbekistan, 8,8% in Mongolia, and 7,9% in the The Kyrgyz Republic.

6. Threefold decrease of anemia prevalence among children in Uzbekistan and Tajikistan, and twofold decrease in The Kyrgyz Republic was revealed between the results of two rounds of sentinel study. The rate of moderate anemia in Tajikistan has decreased 7 times, and in Uzbekistan and The Kyrgyz Republic moderate anemia was not found in 2004. These results correspond with the data on availability of fortified flour in sampled households in Uzbekistan and The Kyrgyz Republic. The dramatic decrease of anemia rate among children in Tajikistan was perhaps caused by the implementation of the iron supplementation program (74,4% of children and women had taken iron tablets during last 12 months, prior to the second round of SS), and by periodical distribution of flour fortified with iron in the framework of some humanitarian aid.

7. No significant differences in the anemia rate among children between the two rounds of SS were found in other countries. These results correspond with the data on the low availability of fortified flour in sampled households in Kazakhstan and Mongolia in 2004. Apparently, fortified flour in Azerbaijan was used during a short period of time, and it was not enough to decrease the anemia rate.

8. The anemia rate among women was higher than among children in certain countries in 2004. Perhaps, this difference is caused by the fact, that many women in these countries have also many children. Anemia prevalence among women was characterized by significant differences in countries as well: 69% in Azerbaijan, 57,5% in Kazakhstan, 51,3% in Uzbekistan, 33,3% in the The Kyrgyz Republic and Tajikistan, and 10% in Mongolia. Obviously, the achieved coverage and duration of using fortified flour was not sufficient to decrease the anemia rate among women.

9. The prevalence of anemia among women in reproductive age in Azerbaijan, Kazakhstan and Uzbekistan in 2004 exceeded the 40% cut-off suggested by the World Health Organization, UNICEF and United Nations University, thus indicating that anemia was still indeed a public health priority for these countries. The levels of anemia prevalence among women in the The Kyrgyz Republic and Tajikistan place these countries in the medium-to-high risk, and in Mongolia – mild-to medium risk categories. The levels of anemia prevalence among children in Azerbaijan, Kazakhstan and Tajikistan in 2004 place these countries in the medium-to-high risk, and in the The Kyrgyz Republic, Mongolia and Uzbekistan – mild-to medium risk categories. Mild anemia was a prevalent form both among children and women in all the countries in 2004. Severe anemia was not found at all, and moderate anemia was

found only in 3,8% of the children in Kazakhstan and Tajikistan, and in 1,3% of the children in Azerbaijan in 2004.

10. The prevalence of low serum ferritin level among children decreased only in Uzbekistan between the two rounds of SS. In all other countries the prevalence of low ferritin level in blood serum of children increased during this period of time. So, only in Uzbekistan was iron status significantly improved between the two rounds of SS. The rate of low ferritin level in blood serum of women was quite high in all the countries in 2004: 50,0% in Azerbaijan, 51,3% in the The Kyrgyz Republic, 46,4% in Kazakhstan, 43,6% in Tajikistan, 28,2% in Uzbekistan, and 25% in Mongolia. The low availability of fortified flour in sampled households in most countries and achieved short duration of using fortified flour were not sufficient for improving the iron status both in children and women.

11. Baseline data on the high prevalence of moderate and severe forms of folic acid deficiency (FAD) among children with significant differences in the participating countries were collected in the first round of SS: 97,6% in The Kyrgyz Republic, 85% in Azerbaijan and Mongolia, 83,3% in Kazakhstan, 57,5% in Tajikistan, and 16,3% in Uzbekistan. The prevalence of FAD decreased in Azerbaijan, The Kyrgyz Republic, Mongolia and Uzbekistan between the two rounds of the sentinel study. These results correspond with the data on availability of fortified flour in sampled households in Azerbaijan, Uzbekistan and the The Kyrgyz Republic in 2004. Improving the dietary intake of folic acid, perhaps, has caused the decrease of FAD rate in Mongolia. No statistically significant changes in the folic acid status in children were found in Kazakhstan and Tajikistan between the two rounds of SS.

12. The prevalence of FAD among women was lower in comparison with the appropriate data for children in Azerbaijan, Kazakhstan, The Kyrgyz Republic and Tajikistan in the 2004 study. On the contrary, in Uzbekistan and Mongolia the rate of FAD was higher among women than among children.

13. According to the results obtained from interviewing women in households in the second round of SS, 100% of women in the The Kyrgyz Republic, 92,3% - in Uzbekistan, 87,5% - in Mongolia, 82,5% - in Kazakhstan, 79,5% - in Tajikistan, and 47,5% of women in Azerbaijan answered that they used iodized salt in their homes. These results are quite close to the results of salt testing for iodine by salt checker, except for Azerbaijan, where salt was iodized in 100% of the households. Salt was iodized in 88,7% of the households in Uzbekistan, 82,5% - in Kazakhstan, 77,5% - in Tajikistan, and 72,5% - in Mongolia (salt in the The Kyrgyz Republic was not tested).

14. Baseline data on median levels of iodine (in μg/L) in urine samples of children with significant differences in the participating countries were collected in the first round of SS in 2002-2003: 154,7 in Azerbaijan, 109,3 in Uzbekistan, 104,5 in Kazakhstan, 78,8 in the The Kyrgyz Republic, 68,8 in Mongolia, and 29,1 in Tajikistan. Two-to-threefold increasing of median levels of urine iodine between two rounds of sentinel study was found in all the countries except Mongolia. These results correspond with the data on availability of iodized salt in sampled households in 2004. Median levels of iodine in urine samples both in children and women were still low (<100 μg/L) in Mongolia and Tajikistan in 2004. The levels of urine iodine excretion by all children in Azerbaijan and Uzbekistan was >100 μg/L in 2004. More than half the children studied had low excretion of urinary iodine (<100 μg/L) in Mongolia (63,8%) and Tajikistan (56,2%) in 2004; these percentages were much less in the The Kyrgyz Republic (25%) and Kazakhstan (7,5%). A similar situation was found among women. Mild-to-moderate forms of low excretion of urinary iodine were prevalent both among children and women in 2004.

15. It was found that 35% of the children and 26% of the women in Uzbekistan, and 69% of the children and 92% of the women in Azerbaijan had very high levels of urine iodine excretion (>300 μg/L) in 2004. These findings can be considered as a sort of alarm on possible iodine overload in these countries.

16. The awareness of women on salt iodization and flour fortification was good in all countries except Azerbaijan. 57,5% of the women in Azerbaijan and the majority of the respondents (90-100 per cent) in other countries were aware of iodized salt; 12,5% of women in Azerbaijan and the majority of the respondents (62-100 per cent) in other countries were aware of fortified wheat flour. The rest of the women were unaware of iodized salt/fortified flour or did not understand what fortification meant.

BACKGROUND

1. The negative consequences of the transition period for the republics of the former USSR, alongside with the certain specificity, are characterized by the generation of many problems. They are connected with essential aggravation of health and nutrition problems among the population, and with increasing the prevalence of alimentary-dependent diseases, especially some micronutrients deficiencies, in particular, iron-deficiency anemia (IDA), iodine-deficiency disorders (IDD) and lack of some vitamins. These forms of micronutrient deficiencies contribute to high infant and maternal morbidity and mortality rates, retardation in physical and mental development of children, especially among the poor parts of the population, as well as a deterioration of social-economic parameters and increase of poverty level.

2. The Japan Fund for Poverty Reduction (JFPR) designed JFPR 9005 Project "Improving Nutrition of Poor Mothers and Children in Asian Countries in Transition". The JFPR 9005 Project is being implemented in mutual collaboration among Asian Development Bank (ADB), UNICEF CARK (Central Asian Republics and Kazakhstan), Kazakh Academy of Nutrition (KAN), and county teams of Kazakhstan, The Kyrgyz Republic, Tajikistan, Uzbekistan, Azerbaijan and Mongolia. The realization of the Project is expected to contribute to the elimination or reduction of the prevalence of IDD, IDA and deficiency of vitamins among population, especially in the poor parts of population in these countries. The Project consists of two main parts of universal salt iodization (USI) by potassium iodate, and wheat flour fortification (WFF) by iron and vitamin-mineral premix. This vitamin-mineral premix consists of the following six micronutrients: iron, zinc, thiamin, riboflavin, folic acid and niacin.

3. The Almaty 2001 Forum on JFPR 9005 Project has recommended carrying out the Sentinel Study (SS) in order to evaluate the effectiveness of the Project implementation in pilot regions in all of the six countries which are involved in the Project. KAN, jointly with Nevin Scrimshaw, elaborated the proposal of SS. The first round of SS was carried out in December 2002 – April 2003 for collecting baseline data on IDA/IDD, and Iron/Iodine/Folic acid status in pilot regions before implementation of the food fortification program in the countries. The second round of SS was carried out in May–August 2004 with the same people in households of pilot regions of each country, 12 months after the beginning of a wide range of food fortification, and the same data on IDA/IDD, and Iron/Iodine/Folic acid status were collected. SS was carried out jointly by the country teams and KAN.

4. ADB and UNICEF supported the study. The children in all the countries were included in both rounds of SS, and women – only in the second round of SS.

5. The SS was designed to evaluate the effectiveness of JFPR 9005 Program implementation in pilot regions. The SS was not a population-based study, and it was restricted to 40 households and 120 individuals in a selected community in a pilot region in each country. The second round of SS in each country was carried out in the same households, and with the same children who were sampled in the first round of SS in specific pilot regions. Besides that, in the second round of SS, women in the same households were interviewed, and their blood and urine samples were analyzed.

6. The preliminary results of the two rounds of SS were presented in the second Almaty Forum in September 2004, devoted to discuss the results of the JFPR 9005 Project implementation and elaboration of the recommendations for future activities. It was recommended that we repeat SS in all the countries every one to two years until fortified food products are accessible for sampled population, and the efficiency of iodine, iron and folic acid status are achieved.

7. The SS should be repeated every one to two years until these deficiencies are no longer a problem in the countries of the region. It will be the only part of the overall project that will attempt to determine biological impact as distinct from process indicators. That is why this should be an interim report from the point of view of fortification efforts, but is the final report from the point of view of KAN's contract under the JFPR 9005 which is ending in 2004.

I. OBJECTIVES AND METHODOLOGY

A. Objectives

8. The main objective of the SS was to evaluate the overall effectiveness of the implementation of the food fortification program (salt iodization and wheat flour fortification) in terms of improving the micronutrient status of selected families in pilot regions of six countries. The sub-objectives of the study were the following:

a. To record the baseline data on iron, folic acid, and iodine status of selected groups of families in which the population was expected to have access to iodized salt and fortified wheat flour within twelve months of the initial survey, and in which improvement in fortified salt and flour distribution is expected. The initial round of SS for obtaining baseline data was to be completed before the first improvements in salt iodization and flour fortification in a country.

b. To obtain data on the iron, folic acid, and iodine status of the same selected group of families in each of the six countries 12 months after beginning a wide range of food fortification and the initial round of the survey.

c. To evaluate the impact of salt iodization and wheat flour fortification program on iron, folic acid, and iodine status of a selected group of families in each of the six countries, by comparing the data received in the two rounds of SS.

B. Methodology

1. Study design

9. The fieldwork of the first round of SS was carried out in pilot regions of all six countries before launching the production and distribution of fortified foods (FF – fortified wheat flour; and IS – iodized salt) for collecting baseline data in December 2002 – April 2003. In each country an area was selected in which the population is expected to have access to iodized salt and fortified flour within twelve months of the initial survey and in which improvement in fortified salt and flour distribution is expected. Within this area, on average forty families have been selected with at least two children between 2 and 15 years of age who can be included in the study. Women in reproductive age, living in these 40 households were selected in the second round of SS.

10. The second round of SS was carried out in May-August 2004, about 12 months later, or in a year after beginning the large-scale production and distribution of fortified foods. The second round of the sentinel study in each country was carried out in the same households, and with the same children who were sampled in the first round of SS in specific pilot regions. In the second round of SS, women in the same households were interviewed, and their blood and urine samples were analyzed.

2. Data collection

11. Data collection was carried out by six teams (one per country) of two people each. All teams were composed of one country coordinator for SS and one field assistant, and both of them were either physicians or biologists. They were responsible for carrying out the fieldwork, interviewing women to find out what their knowledge is on fortified food products, availability and use of iodized salt and fortified wheat flour, haemoglobin analysis in the field, taking blood, urine, salt and flour samples and transporting them to local and KAN's laboratories for analyses.

3. Methods

12. **Haemoglobin** was measured by HemoCue during the fieldwork at the sentinel study site by the Country team. The prevalence of anemia in a population is best determined by using a reliable method of measuring haemoglobin concentration. The only methods generally recommended for use in surveys to determine the population prevalence of anemia by haemoglobinometry are the cyanmethaemoglobin method in the laboratory and the HemoCue system[1], which is a reliable quantitative method for determining haemoglobin concentrations in the field surveys [2], based on the cyanmethaemoglobin method. The Haemo Cue system gives satisfactory accuracy and precision when evaluated against standard laboratory methods[3].

13. A field haemoglobin analyser (Hemocue™) was used to assess haemoglobin to the nearest 0.1 g/dL. Haemoglobinometers were checked several times a day with a control cuvette. The instruments were only used if the reading was within ±0.3 g/dL of the cuvette factory value. The cut-off points used to define the different classes of anemia are shown in Table 1. [4]

Table 1: Definition of Anemia According to Blood Haemoglobin Concentration (g/dL)

Population, age	Severe Anemia	Moderate Anemia	Mild Anemia	No Anemia
Children (6-59 months)	<7	7-9.9	10-10.9	≥11
Children (5-11 years)	<7	7-9.9	10-11.4	≥11,5
Children ≥ 12 years	<7	7-9.9	10-11.9	≥12
Women (15-45 years)	<7	7-9.9	10-11.9	≥12

Source: Methods of assessing iron status. In: /Iron Deficiency Anemia. Assessment, Prevention and Control. A Guide for programme managers. UNICEF, UNU, WHO, 2001, p. 33-46.

14. In the assessment of the public health significance of this indicator, WHO, UNICEF and UNU (1996)[5] indicated that a prevalence of mild to severe anemia of at least 40 per cent should be considered 'high', a prevalence of 15-40 per cent, 'medium', and a prevalence of less than 15 per cent, 'low'.

15. The **Ferritin** level in blood samples in the The Kyrgyz Republic and Uzbekistan was measured in a selected national laboratory by the Country team using immune enzyme method; in Azerbaijan, Kazakhstan, Mongolia and Tajikistan – in Almaty. The Radioisotope method was used for measurement of ferritin level in the first round of SS, and immune

[1] Reference and selected procedures for the quantitative determination of haemoglobin in blood: approved standards. 2nd ed. Villanova, PA, National Committee for Clinical Laboratory Standards, 1994.

[2] Van Schenck H., Falkensson M., Lundberg B. Evaluation of "HemoCue", a new device for determining haemoglobin. Clinical Chemistry, 1986, 32:526-529.

[3] Johns W.L., Lewis S.M. Primary health screening haemoglobinometry in a tropical community. Bulletin of WHO, 1989, 67:627-633.

[4] Methods of assessing iron status. In: /Iron Deficiency Anemia. Assessment, Prevention and Control. A Guide for programme managers. UNICEF, UNU, WHO, 2001, p. 33-46.

[5] WHO, UNICEF and UNU (1996), 'Indicators for Assessing Iron Deficiency and Strategies for its Prevention', draft based on a WHO, UNICEF and UNU consultation on 6-10 December 1993, WHO: Geneva.

enzyme method - in the second round of SS (in KAN's laboratory). So, the immune enzyme method was used for measurement of ferritin in blood serum samples, which were collected in all the six countries in the second round of SS.

16. The assessment of iron status was performed through a measurement of serum ferritin. Ferritin is an important iron-binding protein, and its main function is iron storage. Low serum ferritin indicates low iron storage, while iron overload conditions are recognizable through elevated serum ferritin concentrations. Values lower than 12 μg/L for children under 5 years and <15 μg/L for children ≥ 5 years of age indicate virtual exhaustion of the body iron stores.[4] However, serum ferritin is also an acute-phase reactant protein that is elevated in response to infection.

17. For immune enzyme method, a commercially available control sample from BioRad was used to obtain a calibration curve on each plate. Serum from a healthy subject was used as a quality control in order to monitor the accuracy and precision of the determinations. Ten replicates of the quality control sample were performed. The overall intra-observer and inter-observer coefficient of variation for ferritin was 15.7%.

18. The **Iodine** level in urine samples in the The Kyrgyz Republic, Mongolia, Tajikistan and Uzbekistan was measured in a national laboratory by using the spectrophotometric method; in Azerbaijan and Kazakhstan – in KAN's laboratory by the same method.[6]

19. For urinary iodine measurements, 10 ml urine samples were collected among all sampled children and women in the households. The cut-off points used to define the different levels of urinary iodine concentration are shown in Table 2.[7] These cut-off points have been developed for school aged children, but they have also been used among younger children and among adult women in the absence of a clear recommendation for those age groups.

Table 2: Definition of IDD and Iodine Overload According to Urinary Iodine Excretion (μg/L)

Severe IDD	Moderate IDD	Mild IDD	Normal excretion	Higher than normal	Iodine Overload
<20	20-49	50-99	100-200	201-299	≥300

Source: Urinary iodine. In: /Assessment of Iodine Deficiency Disorders and Monitoring their Elimination. A Guide for programme managers. ICCIDD, UNICEF, WHO, 2001, p. 31-36

20. **Folic Acid** levels in blood plasma samples were measured by high performance liquid chromatography (HPLC) method in KAN's laboratory, Almaty. Nevin Scrimshaw arranged to one of the chemist-analyst from KAN (Askar Akkulov), a special training course on HPLC method for folic acid analysis in Chemical laboratory, Tuft's University, USA. After this course Askar Akkulov has adjusted the appropriate method of analysis of folic acid in KAN's laboratory.

21. A 5 ml sample of venous blood was collected from the antecubital vein among all the sampled children and women. Blood samples were centrifuged soon after collection. Plasma samples were transported in vaccine carriers at 4°C, frozen at -20°C within 12 hours and kept frozen until analysis. Folic acid was analyzed by high-performance liquid chromatography using a fluorescent detector[8]. The analytical method for the measurement of 5-

[6] Dunn J.T. et al. Methods for measuring iodine in urine. The Netherlands, ICCIDD, 1993.

[7] Urinary iodine. In: /Assessment of Iodine Deficiency Disorders and Monitoring their Elimination. A Guide for programme managers. ICCIDD, UNICEF, WHO, 2001, p. 31-36.

[8] Snow, C. F. (1999), 'Laboratory Diagnosis of Vitamin B_{12} and Folate Deficiency: A Guide for the Primary Care Physician', *Archives of Internal Medicine*, 159 (28 June), pages 1289-1298. Chladek, Jaroslav, Ludek Sispera and Jifina Martinkova

methyltetrahydrofolate (5-MTHF), the main metabolite of folic acid in blood, was based on the chromatographic separation of specially prepared serum samples with a C18 column, using mobile phase with acetonitrile-phosphate buffer containing hexanesulphonic acid as a coupling agent. The quantitative measurement of 5-MTHF was conducted in a concentration range of 40 mg/ml by using an external standard. The concentration of the external standard was controlled spectrophotometrically.

22. The cut-off points used to define the different levels of folic acid deficiency are shown in table 3.

Table 3: Definition of Folic Acid Deficiency According to Plasma Folic Acid Concentration (μg/L or ng/mL)

Population	Severe FAD	Mild FAD	Marginal FA Level	Normal FA Level
Women and children	<1.3	1.3<3.0	3-6	>6

Sources: For folic acid deficiency (FAD): IOM (2000), 'Dietary Reference Intakes: Thiamin, Riboflavin, Niacin, Vitamin B_6, Folate, Vitamin B_{12}, Pantothenic Acid, Biotin and Choline', Institute of Medicine of the National Academies: Washington, DC. For folic acid (FA): Brody, T. and B. Shane (2001), 'Folic Acid', pages 427-462 in Bucker, R. B., J. W. Suttie, D. B. McCormick and L. J. Machlin (eds), *Handbook of Vitamins* (Third Edition), Marcel Dekker: New York.

4. Data management

23. Dr. Shamil Tazhibayev, Vice-president of KAN, served as the Regional Coordinator for the Sentinel Study and was responsible for standardizing and assuring the quality control of the studies. He also collated, compared and interpreted the combined results. To provide assistance and guidance in setting up the standard studies, Dr. Tazhibayev paid a five-day visit to each participating country in December 2002-March 2003.

24. All the six country project coordinators managed all activities of the country team, including the field work, interviewing women, collecting blood, urine, salt and flour samples, testing salt for iodine and flour for iron, blood samples for Haemoglobin and Ferritin levels, and urine samples for iodine at National Laboratories, and sending collected data, and blood and urine samples to KAN, Almaty.

II. RESULTS

A. Anemia rate: haemoglobin level in whole capillary blood samples

25. Statistically significant decrease of the average level of haemoglobin (Hb) in whole capillary blood samples of children was revealed in Tajikistan and Uzbekistan in the second round of SS in comparison with the appropriate data of the first round of SS (Table 4). Children had mean blood haemoglobin levels of 12.8 g/dL in Tajikistan and The Kyrgyz Republic, 12.6 g/dL in Uzbekistan and Mongolia, 12.1 g/dL in Azerbaijan, and 11.8 g/dL in Kazakhstan in 2004. So, only in Kazakhstan was the mean level of haemoglobin lower than the cut-off for definition of anemia (<11.0 g/dL or < 11.5 or <12.0 g/dL) among children of different ages.

Table 4. The results of measurement of Haemoglobin (Hb) level in whole capillary blood of children 2-15 years of age, comparative data of the first and second rounds of the Sentinel Study, by countries

HAEMOGLOBIN		Children's whole capillary blood samples, countries					
	Year	AZER.	KAZ.	KYR.	MON.	TAJ.	UZB.

(2000), 'High-Performance Liquid Chromatographic Assay for the Determination of 5-Methyltetrahydrofolate in Human Plasma', *Journal of Chromatography*, B 744 (2) (21 July), pages 307-313. Hare, Lesley G. (no date), 'Rapid Methods for the Determination of Food Folates', Ph.D. thesis, Food Microbiology Research Group, University of Ulster: <*www.science.ulst.ac.uk/food/Folate_Assay.htm*>.

HAEMOGLOBIN	Year	Children's whole capillary blood samples, countries					
		AZER.	KAZ.	KYR.	MON.	TAJ.	UZB.
Mean±SE, g/dL	**2003**	**12,0±0,98**	**11,4±0,15**	**12,5±0,12**	**12,6±0,14**	**10,7±0,19**	**11,9±0,19**
95% Confidence Interval	2003	11,9-12,2	11,1-11,7	12,2-12,7	12,3-12,9	10,3-11,1	11,7-12,2
Mean±SE, g/dL	**2004**	**12,1±0,88**	**11,8±0,12**	**12,8±0,10**	**12,6±0,10**	**12,8±0,19**	**12,6±0,12**
95% Confidence Interval	2004	11,9-12,2	11,6-12,0	12,6-13,0	12,4-12,8	12,4-13,1	12,4-12,9
Anemia, total, %	**2003**	**20,9**	**50,0**	**15,0**	**12,5**	**70,0**	**31,4**
	2004	**25,0**	**37,5**	**7,9**	**8,8**	**24,1**	**10,5**
Mild:	2003	18,6	38,8	13,8	12,5	40,0	29,1
	2004	23,7	33,8	7,9	8,8	20,3	10,5
Moderate:	2003	2,3	11,2	1,2	-	27,5	2,3
	2004	1,3	3,8	-	-	3,8	-
Severe:	2003	-	-	-	-	2,5	-
	2004		-	-	-	-	-
Anemia: FF*, %	2004	23,4 (15)	100,0 (2)	7,3 (3)	12,5 (1)	0,0	14,5 (9)
Anemia: OF*, %	2004	31,3 (5)	42,3 (33)	11,4 (4)	13,2 (9)	24,4 (19)	4,2 (1)

* FF – children used fortified flour; OF – children used ordinary flour; in brackets – number of children

26. Baseline data on anemia prevalence among children with significant differences by countries were collected in the first round of SS: 70% in Tajikistan, 50% in Kazakhstan, 31,4% in Uzbekistan, 20,9% in Azerbaijan, 15% in the The Kyrgyz Republic, and 12,5% in Mongolia. The prevalence of anemia among children in 2004 was the following, by countries: 37,5% in Kazakhstan, 25% in Azerbaijan, 24,1% in Tajikistan, 10,5% in Uzbekistan, 8,8% in Mongolia, and 7,9% in the The Kyrgyz Republic.

27. So, the comparative results of the two rounds of SS allowed revealing that anemia rates among children of 2-15 years of age in some countries decreased (Table 4 and Fig. 1), especially in those countries where households had fortified flour. The threefold decrease of anemia prevalence among children in Uzbekistan and Tajikistan, and twofold decrease in the The Kyrgyz Republic was revealed between the two rounds of the sentinel study. The rate of moderate anemia in Tajikistan decreased 7 times, in Uzbekistan and The Kyrgyz Republic moderate anemia was not found in 2004.

28. These results correspond to the data on availability of fortified flour in sampled households in Uzbekistan and the The Kyrgyz Republic. In Uzbekistan, 80% of households had fortified flour for 11,5 months. In the The Kyrgyz Republic, where flour was not tested, 48,8% of the interviewed women answered that they consumed fortified wheat flour for 8,1 months (Fig. 2 and Table 11).

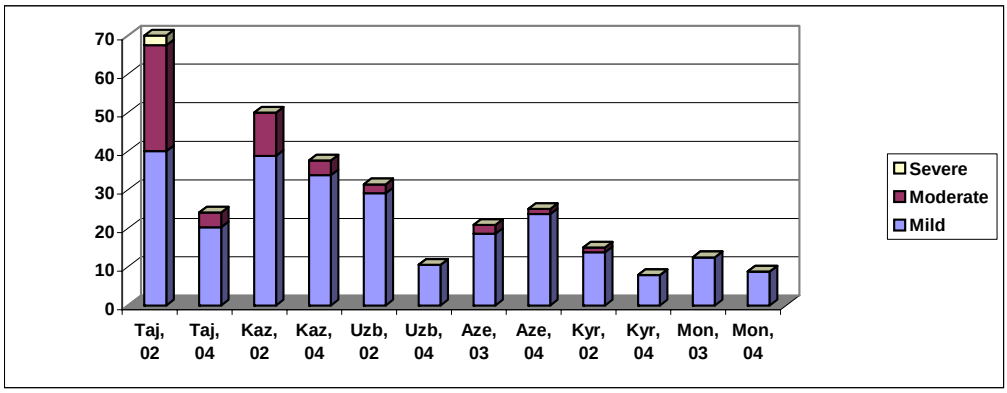

Fig. 1. The prevalence of anemia among children 2-15 years of age, comparative data of the first and second rounds of Sentinel Study, by countries

29. The dramatical decrease of the anemia rate among children in Tajikistan, perhaps, is caused by the implementation of the iron supplementation program (74,4% of children and women had taken iron tablets for last 12 months), and by the periodical distribution of iron fortified flour in the framework of some humanitarian aid. According to the spot test results, only in one in every 40 households (2,5%) flour was really fortified in Tajikistan. Nevertheless 46% of women answered that they used fortified flour for 12 months. This discrepancy may be related with the fact that many households in Tajikistan were periodically supplied by flour fortified by iron in the framework of some humanitarian aid.

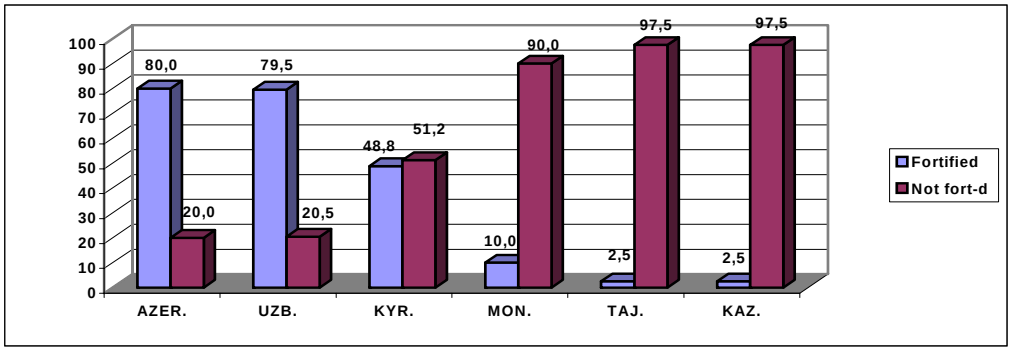

Fig. 2. Percent of households using fortified or not fortified flour

Note: These data are the spot test results of flour for iron, except for the The Kyrgyz Republic, where flour was not tested, and the data is received by interviewing women on the consumption of fortified/not fortified flour

30. In Kazakhstan and Mongolia, where respectively 2,5% and 10% of households had fortified flour, there were no significant differences in the prevalence of anemia between the results of SS rounds one and two.

31. The anemia rate among children in Azerbaijan even slightly increased between the two rounds of SS. Though 80% of households in Azerbaijan had fortified flour in the second round of SS, 42,5% of women answered that they used not fortified (ordinary) flour, and another 57,5% of the women did not know what kind of flour they used. 80% of the women in Azerbaijan had not even heard about fortified flour, 7,5% of women did not know what it

means, and only 12,5% of the women had heard about fortified flour. Fortified flour in Azerbaijan was perhaps used during a short period of time, which was not sufficient for decreasing the rate of anemia. Flour fortification in Azerbaijan started late.

32. Only mild forms of anemia were found among children in Uzbekistan, Azerbaijan and the The Kyrgyz Republic in 2004. In spite of the threefold decrease of the anemia rate in Tajikistan between the first and second rounds of SS, some children (3,8%) there still suffered from moderate anemia in 2004. 1,3% and 3,8% of the children accordingly in Azerbaijan and Kazakhstan still had moderate anemia in the 2004 study, but no case of severe anemia was revealed in any of the six countries.

33. The availability of fortified flour in households in pilot regions does not reflect the national level of production and distribution of fortified flour. It reflects the status of distribution of fortified flour in pilot regions and the availability of the flour in sampled households. For example, in Kazakhstan about 12% of the annual demand for fortified wheat flour for the population is already produced. This amount is more than enough to supply 100% of the demand of the population in pilot regions with fortified wheat flour, but unfortunately, the distribution of fortified flour was not effective in reaching the pilot population.

34. The levels of anemia prevalence among children in Azerbaijan, Kazakhstan and Tajikistan in 2004 place these countries in the medium-to-high risk, and in the The Kyrgyz Republic, Mongolia and Uzbekistan – mild-to-medium risk categories, in compliance with the 15-40 per cent and <15 per cent cut-off accordingly, suggested by the World Health Organization, UNICEF and United Nations University. Mild anemia was a prevalent form both among children and women in all the participating countries in 2004. Severe anemia was not found at all, and moderate anemia was found only in 3,8% of the children in Kazakhstan and Tajikistan, and in 1,3% of the children in Azerbaijan in 2004.

35. Women had mean blood haemoglobin levels of 13.0 g/dL in Mongolia, 12.7 g/dL in Tajikistan, 12,4 g/dL in The Kyrgyz Republic, 11.8 g/dL in Uzbekistan, 11.5 g/dL in Kazakhstan, and 11.4 g/dL in Azerbaijan in 2004 (Table 5).

Table 5. The results of measurement of Haemoglobin (Hb) level in whole capillary blood of women between 15-49 years of age, the results of the second round of Sentinel Study, by countries

HAEMOGLOBIN	**Women's whole capillary blood samples, countries**					
	AZER.	**KAZ.**	**KYR.**	**MON.**	**TAJ.**	**UZB.**
Mean±SE, g/dL	**11,4±0,15**	**11,50,26**	**12,4±0,21**	**13,0±0,18**	**12,7±0,26**	**11,8±0,17**
95% Confidence Interval	11,1-11,7	10,9-12,0	12,0-12,8	12,7-13,4	12,1-13,2	11,5-12,2
Anemia, total, %	**69,2**	**57,5**	**33,3**	**10,0**	**33,3**	**51,3**
Mild:	64,1	45,0	30,8	7,5	28,2	43,6
Moderate:	5,1	10,0	2,6	2,5	5,1	7,7
Severe:	0	2,5	-	-	-	-
Anemia, FF*, %	65,6 (21)	100,0 (1)	25,0 (5)	0,0	0,0	58,0 (18)
Anemia, OF*, %	75,0 (8)	56,4 (22)	42,1 (8)	8,8 (3)	33,3 (13)	25,0 (2)

* FF – women used fortified flour; OF – children used ordinary flour; in brackets – number of women

36. The prevalence of anemia among women was characterized by significant differences in each of the participating countries as well: 69% in Azerbaijan, 57,5% in Kazakhstan, 51,3% in Uzbekistan, 33,3% in The Kyrgyz Republic and Tajikistan, and 10% in Mongolia.

Obviously, the achieved duration of the use of fortified flour was not sufficient to cause any significant decrease in the anemia rate among women. Unfortunately, women were not included in the first round of SS, and for this reason it was not possible to make appropriate comparisons on changing the anemia rate among sampled women.

37. The lowest anemia rate among both women and children in Mongolia can be connected with the high consumption of meat products in this country. It is well known that the bioavailability of heam iron from meat products is much higher than from plant foods.

38. Only in Kazakhstan did some women (2,5%) suffer from severe anemia, in all the countries there were 2,5% to 10% of women who had moderate anemia. The rate of mild anemia was 7,5% to 64,1% in these countries.

39. The prevalence of anemia among women in reproductive age in Azerbaijan, Kazakhstan and Uzbekistan in 2004 exceeded the 40% cut-off suggested by the World Health Organization, UNICEF and United Nations University, thus indicating that anemia is still indeed a public health priority for these countries. The levels of anemia prevalence among women in The Kyrgyz Republic and Tajikistan place these countries in the medium-to-high risk, and in Mongolia – mild-to-medium risk categories, in compliance with the 15-40% and <15% cut-off accordingly.

B. Ferritin level in blood serum and iron depletion

40. Children had the mean serum ferritin levels of 38.6 μg/L in Uzbekistan, 19.6 μg/L in Tajikistan, 19.5 μg/L in Mongolia, 19.1 μg/L in Kazakhstan, 18.1 μg/L in Azerbaijan, and 17,3 μg/L in The Kyrgyz Republic in 2004 (Table 6). So, in all participating countries, the mean levels of ferritin were higher than the cut-off for definition of low ferritin level (< 12 μg/L or <15.0 μg/L) or iron depletion among children of different ages.

Table 6. The results of the measurement of Ferritin level in blood serum samples of children between 2-15 years of age, comparative data of the first and second rounds of Sentinel Study, by countries

FERRITIN		**Children's blood serum samples, countries**					
	Year	**AZER.**	**KAZ.**	**KYR.**	**MON.**	**TAJ.**	**UZB.**
Mean±SE, μg/L	**2003**	**29,4±1,95**	**17,6±1,45**	**35,6±1,77**	**38,0±2,23**	**32,8±1,97**	**31,2±1,61**
95% CI	2003	25,5-33,3	14,7-20,4	32,1-39,2	33,5-42,4	28,8-36,7	28,0-34,4
Mean±SE, μg/L	**2004**	**18,1±1,4**	**19,1±2,33**	**17,3±1,88**	**19,5±2,73**	**19,6±1,76**	**38,6±1,83**
95% CI	2004	15,3-20,9	14,5-23,7	13,5-21,0	14,1-25,0	16,1-23,1	34,9-42,2
Low level, % [1]	**2003**	**15,2**	**43,8**	**4,9**	**5,0**	**8,7**	**8,1**
	2004	**48,7**	**53,8**	**51,2**	**52,5**	**47,4**	**5,1**
Low level: FF*, %	2004	51,6 (33)	100,0 (2)	43,9 (18)	25,0 (2)	0,0	4,8 (3)
Low level: OF*, %	2004	37,5 (6)	48,7 (38)	60,6 (20)	61,8 (42)	50,0 (39)	6,3 (1)

[1] Cut off points for low level of ferritin or iron depletion for children: <12 μg/L - for children under 5 years; <15 μg/L - for children of 5 and more years. Source: Methods of assessing iron status. In: Iron Deficiency Anemia. Assessment, Prevention and Control. A Guide for programme managers. UNICEF, UNU, WHO, 2001, p. 33-46.

* FF – children used fortified flour; OF – children used ordinary flour; in brackets – number of children

41. The average level of serum ferritin in children increased only in Uzbekistan between the two rounds of SS. It did not change significantly in Kazakhstan. In other countries (Mongolia, The Kyrgyz Republic, Tajikistan and Azerbaijan) the mean level of serum ferritin in children decreased in the same period of time.

42. The prevalence of low serum ferritin level among children decreased only in Uzbekistan between the two rounds of SS. In all other countries the prevalence of low ferritin level in blood serum of children increased during this period of time. So, only in Uzbekistan was iron status improved between the two rounds of SS (Fig. 3).

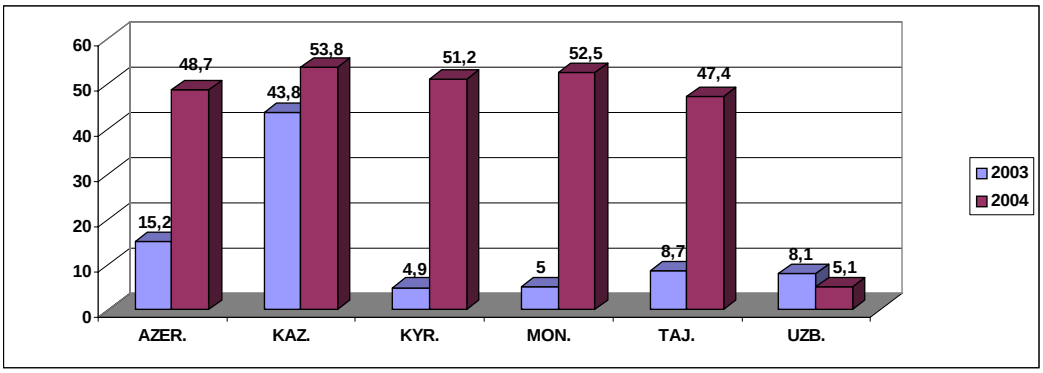

Fig. 3. The prevalence of low ferritin level in blood serum of children, comparative data of the first and second rounds of the Sentinel Study, by countries

43. Women had the mean serum ferritin levels of 36.0 μg/L in Mongolia, 27.9 μg/L in Tajikistan, 27.7 μg/L in Kazakhstan, 26.3 μg/L in Uzbekistan, 19,1 μg/L in The Kyrgyz Republic, and 16.0 μg/L in Azerbaijan in 2004 (Table 7). So, in all the participating countries the mean levels of ferritin were higher than the cut-off for definition of low ferritin level (<15.0 μg/L) or iron depletion among women.

Table 7. The results of measurement of Ferritin level in blood serum samples of women between 15-49 years of age, the results of the second round of Sentinel Study, by countries

FERRITIN	**Women's blood serum samples, countries**					
	AZER.	**KAZ.**	**KYR.**	**MON.**	**TAJ.**	**UZB.**
Mean±SE, μg/L	**16,0±**2,21	**27,7±**4,86	**19,1±**1,68	**36,2±**6,1	**27,9±**4,89	**26,3±**2,85
95% CI	11,5-20,5	17,8-37,5	15,7-22,6	23,9-48,5	18,0-37,8	20,5-32,1
Low level, % [1]	**50,0**	**47,4**	**51,3**	**25,0**	**43,6**	**28,2**
Low level, FF*, %	50,0 (16)	100,0 (1)	47,6 (10)	25,0 (1)	0,0	32,3 (10)
Low level, OF*, %	50,0 (4)	46,2 (18)	52,6 (10)	23,5 (8)	43,6 (17)	12,5 (1)

[1] Cut off points for low level of ferritin or iron depletion for women: <15 μg/L. Source: Methods of assessing iron status. In: Iron Deficiency Anemia. Assessment, Prevention and Control. A Guide for programme managers. UNICEF, UNU, WHO, 2001, p. 33-46.

* FF – women used fortified flour; OF – women used ordinary flour; in brackets – number of women

44. The highest prevalence of low serum ferritin level or iron depletion among women was found in Azerbaijan (50.0%), followed by the Kyrgyz Republic (51.3%), Kazakhstan (47.4%), Tajikistan (43.6%), Uzbekistan (28.2%) and Mongolia (25%) in 2004 study. These data on prevalence of low ferritin level in blood serum closely correlate with the high rate of anemia among the observed women (see Table. 5).

45. The prevalence of low serum ferritin level among children was different when compared with appropriate results among women in 2004. Nevertheless, these data allows finding that iron depletion was still a public health problem in the pilot regions of Azerbaijan, Kazakhstan, The Kyrgyz Republic, Mongolia and Tajikistan both among children and women in 2004. Even in Uzbekistan the prevalence of low serum ferritin level among women was still quite high in 2004. Apparently, a low availability of fortified flour in sampled households in these countries and achieved short duration of using fortified flour were not sufficient to improve the iron status both of children and women.

46. It is known that the serum ferritin level is the most specific biochemical test that correlates with a relative total body iron stores. That is why a low serum ferritin level reflects depleted iron stores and hence is a precondition for iron deficiency.

47. Serum apoferritin is an acute-phase reactant protein and is therefore elevated in response to any infectious or inflammatory process. Consequently, serum ferritin in the normal range reflects iron sufficiency only in the absence of these conditions. In this connection, the interpretation of serum ferritin is problematic in populations in which the incidence of infection or inflammation is high, with the exception of parasitic infections and malaria [9].

C. Folic acid level in blood plasma and folic acid deficiency

48. Children had the following mean plasma folic acid levels (in μg/L): 9.27 in Uzbekistan, 3.9 in Mongolia, 3.27 in Azerbaijan, 2.67 in Tajikistan, 2.49 in The Kyrgyz Republic, and 1.96 in Kazakhstan in 2004 (Table 8). So, only in 3 countries (Uzbekistan, Mongolia and Azerbaijan) were the mean levels of folic acid higher than the cut-off for definition of folic acid deficiency (< 3 μg/L) among children, and only in Uzbekistan did the mean level of folic acid exceed the cut-off for definition of marginal levels for folic acid (3-6 μg/L).

Table 8. The results of measurement of Folic Acid level in blood plasma of children 2-15 years old, comparative data of the first and second rounds of the Sentinel Study, by countries

FOLIC ACID		Children's blood plasma samples, countries					
		AZER.	KAZ.	KYR.	MON.	TAJ.	UZB.
Mean±SE, μg/L	**2003**	**1,61±0,201**	**1,58±0,226**	**0,77±0,083**	**1,89±0,198**	**3,12±0,325**	**8,56±0,621**
95% CI	2003	1,21-2,01	1,13-2,03	0,61-0,94	1,50-2,29	2,47-3,77	7,32-9,79
Mean±SE, μg/L	**2004**	**3,27±0,286**	**1,96±0,121**	**2,49±0,247**	**3,90±0,431**	**2,67±0,295**	**9,27±0,498**
95% CI	2004	2,70-3,84	1,72-2,20	2,0-2,98	3,05-4,76	2,08-3,26	8,28-10,27
Folic acid deficiency: total, %	**2003**	**85,0**	**83,34**	**97,56**	**85,00**	**57,50**	**16,28**
	2004	**51,89**	**83,75**	**68,8**	**57,5**	**69,2**	**7,7**
Mild	2003	28,75	20,51	13,41	47,50	21,25	10,47
	2004	29,11	56,25	32,5	27,5	33,3	6,4
Severe	2003	56,25	62,82	84,15	37,50	36,25	5,81
	2004	22,78	27,5	36,4	30,0	35,9	1,3
*FAD: FF, %		54,7 (35)	0,0	56,7 (21)	62,5 (5)	100,0 (2)	9,7 (6)
*FAD: OF, %		37,5 (6)	83,3 (65)	80,0 (32)	57,3 (39)	66,7 (52)	0,0

* FAD – Folic acid deficiency; FF – children used fortified flour; OF – children used ordinary flour; in brackets – number of children

49. Statistically significant increase of the average level of folic acid in blood plasma of children was revealed in Azerbaijan, The Kyrgyz Republic, Mongolia and Uzbekistan in 2004 in comparison with 2002-2003 data.

50. Very high prevalence of folic acid deficiency (FAD) was revealed by the analysis of the baseline data collected in the first round of SS in all the countries except Uzbekistan, where folic acid deficiency rate was 16,3%. The prevalence of severe FAD exceeded the rate of mild FAD in five countries (Azerbaijan, Kazakhstan, The Kyrgyz Republic, Mongolia and Tajikistan) in 2002-2003.

51. Folic acid is one of the six micronutrients in the composition of the premix "KAP Complex", which was used for wheat flour fortification in the framework of JFPR 9005

[9] Methods of assessing iron status. In: /Iron Deficiency Anemia. Assessment, Prevention and Control. A Guide for programme managers. UNICEF, UNU, WHO, 2001, p. 33-46.

Project. The prevalence of FAD decreased in Azerbaijan, The Kyrgyz Republic, Mongolia and Uzbekistan between the two rounds of sentinel study (Table 8 and Fig. 4). But even in 2004 the prevalence of severe FAD was quite high in all countries, and it still exceeded the rate of mild FAD in The Kyrgyz Republic, Mongolia and Tajikistan.

52. It can be supposed that the use of fortified flour caused the decrease of FAD prevalence in Uzbekistan and The Kyrgyz Republic in 2004, because 80% of the households in Uzbekistan and 46% in The Kyrgyz Republic had access to fortified flour during 11,5 and 8 months accordingly. Improving the dietary intake of folic acid, perhaps, caused the decrease of FAD rate in Azerbaijan and Mongolia.

53. The prevalence of FAD did not decrease between the two rounds of the sentinel study in Kazakhstan and Tajikistan, where only in one in forty households (2,5%) flour was really fortified in accordance with the spot test results for iron. 46% of sampled women in Tajikistan answered that they used fortified flour, perhaps, because many households in this country were periodically supplied with flour, which was fortified by iron, in the framework of some humanitarian aid. It seems that the flour which was distributed by humanitarian aid programs was not fortified with folic acid.

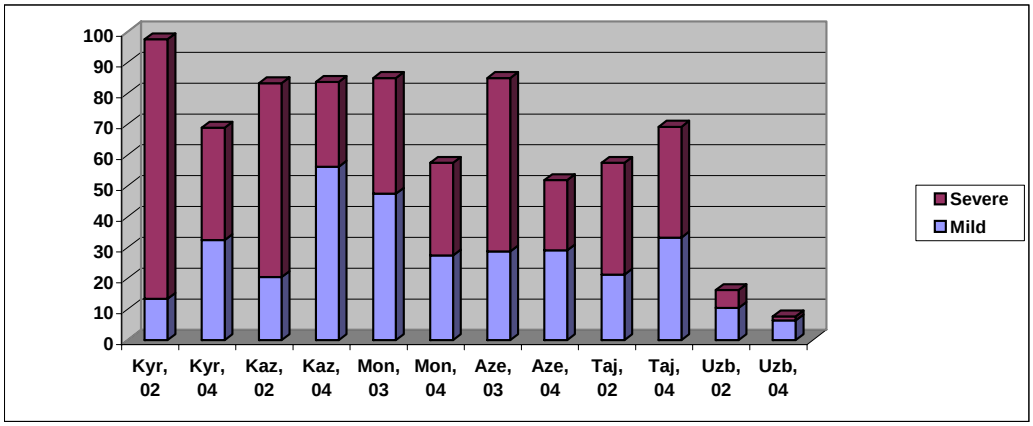

Fig. 4. The prevalence of folic acid deficiency among children, comparative data of the first and second rounds of Sentinel Study, by countries

54. The average level of folic acid in blood plasma of women was higher in comparison with appropriate data for children in Azerbaijan, Kazakhstan, The Kyrgyz Republic and Tajikistan, but not in Uzbekistan and Mongolia in 2004 (Table 9). Only in Mongolia was the mean level of folic acid lower than the cut-off for definition of folic acid deficiency (< 3 μg/L) among women. The prevalence of FAD among women was highest in Mongolia (75%), and then followed Kazakhstan (65%), The Kyrgyz Republic (59%), Uzbekistan (33,3%), Tajikistan (30,8%), and Azerbaijan (12,8%).

Table 9. The results of measurement of Folic Acid (Hb) level in blood plasma of women 15-49 years old, the results of the second round of Sentinel Study, by countries

FOLIC ACID	Women's blood plasma samples, countries					
	AZER.	KAZ.	KYR.	MON.	TAJ.	UZB.
Mean±SE, μg/L	**5,00±0,354**	**3,17±0,401**	**3,71±0,685**	**2,43±0,259**	**5,02±0,545**	**4,25±0,326**
95% CI	4,29-5,72	2,36-3,98	2,32-5,09	1,91-2,95	3,92-6,13	3,59-4,91
Folic acid deficiency: total, %	**12,8**	**65,0**	**59,0**	**75,0**	**30,8**	**33,3**
Mild	12,8	42,5	28,2	60,0	12,8	30,8

FOLIC ACID	Women's blood plasma samples, countries					
	AZER.	KAZ.	KYR.	MON.	TAJ.	UZB.
Severe	0,0	22,5	30,8	15,0	17,9	2,6
Folic acid deficiency: FF*, %	15,6 (5)	0,0	42,9 (9)	50,0 (2)	0,0	32,3 (10)
Folic acid deficiency: OF*, %	0,0	66,7 (26)	70,0 (14)	79,4 (27)	30,8 (12)	37,5 (8)

* FF – women used fortified flour; OF – women used ordinary flour; in brackets – number of women

55. One problem in interpreting the plasma folic acid levels is that they reflect recent dietary intake, and FAD can be ascribed only where the serum folate remains low over a period of time [10]. On the other hand, plasma folic acid level can be changed quite quickly after consumption of this vitamin. So, the constancy in consumption of fortified flour and other food sources of folic acid is important for interpreting plasma folate levels. But dietary intake characteristics, including the consumption of fortified flour, are usually not constant, and because of this they can influence the plasma folate levels.

D. Urine iodine excretion

56. Most iodine absorbed in the body eventually appears in the urine. Therefore, urinary iodine excretion is a good marker of very recent dietary iodine intake. In individuals, urinary iodine excretion can vary somewhat from day to day and even within a given day. However, this variation tends to even out among populations. In most countries that started to implement IDD control programs, urinary iodine excretion, rather than thyroid size, is used as the principal indicator of impact. [11]

57. Baseline data on median levels of iodine (in μg/L) in urine samples of children among children with significant differences in the participating countries were collected in the first round of SS in 2002-2003: 154,7 in Azerbaijan, 109,3 in Uzbekistan, 104,5 in Kazakhstan, 78,8 in The Kyrgyz Republic, 68,8 in Mongolia, and 29,1 in Tajikistan (Table 10 and Fig. 5). These data indicate that in the last three countries, especially in Tajikistan, there were problems with low urine iodine excretion among children.

58. The median levels of iodine in urine samples of children in four counties (Azerbaijan, Kazakhstan, The Kyrgyz Republic and Uzbekistan) were >100 μg/L, and in two countries (Mongolia and Tajikistan) they were <100 μg/L in 2004: 308,1 in Azerbaijan, 246,8 in Kazakhstan and Uzbekistan, 104,5 in Kazakhstan, 133,4 in The Kyrgyz Republic, 94,2 in Tajikistan, and 58,6 in Mongolia. So, the median levels of iodine in urine samples in children increased two- to threefold in all the countries except Mongolia, between the two rounds of SS.

Table 10. The results of measurement of iodine level in urine samples of children between 2-15 years of age, comparative data of the first and second rounds of the Sentinel Study, by countries

URINE IODINE/IDD		Children's urine samples, countries					
		AZER.	KAZ.	KYR.	MON.	TAJ.	UZB.
Median, μg/L	**2003**	**154,7**	**104,5**	**78,8**	**68,8**	**29,1**	**109,3**
	2004	**308,1**	**246,8**	**133,4**	**58,6**	**94,2**	**246,8**

[10] T.Brody, Barry Shane "Folic Acid". In: Handbook of Vitamins. Third Edition, edited by R.B.Bucker, J.W.Suttie, D.B.McCormick and L.J.Machlin. New York, 2001, p. 427-462.

[11] Urinary iodine. In: /Assessment of Iodine Deficiency Disorders and Monitoring their Elimination. A Guide for programme managers. ICCIDD, UNICEF, WHO, 2001, p. 31-36.

URINE IODINE/IDD		Children's urine samples, countries					
		AZER.	KAZ.	KYR.	MON.	TAJ.	UZB.
Mean±SE, µg/L	**2003**	**152,4±4,55**	**115,2±8,09**	**77,5±5,25**	**86,3±7,67**	**43,5±4,72**	**133,4±11,64**
95% CI	2003	143,3-161,4	99,1-131,3	67,1-88,0	71,0-101,6	34,1-52,9	110,2-156,5
Mean±SE, µg/L	**2004**	**296,8±4,59**	**227,2±6,87**	**128,3±5,55**	**80,1±6,74**	**93,5±3,76**	**238,6±9,11**
95% CI	2004	287,7-305,9	213,6-240,9	117,2-139,3	66,7-93,5	85,9-101,0	220,5-256,8
IDD : total, %	**2003**	**10,0**	**48,8**	**67,5**	**63,8**	**88,8**	**47,7**
	2004	**0**	**7,5**	**25,0**	**63,8**	**56,2**	**0,0**
Mild:	2003	7,5	28,8	37,3	27,5	16,3	16,3
	2004	0	7,5	18,1	20	45,2	0,0
Moderate:	2003	1,3	12,5	13,3	26,3	42,5	14,0
	2004	0	0	2,8	33,8	11,0	0,0
Severe:	2003	1,3	7,5	16,9	10,0	30,0	17,4
	2004	0	0	4,2	10,0	0	0,0
IDD: IS*<15 ppm, %		0	-		60,0 (6)	66,7 (8)	0,0
IDD: IS*>15 ppm, %		0	7,5 (5)		52,1 (25)	55,6 (30)	0,0
IDD: NIS*, %		-	10,0 (1)		99,9 (20)	35,7 (5)	0,0
Urine iodine: 201-300 µg/L, % (higher than normal)	2003	7,5	13,8	0,0	6,3	1,3	17,4
	2004	26,9	68,8	0,0	1,3	0,0	32,1
*IS *<15 ppm: 201-300 µg/L,%	2004	8,3 (2)	-		0,0		45,5 (10)
*IS *>15 ppm: 201-300 µg/L,%	2004	33,9 (19)	71,2 (47)		2,1 (1)		27,0 (13)
*NIS: 201-300 µg/L, %	2004	-	50,0 (5)		0,0		25,0 (2)
Urine iodine: >300 µg/L, % (overload)	**2003**	**0,0**	**0,0**	**0,0**	**1,3**	**0,0**	**11,6**
	2004	**69,2**	**2,5**	**0,0**	**1,3**	**0,0**	**34,6**
*IS *<15 ppm: >300 µg/L, %		87,5 (24)	-		0,0		27,2 (6)
*IS *>15 ppm: >300 µg/L, %		60,7 (34)	3,0 (2)		2,1 (1)		41,7 (20)
*NIS: >300 µg/L, %		-	0,0		0,0		25,0 (2)

*IS – children used iodized salt; NIS – children used not iodized salt; in brackets – number of children

59. The average level of urine iodine excretion of children in Azerbaijan in 2004 exceeded the cut-off for defining the overload of iodine (≥300 µg/L). In Kazakhstan and Uzbekistan the average levels of urine iodine excretion of children in 2004 were higher than the cut-off for defining the normal excretion (100-200 µg/L).

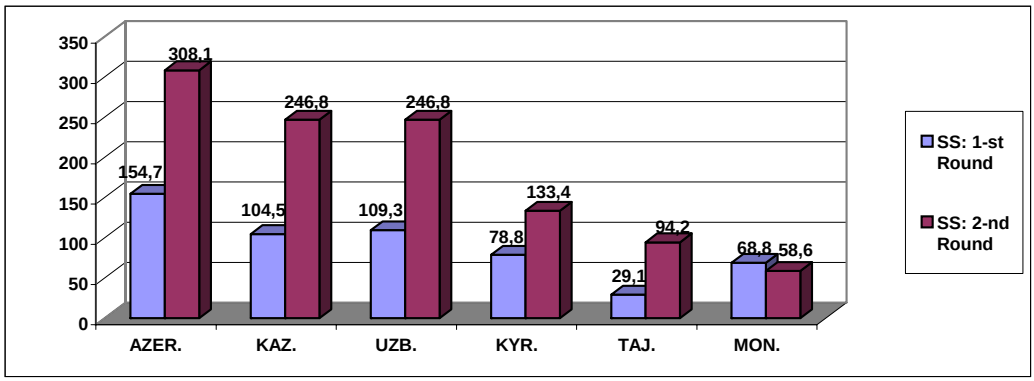

Fig. 5. The median iodine level in urine samples of children between 2-15 years of age, comparative data of the first and second rounds of the Sentinel Study, by countries

60. The prevalence of low urine iodine excretion among sampled children was very high in all the countries, except Azerbaijan, according to the results of the first round of SS: 88,8% in Tajikistan, 67,5% in The Kyrgyz Republic, 63,8% in Mongolia, 48,8% in Kazakhstan, 47,7% in Uzbekistan, and 10% in Azerbaijan (Table 10 and Fig. 6). The severe and moderate IDD were quite prevalent in these first five countries.

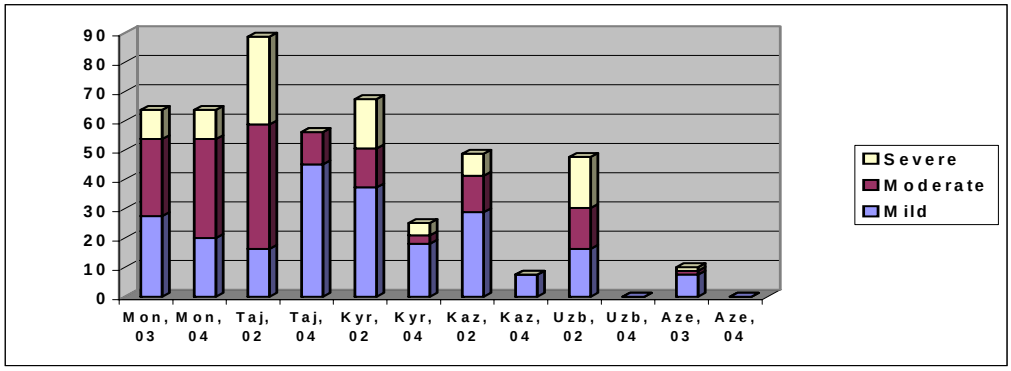

Fig. 6. IDD prevalence among children, by the levels of iodine in urine, comparative data of the first and second rounds of the Sentinel Study, by countries

61. A considerable decrease of IDD rate among children was revealed between the two rounds of the sentinel study in all countries, except Mongolia. The levels of urine iodine excretion by all children in Azerbaijan and Uzbekistan were >100 µg/L in 2004. More than half of the children studied had low excretion of urinary iodine (<100 µg/L) in Mongolia (63,8%) and Tajikistan (56,2%) in 2004; these percentages were much less in The Kyrgyz Republic (25%) and Kazakhstan (7,5%). Mild-to-moderate forms of low excretion of urinary iodine were prevalent among children in 2004.

62. It is obvious that the increased iodized salt production, better distribution and use of iodized salt in household level are the main causes of the considerable increase of the median levels of urine iodine and decrease in the prevalence of low urine iodine excretion (IDD) in children between the two rounds of SS. In 100% of the sampled households in Azerbaijan, 89,7% in Uzbekistan, 82,5% in Kazakhstan, 77,5% in Tajikistan and 72,5% in Mongolia, the salt was iodized (Fig. 7). Unfortunately, the Country Team for SS in The Kyrgyz Republic did not test the salt samples for iodine.

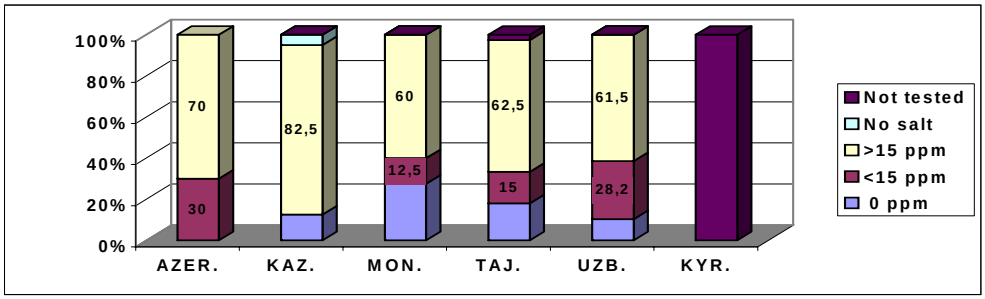

Fig. 7. Iodine content in edible salt in households, the results of the second round of sentinel study

63. The highest level of adequately iodized salt (>15 ppm) was found in 82,5% of households in Kazakhstan. In other countries, 60-70% of households had adequately iodized salt, and the levels of iodine in the salt collected in 10-28% of households were low (<15

ppm). Salt in some of households was not iodized at all in Mongolia (27,5%), Tajikistan (17,5%), Kazakhstan (12,5%) and Uzbekistan (10,3%).

64. The median levels of iodine in urine samples of women in four counties (Azerbaijan, Kazakhstan, The Kyrgyz Republic and Uzbekistan) were >100 μg/L, and in two countries (Mongolia and Tajikistan) they were <100 μg/L in 2004 (Table 11). The average level of urine iodine excretion in women in Azerbaijan exceeded the cut-off for defining the overload of iodine (≥300 μg/L) in 2004. In Kazakhstan and Uzbekistan the average levels of urine iodine excretion in women were higher than the cut-off for defining the normal excretion (100-200 μg/L) in 2004. A similar situation was found among children in 2004.

Table 11. The results of measurement of iodine level in urine samples of women between 15-49 years of age, the results of the second round of the Sentinel Study, by countries

URINE IODINE/IDD	Women's urine samples, countries					
	AZER.	**KAZ.**	**KYR.**	**MON.**	**TAJ.**	**UZB.**
Median, total, μg/L	**315,0**	**213,7**	**116,8**	**72,0**	**98,3**	**205,4**
Mean±SE, μg/L	**308,4±7,76**	**191,3±14,35**	**117,4±8,24**	**99,5±14,0**	**90,9±5,5**	**201,2±13,73**
95% CI	292,7-324,1	162,3-220,4	100,7-134,1	71,1-127,9	79,8-102,0	173,4-229,0
IDD: total, %	**2,5**	**15,4**	**30,8**	**60,0**	**54,5**	**5,0**
Mild:	2,6	5,1	20,5	27,5	40,9	5,1
Moderate:	0,0	2,6	5,15	25,0	4,5	0,0
Severe:	0,0	7,7	5,15	7,5	9,1	0,0
IDD: IS*<15 ppm, %	0,0	-		60,0 (3)	66,7 (4)	9,1 (1)
IDD: IS*>15 ppm, %	3,6 (1)	9,0 (3)		50,0 (12)	51,9 (14)	4,3 (1)
IDD: NIS*, %	-	40,0 (2)		81,8 (9)	14,3 (1)	25 (1)
Urine iodine: 201-300 μg/L, %	5,1	51,3	0,0	2,5	0,0	25,6
*IS *<15 ppm: 201-300 μg/L,%	0,0	-		0,0	0,0	45,5 (5)
*IS *>15 ppm: 201-300 μg/L,%	7,1 (2)	51,5 (17)		4,1 (1)	0,0	25 (6)
*NIS: 201-300 μg/L, %	-	40,0 (2)		0,0	0,0	25 (1)
Urine iodine: >300 μg/L, %	**92,3**	**5,1**	**0,0**	**0,0**	**0,0**	**25,6**
*IS *<15 ppm: >300 μg/L, %	100,0	-		0,0	0,0	9,1 (1)
*IS *>15 ppm: >300 μg/L, %	89,3 (25)	6,1 (2)		8,3 (2)	0,0	33,3 (8)
*NIS: >300 μg/L, %	-	0,0		0,0	0,0	25 (1)

*IS – women used iodized salt; NIS – women used not iodized salt; in brackets – number of women. In The Kyrgyz Republic salt was not tested.

65. More than half the women studied had low excretion of urinary iodine (<100 μg/L) in Mongolia (60,0%) and Tajikistan (54,5%) in 2004; these percentages were much less in The Kyrgyz Republic (30,8%), Kazakhstan (15,4%), Uzbekistan (5,1%), and Azerbaijan (2,6%). Mild-to-moderate forms of low excretion of urinary iodine were prevalent among women in 2004 (Fig. 8). A similar situation on the prevalence of low urinary iodine excretion was found among children in 2004.

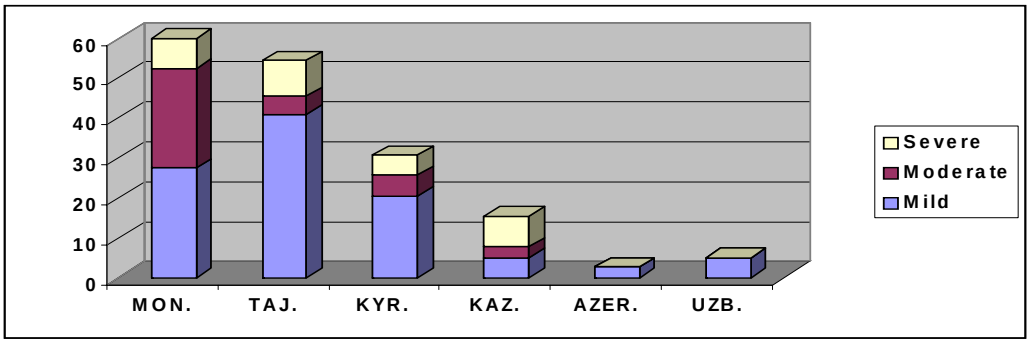

Fig. 8. IDD prevalence among women, by the levels of iodine in urine, data of the second round of the Sentinel Study, by countries

66. There are some unsettled data indicating the possibility of iodine overload in Azerbaijan and Uzbekistan, where higher than normal level of urine iodine excretion and iodine overload was revealed: 35% of children and 26% of women in Uzbekistan, and 69% of children and 92% of women in Azerbaijan had very high level of urine iodine excretion (>300 μg/L) in 2004 (Fig. 9). The dosage and mixing of potassium iodate with salt during iodized salt production needs to be increased, and proper internal and external quality control of iodized salt needs to be carried out in these countries.

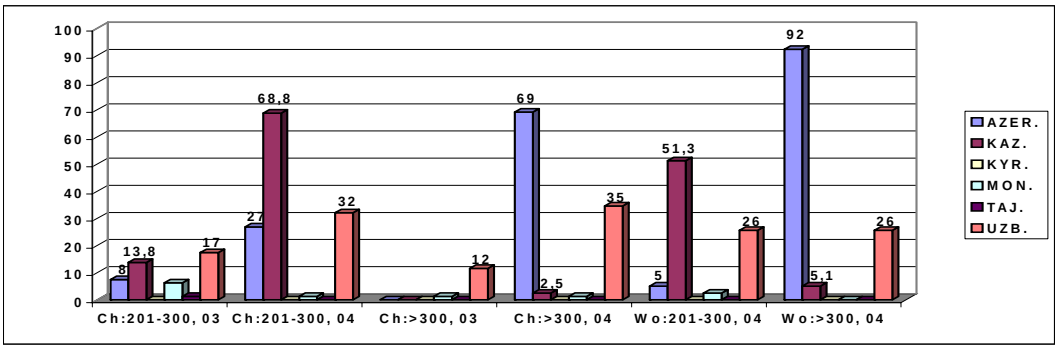

Fig. 9. The prevalence of high levels of urine iodine excretion and iodine overload, comparative data of the first and second rounds of the Sentinel Study, by countries

Note: **Ch:201-300, 03** means percentage of children with the level of urine iodine 201-300 μg/L in 2003.
Ch:201-300, 04 means percentage of children with the level of urine iodine 201-300 μg/L in 2004.
Ch:>300, 03 means percentage of children with the level of urine iodine >300 μg/L in 2003.
Ch:>300, 04 means percentage of children with the level of urine iodine >300 μg/L in 2004.
Wo:201-300, 04 means percentage of women with the level of urine iodine 201-300 μg/L in 2004.
Ch:>300, 04 means percentage of women with the level of urine iodine >300 μg/L in 2004.

E. Awareness and knowledge of women about IDA/FF and IDD/SI and use of fortified food

67. Awareness of women on salt iodization and flour fortification was good in all countries except Azerbaijan (Table 12). 57,5% of the women in Azerbaijan and the majority of the respondents (90-100 per cent) in other countries were aware of iodized salt, and 80-100% of them answered that they used iodized salt in households. Most of these women kept salt in a closed container, and knew that iodized salt prevents goiter and/or IDD. The level of knowledge and use of iodized salt in Azerbaijan was lower. 12,5% of the women in Azerbaijan and the majority of the respondents (62-100%) in other countries were aware of

fortified wheat flour. The remaining number of women was unaware of iodized salt/fortified flour or did not understand what fortification meant.

68. According to the results of interviewing women in households in the second round of SS, 92,3% of the women in Uzbekistan, 48,8% - in The Kyrgyz Republic, 46,2% - in Tajikistan, 2,5% - in Mongolia, and none of the women in Azerbaijan and Kazakhstan answered that they used fortified flour products in their homes.

69. Though 80% of the households in Azerbaijan had fortified flour in the second round of SS, 42,5% of the women answered that they used not fortified (ordinary) flour, and another 57,5% of women did not know what kind of flour they used. 80% of the women in Azerbaijan had not even heard about fortified flour, 7,5% of them did not know what it means, and only 12,5% of the women had heard about fortified flour. Apparently, fortified flour in Azerbaijan was used during a short period of time, which was not sufficient to decrease the rate of anemia. Flour fortification in Azerbaijan started late.

70. According to the spot test results, only in one in forty households (2,5%) flour was really fortified in Tajikistan. Nevertheless, 46% of the women answered that they used fortified flour during 12 months. This discrepancy may be related with the fact that many households in Tajikistan were periodically supplied by flour fortified with iron in the framework of some humanitarian aid.

71. The duration of using fortified flour products was different in each of the participating countries: 12 months in Tajikistan, 11,5 months in Uzbekistan, 8,1 months in The Kyrgyz Republic, and 6 months in Mongolia. The results of spot tests of flour for iron revealed that flour was fortified in 80% of the households in Azerbaijan, 79,5% - in Uzbekistan, 10% - in Mongolia, 2,5 % in Kazakhstan and Tajikistan (flour in The Kyrgyz Republic was not tested).

72. Most women in Azerbaijan, Tajikistan and Kazakhstan answered that they usually bake bread at home. In Uzbekistan, The Kyrgyz Republic and Mongolia most women usually bought bread at a grocery store/shop.

73. According to the results of interviewing women in households in the second round of SS, 100% of the women in The Kyrgyz Republic, 92,3% - in Uzbekistan, 87,5% - in Mongolia, 82,5% - in Kazakhstan, 79,5% - in Tajikistan, and 47,5% of the women in Azerbaijan answered that they used iodized salt in family. These results are quite close to the results of salt testing for iodine by salt checker, except Azerbaijan, where salt was iodized in 100% of households. Salt was iodized in 88,7% of the households in Uzbekistan, 82,5% - in Kazakhstan, 77,5% - in Tajikistan, and 72,5% - in Mongolia (salt in The Kyrgyz Republic was not tested).

Table 11. The results of interviewing women on fortified food, the second round of SS, by countries

Questions	Answer	Women's answer in percent, by countries					
		AZER.	KAZ.	KYR.	MON.	TAJ.	UZB.
Have you ever heard about iodization of edible salt?	Yes	57,5	92,5	100,0	100,0	89,7	100,0
	No	32,5	2,5	-	-	7,7	-
	Don't know	10,0	5,0	-	-	2,6	-
What kind of edible salt do you usually use in your household?	Iodised salt	47,5	82,5	100,0	87,5	79,5	92,3
	Ordinary salt	5,0	-	-	12,5		7,7
	Don't know	47,5	17,5	-	-	20,5	-
If you use IS, how long have you been using it?	Average number of months	14,8	17,3	22,4	33,6	12,0	4,4
Why should we use iodized salt? It prevents:	Goiter	45,0		-	62,5	82,1	
	Foetus disorder			-	-		
	IDD	7,5	62,8	100,0	37,5	5,1	76,9
	Other		2,5	-	20,0		23,1

Questions	Answer	Women's answer in percent, by countries					
		AZER.	KAZ.	KYR.	MON.	TAJ.	UZB.
	Don't know	52,5	34,7	-	5,0	12,8	
The results of salt testing. Salt is:	Not iodized		12,5		27,5	17,5	10,3
	Iodized, <15 ppm	30,0			12,5	15,0	28,2
	Iodized, =>15 ppm	70,0	82,5		60,0	62,5	61,5
	No salt at home		5,0				
	Salt not tested			100,0		2,5	
Where do you keep salt?	In closed container	52,5	80,0	100,0	92,5	79,5	82,1
	In open container	45,0	20,0	-	7,5	17,9	17,9
	In cloth sack	2,5	-	-	-	2,6	
	No salt at home		-	-	-		
Have you ever heard about wheat flour fortification with vitamins and microelements?	Yes	12,5	62,5	100,0	95,0	61,5	100,0
	No	80,0	20,0	-	2,5	35,9	
	Don't know	7,5	17,5	-	2,5	2,6	
What kind of flour do you usually use for food preparation?	Ordinary flour	42,5	100,0	51,2	97,5	46,2	15,4
	Fortified flour		-	48,8	2,5	46,2	84,6
	Don't know	57,5	-	-	-	7,6	
If you do use FF and/or bread prepared from FF, how long have you been using it?	Average number of months		-	8,1	6	12	11,5
The results of flour testing by Spot Test. Flour is:	Fortified	80,0	2,5		10,0	2,5	79,5
	Not fortified	20,0	95,0		85,0	95,0	20,5
	No flour in home		2,5		5,0		
	Flour not tested		-	100,0	-		
Does your family usually bake bread at home or buy it in grocery/shop?	Bake at home	100,0	65,0	29,3	32,5	87,2	28,2
	Buy in grocery		32,5	70,7	67,5	12,8	71,8
	Don't know		2,5	-	-		
Why is it neecessary to use food prepared from fortified flour?	Prevents anemia	15,0	50,0	100,0	57,5	61,5	92,3
	Prevents hypovit.		-	-	20,0		7,7
	Other	2,5	-	-	10,0		
	Don't know	82,5	50,0	-	20,0	38,5	
Have you taken iron tablets during the last 12 months?	Yes		25,0	-	27,5	74,4	20,5
	No	100,0	75,0	100,0	72,5	25,6	79,5
	Don't know			-	-		
Have your children taken iron tablets during the last 12 months?	Yes		10,0	-	35,0	74,4	
	No		90,0	100,0	65,0	25,6	100,0
	Don't know	100,0	-	-			

74. These data on awareness and knowledge of the sampled women on IDA/FF and IDD/SI, and use of fortified foods reflect the situation only in the households in pilot regions, which were sampled for the purposes of a sentinel study, and they do not represent the picture in the whole country or even in the whole pilot region.

III. DISCUSSION

75. The implementation of the SS was a necessary step to evaluate the overall effectiveness of the implementation of the food fortification program (salt iodization and wheat flour fortification) in terms of improving the micronutrient status of selected families in pilot regions of six countries which were involved in JFPR 9005 Project "Improving Nutrition of Poor Mothers and Children in Asian Countries in Transition". The comparison of the results of the two rounds of SS, which were carried out before and 12 months after the

beginning of the implementation of the food fortification program, has allowed us to evaluate the impact of salt iodization and wheat flour fortification programs on iron, folic acid, and iodine status of children living in a selected group of families in each of the six participating countries. Women were included only in the second round of SS, and the data received on women can be used in the future for comparison with the results, which will be collected in the next round/rounds of the sentinel study.

76. Statistically significant decrease of the prevalence of both anemia and low level of serum ferritin among children, which was caused by the implementation of the flour fortification program, was found in Uzbekistan, the only country where fortified flour was really available and used in most of the sampled households (79,5%) during 11,5 months. The prevalence of anemia in this country decreased from 31,4% in the first round of SS to 10,5% in the second round of SS. The threefold decrease of anemia rate was combined with the improvement of iron status: the level of serum ferritin significantly increased and the prevalence of low serum ferritin decreased from 8,1% to 5,1% between the two rounds of SS.

77. The threefold decrease of anemia prevalence among children in Tajikistan, and twofold decrease in The Kyrgyz Republic was revealed between the results of the two rounds of the sentinel study. However, fortified flour was available only in 2,5% of households in Tajikistan, and in 48,8% of the households in The Kyrgyz Republic during 8 months. The prevalence of low ferritin level in the blood serum of children has even increased in these countries during this period of time. Apparently, the low availability of fortified flour in sampled households and the achieved short duration of using fortified flour were not sufficient to improve the iron status of children in these countries. The dramatic decrease of anemia rate among children in Tajikistan, apparently, was caused by the implementation of the iron supplementation program (74,4% of children had taken iron tablets during 12 months prior to the second round of SS), and by periodical distribution of flour fortified with iron in the framework of some humanitarian aid.

78. No significant differences in the anemia rate among children between the two rounds of SS were found in other countries (Azerbaijan, Kazakhstan and Mongolia), and the prevalence of low ferritin level in blood serum of children even increased in these countries during this period of time. These results correspond to the very low availability of fortified flour in sampled households in Kazakhstan (2,5% of the households) and Mongolia (10% of the households had fortified flour during 6 months). Though 80% of the households in Azerbaijan had fortified flour in the second round of SS, 42,5% of the women answered that they used not fortified (ordinary) flour, and another 57,5% of the women did not know what kind of flour they used. 80% of the women in Azerbaijan had not even heard about fortified flour, 7,5% of the women did not know what it means, and only 12,5% of the women had heard about fortified flour. Fortified flour in Azerbaijan was probably used during a very short period of time, which was not sufficient to decrease the rate of anemia and improve the iron status of sampled children.

79. Uzbekistan's experience, where statistically significant decrease of the prevalence both of anemia and low level of serum ferritin among children as a result of a proper distribution and use of fortified flour in sampled households during 11,5 months was found, can indicate the effectiveness of the wheat flour fortification program in terms of decreasing anemia rate and improving iron status among sampled children. This conclusion is confirmed by the results of folic acid analysis in the blood of children: Uzbekistan was the only country where more than twofold decrease of the prevalence of folic acid deficiency between the two rounds of the sentinel study was revealed. So, the implementation of the wheat flour fortification program in this country was effective in terms of decreasing the prevalence of folic acid deficiency among sampled children as well. Only a small decrease of the

prevalence of folic acid deficiency (61-70,5% decreasing) among sampled children was found in Azerbaijan, The Kyrgyz Republic and Mongolia as a result of the implementation of the wheat flour fortification program.

80. The lack of effectiveness of the program implementation in terms of decreasing the anemia rate and/or improving iron and folic acid status among sampled population in other countries was caused by the low availability of fortified flour and/or using it during only a short period of time. Taking Uzbekistan's experience into consideration, it is possible to anticipate that improving the mechanisms of distribution of fortified flour and making fortified flour products available for use in sampled households in all countries involved in the project can lead to the decrease of anemia rate and improve iron and folic acid status among population.

81. The salt iodization program was effective in five of the six participating countries (except Mongolia) in terms of higher coverage of the households by iodized salt, increasing the medium level of urine iodine excretion and decreasing the prevalence of low level of urine iodine in sampled population. The program was most effective in Azerbaijan and Uzbekistan, where 100% of the sampled children had normal or higher than normal levels of urine iodine excretion in 2004 as a consequence of the implementation of the program. Azerbaijan and Uzbekistan were the countries where accordingly 100% and 88,7% of the households had iodized salt and the families used iodized salt. The program was quite effective in Kazakhstan, where adequately iodized salt was used in 82,5% of the households, and the prevalence of low urine iodine excretion decreased 6,5 times. It was less effective in Tajikistan, where iodized salt was used in 77,5% of households. The only country where the program was not effective is Mongolia, where one third of the households (27,5%) did not use iodized salt, and only 60% of the households had adequately iodized salt in 2004.

82. Therefore, the same way as with the flour fortification program, the effectiveness of the salt iodization programme depends on the availability and use of fortified salt in sampled families, and the effectiveness is much the higher and better if the whole population have access to fortified food.

RECOMMENDATIONS

83. Taking into consideration the results of the two rounds of SS, the following recommendations can be made:

a. To strengthen the management of JFPR Project in terms of ensuring the proper distribution, availability and affordability of fortified food products for the population in pilot regions, where households were sampled for the SS.

b. To improve communication activities in pilot regions to increase the knowledge of the population on micronutrients deficiency (IDA, IDD and deficiency of vitamins) and their prevention by consumption of fortified food products, and to create the demand of the population for these fortified products.

c. To make the following changes in the design of the next round/rounds of SS.

   (i) To plan two field visits of the Country Coordinator for SS before the field work for the next round of sentinel study. **The first field visit** should be done in six months (conceivably in May-June 2005) for

questionnaire based interview of women in 40 households, and semi-qualitative testing of salt for iodine (salt checker) and flour for iron (spot test) in households. The results and recommendations of the field visit should be shared and discussed with the Country Team for further improvement of the availability and consumption of fortified food products in pilot regions. **The second field visit** should be done in 12 months (conceivably in November-December 2005) for questionnaire based interview of women in 40 households, and semi-qualitative testing of salt for iodine (salt checker) and flour for iron (spot test) in households. The results of the second field visit of the Country Coordinator should be used for decision making on the timing for carrying out the next round of SS in the country.

(ii) To elaborate and use a new version of the questionnaire for the sentinel study, which will allow collecting proper data on the amount and duration of in which fortified food products were used by the sampled families.

(iii) To amplify the second round of the sentinel study with the quantitative dietary intake assessment of women and children by using the 24-hour food consumption recall method. The results of this study will allow receiving data on food sources of micronutrients (iron and vitamins), and the enhancers (heam iron, ascorbic, folic and organic acids) and inhibitors (non heam iron, fitate, dietary fibers, tea) of iron absorption, and can be used for more detailed explanation of the whole results of the sentinel study, and the effectiveness of the project.