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MICRONUTRIENT STATUS SURVEY – TAJIKISTAN 2003

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Contents

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Abbreviations, Acronyms and Special Terms

5-MTHF	5-methyltetrahydrofolate
APC	Anaemia prevention and control
BMI	Body mass index
CRP	C-reactive protein
ELISA	Enzyme-linked immunosorbent assay
FAD	Folic acid deficiency
GBAO	Gorno-Badakhshan Autonomous Oblast
MICS	Multiple Indicator Cluster Survey
MSS-T	Micronutrient Status Survey in Tajikistan
NGO	Non-governmental organization
Oblast	Region (government administrative unit), regional
Rayon	District (government administrative unit)
RDA	Recommended daily allowance
RRS	Region of Republican Subordination
sTfR	Serum transferrin receptor
WHO	World Health Organization

EXECUTIVE SUMMARY

1. A national survey for the evaluation of micronutrient deficiencies in Tajikistan was carried out in August and September 2003 by the Ministry of Health of the Republic of Tajikistan, with the technical assistance of the Italian Institute for Research on Food and Nutrition and the Kazakh Academy of Nutrition. The survey was promoted and supported by the Asian Development Bank, UNICEF and the World Health Organization.

2. The main objective of the survey was to determine the prevalence of anaemia, evaluate the status of iron deficiency and gauge the extent of iodine deficiency among women of childbearing age (15 to 49 years of age) and among children under 5 years of age (6 to 59 months of age) at the national level and at the subnational, regional level. Additional objectives were to evaluate feeding patterns among infants and young children (0 to 24 months), assess dietary intake among non-pregnant women of reproductive age and investigate plasma folate levels among non-pregnant women of reproductive age.

3. The sample was designed to give estimates of the prevalence of anaemia among children and women and the prevalence of exclusive breastfeeding among infants within a 6.5 per cent margin of error at the 95 per cent confidence level in each stratum. A total of 5,232 subjects (1,232 children 0 to 6 months of age, 2,000 children 6 to 59 months and 2,000 women of childbearing age) was targeted. Among all children 6 to 59 months and all non-pregnant women, capillary blood was collected for measurements of haemoglobin, ferritin, transferrin receptor and C-reactive protein. Anthropometry was measured among non-pregnant women.

4. Low body mass index (BMI) was observed in 9 per cent of the women. The highest prevalence of undernutrition among women was found in GBAO (Gorno-Badakhshan Autonomous Oblast, or Region), 20 per cent, followed by Khatlon oblast, 10 per cent, Sughd oblast, 8 per cent, and the Region of Republican Subordination (RRS, the oblast geographically surrounding, but not including the capital, Dushanbe), 6 per cent. The overall prevalence of severe forms of malnutrition (<16 kg/m^2) among women was less than 1 per cent, although, in GBAO, 3 per cent of women showed this condition. According to international references, when the prevalence of low BMI is higher than 9 per cent, the public health problem is at a medium level of concern, and, when it is 20 per cent or more, the prevalence should be considered high. At the same time, one fourth of the women (26 per cent) were overweight or obese (BMI >25 kg/m^2), with a higher prevalence in RRS (36 per cent) and Sughd (25 per cent) than in Khatlon (16 per cent) and GBAO (12 per cent).

5. The overall prevalence of anaemia among women was 41 per cent, with significant differences by population strata: 29 per cent of the women in RRS and 33 per cent of the women in Sughd were anaemic, while 63 per cent in Khatlon and 43 per cent in GBAO had mild to severe anaemia. Severe cases of anaemia were only present in 1 per cent of the population. Increased levels of serum transferrin receptor (sTfR), indicative of iron deficiency, were observed in 29 per cent of the women, with a higher prevalence in Khatlon (36 per cent) and GBAO (31 per cent) than in RRS (23 per cent) and Sughd (27 per cent).

6. The national prevalence of anaemia among children 6 to 59 months old was 38 per cent. The prevalence was lower in RRS and Sughd (30 per cent) than in Khatlon (50 per cent) and GBAO (55 per cent). Severe cases of anaemia were present in 1 per cent of the cases, though the corresponding figure was 3 per cent in GBAO. The prevalence of anaemia was highest among children under 2 years of age, among whom more than half (56 per cent) had haemoglobin below 11 g/dL. Iron deficiency (elevated sTfR) was present in 54 per cent of the children with moderate and severe anaemia and in 36 per cent of the children with mild anaemia or with normal haemoglobin levels. In

Khatlon, unlike other regions of the country, iron deficiency was present to a similar extent among anaemic and non-anaemic children (45 and 50 per cent, respectively).

7. The overall prevalence of anaemia among non-pregnant women of reproductive age exceeded the 40 per cent cut-off suggested by the World Health Organization, UNICEF and United Nations University, thus indicating that anaemia is indeed a public health priority for the country. Among children, it was 37.6 per cent, a level placing the country in the medium-to-high risk category. However, the distribution of anaemia was not uniform. In all regions of the country, the prevalence was medium to high (15 to 40 per cent), but it was seriously high in Khatlon. For both women and children, Khatlon was the most affected region: the prevalence among women was 63 per cent, and the prevalence among children was 52 per cent. The presence of several household members together in this situation indicates that anaemia is a life-cycle issue and that it requires a set of interventions targeting different age groups at the same time.

8. More than half the women studied (57 per cent) had low excretion of urinary iodine (<50 μg/L), with a higher prevalence in Khatlon (64 per cent) and RRS (60 per cent) than in Sughd (48 per cent) and GBAO (40 per cent). Severe cases of deficiency were more common in Khatlon (26 per cent) and RRS (26 per cent) than in Sughd (17 per cent) and GBAO (12 per cent). Only 3 per cent of the samples had excess urinary iodine, with higher prevalence in GBAO (8 per cent). Two thirds of the children studied (64 per cent) had low values of urinary iodine, with a higher prevalence in Khatlon (68 per cent) and RRS (65 per cent) than in Sughd (60 per cent) and GBAO (54 per cent). Severe cases of deficiency were more common in RRS (33 per cent) and Khatlon (26 per cent) than in Sughd (21 per cent) and GBAO (19 per cent). Five per cent of the cases had excess iodine urinary excretion. The presence of 60 per cent of women and 63 per cent of children with iodine excretion <100 μg/dL indicates a serious public health problem.

9. The simultaneous presence of iron and iodine deficiency in the same individuals and in multiple individuals in the same households should be considered likely. Such a combination of deficiencies may seriously hamper cognitive development in children.

10. The measurement of folic acid in serum in a subsample of 300 women in RRS revealed a high rate (73.7 per cent) of folic acid deficiency (FAD), including 38.3 per cent with mild FAD and 35.3 per cent with severe FAD.

11. In a subsample of 300 women in RRS, an average energy intake of 2,145 kcal/day was observed: 12 per cent from protein, 16.9 per cent from fat and 71.1 per cent from carbohydrates. Iron intake was 21.8 mg/day, that is, 74.1 per cent of the recommended daily allowance (RDA) for diets with low iron bioavailability. Eighty-seven per cent of the women had iron intake below this RDA value. The survey indicated a good intake level of vitamin C, pyridoxine, vitamin E, thiamin and niacin. Inadequate intake was revealed for pantothenic acid, vitamin B_{12}, folic acid, biotin, vitamin A and riboflavin. Bread accounted for 53.3 per cent of total energy intake, 60.5 per cent of carbohydrate intake, 58.1 per cent of protein, 44.8 per cent of fibre, and 12.1 per cent of fat. Bread was also one of the main sources of minerals and vitamins. Intake of animal protein was low, and animal products were consumed rarely.

12. The majority of sampled children under 2 years of age (97 per cent) had been breastfed at least partially at some stage of their lives. Two thirds (64 per cent) of the infants under 4 months of age and 50 per cent of the infants under 6 months were exclusively breastfed. The comparison between the Multiple Indicator Cluster Survey carried out in Tajikistan in 2000 and the present survey indicates that the exclusive breastfeeding rate among infants aged under 3 months went from 19 to 64 per cent (confidence interval 57-71). Tajikistan seems to perform better with exclusive

breastfeeding, since the rate of exclusive breastfeeding among infants under 4 months is the highest among the countries in the region (64 per cent).

13. The early introduction of liquids other than breastmilk is a very popular practice in Tajikistan. The survey found that water and black tea were introduced in the first month of life. Fruit juices were administered among 9 per cent of infants in the first semester of life; this was very popular in Sughd, where almost half the children under 5 months of age consumed fruit juices. Complementary foods were given to the children starting from 4 to 5 months of age. In the second semester of life, more than half of the children consumed fruit (54 per cent) and vegetables (52 per cent). The introduction of foods rich in carbohydrates (cereal porridge, pasta, biscuits, potatoes) took place within the first 6 months of age. Meat was introduced around 6 months of age; in the second semester of life, fewer than one fourth (23 per cent) of the children were consuming it, and, in the second year of life, approximately half the children (48 per cent) were consuming it.

14. Poor diet is a major cause of iron and folate deficiency. In infants under 2, diets generally contained insufficient animal products, and the non-haem iron was likely to be poorly bioavailable as a result of the presence of inhibitors of iron absorption, such as black tea, and the absence of enhancers, such as fresh fruit or vegetables, besides the early introduction of cow's milk. Among women, the mean iron intake was below the RDA, and the risk of iron inadequacy was therefore very high. Poor maternal iron stores therefore seem to have been common, leading to poor foetal iron stores, which would be another factor in the early occurrence of anaemia among infants.

15. Salt samples were iodized in 52 per cent of the cases (households). However, in about half the cases, salt was insufficiently iodized (<15 ppm). Adequately iodized salt was thus being used in only 28 per cent of the cases, with large differences among the regions of the country, from a minimum of 13 per cent in Khatlon to a maximum of 63 per cent in GBAO. Home storage was generally good. In 2000, 20 per cent of households were using properly iodized salt (>15 ppm).

16. Awareness of the benefits of salt iodization was good. The majority of the respondents (85 per cent) were aware that salt may be fortified with iodine. Only 18 per cent of the households interviewed declared they were aware of the practice of flour fortification, while the rest were unaware or did not understand what fortification meant.

INTRODUCTION

Since the early 1990s, Tajikistan has been suffering great hardship as a result of a civil war, an economic crisis and several environmental disasters, including floods and the significant spread of pests. The socio-economic and health situation in the country deteriorated substantially, and the impact on the well-being of the population was considerable. During the 1990s, the infant mortality rate was much higher than it had been previously. In 1998, the mortality rate for infectious and parasitic diseases (60 per 100,000 population) and the mortality rate for respiratory diseases (185 per 100,000 population) were the highest among the countries in the region. The incidence of malaria increased enormously, reaching a peak of 519.9 per 100,000 population in 1997. As a result of the major food emergency in 1999-2001, malnutrition rates rose appreciably. However, recent data indicate that the acute emergency is over, thanks to external aid and to a gradual improvement in the internal development situation in the country. A national survey conducted by a consortium of non-governmental organizations (NGOs) in September 2003[1] found that global acute malnutrition among children under 5 ranged from 3.3 per cent in Sughd to 7.1 per cent in Kulob in Khatlon oblast (region), with an overall median for the country of 4.7 per cent. A similar survey coordinated by Action Against Hunger[2] in October and November 2001 had found a prevalence of 17.3 per cent, indicating that acute malnutrition was being tackled in most parts of the country.

Despite these achievements, the health and nutrition problems still appear to be serious. The 2003 survey indicated that stunting rates (height-for-age z-scores <-2) ranged between 32.5 per cent in GBAO (Gorno-Badakhshan Autonomous Oblast) to 41.2 per cent in Kurgan Teppe in Khatlon oblast, with an overall country mean of 36.2 per cent: essentially the same rate observed in the 2001 survey (37.3 per cent). Stunting is a condition originating in the first two years of life and is caused by a combination of inadequate micronutrient intake and repeated exposure to infections. However, micronutrient status had never been well investigated in Tajikistan.

Thus, the Asian Development Bank, UNICEF and the World Health Organization (WHO) proposed a national survey for the evaluation of the most important indicators of micronutrient deficiency. The survey was carried out by the Ministry of Health of Tajikistan, with the technical assistance of the Italian Institute for Research on Food and Nutrition and the Kazakh Academy of Nutrition. The fieldwork was implemented during August and September 2003.

The selection among the micronutrients to be investigated was dictated by the likelihood of finding a shortage among the population and by the significance of the health impact of the relevant deficiency, as well as by practical considerations linked to the possibility of measuring the relevant deficiency within the population with suitable accuracy and little invasiveness and at acceptable cost. The low intake of animal products rendered the diet of large sectors of the population of Tajikistan low in haem iron, zinc and retinol. The limited intake of fresh fruits and vegetables was likely to affect the intake of vitamin C, thus also affecting the absorption of non-haem iron, folate and pro-vitamin A carotenoids. Furthermore, the low iodine content in water and in the food chain made it difficult to meet the requirements for this nutrient. Low iron and folate lead to anaemia, which is responsible for impaired physical and cognitive development in children, poor mental and physical performance in adults and increased risks of infectious disease. Iodine deficiency leads to the insufficient production of thyroid hormones, which affects muscles, the heart, the liver and the kidneys, as well as the developing brain.

In Tajikistan, information on anaemia prevalence was mainly based on clinical assessments in hospitals, and the extent to which anaemia prevalence was determined by iron deficiency was not clear. Official figures were somewhat inconsistent: in the period 1990-1997, more than one third of births (31.5-37 per cent) were complicated by anaemia. According to the UN Development

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[1] Action Against Hunger, Mercy Corps et al., National Nutrition and Water and Sanitation Survey, 2003, Tajikistan, preliminary results, 1 December 2003.

[2] Action Against Hunger and European Commission's Humanitarian Aid Office, National Nutrition Survey, Tajikistan, May-June 2002.

Programme (citing the Ministry of Health), 60 per cent of women of childbearing age and 61.5 per cent of teenagers were anaemic in 1998. According to the National Programme for Anaemia Prevention and Control (1998), anaemia was present in 96 per cent of all pregnant women. In 46 per cent of the cases, there was combined folic acid deficiency (FAD). Among non-pregnant women, anaemia was present in 25 to 32 per cent of the cases in urban areas and in 32 to 56 per cent of the cases in rural areas. In 1999, the national programme gave figures of 87 per cent for pregnant women, 48 per cent for women of childbearing age and 52 per cent for children under 5.

Iodine deficiency disorders are a crucial public health problem in Tajikistan. The majority of the population is at risk of severe iodine deficiency disorders. In 1994, the goitre rate detected[3] among children by ultrasound was 42 per cent in Dushanbe and 85 per cent in Tursun-Zade in the Region of Republican Subordination (RRS, the oblast geographically surrounding, but not including the capital, Dushanbe). A number of studies conducted in the country showed the high incidence of this deficiency especially among women (about 80 per cent) and children (about 60 per cent). The UNICEF Multiple Indicator Cluster Survey (MICS) carried out in Tajikistan in 2000 found that only 20 per cent of the population consumed iodized salt, with a prevalence that was higher in urban areas (32 per cent) than in rural areas (16 per cent)[4]. Cases of infantile cretinism were described, although a prevalence figure was not available.

A 2002 survey indicated that vitamin A deficiency (serum retinol <20 μg/dL) was present among 27 per cent of children under 5, a value that was similar to the value detected in neighbouring countries. Information on folate status was unavailable.

In order to plan suitable corrective actions, it is also important to possess a more accurate assessment of the nutrient adequacy of diets, as well as a description of dietary patterns, so as to identify which food groups contribute to the intake of the various nutrients.

I. OBJECTIVES AND METHODOLOGY

A. Objectives

The main objectives of the Micronutrient Status Survey in Tajikistan, 2003 (MSS-T) were: (1) to identify levels of anaemia, (2) to evaluate iron status and (3) to gauge levels of iodine deficiency among women of childbearing age (15 to 49 years) and among children under 5 years of age (6 to 59 months) at the national level and at the subnational, regional level.

Additional objectives were: (1) to evaluate feeding patterns among infants and young children 0 to 24 months of age, (2) to assess dietary intake among non-pregnant women of reproductive age and (3) to assess the plasma folate level among non-pregnant women of reproductive age.

The information collected and presented in this report will be used as a baseline for a future nutritional programme aimed at improving children's nutritional status in Tajikistan and for nutrition monitoring activities.

B. Methodology

1. Sampling

The MSS-T was carried out on a representative sample of women and children in each of the four oblasts (Khatlon, RRS, Sughd and GBAO). A cluster design was selected because detailed census information was not available, but also in order to facilitate the fieldwork. The calculation of the

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[3] Gerasimov, Gregory (1997), 'Iodine Deficiency Disorders Programme Activities in Tajikistan', UNICEF and the International Council for the Control of Iodine Deficiency Disorders.

[4] SSA (State Statistical Agency of the Republic of Tajikistan) and UNICEF (2000), 'Multiple Indicator Cluster Survey, Tajikistan, 2000', UNICEF: <*www.childinfo.org*>.

sample size was based on the expected prevalence of anaemia using estimates given by conditions of uncertainty (50 per cent). This led to a maximum sample size that would permit estimates of the prevalence among children and adult women within an absolute range of precision of 4 per cent at the national level and 6.5 per cent at the subnational, regional level, a 95 per cent confidence level and a 10 per cent estimate of sample loss. Because a cluster sample methodology was adopted, the sample size was calculated in consideration of a design effect of 2 in order to compensate for the likely decreased sample variance. The sample size for each oblast was calculated using the following formula:

$$n = (z^2_{1-\alpha} \cdot p(1-p)/m^2) \cdot D + 10\%$$

where:

n = sample size
$z_{1-\alpha}$ = standard normal deviate corresponding to $\alpha = 0.05$
D = design effect (2)
p = estimated prevalence of micronutrient deficiency (anaemia = 0.50)
m = expected precision (0.065)
10% = sample loss

A sample size of 500 children aged 6-59 months and 500 non-pregnant women aged 15-49 years is sufficient to give estimates of the prevalence of anaemia with a 6.5 per cent error at the 95 per cent confidence level in each stratum, considering a 10 per cent rate of refusals and lost samples. An additional sample of infants aged 0-6 months was selected in order to allow for the assessment of breastfeeding and complementary feeding. The sample size was calculated based on the 19 per cent figure for exclusive breastfeeding reported in MICS[5]. A sample size of 308 infants aged 0-6 months is sufficient to give estimates of the proportions of these indicators with a 6.5 per cent error at the 95 per cent confidence level in each stratum. A total number of 5,232 subjects (1,232 children aged 0-6 months, 2,000 children 6-59 months and 2,000 women of childbearing age) was targeted.

For practical and logistical reasons, 20 clusters were selected in each oblast (RRS, Sughd, Khatlon, GBAO). Clusters were allocated to smaller administrative units (cities, villages and settlements), with a probability-proportional-to-size methodology. Census data (1999) provided by the State Statistical Agency were used in order to have a detailed list of inhabitants at the village level. The list of administrative units chosen is provided in Annex I. In the case of the selection of very small villages with insufficient numbers of households, other, geographically proximate villages were added in order to reach the fixed number of subjects per cluster (25 children under 5 years of age, 25 women of childbearing age and 16 infants under 6 months of age). Because this criterion of geographical proximity was followed, it was possible to produce additional administrative units within which the characteristics were nearly uniform. In each location, a household selected haphazardly was used as the starting point for a random walk.

For logistical reasons, dietary intake and serum folate could only be assessed in RRS. Among the sample of 500 women selected for the survey, a subsample of 300 women of fertile age (15-49 years) were interviewed.

2. Data collection

Data collection was carried out by ten teams of three people each. All teams were composed of one

[5] SSA (State Statistical Agency of the Republic of Tajikistan) and UNICEF (2000), 'Multiple Indicator Cluster Survey, Tajikistan, 2000', UNICEF: <*www.childinfo.org*>.

person with specific training in interview techniques, one paediatrician and one laboratory technician. An additional team was in charge of the assessment of dietary intake and folate status in the subsample (see above).

A questionnaire was designed so as to provide relevant indicators of the health and nutrition status of the children under 5 years of age and women of reproductive age as outlined in the survey objectives. The questions were translated into Russian and then back-translated into English. The iodine content of salt used in the household was evaluated by testing the content of potassium iodate or potassium iodide. Weight and supine length were measured for all women 15 to 49 years of age; neither weight, nor height were measured among pregnant women. Anthropometric measurement procedures were standardized on the basis of guidelines published by the United Nations (1989) and WHO (1995)[6]. Measurers were adequately trained and performed a quality control exercise.

A 24-hour recall methodology was used for the quantitative assessment of food, energy and nutrient intake among women. A colour photo album with pictures of food products and dishes of different sizes was used to facilitate the interviews and the determination of the quantities of food products consumed. The information was recorded in a questionnaire.

3. Biochemical assays

Among all children 6 to 59 months of age and among non-pregnant women, capillary blood was collected for the measurement of haemoglobin, ferritin, transferrin receptor and C-reactive protein (CRP). The medical staff included within the teams were extensively trained to obtain good capillary samples. The subjects were asked to sit and relax; the middle fingers of their left hands were massaged gently and each pricked with a sterile lancet. The first drop of blood was removed, and the second one was collected by capillarity in a cuvette containing dry Drabkin's reagent for haemoglobin analysis. Medical staff collected an additional 300 μL of blood in a tube (Microtainer™) containing serum separator gel. The tube was labelled with the identification code of the subject and stored in a cold box for up to 72 hours. The samples were then centrifuged for serum separation. Serum samples were aliquoted, diluted and analysed with a sandwich enzyme-linked immunosorbent assay (ELISA) method so as to allow the determination of ferritin, CRP and soluble transferrin receptor using three different antibodies on 96-well plates.

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 anaemia are shown in Table 1[7]. At elevations above 1,000 m, haemoglobin concentrations increase as an adaptive response to the lower partial pressure of oxygen and reduced oxygen saturation of blood. The compensatory increase in red cell production ensures that sufficient oxygen is supplied to tissues. The cut-off points quoted in Table 1 are only valid at sea level or at an altitude below 1,000 m. In order to estimate correctly the prevalence of anaemia at the higher altitude of many survey sites in Tajikistan, the correction procedure of the International Nutritional Anaemia Consultative Group[8] was used. This is based on a curve that describes haemoglobin changes with altitude and that was developed from data on 2- to 5-year-old children with little or no iron deficiency in clinics at 1,200 to 3,000 m elevation within the Paediatric Nutrition Surveillance System of the Centres for Disease Control. Adjustments are

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[6] United Nations (1989), 'How to Weigh and Measure Children: Assessing the Nutritional Status of Young Children in Household Surveys', United Nations: New York. WHO (1995), 'Physical Status: The Use and Interpretation of Anthropometry, Report of a WHO Expert Committee', *WHO Technical Report Series*, No. 854.

[7] WHO, UNICEF and UNU (United Nations University) (1998), 'Iron Deficiency Anaemia: Assessment, Prevention and Control', World Health Organization: Geneva.

[8] International Nutritional Anaemia Consultative Group (2002), 'Adjusting Haemoglobin Values in Programme Surveys'. International Nutritional Anaemia Consultative Group: Washington, DC.

reported in Table 2. For elevations above 3,000 m, the correction values are extrapolated. Hb values measured in the field were recorded uncorrected. Later, the altitude of the closest district centre was recorded, and correction values were subtracted according to the observed individual values. The cut-off point at sea level was then applied for the diagnosis of anaemia. In the assessment of the public health significance of this indicator, WHO, UNICEF and UNU (1996)[9] indicated that a prevalence of mild to severe anaemia 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'.

The assessment of iron status was performed through a measurement of serum ferritin and serum transferrin receptor (sTfR). Ferritin is an important iron-binding protein, and its main function is iron storage. Low serum ferritin indicates low iron stores, while iron overload conditions are recognizable through elevated serum ferritin concentrations. Values lower than 12 μg/L indicate virtual exhaustion of the body iron stores. However, serum ferritin is also an acute-phase reactant protein that is elevated in response to infection. In order to avoid false negative cases, CRP was also measured. When CRP values were higher than 5 mg/L, ferritin values were not considered for the assessment of iron status. The soluble transferring receptor in serum seems to correlate well with the amount of receptor expressed at the cell membrane, which in turn reflects the cellular need for iron[10]. STfR increases with tissue iron deficiency and with increased erythropoiesis. It does not appear to be elevated by inflammatory diseases[11]. STfR is not affected by infectious status. Values of sTfR greater than 8.5 mg/L were considered indicative of poor iron status. Serum ferritin, CRP and sTfR were measured using a simple ELISA procedure. 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 by each of two laboratory technicians. The overall intra-observer and inter-observer coefficient of variation for ferritin was 14.9 per cent, for CRP, 18 per cent, and for sTfR, 16.5 per cent.

For urinary iodine measurements, a 10 mL urine sample was collected among all children (6-59 months) and women (18-45 years) in the households. A urinary iodine concentration between 100 and 200 μg/L is considered normal. An excretion of 50 to 99 μg/L indicates a mild deficiency, while 20 to 49 μg/L indicates a moderate deficiency. A concentration below 20 μg/L is indicative of severe iodine deficiency. A urinary iodine concentration higher than 200 μg/L indicates higher than normal excretion, while 300 μg/L indicates iodine overload. These cut-off points have been developed for school age 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. The urinary iodine concentration was measured by using a colorimetric method modified for microplate reading. The overall intra-observer and inter-observer coefficient of variation was 9 per cent.

A 5 mL sample of venous blood was collected from the antecubital vein among a subsample of 300 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 analysed by high-performance liquid chromatography using a fluorescent detector[12]. The analytical method for the measurement of 5-methyltetrahydrofolate (5-MTHF), the

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[9] 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.

[10] Huebers, H. A., Y. Beguin, P. Pootrakul, D. Einspahr and C. A. Finch (1990), 'Intact Transferrin Receptors in Human Plasma and their Relation to Erythropoiesis', *Blood*, 75 (1), pages 102-107. See also Cook, J. D., R. D. Baynes and B. S. Skikne (1994), 'The Physiological Significance of Circulating Transferrin Receptors', *Advanced Experimental Medical Biology*, 352, pages 119-126.

[11] Ferguson, B. J., B. S. Skikne, K. M. Simpson, R. D. Baynes and J. D. Cook (1992), 'Serum Transferrin Receptor Distinguishes the Anaemia of Chronic Disease from Iron Deficiency Anaemia', *Journal of Laboratory and Clinical Medicine*, 119 (4), pages 385-390. See also Nielsen, O. J., L. S. Andersen, N. E. Hansen and T. M. Hansen (1994), 'Serum Transferrin Receptor Levels in Anaemic Patients with Rheumatoid Arthritis', *Scandinavian Journal of Clinical and Laboratory Investigation*, 54 (1), pages 75-82.

[12] Snow, C. F. (1999), 'Laboratory Diagnosis of Vitamin B_{12} and Folate Deficiency: A Guide for the Primary Care

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 ng/mL by using an external standard. The concentration of the external standard was controlled spectrophotometrically. The cut-off point used to define the different classes of FAD and marginal and normal levels of folic acid in blood plasma are shown in Table 3.

4. Data management

The daily input of the information collected was carried out by a team of four data entry specialists using a specifically designed software. Data sets were checked for outliers. In order to identify outliers, distributions were plotted for each variable. The following values were considered outliers and excluded from further data analysis: haemoglobin (g/dL): <5 and >16; women's weight (kg): <30; women's height (cm): <130. In order to calculate national prevalence figures, a weighting factor was applied. For continuous variables (for example, haemoglobin, serum ferritin, urinary iodine, birthweight, body mass index, or BMI), one-way Anova with a post-hoc comparison of means (Sheffe's test) was performed. Some variables were also transformed into categorical variables, and cross-tabulations produced. Confidence intervals of proportions were calculated using Epi6 Cluster Sampling Analysis. The primary sampling unit was the cluster number. The primary stratum from which primary sampling units were chosen was the population strata.

Dietary intake data were converted into nutrients using a software specially designed by the Russian Academy of Sciences based on Russian food composition data.

II. RESULTS

A. Population Representativity

The sampling methodology was followed, and the required population was identified, but the biological samples could not be obtained from all individuals. A negligible number of households refused to take part in the survey. The final number of households participating is reported in Table 4. This figure was used to determine the weighting factors required to calculate national estimates so as to compensate for the overrepresentation of GBAO in the study sample.

Not all women or children agreed to provide biological samples. Since, in the course of the survey, the refusal rate looked greater than the estimated 10 per cent, additional individuals (10 per cent more) were included in the sample. This correction was implemented during the survey, and the final number of individuals for whom haemoglobin was measured was therefore above the required number in each oblast for both women and children. However, there were technical problems in the sample collection, transport, storage and analysis for the other biochemical determinations. The amount of blood collected was sometimes inadequate, or samples were haemolysed. In some cases there, was a problem of sample labelling that could not be resolved in the central laboratory. Finally, some batches for analysis had to be discarded based on quality control criteria, and the sample collected was not sufficient to carry out replicates. As a result, the required sample size was not achieved for sTfR (78 per cent for women and 69 per cent for children), ferritin (86 per cent for women and 79 per cent for children) and iodine (92 per cent for women and 83 per cent for children) (Table 5). The sample loss was not homogeneous across

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Physician', *Archives of Internal Medicine*, 159 (28 June), pages 1289-1298. Chladek, Jaroslav, Ludek Sispera and Jifina Martinkova (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*>.

clusters, and this led to an increased design effect. For both these reasons, the confidence intervals for these determinations are greater than expected.

B. The Demographic and Socio-Economic Background of the Population

Two thirds of the surveyed households were composed of single families, that is, one couple with or without children, while, in each of the remaining households, there were at least two families. In Khatlon, households composed of more families were more frequent (33 per cent, in contrast to the 22 per cent national average). The surveyed households had an average of six members. Single person households were uncommon, accounting for less than 2 per cent of the households surveyed. Households included in the survey had, on average, one child under 5. The ratio of dependent (boys and girls under 18, plus adults above 65) to independent individuals (adults 18 to 65 years of age) was less than 1 in the whole population (0.74±0.75). This ratio was higher in GBAO, corresponding to the higher vulnerability.

Almost all the households were headed by a man (89 per cent); a greater proportion of woman-headed households was found in RRS (16 per cent) and Sughd (15 per cent) than in Khatlon (2 per cent) and GBAO (9 per cent). The population had a good educational background. In all strata, the majority of the interviewees had attended secondary school or had university degrees. More than 40 per cent of the heads-of-household had a university degree. The lowest educational level (incomplete elementary school) was reported by 4 per cent of the surveyed households, and no illiterate individuals were reported.

Farming (37 per cent) and 'official' salaries (21 per cent) were the most common sources of income in Tajikistan. In GBAO, private business and official salaries covered the majority of household cash income (70 per cent). Official salaries were also common in RRS (22 per cent) and Sughd (26 per cent). Khatlon is an area characterized by farming (82 per cent); farming is also practised in one third of the households in RRS (36 per cent). Dependence on social aid was reported by 9 per cent of the population, with a higher occurrence in RRS than in other oblasts. Absence of any kind of salary was reported among 19 per cent of the households surveyed. More than half the population (53 per cent) had the possibility of growing fruits and vegetables; the corresponding figure was more than two thirds in Khatlon (77 per cent) and GBAO (79 per cent). Similar proportions were observed for small animal breeding and for meat and milk production.

Food donations among friends and neighbours were scarce (2 per cent of the households), with a significantly higher prevalence (5 per cent) in GBAO. The sale of household goods was practised by 11 per cent of the population, with a higher prevalence in Khatlon (22 per cent). Fifteen per cent of the households received social assistance in the form of food aid, with significant differences among the country's regions: only 3 per cent of households in Khatlon received social assistance, as opposed to 54 per cent in GBAO, 26 per cent in RRS and 13 per cent in Sughd.

C. Women's Nutritional Status

1. Body mass index

Low BMI was observed among 9 per cent of the women (Table 6). The highest prevalence of women's undernutrition was found in GBAO (20 per cent), followed by Khatlon (10 per cent), Sughd (8 per cent) and RRS (6 per cent). The overall prevalence of severe forms (<16 kg/m^2) of malnutrition among women was less than 1 per cent, but, in GBAO, 3 per cent of women showed this condition. According to international references, when the prevalence of low BMI is higher than 9 per cent, the public health problem is at a medium level of concern, and, when it is 20 per cent or more, the prevalence should be considered high. At the same time, one fourth of the women (26 per cent) were overweight or obese (BMI >25 kg/m^2), with a higher prevalence in RRS (36 per cent) and Sughd (25 per cent) than in Khatlon (16 per cent) and GBAO (12 per cent). Higher degrees of obesity (BMI >30 kg/m^2) were uncommon and present only with a moderate level of severity (7 per cent). Moderate obesity also showed a significantly higher prevalence in RRS (11 per cent) and Sughd (7 per cent) compared to Khatlon (2 per cent) and GBAO (3 per cent)

2. Anaemia and iron deficiency

Women of fertile age had mean blood haemoglobin of 12.2±1.8 g/dL (Table 7). Women living in RRS and Sughd showed significantly higher haemoglobin than those living in Khatlon, while women in GBAO had values that were somewhat intermediate between Khatlon and RRS. As shown in Figure 1, the distribution of haemoglobin in Khatlon (green line) is shifted towards the area corresponding to anaemia. The overall prevalence of anaemia was 41 per cent (Table 8), with significant differences by population strata: 29 per cent of the women in RRS and 33 per cent of the women in Sughd were anaemic, while 63 per cent in Khatlon and 43 per cent in GBAO had mild to severe anaemia. In these two regions, the prevalence was higher than the 40 per cent threshold indicative of a public health priority. It should also be noted that severe cases of anaemia were only present in 1 per cent of the population. The presence of anaemia was the same in younger women (15-24 years) and in older women (35-49 years).

The presence of an acute infection (serum CRP >5 mg/L) was observed in 7 per cent of the women, with a significantly higher prevalence in GBAO (10 per cent) and Khatlon (9 per cent). In women with serum CRP ≤5 mg/L, serum ferritin concentration was 49.8±38.4, with significantly higher values in Khatlon and GBAO (Table 9). Using a 12 mg/L cut-off, 13 per cent of the women had low ferritin, with higher prevalence in RRS (17 per cent) and Sughd (13 per cent) than in Khatlon (8 per cent) and GBAO (7 per cent) (Table 10). The use of a 30 mg/L cut-off instead and the inclusion of women with increased CRP gave a prevalence of low ferritin values at 38.6 per cent (confidence interval 34.7-42.5), but with still higher prevalence in Sughd and RRS.

The use of sTfR offered a different picture of the prevalence of iron deficiency. Women living in Khatlon had, in fact, a significantly higher concentration of sTfR (Table 11). According to this indicator, 29 per cent of the women were affected by iron deficiency, with higher prevalence in Khatlon (36 per cent) and GBAO (31 per cent) than in RRS (23 per cent) and Sughd (27 per cent) (Table 12). There was no age trend in the prevalence of iron deficiency.

Iron deficiency was a major cause of anaemia. Iron deficiency (elevated sTfR) was present in 56 per cent of the women with moderate and severe anaemia and in 27 per cent of the women with mild anaemia or with normal haemoglobin levels. However, in Khatlon, iron deficiency was present to the same extent in anaemic and non-anaemic women (37 and 36 per cent, respectively).

3. Iodine

One third of the women (35 per cent) reported that they had been or were still affected with goitre, with significantly higher prevalence in Khatlon (45 per cent) and Sughd (35 per cent) than in RRS (26 per cent) and GBAO (12 per cent). Table 13 shows the distribution of urinary iodine in the women examined. The median level (94 μg/L) was below the expected value of 100 μg/L, and the 20th centile (20 μg/L) was very much lower than 50μg/L, indicating that the iodine status of women was inadequate. Urinary iodine was lowest in RRS and Khatlon, while it was highest in GBAO. In Sughd, the median (105μg/L) was above the cut-off point, while the 20th percentile was below 50μg/L (29μg/L).

More than half the women studied (57 per cent) had urinary iodine <50 μg/L (Table 14), with a higher prevalence in Khatlon (64 per cent) and RRS (60 per cent) than in Sughd (48 per cent) and GBAO (40 per cent). Severe cases of deficiency were more common in Khatlon (26 per cent) and RRS (26 per cent) than in Sughd (17 per cent) and GBAO (12 per cent). Only 3 per cent of the samples had excess urinary iodine, with higher prevalence in GBAO (8 per cent). These results are consistent with the data on salt iodization. There was no age trend in urinary iodine excretion.

4. Folate status (RRS subsample)

The measurement of folic acid in serum revealed a high rate of FAD (73.7 per cent) in the subsample of 300 women in RRS, including 38.3 per cent with mild FAD and 35.3 per cent with severe FAD (Table 15, Figure 2). The rate of FAD was higher in rural areas (78.3 per cent) than in urban areas (58.6 per cent). One fifth of the women (21.7 per cent) had marginal levels of folic acid in plasma, and only 4.7 per cent of women had normal levels. Normal levels were more frequent in urban areas (12.9 per cent) than in rural areas (2.2 per cent). These results indicate that FAD is an important public health problem in Tajikistan.

5. Use of iron folate supplements

Approximately one third of the women (36 per cent) declared they used iron and folate supplements, with a significantly higher percentage in GBAO (63 per cent) and Sughd (48 per cent) than in RRS (29 per cent) and Khatlon (27 per cent) (Table 16).

6. Dietary intake (RRS subsample)

An average energy intake of 2,145 kcal/day was observed: 12 per cent from protein, 16.9 per cent from fat and 71.1 per cent from carbohydrates (17.9 per cent from simple sugars and 53.2 per cent from complex carbohydrates). Around 50 per cent of fat was provided by vegetable oil.

Iron intake was 21.8 mg/day, that is, 74.1 per cent of the recommended daily allowance (RDA) for diets with low iron bioavailability (29.4 mg/day for iron, with bioavailability of 10 per cent) (Table 17). Eighty-seven per cent of the women had iron intake below this RDA value; all the women would have had an iron intake below the RDA if the RDA for diets with very low bioavailability (58.8 g/day, with bioavailability of 5 per cent) had been considered. This would be justified because heam iron intake was 0.16 mg/day (only 0.72 per cent of total iron). Calcium intake was 504 mg/day, and, among almost all women (99 per cent), it was less than the RDA. In contrast, the intake of phosphorus, magnesium and potassium was higher than the RDA (Figure 3).

The survey indicated a good intake level of vitamin C (152.9 mg/day, 204 per cent of RDA), pyridoxine (2.23 mg/day, 171 per cent of RDA), vitamin E (22.4 mg/day, 149.3 per cent of RDA), thiamin (1.4 mg/day, 127.3 per cent of RDA) and niacin (14.7 mg/day, 100 per cent of RDA) (Figure 4). Inadequate intake was revealed for pantothenic acid (3.1 mg/day, 56.4 per cent of RDA), vitamin B_{12} (1.46 μg/day, 60.8 per cent of RDA), folic acid (243 μg/day, 60.8 per cent of RDA), biotin (18.9 μg/day, 63 per cent of RDA), vitamin A (476.7 μgRE/day, 68.1 per cent of RDA) and riboflavin (0.86 mg/day, 78.2 per cent of RDA).

The main source of energy and macronutrients (excluding fat) was bread. Bread consumption was higher in rural areas (538 g/day) than in urban areas (342 g/day). Bread accounted for 53.3 per cent of total energy intake, 60.5 per cent of carbohydrate intake, 58.1 per cent of protein, 44.8 per cent of fibre and 12.1 per cent of fat (Figure 5). Bread was also one of the main sources of minerals (79 per cent of sodium, 45 per cent of phosphorus, 43 per cent of iron, 22 per cent of calcium, 20 per cent of potassium and 16 per cent of magnesium) (Figure 6) and vitamins (54.9 per cent of folic acid, 52.1 per cent of thiamin, 51.6 per cent of niacin, 48.4 per cent of pantothenic acid, 43.9 per cent of biotin, 43.6 per cent of vitamin E, 28.7 per cent of pyridoxine, and 25.6 per cent of riboflavin) (Figures 7a and 7b).

Intake of animal protein was low, and animal products were consumed rarely. Many women had not consumed any animal products during the two days preceding the interviews. Average consumption was 55.5 g/day of dairy products, 44 g/day of meat and 7 g/day of eggs. Because of this, the intake level of pre-formed retinol was only 54 μg/day, and the level of vitamin B_{12} intake was 60.8 per cent of RDA. Vitamin B_{12} came from meat (75.3 per cent), milk and yogurt (15.1 per cent), curds (7.5 per cent) and eggs (2.1 per cent). Iron intake from animal products was negligible.

Vegetables were important sources of vitamin C, carotenoids and folate. Green leafy vegetables provided 46.1 per cent of vitamin C, 75.6 per cent of pro-vitamin A and 15.6 per cent of folate; melons and pumpkins provided 25.5 per cent of vitamin C, 11.7 per cent of pro-vitamin A and 11.6 per cent of folate; fruits and berries provided 11.9 per cent of vitamin C, 1 per cent of pro-vitamin A and 1.5 per cent of folate. Vitamin C intake was high due to the seasonal consumption of vegetable food products. Vegetable products were also the second most important source of iron: 39 per cent altogether from green leafy vegetables, melons and pumpkins, and fruits and berries.

D. Children 0-59 Months

1. Anaemia and iron deficiency

Table 18 illustrates the mean haemoglobin value in the various strata of the population. Children 6 to 59 months old had mean blood haemoglobin of 11.2±1.6 g/dL. Values were significantly lower in GBAO and Khatlon than in RRS and Sughd. Figure 8 shows the distribution of haemoglobin in children aged 6 to 59 months. In both Khatlon (green line) and GBAO (yellow line), the curves are shifted to the left, and both median values are below the cut-off point for mild anaemia, but in GBAO the curve is also skewed, indicating that a higher proportion of children fall below the 7 mg/dL cut-off. The overall national prevalence of anaemia was 38 per cent (Table 19). The prevalence was lower in RRS and Sughd (30 per cent) than in Khatlon (50 per cent) and GBAO (55 per cent). Severe cases of anaemia were present in 1 per cent of the cases, but in 3 per cent in GBAO. Figure 9 shows the prevalence of anaemia among different age groups. The mean value of haemoglobin was significantly higher in the fourth and fifth year of life compared to the first three years. The prevalence of anaemia was highest among children under 2 years of age. More than half (56 per cent) of the children had haemoglobin below 11 g/dL. Among older children, the prevalence decreased to less than a half, and it was as low as 22 per cent at 5 years of age.

The prevalence of high values of CRP was 8.1 per cent (confidence interval 6.1-10.1) at the national level, but it was much higher in GBAO (21.3 per cent, confidence interval 16.9-25.8) and in Sughd (10.2 per cent, confidence interval 5.4-15.0). For this reason, an assessment of iron status based on serum levels of ferritin was not feasible, and the measurement of sTfR was considered instead. Children living in Khatlon had significantly higher concentrations of sTfR relative to children in other oblasts (Table 20). According to this indicator, 39 per cent of children surveyed were iron deficient, with a higher prevalence in Khatlon (51 per cent) and GBAO (42 per cent) than in RRS (37 per cent) and Sughd (33 per cent) (Table 21). The mean value of sTfR was not different across age groups. However, a smaller proportion of high sTfR was observed in the fifth year of life (Figure 10).

As among women, also among children iron deficiency was a major cause of anaemia. Iron deficiency (elevated sTfR) was present among 54 per cent of the children with moderate and severe anaemia and among 36 per cent of the children with mild anaemia or with normal haemoglobin levels. In Khatlon, unlike other regions of the country, iron deficiency was present to a similar extent in anaemic and non-anaemic children (45 and 50 per cent, respectively).

2. Iodine

Table 22 shows the urinary concentration of iodine among children 6 to 59 months of age. The median level of the indicator was 73μg/L, and the 20th centile showed 12μg/L, indicating that the iodine status of children was inadequate. RRS and Khatlon had the lowest values; GBAO and Sughd also had low excretion, although the extent of deficiency was lower.

Two thirds of the children studied (64 per cent) had low values of urinary iodine (Table 23), with a higher prevalence in Khatlon (68 per cent) and RRS (65 per cent) than in Sughd (60 per cent) and GBAO (54 per cent). Severe cases of deficiency were more common in RRS (33 per cent) and Khatlon (26 per cent) than in Sughd (21 per cent) and GBAO (19 per cent). Again, this finding was consistent with the use of iodized salt among households. Five per cent of the cases showed excess iodine urinary excretion, with no significant differences across regions.

3. Infant feeding patterns

The majority of sampled children under 2 years of age (97 per cent) had been breastfed at least partially at some stage of their lives. Two thirds (64 per cent) of the infants under 4 months of age and 50 per cent of the infants under 6 months of age were exclusively breastfed (Figure 11). Exclusive breastfeeding was significantly more common in Khatlon (74 per cent among infants under 4 months and 60 per cent among infants under 6 months). There was a small proportion of infants (1 per cent) who were exclusively breastfed beyond the age of 6 months.

The introduction of foods, in addition to breastmilk, was carried out among 13 per cent of the infants at 4 months of age and among 26 per cent of the infants at 6 months. The introduction of liquids other than breastmilk was observed in one fourth of the cases. Predominant breastfeeding was practised among 8 per cent of infants between 6 and 12 months of age. In the second year of life, 2 per cent of the children continued to receive breastmilk with other liquids. Breastfeeding on demand was widely practised (98 per cent of the infants).

Infant formula, not commonly used during the first six months of life (7 per cent), was introduced around the age of 5 or 6 months, at the cessation of breastfeeding, as a transition food. Its use was more common in RRS (even in the first months of life) than in the other oblasts. Cow's milk was used as an alternative to breastmilk among infants under 6 months of age in 10 per cent of the cases (more in RRS and GBAO). Cow's milk became a major food after the age of 6 months. In Khatlon and Sughd, the consumption of cow's milk during the 24 hours previous to the survey was reported for a majority of children, while in GBAO and RRS only about half the children had consumed cow's milk during the previous 24 hours. Fermented milk was introduced at around the age of 5 or 6 months in GBAO and Khatlon and later in RRS and Sughd; it was always uncommon in Khatlon. Fermented milk was not used as a breastmilk substitute. The consumption of diluted cow's milk was practised among 10 per cent of children under 6, with higher prevalence in GBAO (17 per cent) and RRS (13 per cent) than in Sughd (11 per cent) and Khatlon (5 per cent). This practice was found among almost two thirds of older children (65 per cent) and among even more in Khatlon (74 per cent), but less in RRS (55 per cent) and GBAO (45 per cent).

The early introduction of liquids other than breastmilk is a very popular habit in Tajikistan. Water is introduced in the first month of life, in RRS earlier than in the other oblasts. The administration of black tea to infants is also very common during the first month of life, particularly in RRS and GBAO. Tea was used in addition or as an alternative to water among 14 per cent of infants under 6 months of age; in the second year of life, 76 per cent of the children were being given black tea. The consumption of herbal tea (camomile, mint) was not common; it was mainly practised in Sughd among children 7 to 12 months old (6 per cent) and 12 to 24 months old (11 per cent). Fruit juice was administered among 9 per cent of infants in the first semester of life; it was very popular in Sughd, where almost half the children 5 months old were consuming it.

Complementary foods were being given to children starting from the fourth to fifth months. During the second semester of life, more than half the children consumed fruits (54 per cent) and vegetables (52 per cent); the figures were higher in Sughd than in the other oblasts. The consumption of fruits and vegetables increased with age, and, in the second year of life, a large majority of children were consuming them. A proportion of children were not consuming fruits or vegetables in the second semester of life or even in the second year. The introduction of foods rich in carbohydrates (cereals, porridge, pasta, biscuits, potatoes) took place in the first six months of life, and the consumption of these foods increased gradually with age. Bread was introduced at 4 to 5 months of age; more than half of the infants aged 6 to 12 months (54 per cent) had consumed bread during the day preceding the survey. Porridge was introduced earlier than bread: around the third month of life. In the second semester of life, 58 per cent of children were consuming porridge. Potatoes were introduced at 5-6 months of life and were being consumed by the majority of the children in the second year of life; biscuits were the earliest solid food to be introduced in the infant diet, as they were administered as early as the first month of life and were being consumed by more than two thirds of the children in the second semester of life. Meat was introduced at around 6 months of age; in the second semester of life, less than one fourth (23 per cent) of the children were consuming meat, and in the second year of life approximately half the children (48 per cent) were consuming it. Fish was rarely present in children's diets; it was introduced in the second semester of life and was being consumed by 12 per cent of the children in the second year of life. Cheese was introduced in the second semester of life, but consumption was reported for only 4 per cent of the infants and for 12 per cent of the children in the second year of life. Eggs were introduced at 5 months.

Nineteen per cent of the infants under 2 years of age received vitamin supplements, with a significantly higher prevalence in RRS (26 per cent) than in other oblasts. The use of iron folate tablets was reported for 10 per cent of the children aged 12 to 24 months who were examined, with a significantly higher prevalence in GBAO (63 per cent) than in Sughd (19 per cent) and RRS (8 per cent); in Khatlon, this practice was virtually absent (Table 24).

4. Infant feeding and anaemia

As previously indicated, anaemia prevalence was higher among children under 24 months of age. The survey indicated that consumption of meat and vegetables positively affected haemoglobin values, while the consumption of black tea had a negative impact. The prevalence of iron deficiency was 49 per cent among drinkers of black tea and 46 per cent among non-drinkers. Among children whose mothers reported meat consumption during the 24 hours previous to the survey, the prevalence of anaemia was 55 per cent, while, among the non-consumers, it was 60 per cent. The prevalence of iron deficiency was 43 per cent among the meat consumers, but 50 per cent among the non-consumers. Among those consuming vegetables, the prevalence was 57 per cent versus 60 per cent among the non-consumers. The prevalence of iron deficiency was 46 per cent versus 49 per cent.

Among children who were given black tea, the prevalence of anaemia was 65 per cent, while, among the non-drinkers, it was 56 per cent. Among the children who had eaten meat and vegetables during the day previous to the survey and who had not had black tea, the prevalence of anaemia was 45 per cent, while, among children with other dietary patterns, the prevalence was 63 per cent. Although this was a small difference, it was still higher than the difference in the prevalence of anaemia between infants whose mothers reported the administration of iron tablets (43 per cent) and infants whose mothers reported no administration of iron tablets (40 per cent). The prevalence of iron deficiency (measured through sTfR) in the latter two groups was not different (39 versus 40 per cent).

E. The Intrahousehold Distribution of Micronutrient Deficiencies

Figure 12 shows the presence of multiple cases of anaemia in households (among women and among children). In Khatlon, 62 per cent of the households had more than one household member with anaemia, a much higher value than in GBAO (32 per cent) or RRS and Sughd (21 per cent each). This was partially due to the characteristics of the households in Khatlon, which tend to have more members. Only 14 per cent of the households in Khatlon were completely unaffected by anaemia, as opposed to 42 per cent in RRS. The odds ratio that a child with an anaemic mother would become anaemic was 1.5 (confidence interval 1.2-1.8). This ratio was higher in GBAO (2.2, confidence interval 1.5-3.2) and lowest in Sughd (0.9, confidence interval 0.5-1.5).

The prevalence of iron deficiency in households is shown in Figure 13. In Khatlon, 47 per cent of households had more than one member who had iron deficiency, while the figure was 40 per cent in RRS, 25 per cent in Sughd and 20 per cent in GBAO. The largest number of households with no members affected by iron deficiency (27 per cent) was in GBAO and Sughd. The odds ratio that a child with an iron-deficient mother would also be iron deficient was 3.6 (confidence interval 2.6-5.1). The odds ratio was highest in Khatlon (5.0, confidence interval 2.6-9.4) and lowest in Sughd (2.1, confidence interval 1.0-4.3).

F. Knowledge, Attitudes and Practices: The Use of Fortified Food Products

1. Iodized salt

In practice, 52 per cent of the salt samples examined were found to be iodized (Table 25). However, in about half the cases, the salt was insufficiently iodized (<15 ppm). The use of adequately iodized salt was therefore 28 per cent, with large differences among the regions of the country, from a low of 13 per cent in Khatlon to a high of 63 per cent in GBAO. This may be due to inadequate iodization at the factory level or to inadequate home storage. Home storage was generally good. In 82 per cent of the cases of home storage, salt was being kept in a closed container, although the incidence of poor storage was higher in Khatlon (32 per cent) than elsewhere. In households where salt iodization was lower than 15 ppm, the majority of the households (85 per cent) used a closed container, an indication that the reason for inadequate iodine content was external to the household (Figure 14).

People may also have sometimes been mistaken about the proper use of iodized salt. Half the households surveyed (53 per cent) declared they used iodized salt, ranging from 15 per cent in Khatlon to 83 per cent in Sughd. However, only half of these households were using properly iodized salt (51 per cent), while 24 per cent were using poorly iodized salt, and 19 per cent were using non-iodized salt.

2. Iron fortified flour

Only 18 per cent of the households interviewed declared they were aware of the practice of flour fortification. The remaining 82 per cent were either unaware, or did not understand what fortification meant. Sughd was the region with the highest number of positive responses (32 per cent), followed by GBAO (24 per cent), RRS (9 per cent) and Khatlon (8 per cent).

However, in most cases (89 per cent), people did not know the reason for the fortified flour. The highest proportion of the well-informed people were in Sughd (32 per cent) and GBAO (24 per cent). Of those who had heard about flour fortification, 49 per cent were able to make the connection between the use of fortified flour and anaemia prevention. Interestingly, people in GBAO had a better understanding (89 per cent) of this link than did people in any other region: RRS (35 per cent), Sughd (26 per cent) and Khatlon (19 per cent). Hypovitaminosis prevention was considered an effect of flour fortification by 5 per cent of the households interviewed.

Most of the households interviewed declared that they usually baked bread at home (89 per cent). Only in Sughd did a small proportion of households (23 per cent) declare that they bought bread from a grocery shop.

III. A COMPARISON WITH MICS 2000

A Multiple Indicator Cluster Survey was carried out by UNICEF in Tajikistan in the year 2000. A comparison between the MICS 2000 and the present survey, which was carried out during 2003, indicates that the rate of exclusive breastfeeding among infants aged under 3 months rose from 19 to 64 per cent (confidence interval 57-71) during the interval. The proportion of infants who were still being breastfed at 12 to 15 months of age was unchanged (75 per cent then; now, 76 per cent), and the proportion who were still being breastfed at 20 to 23 months of age increased from 35 to 54 per cent. The onset of complementary feeding appeared to be delayed in the 2003 sample, as the proportion of children receiving breastmilk and semi-solid foods at the age of 6 to 9 months was 79.7 per cent in 2000 and 66 per cent in 2003. Despite some differences in the questionnaires (a larger number of questions on infant feeding in the micronutrient survey) and in the sample size (325 children under 6 in the MICS and 1,232 in the micronutrient survey), the survey methodologies are comparable (the definition of exclusive breastfeeding and the use of the 24-hour recall methodology). Thus, the breastfeeding rate should have, in fact, increased.

In 2000, 20 per cent of the households were using properly iodized salt (>15 ppm), while, in 2003, this proportion was 28 per cent. The analysis of the regional breakdown indicates that Sughd and RRS stayed approximately at the same level (Sughd: 52 per cent in 2000 and 46 per cent in 2003; RRS and Dushanbe: 12 per cent in 2000 and 18 per cent in 2003), while Khatlon and, particularly, GBAO showed an increase (Khatlon: 1.8 per cent in 2000 and 13 per cent in 2003; GBAO: 2.5 per cent in 2000 and 63 per cent in 2003).

IV. COMPARISONS ACROSS CENTRAL ASIA AND KAZAKHSTAN

Between 1995 and 2000, demographic and health surveys were carried out in all countries of the region. The surveys also included the measurement of blood haemoglobin with the HaemoCue technique. In Figure 15, the prevalence of anaemia among non-pregnant women 15 to 49 years of age is compared across the different countries. The highest prevalence was reported in Uzbekistan in 1996, where 60 per cent of the women of fertile age were affected, and the lowest in Kazakhstan in 1999 (36 per cent). In Tajikistan, the prevalence of anaemia is closer to the lower end than the higher end of this range. Most of the anaemia cases were mild, and the prevalence of severe forms of anaemia did not exceed 1 per cent in all countries.

Also, among children 6 to 59 months old, anaemia prevalence in Tajikistan (37.7 per cent) was close to the lowest value among the countries in the region (Turkmenistan at 35.9 per cent) and not at all comparable to the 69.9 per cent prevalence observed in Kazakhstan in 1995 (Figure 16).

The iodine status among women in Tajikistan can be compared to that of neighbouring Kazakhstan. The 66-127 μg/L median values observed in the different regions of Tajikistan (national median value of 94 μg/L) are comparable to the median values of 72-157 μg/L observed in the different regions of Kazakhstan in 1999[13], and the proportion of women with urinary iodine excretion below 100 μg/L (57 per cent) is similar to that observed in Kazakhstan (53 per cent).

Salt iodization data are available for Turkmenistan, where the majority of households (76.8 per cent) were using adequately iodized salt (≥15 ppm). A similar picture was observed only in GBAO (63 per cent using adequately iodized salt, and 18 per cent using non-iodized salt), while, in the rest of the countries, salt was either poorly iodized, or not iodized at all.

Tajikistan seems to perform better with exclusive breastfeeding, since the rate of exclusive breastfeeding among children under 4 months is the highest among the countries in the region (64 per cent) (Figure 17). In all surveys, the 24-hour recall methodology was used, but there may be methodological differences related to the structure of the questionnaires and the definition of exclusive breastfeeding. In Tajikistan, the latter allowed the use of vitamin and mineral supplements. The proportion of children who were not breastfed is also the lowest in the region in Tajikistan (4 per cent), and this value was not affected by the interview design.

[13] Ospanova, F. (2000), 'Iodine Urine Excretion as Estimation of Iodine Status of Reproductive Age Women', *Astana Medical Journal*, 2000, pages 109-111.

V. DISCUSSION

A. Assessment of Micronutrient Status

The implementation of the Micronutrient Status Survey in Tajikistan (2003) was a necessary step in a critical appraisal of public health nutrition strategies that relied on data obtained from local samples or clinical evaluations. The MSS-T has permitted the prevalence of anaemia, iron deficiency and iodine deficiency to be determined among a representative sample of the population at the national and subnational, regional level.

The overall prevalence of anaemia among non-pregnant women of fertile age was 42 per cent (confidence interval 37.7-46.0), that is, it exceeded the 40 per cent cut-off suggested by WHO, UNICEF and UNU[14], thus indicating that anaemia is indeed a public health priority for the country. Among children, it was 37.6 per cent (confidence interval 34.2-41.1), which places the country in the medium-high risk category. Among the Central Asian countries, Tajikistan is towards the lower end of the range for both women and children. Anaemia was mainly present in the mild or moderate forms, and severe anaemia occurred among less than 1 per cent of women or children. However, the distribution of anaemia was not uniform, and knowledge of the distribution is important for programme targeting purposes. First of all, there were significant geographical differences. In all the regions of the country, the prevalence was medium high (15-40 per cent), but it was seriously high in Khatlon. Khatlon was the most affected oblast in terms of both women and children. The prevalence among women was 63 per cent, more than double the corresponding figure in RRS or Sughd, and the prevalence among children was 52 per cent, with a smaller, but still dramatic differential with the areas of low prevalence (RRS and Sughd, where it was 31 per cent). In 62 per cent of households, more than one household member was affected by anaemia, twice as high as the proportion in GBAO (32 per cent) and three times as high as that in RRS and Sughd (21 per cent). In GBAO, anaemia is a major issue for children (55 per cent), but not so high among women (36 per cent). The presence of several household members indicates that anaemia is a life-cycle issue and requires a set of interventions targeting the different age groups at the same time.

Age was a second important factor affecting the occurrence of anaemia. Among children under 2, the rate of anaemia was twice that among children aged above 3. This age pattern was the same in all regions of the country except Khatlon, where the rate remained high throughout childhood: 47 per cent (6-12 months), 62 per cent (13-24 months), 62 per cent (25-36 months), 54 per cent (37-48 months) and 39 per cent (49-59 months). In other words, while children in the other regions had the opportunity to catch up with their red blood cell mass, children in Khatlon could not do so.

Iron deficiency accounts for more than half the incidence of moderate and severe anaemia, but for only one third of the incidence of mild anaemia, the most common form of anaemia. Additional causes of anaemia are folate deficiency and, possibly, vitamin A deficiency. Although it issued from a subsample, the finding is indicative of a very high prevalence of FAD, with almost three fourths of the sample affected by deficiency of some degree, and one third affected by severe deficiency. The subsample was selected in the region with the lowest prevalence of anaemia and in a season with optimal folate intake (August-September). Thus, it is likely that the FAD problem in Tajikistan may be generalized and may be even more important during winter and spring. Serum retinol was not measured in the MSS-T, but vitamin A deficiency was revealed in 27 per cent of the cases in a 2002 survey.

Iron deficiency has an impact beyond its role in the genesis of anaemia, and it should therefore also be considered in its own right. The assessment of iron status in a population should be carried out by measuring both serum ferritin and sTfRs. The former is an indicator of the presence of iron stores, while the latter are an indicator of unmet needs in iron when stores are

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[14] 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.

depleted. However, ferritin is also an acute phase reactant. In the MSS-T, the presence of infections dissuaded researchers from a consideration of serum ferritin data. A high prevalence of acute infections was, in fact, indicated by elevated CRP among 7 to 10 per cent of the women and 8 to 21 per cent of the children depending on the region of the country. Furthermore, ferritin levels were higher in regions with lower haemoglobin values and higher CRP values (Khatlon and GBAO), and this suggested that sub-acute infections could also be responsible for elevated ferritin. The use of sTfR may be pointing out only the cases of the most-advanced iron depletion and may be underestimating the dimension of iron deficiency, as the cases of marginal deficiency and low stores, which may also have functional consequences, would go undetected. This is probably why the regional differentials in sTfR are smaller than the differentials in haemoglobin. In addition to its role in the genesis of anaemia, iron deficiency is going to be associated with poor cognitive development and poor capacity for aerobic exercise, and folate is going to be associated with a high incidence of neural tube defects and high homocysteine values.

Poor diet is a major cause of iron and folate deficiency. Among infants under 2, diets contain insufficient animal products, and the non-haem iron is likely to be poorly bioavailable as a result of the presence of inhibitors of iron absorption, such as black tea, and the absence of enhancers, such as fresh fruits and vegetables. In addition, the early introduction of cow's milk to diets (very common in Khatlon) may be responsible for iron losses. Among women, the mean iron intake is below the RDA, and the risk of iron inadequacy is therefore very high. Poor maternal iron stores may thus be common and may be leading to poor foetal iron stores, another factor in the early occurrence of anaemia among infants. Not surprisingly, the odds ratio that a child will be iron deficient is two times higher in the region where maternal anaemia is more prevalent, that is, Khatlon (5.0, confidence interval 2.6-9.4), than in the region with the lowest prevalence of maternal anaemia, that is, Sughd (2.1, confidence interval 1.0-4.3).

The nutritional deficiency of folate is common among people consuming a limited diet[15]. Pregnant women are at risk of folate deficiency because pregnancy significantly increases the folate requirement, especially during periods of rapid foetal growth (that is, in the second and third trimester)[16]. During lactation, losses of folate in milk also increase the folate requirement. Most women in Tajikistan have many children, and breastfeeding rates and duration are high.

Overall, the diet of the subsample of women interviewed was in line with recommendations[17], with the exception of high simple sugar intake (15.8 per cent of total energy intake instead of <10 per cent). Total carbohydrate intake (71.1 per cent) was closer to the upper limit of the recommendations (75 per cent). Fat intake was also low (16.9 per cent).

A second major priority for the public health system is iodine deficiency. The fact that 60 per cent of women and 63 per cent of children show iodine excretion <100 µg/dL indicates a serious public health problem. The regional and age differentials observed for anaemia were not observed for iodine to the same extent, and the differentials also had a different distribution. Khatlon was again the most affected region, with the lowest median excretion among both women and children, but RRS had similar values, while the two mountain regions (GBAO and Sughd) had much higher values. In GBAO, this is quite likely due to the successful implementation of the salt iodization programme, as the highest proportion of households consuming adequately iodized salt was observed in this region (63 per cent). The presence of combined iron and iodine deficiency in infants is a serious concern in terms of cognitive development and the thyroid function in these children.

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[15] Chanarin, I. (1979), *The Megaloblastic Anaemias*, 2nd edition, Blackwell Scientific Publications: Oxford.

[16] McPartlin, J., A. Halligan, J. M. Scott, M. Darling and D. G. Weir (1993), 'Accelerated Folate Breakdown in Pregnancy', *Lancet*, 341, pages 148-149.

[17] Food and Nutrition Information Centre (2003), 'Dietary Reference Intakes (DRI) and Recommended Dietary Allowances (RDA)', Food and Nutrition Information Centre, National Agricultural Library, US Department of Agriculture: <*www.nal.usda.gov/fnic/etext/000105.html*> (accessed 17 September 2003). See also Garrow, J. S., W. P. T. James and A. Ralph (eds) (1999), *Human Nutrition and Dietetics*, 10th edition, Churchill Livingstone: London.

B. Implications for Programmes[18]

This serious picture of micronutrient inadequacies has led to calls for the actions necessary to achieve a substantial reduction in anaemia and iron deficiency. An anaemia prevention and control (APC) strategy has been designed. The APC includes multiple interventions that are being introduced in phases (Figure 18). At the national level, the strategy revolves around the provision of iron (and folic acid) supplements to all pregnant women and a start to the fortification of wheat flour with iron (ferrous sulfate).

Since 1999, there has been a national project to develop an effective preventive supplementation intervention targeting all women of childbearing age, all pregnant women and all children 6 to 24 months of age. The Ministry of Health and UNICEF agreed to carry out this phase of the APC in Kurgan Tube (in Khatlon oblast). This area had been severely affected by the 1992 civil war and remains among the most vulnerable in the country in terms of poverty and the prevalence of risks of infectious and chronic diseases. It showed levels of anaemia that were estimated from health records at over 72 per cent among pregnant women and among children under 5 years of age. Because of ongoing problems and needs, the area was also a focus of assistance from many NGOs and international agencies, including UNICEF.

The start of community-level activities was originally planned for October 1998, but the oblast began the APC activities in April 1999. A programme review carried out in June 2001 reported problems in the creation of a management structure, communications, training and the first distributions of supplies of supplements and information, education and communications materials.

An APC working group, initially consisting of six main specialists from the Health Department, was established at oblast level, and APC groups were to be set up within the health structure in each rayon (district) and at village levels. In the oblast health system, the main focus of the APC was and continues to be the distribution of iron supplements and compliance with the use of these supplements on a weekly basis by the target groups. (Monday has become widely known as 'iron day'.) The programme review indicated that the major factor affecting compliance in the rayons that were visited appeared to be the level of effort devoted to the distribution of supplements and to the monitoring of the compliance of individual health professionals. Some professionals reported 100 per cent compliance and stated that they had been personally delivering pills and syrup to individuals in their service areas. Consistently, there were reports of high compliance for children and for pregnant women. After two years of project activities, even among those who were not participating in the preventive supplementation activities, most people were familiar with one or another of the messages about the improvement of diets, the avoidance of tea with meals and the use of iron supplements.

The Ministry of Health indicated that, in 2003, the distribution of iron folate supplements to health centres was above 60 per cent for children aged 13-24 months and 40-80 per cent for women of reproductive age. Sughd showed the highest coverage. Data for GBAO have not been provided. However, the MSS-T pointed out differences in the implementation of the iron supplementation programme. The use of iron folate tablets among women was 36 per cent, ranging between 27 per cent in Khatlon and 63 per cent in GBAO. In the clusters located in Kurgan Tube, the positive responses were no higher than they were in other clusters of Khatlon. Only 9 per cent of children 6 to 59 months of age were taking iron tablets (ranging from 0 in Khatlon to 51 per cent in GBAO). If the analysis is restricted to children aged 12 to 24 months, 64 per cent of the children in GBAO and 18 per cent of the children in Sughd were taking iron tablets, but only 6 and 1 per cent, respectively, were taking the tablets in RRS and Khatlon. Again, in the clusters located in Kurgan Tube, the positive responses were no higher than they were in other clusters of Khatlon. The highest proportion of children and women reporting the use of iron and folate tablets was observed in

[18] This section is largely taken from Gleason, Gary R. (2001), 'Anaemia Control and Prevention Review: Khatlon Oblast, Tajikistan', June, International Nutrition Foundation: Boston.

GBAO. Finally, there also seemed to have been a problem of compliance among the population, although this has not been demonstrated.

Education activities focusing on good nutrition, including anaemia prevention, were conducted by the National Reproductive Health Centre in 2000-03. Ten thousand leaflets on anaemia prevention were distributed, and more than 40,000 people in 60 districts and cities were involved in the campaign. Several television programmes and radio spots on the prevention of anaemia were broadcast. However, UNICEF has pointed out that the campaign was plagued by poor planning in supply, distribution and communications. This was due to logistical problems (some village medical units are up to 70 km from a hospital, and there is little or no public transportation), but also to poor motivation and enthusiasm among Ministry of Health staff that were directly involved in programme implementation at the provincial and district levels.

The regional project of the Asian Development Bank, 'Improving Nutrition for Poor Mothers and Children' (JFPR 9005), was initiated at the end of 2001. It includes grants to support the universal iodization of salt and the fortification of wheat flour in Tajikistan. The goal of the programme is to ensure that at least 66 per cent of households use iodized salt and that fortified wheat flour accounts for 33 per cent of domestic consumption. The MSS-T found that 52 per cent of households were using iodized salt, but in only 28 per cent was the level of iodization adequate (>15 ppm). The 66 per cent goal had nearly been reached in GBAO, where 63 per cent of the households were consuming adequately iodized salt, but the other regions of the country were still well behind the goal. Khatlon, the region with the greatest need, showed the lowest rate of iodized salt consumption.

Since 24 per cent of the households visited during the survey were using poorly iodized salt (<15 ppm), an effort clearly had to be made to control for iodine content during production. In March 2004, the Tajik State Centre for Standardization and Metrology approved new norms for iodized salt (45±15 ppm). At the time of the survey, people may have still been using stocks of salt iodized according to the previous norms (30±5 ppm). Quality controls are carried out at factory sites and at the level of the retailers and users by the Sanitary Epidemiological Service. However, there are still gaps in the monitoring of iodized salt during production and marketing. The controls are, in fact, qualitative and not quantitative. Furthermore, producers failing to meet the norms have not been penalized with sanctions.

Non-iodized salt reaches dinner tables largely because private dealers get their supplies from the salt deposits around Vose (Khatlon). This 'technical' salt is intended for industrial and other non-food applications, but it is also being used for household consumption. It costs less than the salt sold in food shops. People prefer to buy salt in larger quantities that last rather than the smaller packages of iodized salt. The GBAO region is also affected to a certain extent because the Vose salt is transported there by truck.

Most people seemed aware of the nutritional importance of iodized salt, but some did not realize they were consuming non-iodized salt, since the packages were not properly labelled. Packages containing non-iodized salt were being fraudulently mislabelled. Enforcement of labelling regulations was lax.

The fortification programme for wheat flour of first and supreme grades was initiated in Tajikistan in May 2003. 'KAP Complex #1', a premix that is used for the fortification of first-grade flour, includes iron (40 ppm), zinc (17.6 ppm), thiamin (1.6 ppm), riboflavin (2.4 ppm), niacin (8 ppm) and folate (1.2 ppm). The composition of the premix was calculated taking into consideration an assumed average consumption of fortified flour of 260 g/person/day.

The results of the survey reveal that women consume 492.5 g/person/day of bread and 19.4 g/person/day of flour and pasta, for a total consumption of 364.0 g/person/day of flour. Because of the high levels of flour consumption in Tajikistan, if women consumed only flour products that had been fortified, they would be able to cover 50 per cent of their daily needs in iron, more than 100 per cent of their daily needs in zinc and more than 100 per cent of their folate needs from this source. Thus, the availability of fortified flour would greatly contribute to the solution of problems of iron and folate deficiency in Tajikistan.

Nonetheless, this objective still seems distant, since, at present, only 3 per cent of flour is fortified, and the programme has so far been concentrated mainly on urban areas. The provision of fortified flour to bakers would not solve the problem in all regions (nor elsewhere in Central Asia), as most rural residents bake their own bread. Furthermore, awareness of the existence and the benefits of fortified flour is still limited. An extension of the fortification programme through the involvement of medium-size mills (under 100 million tonnes per year) and in-home flour fortification strategies may be essential and are currently under study.

A greater availability of fortified flour will not, however, be a sufficient step to reach the other principal high-risk category in the population: infants. For infants, other forms of mineral enrichment should be sought, such as fortified cereals, fortified dairy products, or other means of in-home fortification. This effort should be accompanied by education campaigns among mothers about more effective complementary diets. Among infants and very young children, a much higher nutrient density in food intake should be established so as to treat and prevent the spread of the several serious harmful effects of multiple micronutrient deficiencies.

APPENDIX

A. The Technical Consultancy Meeting on Nutrition

At ‘The Problems of Micronutrient Disorders in Tajikistan’, a conference in January 2004 that was devoted to a discussion of the completed MSS-T, it was agreed that recommendations based on the results of the survey should be formulated during a subsequent technical consultancy meeting on nutrition. In April, two weeks prior to that meeting, the preliminary report of the MSS-T was distributed among experts of the Ministry of Health. The meeting itself was duly held in Dushanbe on 3-5 May 2004[19]. The participants included experts of the Ministry of Health (Tajikistan), the Asian Development Bank, the Kazakh Academy of Nutrition (Almaty, Kazakhstan), the National Institute for Research on Food and Nutrition (Rome, Italy), the UNICEF country office for Tajikistan (Dushanbe), the UNICEF Area Office for the Central Asian Republics and Kazakhstan (Almaty, Kazakhstan) and the World Health Organization, plus health care supervisors and chiefs of health departments in GBAO and Khatlon and Sughd oblasts and others.

At the meeting, the main speakers were Francesco Branca (National Institute for Research on Food and Nutrition, Italy), who talked about ‘The Status of Micronutrients in Tajikistan’, Professor S. Tazhibayev (Kazakh Academy of Nutrition), who spoke on ‘The Status of Women, Nutrition and Folic Acid’, Dr S. Kurbanov (a Ministry of Health expert on iodine deficiency anaemia), who offered a paper on ‘The Realization of the Programme on the Prevention of Anaemia in Tajikistan’, D. D. Pirov (a Ministry of Health expert on iodine deficiency disorders), who presented ‘A Review of the Programme on Iodine Deficiency Disorders in Tajikistan’, Kh. D. Aminov (head of the Department of Maternal and Child Health of the Ministry of Health), who examined ‘The National Programme on Vitamin A Deficiency’, and Kh. S. Khairov (head of the Nutrition Department of the Ministry of Health) who gave a discourse on ‘The National Programme on Nutrition’.

Following the presentations, all participants actively took part in discussions. Working groups were formed on four topics: iodine deficiency disorders, iodine deficiency anaemia, vitamin A deficiency and infant feeding. The afternoon of the first day and the entire second day of the meeting were devoted to the working group discussions.

On the third day, rapporteurs from each of the working groups presented recommendations on policy, strategy and plans of action. The meeting was subsequently given over to a general consideration of the recommendations. Final recommendations were then adopted on each programme (that is, iodine deficiency disorders, iodine deficiency anaemia, vitamin A deficiency and infant feeding). A strategic workshop was scheduled for the end of July to develop concrete plans of action for these programmes.

B. The Recommendations

For the Ministry of Health of the Republic of Tajikistan on the Improvement of the Status of the Nutrition of Mothers and Children Based on the Results of the National Micronutrient Status Survey in Tajikistan:

General recommendations

- The Ministry of Health should ensure the adequate coordination, management and implementation of all nutrition programmes.
- Nutrition surveillance activities should be carried out at the national and regional levels.

[19] The meeting was authorized by Ministry of Health directive No. 184 of 19 April 2004, ‘On the Nutrition Technical Consultancy Meeting’.

- Assistance should be provided so as to involve donors and other financial institutions in the process of food fortification.
- Assistance should be provided for the execution of the Dushanbe Declaration on Food Fortification.

Recommendations on iodine deficiency anaemia

1. Introduction

- Good nutrition is the foundation of the development of a country. The prevention and treatment of anaemia will facilitate the achievement of the Millennium Development Goals.
- These recommendations have been drafted to ensure the consistency and efficacy of the national prevention and control programme on iodine deficiency anaemia and to identify clear implementation mechanisms, as well as financial and institutional sustainability.
- The recommendations refer to the next five years or until another assessment of the situation is carried out.

2. General policy

- A national nutrition policy and a national nutrition plan should be formulated.
- Complementary feeding guidelines should be designed and included in the national nutrition plan. The guidelines should follow WHO-UNICEF protocols.
- The prevention and control strategy on iodine deficiency anaemia includes food fortification, food supplementation among target groups, dietary diversification, monitoring and evaluation, capacity-building, and information, education and communication.
- The strategy should be national and intersectoral, but it should be implemented under the guidance of the Ministry of Health.
- The various programmes (breastfeeding, helminthoses control, reproductive health, the integrated management of childhood illness, family planning) should be assimilated within an overall primary health care strategy.
- Collaboration among government institutions, UN organizations, NGOs and other national and international organizations contributing to the prevention and control strategy on iodine deficiency anaemia should be promoted.

3. Fortification

- Micronutrient fortification should be part of a long-term strategy aimed at the prevention and control of iodine deficiency anaemia.
- The production of fortified wheat flour should be expanded through the involvement of medium-scale enterprises.
- A national legal and regulatory environment for food fortification should be established.

4. Supplementation

- The distribution of iron and folate supplements for children 6 to 24 months of age and for women of reproductive age should be continued until a satisfactory coverage of the flour fortification programme has been achieved.
- Supplementation should be more well targeted by, for example, restricting the target groups. (Thus, in Khatlon oblast, the target group could be limited to women 15 to 40 years of age.)
- The efficiency of the supplementation programme should be increased by taking into account

past experiences and ongoing programmes.
- The feasibility of various interventions aimed at the provision to children under 2 of micronutrients through means other than supplements, such as in-home fortification, should be explored.

5. Monitoring and evaluation

- A monitoring and evaluation system should be created in the Ministry of Health.
- Through the monitoring and evaluation system, information should be gathered on anaemia prevalence and the performance of supplementation and fortification programmes.

6. Capacity-building

- Guidelines for the prevention and treatment of anaemia according to WHO recommendations should be developed.
- Programme management capacities at all levels should be strengthened.
- Training on issues of relevance for strategies and policies on iodine deficiency anaemia should be introduced into pre-service and in-service training programmes in medical institutions.
- One independent government reference laboratory should be established to regulate fortified flour.
- One independent government reference laboratory should be established for the assessment of the status of anaemia and iron intake.

7. Information, education and communication

- An information, education and communication programme to encourage healthy nutrition should be implemented for the benefit of the population.
- Social marketing projects that promote preventive micronutrient supplementation and the use of fortified products should be carried out.

Recommendations on iodine deficiency disorders

1. General policy

- The current law on salt iodization should be reviewed and amended in light of the declaration 'To Achieve Universal Salt Iodization by 2005', and implementation mechanisms should be developed.
- An interagency committee should be established to oversee the efforts to achieve universal salt iodization and eliminate iodine deficiency disorders. The committee should be composed of representatives of the Ministry of Health, salt producers, the Ministry of Industry, the Ministry of Agriculture and the mass media, as well as religious leaders.

2. Quality control

- A quality control system should be implemented in salt production operations.
- An external inspection system should be created to monitor salt production and marketing.
- The capacity of laboratories to monitor the level of iodine in salt should be enhanced through specialist training, equipment maintenance and the efficient provision of reagents.

3. Monitoring and evaluation

- Salt-testing kits should be distributed to retailers so as to allow them to assess the quality of the salt batches they purchase.
- Salt iodization should be periodically checked (at least once per year) at the household level in selected villages in collaboration with NGOs based in the various oblasts.
- The level of urinary iodine should be periodically monitored (every two years) among first-to-fifth grade pupils in selected primary schools throughout the country.

4. Information, education, communication

- Information on good manufacturing practices in salt iodization should be distributed among salt producers, and regulations on the production, packaging and marketing of iodized salt should be enforced.
- Information should be distributed among retailers on their responsibilities in the purchase and sale of iodized salt and on methods to check the quality of the iodized salt they market.
- Information, education and communication activities on the benefits of the consumption of iodized salt should be carried out regularly with the involvement of NGOs and community leaders.

Recommendations on the prevention of vitamin A deficiency

1. Supplementation

- Vitamin A supplements should be distributed through the health care system in line with WHO recommendations:
  - Infants 6 to 11 months old: 100,000 international units once per year,
  - Infants 12-59 months old: 200,000 international units twice per year, and
  - Post-partum women (within 40 days of delivery): 200,000 international units (single dose).

2. Fortification

- A feasibility study for a vitamin A fortification programme should be carried out, including the selection of a suitable product (for example, vegetable oil) and an assessment of the technical and marketing implications.

3. Monitoring and evaluation

- An effective monitoring and evaluation system for vitamin A supplementation should be created.
- The establishment of a personal card system that covers growth data, vitamin A doses, immunization and health records should be studied.

4. Capacity-building

- The capacities of medical personnel in the prevention (through improved breastfeeding and appropriate complementary feeding), diagnosis and treatment of vitamin A deficiency should be strengthened.

5. Information, education and communication

- Information on methods to prevent vitamin A deficiency through good diets, fortified foods and supplements should be distributed to the public through local authorities, local and international NGOs and the media.

Recommendations on infant feeding

1. Breastfeeding

- The International Code of Marketing of Breastmilk Substitutes should be adopted in Tajikistan, and a law should be passed to ensure the implementation of the code.
- The status of the implementation of the national breastfeeding policy should be reviewed.
- The national breastfeeding committee should be revitalized through the involvement of NGOs and women's organizations.
- The mothers support group programme should be revitalized in close cooperation with local NGOs and women's organizations.
- The Baby-Friendly Hospitals Initiative should be expanded through the recertification of hospitals and the certification of additional maternal hospitals and child policlinics.

2. Complementary feeding

- The complementary feeding module of the strategy for the integrated management of childhood illness should be implemented. Research on complementary feeding practices should be carried out.
- Complementary feeding guidelines in line with the WHO-UNICEF protocols should be designed and included in the national nutrition plan.
- Fortified complementary feeding products (biscuits, cereals and so on) should be developed and pilot-tested.
- In house micronutrient fortification strategies should be pilot-tested.
- The growth-monitoring scheme should be strengthened and expanded nationwide.

3. Capacity-building

- Infant feeding policies and strategies should be covered in pre-service and in-service training curricula.
- Periodic training in infant feeding should be carried out among health authorities and health care workers.
- Periodic training in effective infant feeding practices should be carried out among caregivers.

4. Information, education and communication

- The activities associated with National Breastfeeding Week should be expanded.
- Information, education and communication materials on infant feeding should be developed, and awareness campaigns should be run, including through the media.

Table 1– Definition of anaemia based on blood haemoglobin concentration (g/dL)

Age	Severe anemia	Moderate anemia	Mild anemia	No anemia
Children (6-59 months)	<7	7–9.9	10-10.9	≥11
Women (15-45 years)	<7	7–9.9	10-11.9	≥12

Table 2 - Haemoglobin adjustments (g/dL) for altitude

Altitude (m)	Haemoglobin (g/dL)	Altitude (m)	Haemoglobin (g/dL)
<1000	0	**3500**	2.6
1000	0.1	**4000**	3.4
1500	0.4	**4500**	4.4
2000	0.7	**5000**	5.5
2500	1.2	**5500**	6.7
3000	1.8		

N.B. The adjustment above 3000 m are extrapolated from an exponential curve obtained from the data below 3000 m.

Table 3 - Definition of folic acid deficiency (FAD) based on plasma folic acid concentration

Age	Severe FAD [20] (μg/L or ng/mL)	Mild FAD [2] (μg/L or ng/mL)	Marginal level of FA [21] (μg/L or ng/mL)	Normal level of FA [3] (μg/L or ng/mL)
Women (15-45 years)	<1,3	1,3<3,0	3-6	>6

Table 4 – Households included in the sample and weighting factor used to produce national estimates

Oblast	Population size (households)	Stratum population as a proprotion of national population	Sample size (households)	Stratum sample as a proportion of total sample	weighting factor
RRS	265745	0,31	481	0,22	1,39
Katlon	262589	0,30	478	0,22	1,38
Sughd	302428	0,35	574	0,26	1,32
GBAO	31710	0,04	634	0,29	0,13
Total	862472	1	2167	1	

Table 5 –Actual sample size for the main sample biochemical determinations

	Enumerated n (%)	Hb n (%)	sTfR n (%)	Ferritin (%)n	Iodine n (%)
Women					
RRS	515 (113)	500 (110)	353 (78)	389 (85)	393 (86)
Katlon	524 (115)	518 (114)	335 (74)	370 (81)	420 (92)
Sughd	607 (133)	506 (111)	376 (83)	417 (92)	432 (95)
GBAO	532 (117)	518 (114)	351 (77)	392 (86)	421 (93)
Total	2178 (120)	2042 (112)	1415 (78)	1568 (86)	1666 (92)
Children					
RRS	561 (123)	467 (103)	325 (71)	354 (78)	344 (76)
Katlon	480 (105)	465 (102)	279 (62)	336 (74)	365 (80)
Sughd	565 (124)	477 (105)	345 (76)	386 (85)	383 (84)
GBAO	616 (135)	501 (110)	303 (67)	356 (78)	413 (91)
Total	2222 (122)	1910 (105)	1252 (69)	1432 (79)	1505 (83)

[20] Folic Acid Deficiency cut off points: mild deficiency 1,3<3,0 ng/ml or μg/L; severe deficiency <1,3 ng/ml or μg/L. Source: "Medicine I. o. (2000) Dietary Reference Intakes: thiamin, riboflavin, niacin, vitamin B6, folate, vitamin B12, pantothenic acid, biotin, and choline. National Academy Press, Washington, D.C."

[21] Cut off points for Folic Acid level in blood plasma: marginal level 3-6 ng/ml.; normal level >6 ng/ml. Source: 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.

Table 6 - Distribution of different classes of Body Mass Index in 25-49 year-old non-pregnant women

	< 16 (Kg/m²)	*16-16.9 (Kg/m²)*	*17.0-18.4 (Kg/m²)*	*18.5-25.0 (Kg/m²)*	*25.1-30.0 (Kg/m²)*	*30.1-40.0 (Kg/m²)*	*>40 (Kg/m²)*	*Total*
RRS	3	6	11	180	76	35		311
%	1.0	1.0	3.5	57.9	24.4	11.3	-	100.0
95% C.I.	0.0-2.4	0.5-3.3	1.3-5.8	51.6-64.1	18.7-30.1	7.0-15.5		
Katlon	1	8	20	206	39	7		281
%	0.4	2.8	7.1	73.3	13.9	2.5	-	100.0
95% C.I.	0.0-1.1	0.3-25.4	3.4-10.8	66.5-80.1	7.9-19.8	0.6-4.4		
Sughd	3	3	20	219	58	23	1	327
%	0.9	0.9	6.1	67.0	17.7	7.0	0.3	100.0
95% C.I.	0.0-2.3	0.0-2.3	3.5-8.7	59.4-74.5	12.1-23.4	3.0-11.1	0.0-0.9	
GBAO	12	14	50	255	30	13	2	376
%	3.2	3.7	13.3	67.8	8.0	3.5	0.5	100.0
95% C.I.	0.6-5.6	1.8-5.7	9.4-17.2	61.0-74.7	5.3-10.7	1.5-5.4	0.0-1.6	
Total	19	31	101	860	203	78	3	1295
* %	0.9	1.9	5.8	65.8	18.5	7.0	0.1	100.0
*95% C.I.	0.2-1.6	1.0-2.8	4.1-7.3	62.1-69.4	15.5-21.6	5.1-9.0	0.0-0.1	

* weighted. Missing values = 79

Table 7 - Serum haemoglobin concentration in 15-49 year-old non pregnant women

	n	*Mean±SD (g/dL)*
RRS	500	12.6±1.8[a]
Katlon	518	11.5±1.6[b]
Sughd	506	12.5±1.8[a,c]
GBAO	518	12.3±1.7[c]
Total	2042	12.2±1.8

Missing values = 136. Anova: F=45.7 and $p<0.01$ Means not sharing common superscript are significantly different (Scheffe's test, $p<0.05$)

Table 8 - Prevalence of anaemia in 15-49 year-old non pregnant women

	Severe (Hb<7 g/dL)	*Moderate (Hb 7.0-9.9 g/dL)*	*Mild (Hb 10.0-11.9 g/dL)*	*Normal (Hb ≥12.0 g/dL)*
RRS	6	34	105	355
%	1.2	6.8	21.0	71.0
95% C.I.	0.1-2.3	4.0-9.6	15.3-26.7	64.3-77.7
Katlon	7	62	257	192
%	1.4	12.0	49.6	37.1
95% C.I.	0.3-2.4	6.6-17.4	40.3-58.9	26.6-47.6
Sughd	5	29	133	339
%	1.0	5.7	26.3	67.0
95% C.I.	0.0-2.0	3.2-8.3	21.9-30.7	61.4-72.6
GBAO	9	24	155	330
%	1.9	4.6	29.9	63.6
95% C.I.	0.7-3.2	2.1-7.1	24.8-34.9	58.1-69.1
Total	27	149	650	1216
*%	1.2	8.0	32.0	58.8
*95% C.I.	0.6-1.8	6.0-10.0	28.5-35.5	54.8-62.8

Table 9 – Serum Ferritin Concentration in 15-49 year-old non pregnant women with CRP≤5 mg/L

	n	*Mean±SD* (µg/L)
RRS	***310***	***40.4±32.1[a]***
Katlon	***290***	***55.2±37.2[b]***
Sughd	***305***	***43.6±38.7[a]***
GBAO	***290***	***61.2±41.6[b]***
Total	***1195***	***49.8±38.4***

Anova: F=19.1 and p=0.0001; Missing Values=983.

Means not sharing common superscript are significantly different (Scheffe's test, $p<0.05$)

Table 10 – Prevalence of low and normal values of serum ferritin in 15-49 year-old non pregnant women with CRP≤5 mg/L

		Low (<12 µg/L)	*Normal (≥12 µg/L)*	*Total*
RRS		52	258	310
	%	16.8	83.2	100.0
	95% C.I.	10.6-22.9	77.1-89.4	
Katlon		23	267	290
	%	7.9	92.1	100.0
	95% C.I.	3.8-12.0	88.0-96.1	
Sughd		41	264	305
	%	13.4	86.6	100.0
	95% C.I.	9.6-17.3	82.7-90.4	
GBAO		21	269	290
	%	7.2	92.8	100.0
	95% C.I.	4.2-10.3	89.7-95.8	
Total		137	1058	1195
	**Row %*	12.8	87.2	100.0
	**95% C.I.*	10.2-15.3	84.7-89.8	

Table 11 – Serum Transferrin Receptor concentration in 15-49 year-old non pregnant women

	N	Mean±SD (mg/L)
RRS	353	7.8±10.5[a]
Katlon	335	11.7±12.6[a]
Sughd	376	7.6±6.3[a]
GBAO	351	8.6±8.9[a]
Total	1415	8.9±9.9

Anova: F=12.9 and p=0.0001; Missing Values=763.

Means not sharing common superscript are significantly different (Scheffe's test, p<0.05)

Table 12 — Prevalence of normal and high values of serum Transferrin Receptor levels in 15-49 year-old non pregnant women

	Normal (≤ 8.5 mg/L))	*High (> 8.5 mg/L))*	*Total*
RRS	271	82	353
%	76.8	23.2	100.0
95% C.I.	67.0-86.5	13.5-33.0	
Katlon	214	121	335
%	63.9	36.1	100.0
95% C.I.	46.0-81.7	18.3-53.9	
Sughd	273	103	376
%	72.6	27.4	100.0
95% C.I.	64.5-80.7	19.3-35.5	
GBAO	243	108	351
%	69.2	30.8	100.0
95% C.I.	55.9-82.6	17.4-44.1	
Total	1001	414	1415
* %	70.7	29.2	100.0
*95% C.I.	64.9-77.8	22.1-35.1	

*weighted. Missing Values=763

Table 13 –Urinary Iodine excretion in 15-49 year-old non pregnant women

	n	*Median (µg/L)*	*20th centile (µg/L)*	*80th centile (µg/L)*
RRS	393	77.5	10.4	170.8
Katlon	420	65.7	12.2	141.4
Sughd	432	105.1	29.2	178.5
GBAO	421	126.7	52.4	224.9
Total	1666	93.6	20.0	182.0

Kruskal-Wallis test: 65.9, p=0.0000; Missing Values=555

Table 14 –Distribution of Urinary Iodine Values

	<20 µg/L	*20-49 µg/L*	*50-99 µg/L*	*100-199 µg/L*	**200-299 µg/L**	**> 300 µg/L**	**Total**
RRS	101	55	81	97	35	24	393
%	25.7	14.0	20.6	24.7	8.9	6.1	100.0
95% C.I.	16.7-34.7	8.6-19.4	15.9-25.4	17.8-31.6	4.7-13.1	0-12.6	
Katlon	109	62	100	112	31	6	420
%	26.0	14.8	23.8	26.7	7.4	1.4	100.0
95% C.I.	16.5-35.4	11.1-18.4	17.3-30.3	18.9-34.4	4.7-10.1	0.2-2.7	
Sughd	72	48	89	160	49	14	432
%	16.7	11.1	20.6	37.0	11.3	3.2	100.0
95% C.I.	10.5-22.8	6.3-15.9	17.7-23.5	31.2-42.9	7.2-15.5	1.7-4.8	
GBAO	51	30	85	146	74	35	421
%	12.1	7.1	20.2	34.7	17.6	8.3	100.0
95% C.I.	6.4-17.9	3.6-10.6	15.8-24.6	30.3-39.1	12.9-22.2	3.4-13.2	
Total	333	195	355	515	189	79	1666
%	22.2	13.0	21.6	29.6	9.2	3.5	100.0
*95% C.I.	17.9-26.6	10.5-15.5	19.0-24.2	25.8-33.4	7.2-11.3	1.5-5.6	

*weighted. Missing Values=519

Table 15 – Plasma folic acid level (ng/ml or µg/L) and prevalence of folic acid deficiency (FAD) in women in urban and rural areas (RRS sub-sample)

	Total n=300	*Urban* n=70	*Rural* n=230
Plasma level (mean±SD)	2,25±1,84	3,01±2,33	2,02±1,60
Normal status (%)	4,7	12,9	2,2
Marginal status (%)	21,7	28,6	19,6
Folic acid deficiency (%)			
Mild	38,3	28,6	41,3
Severe	35,3	30,0	37,0
Total FAD	73,7	58,6	78,3

Table 16 - Reported use of Iron Folate Tablets in women

	Yes	*No*	
RRS	144	355	499
%	28.9	71.1	100.0
95% C.I.	21.4-36.3	63.7-78.6	
Katlon	140	384	524
%	26.7	73.3	100.0
95% C.I.	16.2-37.2	62.8-83.8	
Sughd	283	297	580
%	48.8	51.2	100.0
95% C.I.	39.0-58.6	41.4-61.0	
GBAO	250	147	397
%	63.0	37.0	100.0
95% C.I.	54.2-71.7	28.3-45.8	
Total	817	1183	2000
* %	36.2	63.8	100.0
*95% C.I.	31.0-41.4	58.6-69.0	

*weighted. Missing Values=195

Table 17 - Iron intake of women in RRS

	Total n=300	*Urban n=70*	*Rural n=230*
mg/day	21,8	21,8	21,7
% RDA [a]	74,1	74,1	73,8
% <29,4 mg/day	87,0	85,7	74,4

a –Iron Deficiency Anaemia. Assessment, Prevention, and Control. A guide for programme managers // UNICEF/UNU/WHO. – Geneva. – 2001. Diet of low (10% bioavailability, RDA = 29,4) or even very low (5% bioavailability, RDA = 58,8) bioavailability of iron can be used for Tajikistan's women because of their very low consumption of meat and meat products.

Table 18 – Haemoglobin concentration in 6-59 month-old children

	n	*Mean±SD (g/dL)*
RRS	467	11.5±1.4[a]
Katlon	465	10.8±1.3[b]
Sughd	477	11.7±1.6[a]
GBAO	501	10.6±1.6[b]
Total	1910	11.2±1.6

Anova: F=93.53 and p=0.00; Missing Values=311

Means not sharing common superscript are significantly different (Scheffe's test, $p<0.05$)

Table 19 –Prevalence of anaemia in 6-59 month-old children

	Severe (Hb <7 g/dL)	*Moderate (Hb7-9.9 g/dL)*	*Mild (Hb10-10.9 g/dL)*	*No Anaemia (Hb≥11 g/dL)*	*Total*
RRS	3	57	84	323	467
%	0.6	12.2	18.0	69.2	100.0
95% C.I.	0.0-1.4	8.5-15.9	14.1-21.8	62.9-75.4	
Katlon	4	107	129	225	465
%	0.9	23.0	27.7	48.4	100.0
95% C.I.	0.0-1.9	15.6-30.4	23.4-32.1	41.8-55.0	
Sughd	4	59	83	331	477
%	0.8	12.4	17.4	69.4	100.0
95% C.I.	0.0-1.6	8.3-16.4	13.5-21.3	63.4-75.4	
GBAO	15	135	126	225	501
%	3.0	26.9	25.1	44.9	100.0
95% C.I.	1.2-4.7	20.6-33.3	21.3-28.9	38.4-51.4	
Total	26	358	422	1104	1910
** %*	0.9	15.8	21.0	62.4	100.0
**95% C.I.*	0.4-1.3	12.9-18.8	18.8-23.2	58.9-65.9	

*weighted. Missing Values=310

Table 20 – Serum Transferrin Receptor concentration in 6-59 month-old children

	n	*Mean±SD (mg/L)*
RRS	***325***	***8.5±7.2[a]***
Katlon	***279***	***15.0±15.6[b]***
Sughd	***345***	***8.1±4.9[a]***
GBAO	***303***	***10.2±9.2[a]***
Total	***1252***	***10.3±10.1[a]***

Anova: F=30.39 and p=0.000000; Missing Values=969.

Means not sharing common superscript are significantly different (Scheffe's test, p<0.05)

Table 21 – Prevalence of normal and high values of serum Transferrin Receptors in 6-59 month-old children

	Normal (≤8.5 mg/L)	*High (>8.5 mg/L)*	*Total*
RRS	205	120	325
%	63.1	36.9	100.0
95% C.I.	50.8-75.3	24.7-49.2	
Katlon	135	144	279
%	48.6	51.4.	100.0
95% C.I.	29.7-67.4	32.6-70.3	
Sughd	2312	114	345
%	67.0	33.0	100.0
95% C.I.	58.2-75.7	24.3-41.8	
GBAO	174	129	303
%	57.4	42.3	100.0
95% C.I.	46.8-68.1	31.9-53.2	
Total	753	499	1252
**Row %*	61.2	38.8	100.0
95% C.I.	54.2-68.2	31.8-45.8	

*weighted. Missing Values=969

Table 22 –Urinary Iodine excretion in 6-59 month old children

	n	*Median (µg/L)*	*20th centile (µg/L)*	*80th centile (µg/L)*
RRS	344	58.3	6.8	178.0
Katlon	365	64.5	12.4	138.7
Sughd	383	75.0	19.1	164.7
GBAO	413	91.2	24.8	186.8
Total	1505	73.1	12.3	164.5

Kruskal-Wallis test: 25.00, p=0.00000; Missing Values=706

Table 23 – Distribution of Urinary Iodine values in 6-59 month old Children

	(<20 µg/L)	*(20-49 µg/L)*	*(50-99 µg/L)*	*(100-199 µg/L)*	*(200-299 µg/L)*	*(>300 µg/L)*	*Total*
RRS	115	42	66	66	31	24	344
%	33.4	12.2	19.2	19.2	9.0	7.0	100.0
95% C.I.	22.3-44.5	8.1-16.3	14.1-24.2	12.2-26.2	5.6-12.5	0.9-13.1	
Katlon	96	56	97	86	20	10	365
%	26.3	15.3	26.6	23.6	5.5	2.7	100.0
95% C.I.	16.8-35.8	10.2-20.5	21.8-31.4	16.0-31.1	2.3-8.7	0.1-5.4	
Sughd	79	58	93	107	26	20	383
%	20.6	15.1	24.3	27.9	6.8	5.2	100.0
95% C.I.	13.8-27.5	10.7-19.6	19.4-29.1	23.1-32.8	3.7-9.8	2.6-7.8	
GBAO	79	45	100	118	44	27	413
%	19.1	10.9	24.2	28.6	10.7	6.5	100.0
95% C.I.	11.4-26.8	7.4-14.4	18.0-30.5	24.5-32.6	6.7-14.6	3.6-9.5	
Total	369	201	356	377	121	81	1505
** %*	26.3	14.2	23.4	23.7	7.1	4.9	100.0
*95% C.I.	21.5-31.1	11.7-16.6	20.8-26.0	20.2-27.3	5.3-8.8	2.8-7.1	

*weighted. Missing values : 706

Table 24 - Use of Iron Folate Tablets in 13-24 month old Children

		Yes	*No*	*Total*
RRS		7	76	83
	%	8.4	91.6	100.0
	95% C.I.	0.0-18.6	81.4-100.0	
Katlon		1	97	98
	%	1.0	99.0	100.0
	95% C.I.	0.0-3.2	96.8-100.0	
Sughd		17	73	90
	%	18.9	81.1	100.0
	95% C.I.	7.3-30.5	69.5-92.7	
GBAO		74	42	116
	%	63.2	35.9	100.0
	95% C.I.	51.9-74.6	24.6-47.2	
Total		99	288	387
	*Row %	9.2	90.8	100.0
	*95% C.I.	4.7-13.8	86.2-95.3	

*weighted.

Table 25 – Presence of Iodised Salt in the Households

		Not iodised	**< 15 PPM**	**≥15 PPM**	*Total*
RRS		225	128	76	429
	%	52.4	29.8	17.7	100.0
	95% C.I.	39.7-64.2	19.5-39.6	9.4-25.7	
Katlon		369	41	59	469
	%	78.7	8.7	12.6	100.0
	95% C.I.	64.0-93.4	2.6-14.9	1.2-23.9	
Sughd		117	174	250	541
	%	21.6	32.2	46.2	100.0
	95% C.I.	10.8-32.5	21.8-42.5	33.2-59.3	
GBAO		100	95	331	526
	%	19.0	18.1	62.9	100.0
	95% C.I.	7.2-30.6	2.9-33.0	45.5-69.7	
Total		811	438	716	1965
	**%*	47.7	24.0	28.3	100.0
	**95% C.I.*	40.4-54.7	19.0-28.9	21.7-34.7	

*weighted. Pearson Chi-square: 593.19, p=0.00000; Missing Values=202

Table 26 - Distribution of iron-folate supplements in 2003

	Target groups			
Area	***Children 6-12 month***	***Children 13-24 month***	***Women of reproductive age***	***Pregnant women***
Khatlon	57,4 %	61,8 %	54,5 %	56,8 %
RRS	49,7 %	60,2 %	40,1 %	41,1 %
Dushanbe	68 %	64 %	49 %	90 %
Sugd	45,2%	69,4%	80,3%	86,6%
GBAO	NA	NA	NA	NA
Total[22]	52 %	63,5 %	58,5%	64,2%

\

[22] Except GBAO

Figure 1- Distribution of haemoglobin in non pregnant women

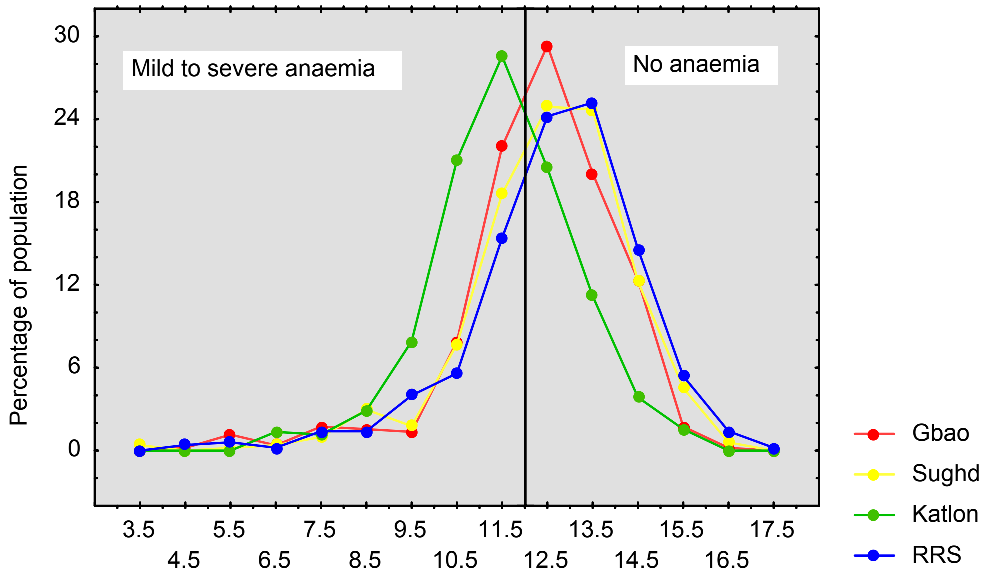

Figure 2- Folic acid deficiency (FAD), marginal and normal levels of plasma folate in non pregnant women (RRS sub-sample)

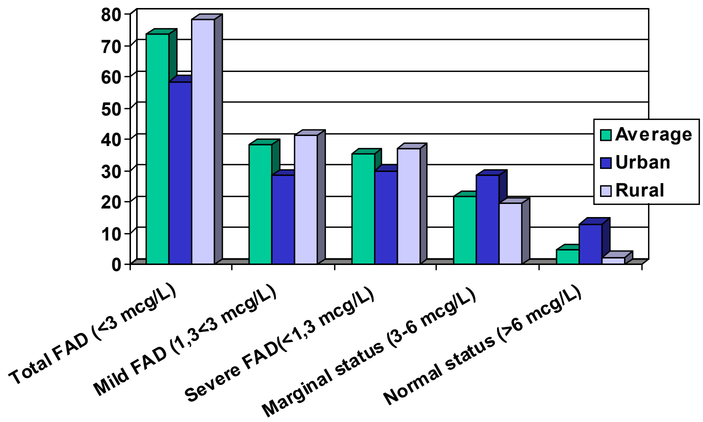

Figure 3 - Daily mineral intake, as % US RDA (RRS sub-sample)

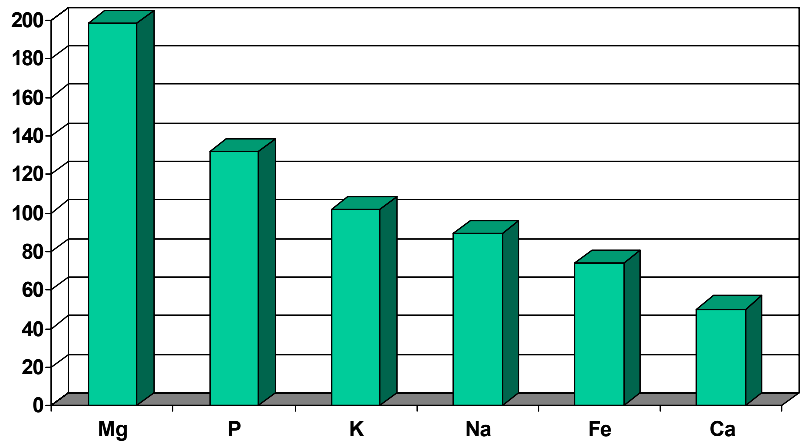

Figure 4 - Daily vitamin intake, as % US RDA (RRS sub-sample)

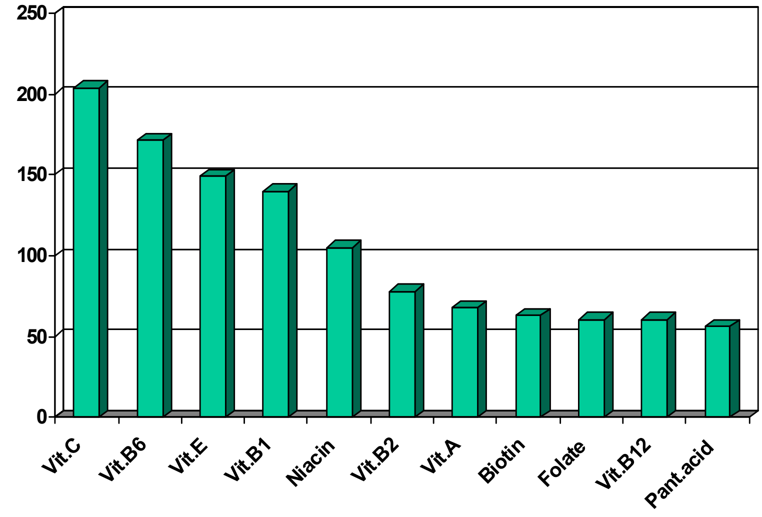

Figure 5 - Food sources of energy and macronutrients (RRS sub-sample)

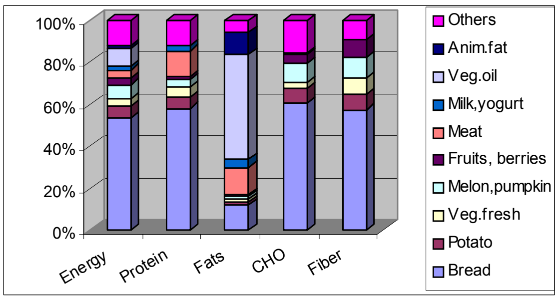

Figure 6 - Food sources of minerals (RRS sub-sample)

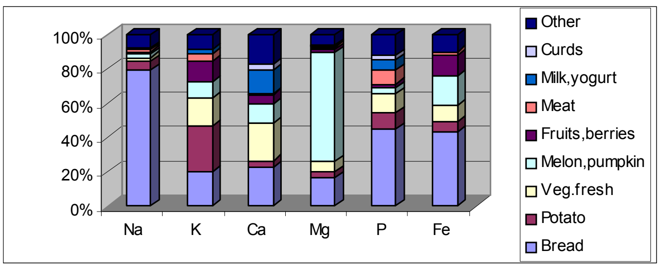

Figure 7a - Food sources of vitamins (RRS sub-sample)

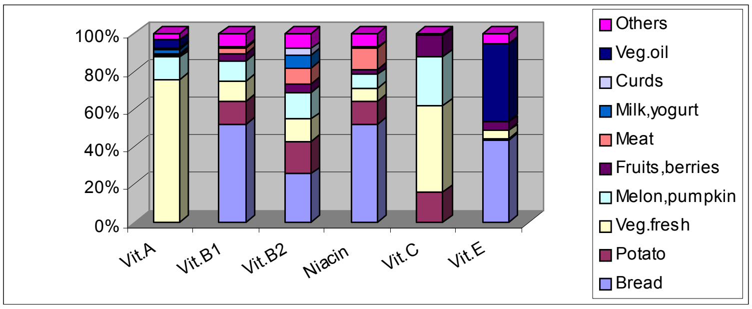

Figure 7b - Food sources of vitamins (RRS sub-sample)

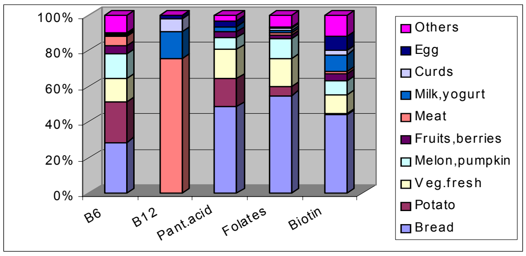

Figure 8 - Distribution of haemoglobin in 6-59 month-old children

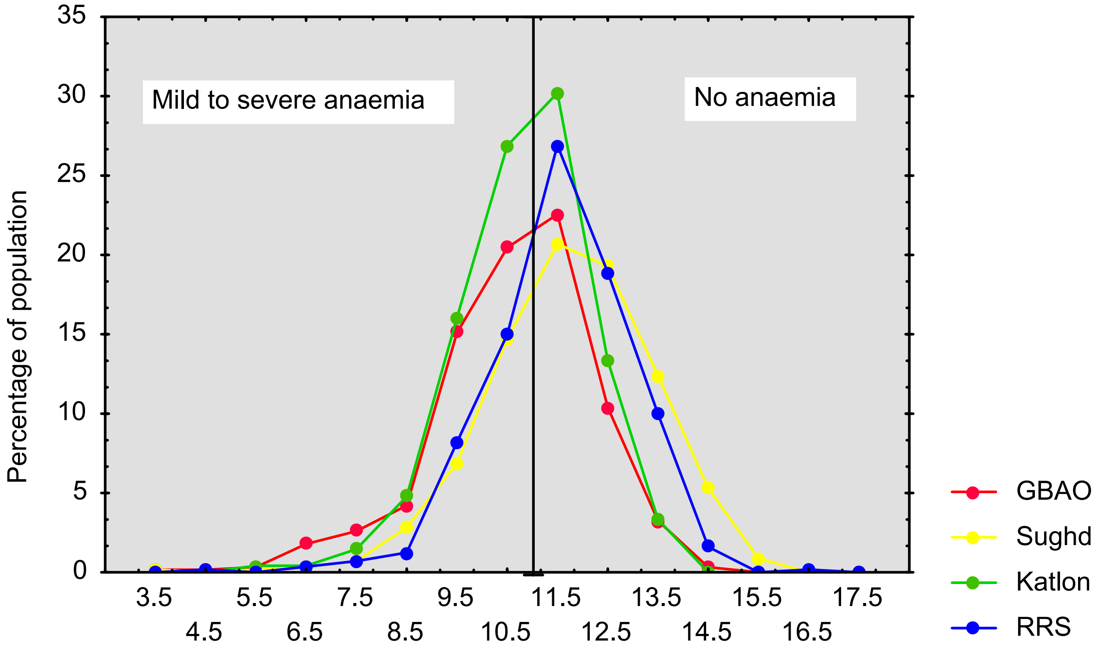

Figure 9 – Prevalence of anaemia in 6-59 month-old children by age group

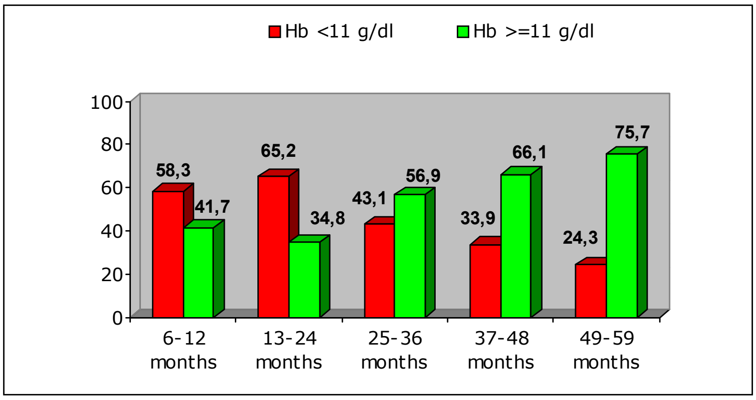

Figure 10 - Prevalence of high sTfR in 6-59 month-old children by age group

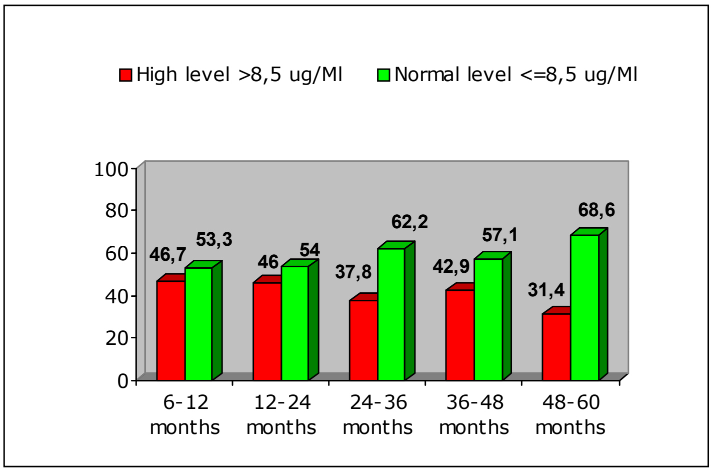

Figure 11 - Feeding pattern in 0-24 month-old children

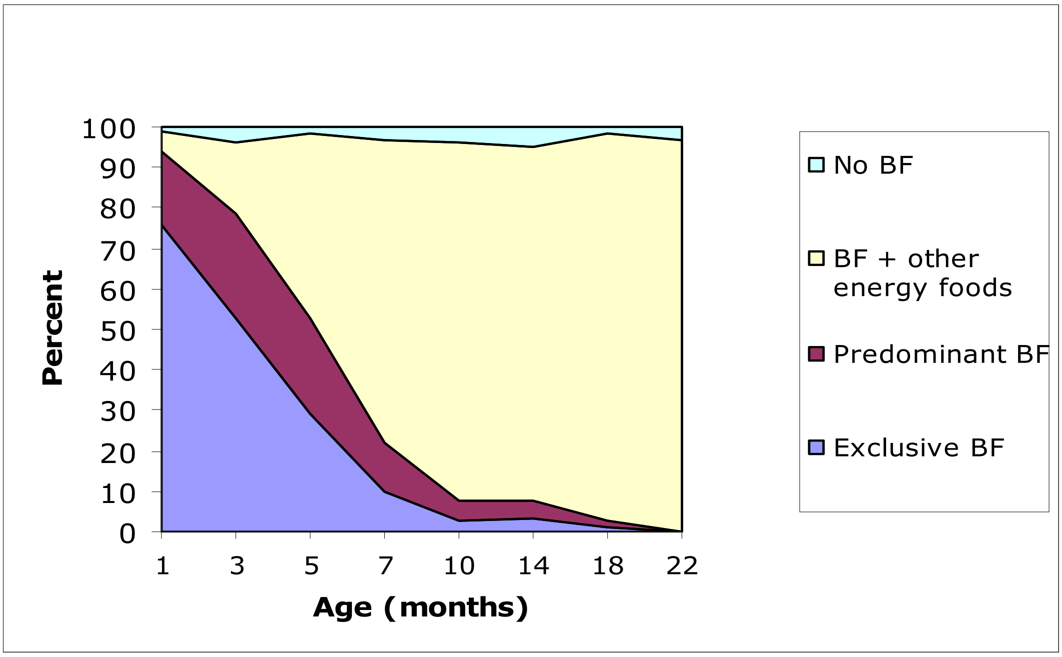

Figure 12 - Prevalence of multiple occurrences of anaemia in the households

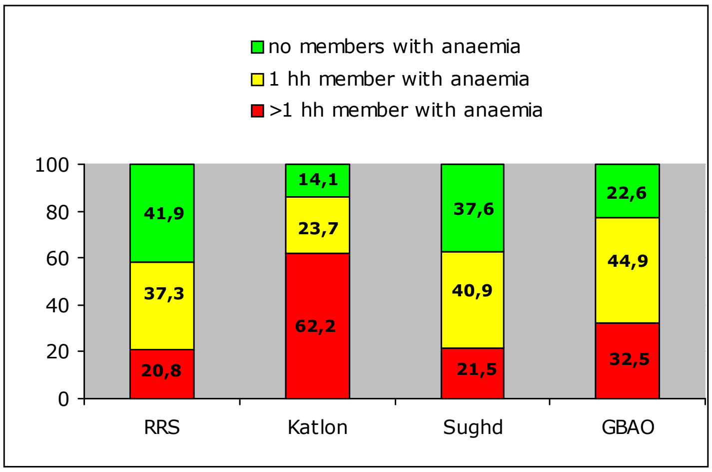

Figure 13 - Prevalence of multiple occurrences of iron deficiency in the households

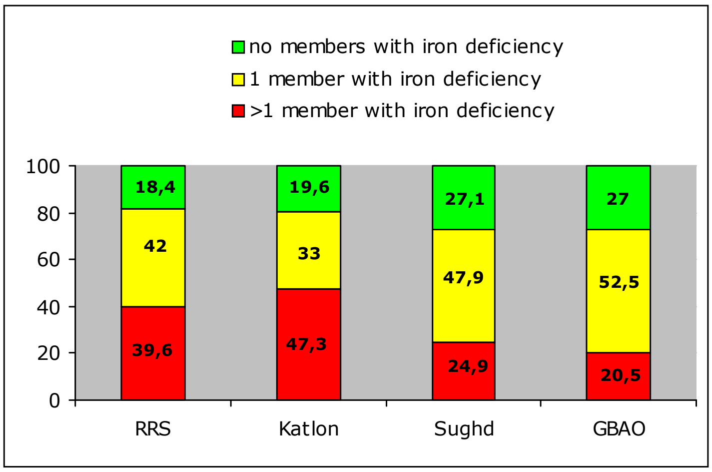

Figure 14 – Presence of iodised salt in the households and storage conditions

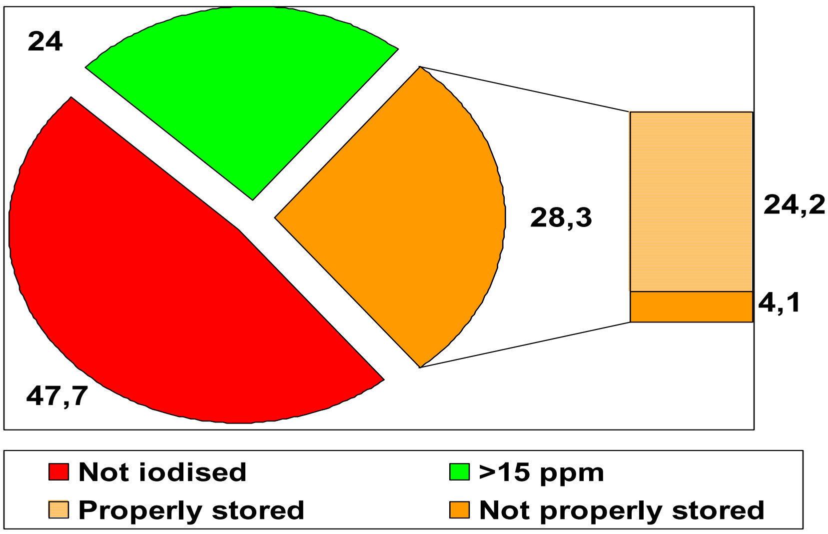

Figure 15 - Prevalence of anaemia in 15-49 year-old non pregnant women in Central Asia

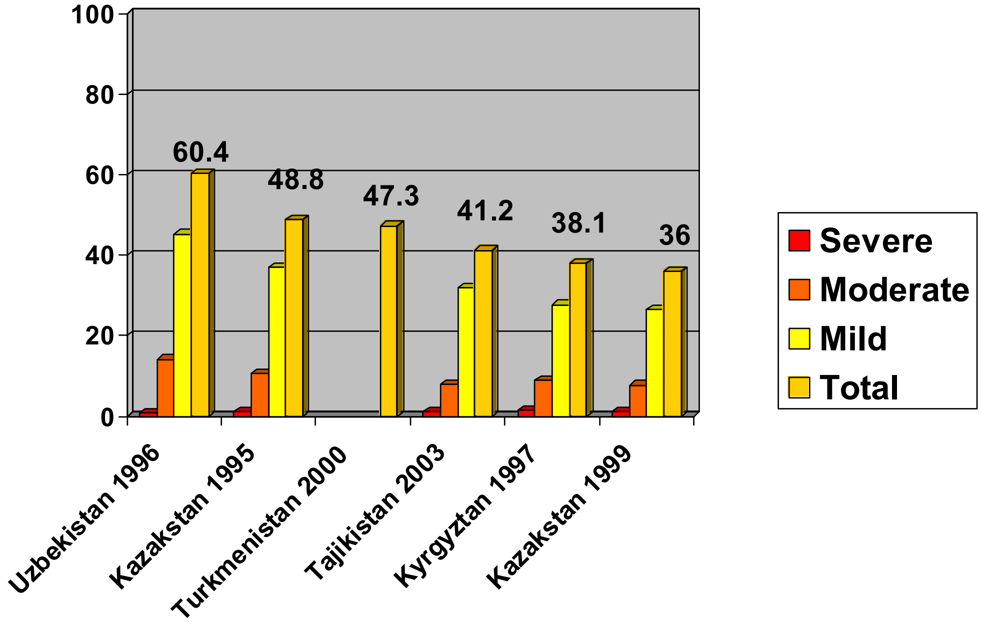

Figure 16 - Prevalence of anaemia in 6-59 month-old children in Central Asia

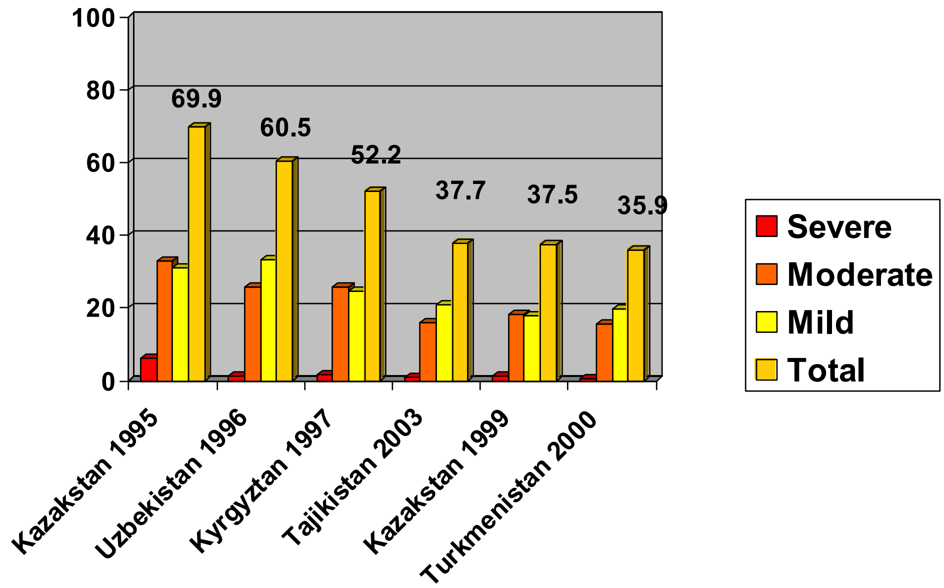

Figure 17 – Breastfeeding pattern in 0-3 month-old children in Central Asia

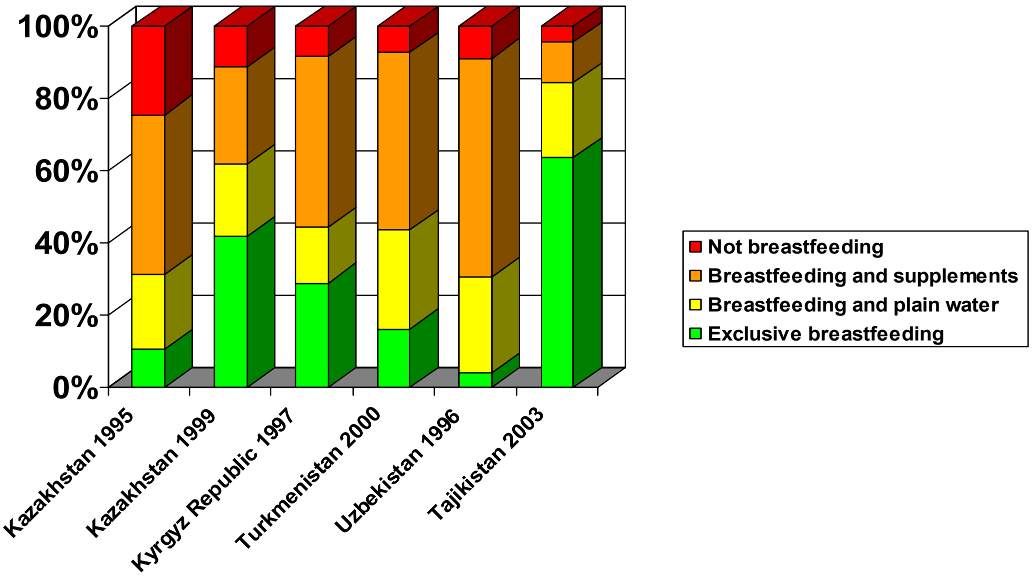

Figure 18 - Strategy for Anemia Prevention and Control in the Central Asian Republics