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Draft Final Report

DRAFT

The Sources and Adequacy of Dietary Iron Intake: An Analysis of Russian Longitudinal Monitoring Survey Data

Nutrition-Related Survey Report: Outcomes of the Russian Longitudinal Monitoring Survey, Rounds 1-4, (1992-94)

by

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March 1996

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University of North Carolina
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and the Institute of Nutrition
Moscow, Russia

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AN ANALYSIS OF RUSSIAN LONGITUDINAL MONITORING SURVEY DATA

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EXECUTIVE SUMMARY

Iron deficiency anemia has been reported to be one of the most widespread nutritional deficiencies worldwide. The iron content of the diet and the availability of this dietary iron are primary determinants of iron adequacy in healthy individuals. In present-day Russia, iron sufficiency is a concern for a number of reasons. Since the liberalization of price policies, there has been a sharp increase in the price of all consumer goods, especially food products. Consumption of meats, fruits and vegetables, which enhance iron availability, is likely to decline because of the relatively high cost of these foods. In addition, the Russian diet is traditionally rich in phytates (from grains) and tannins (from tea) which inhibit intestinal iron absorption. The amount of dietary iron available for absorption is critically modified by the presence of these enhancing and inhibiting factors.

This report describes the mean intakes of total dietary and bioavailable iron in women and children in Russia in rounds 1-4 (August 1992 - February 1994) of the Russian Longitudinal Monitoring Survey (RLMS). The report provides an in-depth analysis of iron nutriture, by combining the available data from four rounds of dietary interviews from different seasons and over a period of two years.

The focus of iron intake assessment is on the two most vulnerable populations: Women and children are at particular risk of iron deficiency because of their higher needs. During their reproductive years, women have increased iron requirements as a result of menstrual losses and pregnancy. The greatest concern is for the developing fetus and the young child, because the growing brain and other sensitive tissues will suffer qualitative and quantitative deficits that are largely irreversible. If the mothers have poor iron status their child will not only have suffered malnutrition in utero, but also will start out with lower iron stores than their well nourished peers. In addition to maintaining ferroprotein and hemoglobin concentrations, growing children have high needs from birth into early adulthood, because their total iron content has to increase commensurate with the increase in total body mass (RDA, 1989).

Mean intakes of total and bioavailable iron (adjusted for the concurrent intake of meat, vitamin C, phytate and tea) are evaluated in a number of in age and gender groups, each of which has different iron needs. The report also identifies major food sources of iron, and assesses important socioeconomic and lifestyle factors which may influence iron status.

The main findings are summarized below.

Women of childbearing age (14-54 years)

• Mean intakes of total dietary iron among women of reproductive age (14-55) are only two thirds of the Russian recommended level. Less than one eighth of total dietary iron is consumed as heme iron which is readily absorbed without interference from other meal components. Because the remainder of the dietary iron (non-heme iron) is poorly absorbed only 4% or less of all dietary iron is actually available for absorption. After correction for concurrent intake of meat and vitamin C (enhancers) and phytate and tea (inhibitors) the average amount of bioavailable iron in young women's diets was less than 0.5 mg/day, not enough to provide robust protection against iron deficiency.

• Tea and phytate intakes with iron-containing meals result in up to 58 % reduction of bioavailable dietary iron in women of child-bearing age.

• Wheat breads and other wheat products were younger women's major food source of bioavailable iron (after adjusting for meat and vitamin C)*. Other grains, including rye, were also important. Grains provided 40 % of bioavailable iron, meat sources contributed approximately 35 % of bioavailable iron.

• Young women with incomes below the poverty level had lower than average intakes of bioavailable iron, and so did women with normal or less than normal body weight.

• An 8 % decrease in bioavailable iron intake between the years 1992-93 and 1993-94 was noted in women of reproductive age.

Middle-aged and elderly women (over 54 years)

• Elderly women tended to get even much less bioavailable iron than young women. In the absence of younger women's iron losses with menses, pregnancy and breast feeding these minimal amounts may give less rise to concern than at a younger age. This does not apply, however, to women with low-grade blood loss associated with dental problems, parasitic infections or gastrointestinal disorders.

• Grains and meats were almost equally important sources of bioavailable iron for older women.

Children

• Judging by bioavailable iron consumption (adjusted for meat, vitamin C, phytate and tea intake) children get on average only about a third of what is estimated to be required for adequate growth and attainment of optimal health.

• Reported children's intakes of bioavailable iron were between 1 and 6% decreased between 1992-93 and 1993-94, attributable mainly to lower heme-iron (meat) consumption.

• Children from families with incomes below the poverty line tended to have lower than average intakes of bioavailable iron.

• Intakes in summer were even lower than during winter, mainly due to lower heme-iron intakes

Several conclusions may be drawn from these data as summarized in the following:

• Iron nutriture of Russian women and children should be of concern, since mean intakes of absorbable iron were consistently below estimated requirements. Continued efforts should be made to implement nutritional monitoring of these at-risk groups both with intake assessment and appropriate biochemical measurements.

• Iron status may be worsening in vulnerable Russian populations since the introduction of market reforms. This appears to be largely due to decreased meat consumption.

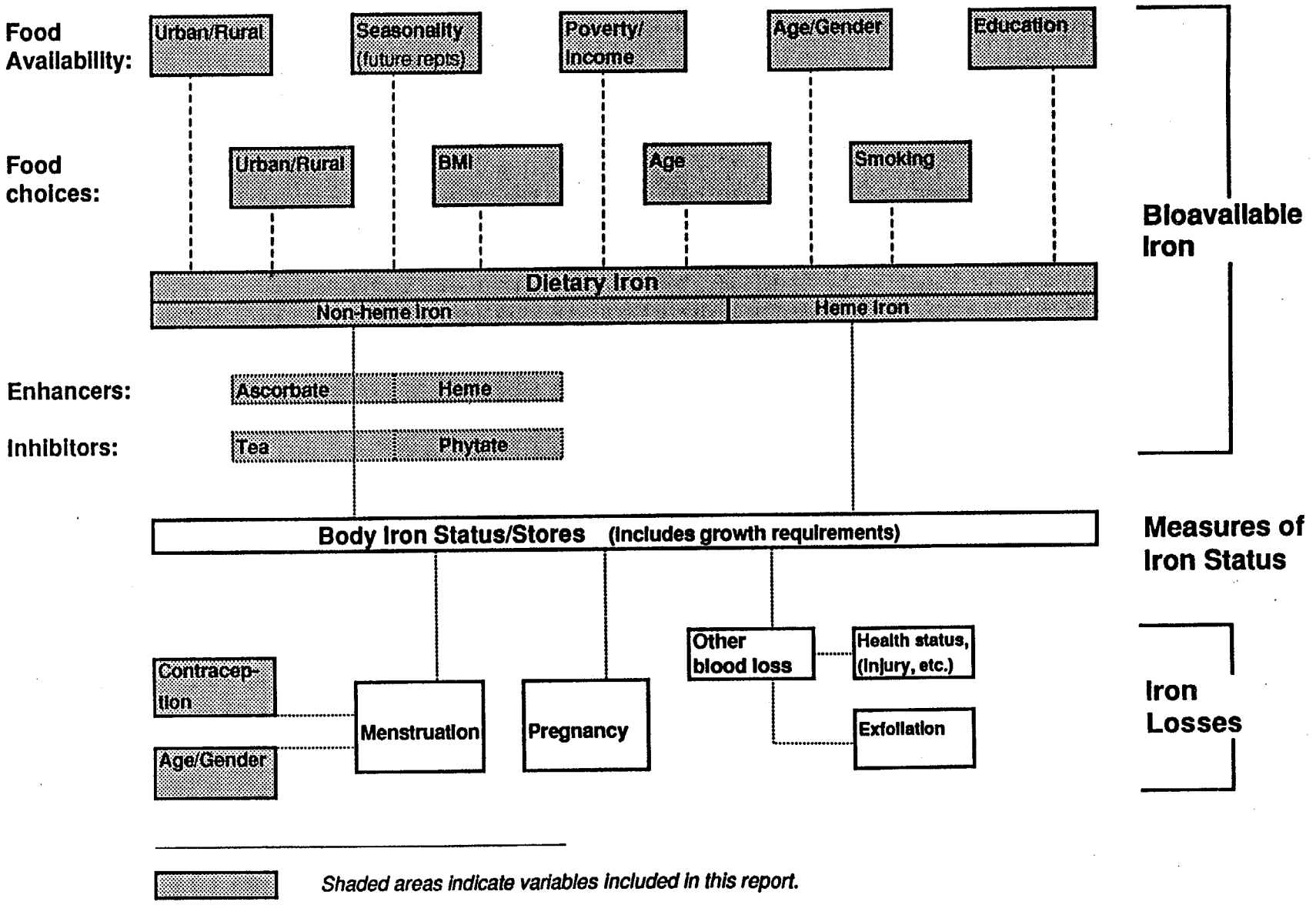
• Non-meat sources of dietary iron could contribute much more to iron nutriture in women and children, if iron absorption inhibitors were avoided or if the timing of their consumption could be changed.

• Consumption of vitamin C-rich foods should be increased. If such vitamin C-rich foods were eaten with the main meals in amounts that meet current US and Russian recommendations, iron availability from non-heme sorces could be considerably increased.

• Efforts should be made to inform health care providers and the lay public how iron bioavailability may be improved by avoiding some food patterns that reduce iron availability (tea, seeds and foods made from highextraction flour in combination with meats and other iron-rich foods). The consumption of vitamin C-rich foods as a part of the main meals should be encouraged.

** Food source and socioeconomic analyses of bioavailable iron have been adjusted for vitamin C, heme iron, tea and phytate consumption with the same meal*

Figure 1: Selected Factors Influencing Iron Status



1. BACKGROUND

Iron deficiency anemia is reported to be one of the most widespread nutritional deficiencies worldwide. The iron content of the diet and the availability of iron in the diet are primary determinants of adequacy in healthy individuals. In present-day Russia, iron sufficiency is a concern for a number of reasons. Since the liberalization of price policies, there has been a sharp increase in the price of all consumer goods, especially food products. The consumer price index rose 900% between January 1991 and January 1992 while household incomes increased by only 354% (Semashko Institute, 1992). The iron sufficiency of the Russian diet--particularly among more vulnerable population groups--may be impaired as a consequence of reduced purchasing power, and subsequent changes in diet. The impact of these changes may be exacerbated by some elements of the traditional Russian diet which adversely affect iron consumption and absorption.

Four specific factors capable of impacting the iron nutriture of vulnerable Russian populations are considered in this report: consumption of meat, vitamin C, tea, and phytates. The availability of iron is understood to be a function of heme iron (found in meats) and non-heme iron (found in both meat and plant sources), which are absorbed to different degrees. Heme iron is more readily absorbed than non-heme iron, i.e., about 23% of heme iron may be absorbed; however, the high cost of meat has made this source of highly available iron less accessible. The absorption of non-heme iron (but not that of heme iron) is affected by meal composition. Depending on the presence of inhibiting and enhancing factors, the amount of non-heme iron available for absorption in a typical meal or snack has been estimated to range from 3 to 8% (Monsen 1982). The presence of heme iron and vitamin C in a meal or snack enhance, while the presence of phytates (from grain products) and tannins (found in teas) inhibit, the absorption of the non-heme iron (Monsen, 1978). The Russian diet is rich in these antagonists to iron absorption; black tea and phytate-rich foods play an important role in the traditional diet. In addition to these dietary factors, absorption of both types of iron is also affected by the iron status of the individual: absorption of dietary iron may increase when body stores are low (Bothwell, 1979). As a result of the variability in rates of absorption, transport and storage, an individual's iron status can be directly assessed only through biochemical measures, although dietary intakes provide an indicator of iron status by estimating the amount of available iron consumed.

This report focuses on the iron nutriture of two population groups--women and children--which are at particular risk of iron deficiency because of increased iron requirements. In addition to maintaining body stores and hemoglobin concentrations, children require iron for growth, during which their total iron mass increases (RDA, 1989). Iron requirements are very high during infancy because of the rapid rate of growth experienced at that time: a six month old infant absorbs about 0.5 to 0.8 mg of iron per day; in later childhood, the daily iron requirement is estimated to be 0.2 to 0.3 mg per day (Hallberg, 1984). For the first six months, iron is supplied primarily by body stores. During this time, the iron in breast milk, which is highly bioavailable (nearly 50% as compared with about 10% from cow's milk), is generally sufficient to avoid deficiency (Brody, 1994). Pre-term infants may, however, be at greater risk for iron deficiency during the first six months of life as their stores may be relatively low (Dallman et al, 1980). After the age of six months, however, supplementation is necessary. In early adolescence, another period of rapid

growth, children are also at risk. During their reproductive years, women's iron requirements are increased as a result of menstrual losses; losses as high as 1.4 mg per day have been observed in 5% of normal women (RDA, 1989). It has been estimated that 1.8 mg of iron per day would cover the needs of most women (RDA, 1989). During pregnancy, iron requirements are further increased to provide iron to the fetus and placenta, and to compensate for blood losses during delivery. 'Anemia of pregnancy' is thought to exist in 20-25% of Russian women, and in up to 30-50% of women in regions such as Siberia (HFA database, WHO Regional Office for Europe).

This paper describes the mean intakes of total dietary and bioavailable iron in women and children in Russia in rounds 1-4 (August 1992 - March 1994) of the Russian Longitudinal Monitoring Survey (RLMS) (The RLMS is described in sections 2.1 and 2.2 below.) The analyses address temporal changes in dietary iron intakes over the four rounds of data collection, and present a more detailed analysis of associations between poor dietary iron intakes and other health, socioeconomic and demographic variables which may affect iron consumption. Because of the day-to-day variance in dietary intakes, data from a single round of 24-hour dietary intakes provides a less stable estimate of mean intakes than does a series of intake data; data from all five rounds will facilitate a more conclusive picture of typical iron intakes in Russia across seasons and within sub-populations. Policy and program implications of these findings are also discussed in this presentation.

Mean dietary iron intakes are assessed in different age and gender groups to evaluate possible dietary iron deficiency in these groups of women and children. Age and gender groups are necessary to assess the adequacy of dietary intakes because, as noted above, the amount of iron required by an individual depends on factors such as rate of growth, menstrual losses, and pregnancy, and is therefore strongly associated with age and gender. Major food sources of both total and bioavailable iron are identified. In addition, a number of other factors which may influence iron status are assessed, including poverty, education, body mass index (BMI: measured as weight (kg) divided by height (cm) squared), smoking status, and contraceptive use. Finally, mean intakes of selected macro nutrients and micro nutrients are provided.

Some of the possible relationships between iron intakes and the socioeconomic and health indicators evaluated in this report are illustrated in Figure 1. As noted earlier, income may affect dietary iron intakes by determining the availability of iron-rich foods such as meats, which are relatively expensive. Education may be associated with iron status because of its relationship with income. In addition, individuals with more education may have greater nutrition awareness and may therefore play a more active role in optimizing dietary iron intakes. Residence in urban areas may be associated with higher income or more education, and thus may also be linked to increased intakes of meat or heme iron. In addition, urban dwellers may have more westernized diets, which may lead to increased consumption of meat, as well as reduced intakes of traditional dietary elements such as tea and grains. Nutritional status indicators such as BMI may reflect total food intakes, which may also be linked to the amount of dietary iron consumed. Smoking is an important indicator of other health behaviors, and may be associated with lower energy intakes, and consequently with lower dietary iron intakes (Margetts 1993; McPhillips 1994). In addition to factors affecting dietary iron intakes, mean intakes among women using different methods of contraception is also assessed. While contraceptive choices may reflect women's income and education, the method used

may also affect iron status by moderating menstrual blood loss and thus determine individual iron requirements.

2. SUBJECTS AND METHODS

2.1 Study population

The individuals included in this study are members of the Russian Longitudinal Monitoring Survey (RLMS) population. The purpose of the RLMS, conducted in collaboration between the University of North Carolina, the Russian Center for Preventive Medicine (RCPM), the Institute of Sociology, Goskomstat (the state statistical office) and the Russian Institute of Nutrition (RIN), is to monitor the effects of Russian reforms on social, economic, and health conditions in the general population through the use of questionnaires, 24-hour dietary recalls and anthropometric measurements. In addition to dietary intakes, the RLMS has collected data on individual health behaviors such as smoking and alcohol consumption, anthropometric data, and health status data such as blood pressure. Other individual-level data includes information on employment, income, education, and reproductive outcomes. Household-level data (including information on income, assets and expenditures), and community data (including information on the retail foods, housing ownership and availability, and transportation) is also being collected.

The survey has been conducted on a probability sample of 6,485 Russian households throughout Russia; the total sample, including all members of the household, comprises 16,845 individuals. The sampling is based on a 3-stage, stratified cluster design. The sample population includes all residential addresses except military, penal and institutionalized populations. The first stage samples 21 of 2,335 raions (regions) which are stratified according to population density. These regions were implicitly stratified by sorting the files into ten quality-of-life zones computed by the Central Economics and Mathematical Institute. Within these zones, regions were sorted according to the percent of population living in urban zones within them. Following standard textbook procedures, proportional-to-population size sampling (PPS) was then used to select 20 primary sampling units (PSUs). In the second stage, PPS procedures were used to select ten districts in each voting district. (The second stage samples 10 random voting districts from each raion). This yielded 200 secondary sampling units (SSUs). In the final stage, a list of household addresses was constructed in each of the SSUs. Voting lists were used as the initial starting point rather than the census as the voting lists were updated much more frequently. From a randomly selected starting point in the list of households, 36 households were selected systematically in each of the 200 SSUs, yielding a sample of 7,200 households. The sample was designed to be a nationally representative of Russia. This analysis has not attempted to disaggregate clusters of subjects representing different geographic regions with the limited data available from a single round of data.

Data collection for the first round of the RLMS was completed August - October, 1992. Round two data was collected between December 1992 and March 1993, the third and fourth rounds were conducted

between July and September 1993, and between October 1993 and February 1994, respectively. A total of 14,974 subjects from 6,445 households participated in all rounds (89.5% of households). Dietary iron intakes were calculated by adding the contributions of 642 individual Russian food items. The current analysis estimates the mean daily dietary and bioavailable iron intake of the 9,890 women (>14 yrs) and children (<14 yrs) who participated in all rounds of the RLMS (45 subjects with missing age and gender information were excluded from analysis), and dietary data for men who participated in round two. Where applicable, data was stratified in seven age/gender groups; these were ages 0 to 6 (males and females), 7 to 13 (males and females), 14 to 54 (females), 55 to 65 (females) and >65 (females).

TABLE 1. DEMOGRAPHIC AND SOCIOECONOMIC DATA, RLMS ROUNDS 1-4

Stratification for these categories was based on status in round 1 except where noted otherwise

Category	All		Women (14+ yrs)		Children (<14 yrs)		Information missing
	N	% of all participants	N	% of responders	N	% of responders	
Age distribution							
0-6	746	11.2	n/a	--	746	42.3	
7-13	1018	15.3	n/a	--	1018	57.7	
14-54	3188	47.8	3188	64.9	n/a	--	
55-65	814	12.2	814	16.6	n/a	--	
>65	909	13.6	909	18.5	n/a	--	
All	6675	100	4911	100	1764	100	
< poverty line [2]	2186	32.7	1452	30.2	734	42.4	43 (6.4%)
> poverty line	4346	65.1	3349	69.8	997	57.6	
Normal (0-6 yrs) [4]			--	--	918	86.3	
Stunted (0-6 yrs)			--	--	62	5.8	
Wasted (0-6 yrs)			--	--	84	7.9	
BMI <18.5 [2] (underweight)			50	2.2	--	--	2666 (54%)
BMI 18.5-24 (normal)			907	40.4	--	--	
BMI 25-29 (overweight)			748	33.3	--	--	
BMI 30+ (obese)			540	24.1	--	--	
University-educated [2]			607	13.5			406 (8.3%)
HS + technical			1248	27.7	--	--	
HS or less			2650	58.8	--	--	
Smokers [2]			301	7.0	--	--	0 (0%)
Non-smokers			4610	93.0	--	--	
Smokers					--	--	
					--	--	
no children in HH [3]			3046	62.0	--	--	152 (8.6%)
1 child in HH			1219	24.8	765	43.4	
2 children in HH			542	11.0	649	36.8	
3+ children in HH			104	2.1	198	11.2	
Women pregnant in round 1[4]			137	2.8	--	--	
breastfeeding in round1 [4]			63	1.3	--	--	

SOURCE: RUSSIAN LONGITUDINAL MONITORING SURVEY (RLMS), ROUNDS 1-4 (AUGUST 1992-FEBRUARY 1994)

[1] *Out of the 6804 women and 3086 children who participated in one or more of rounds 1-4 only those were included who participated in all four rounds.*

[2] *Classification for this category was based on status in round 1*

[3] *Number of children in household at the time of round 4 interview.*

[4] *Participants were asked the question "Do you currently breastfeed?" only in round 1.*

Some basic demographic and socioecononomic characteristics of the sample are provided in table 1. As shown in this table, approximately 50 % of the sample fell below the poverty line. A disproportionate number of children had household incomes below the poverty line. Sixty-three percent of children below age 14 fell below the poverty line, while only 51 percent of the total sample and 47 % of females over 14 fell in this low-income group. Approximately 14% of the population over 14 years of age had a university education; similar proportions of men and women had higher education. Seventy-eight percent of the sample was drawn from urban areas.

Table 1 also provides data on stunting and wasting in children, and body mass index in adults. These nutritional status indicators show that a large proportion of the Russian adult population was overweight (33 % of the sample) and obese (18%). Women tended to be more obese than men: 25 % of women had BMIs 30. Eighty-six percent of children were in the normal ranges for height and weight according to growth charts. Finally, the table illustrates the prevalence of smoking, which may be an indicator of other health and nutrition behaviors. Although 28 % of all men and women reported smoking, a relatively small proportion of women--only 7 %--were smokers.

2.2 Dietary Assessment

2.2.1 Methodology

Dietary information was collected by trained interviewers who visited each participating household during the first round of the survey and solicited 24 hour recalls for each individual in the household. Dietary intake data entry was facilitated by development of menu-driven software (Glukala) designed by the Russian Institute of Preventive Medicine to link detailed Russian food names to a nutrient database with 642 individual items. Interviewers were trained to capture detailed food names codable with this system. Data entry was then carried out by trained coders directly at the computer.

Foods were coded for computer analysis of nutrient content using revised Russian food composition tables (Kohlmeier et al., 1995) based on the work of Sliroljom and Shaternikova (1984). Comparisons to another Russian nutrient data source, from the Russian Institute of Nutrition (RIN), and other western sources of food composition, (the USDA tables and the German BLS tables) were made and a new table developed. Protein, fat, iron, and ascorbie acid (vitamin C) were compared across the four different food composition tables. Revisions made to the food composition table consisted mainly of three basic types: changing the values to reflect the food in its commonly used form; changing the value of a specific nutrient because the value recorded was not plausible or not in line with common knowledge; adding values for specific nutrients that were missing.

> The Russian food composition tables contained surprisingly high iron levels for a number of fruits and vegetables. The iron values of 365 foods were changed to agree with the composite document. These changes were deemed necessary because of

large discrepancies in the iron content of foods according to the information available from the USDA, the Russian Institute of Nutrition and Glukala. The issue was resolved by looking at each and every iron value and changing it, if necessary, according to the following protocol:

a) identify the foods in which the percent agreement between Glukala and Institute of Nutrition iron values is <75% or >125%;
b) compare the Glukala and Institute of Nutrition values for a nutrient's content to the USDA value for that food. If either the Glukala or the RIN value is obviously closer to the USDA value, the closer value is used;
c) if the USDA value falls between the Glukala and RIN values, adopt the USDA value.

Missing values were a significant problem only for the baby formulas. Nutrient contents for all 41 nutrients in the array were filled in for the six most commonly used baby formulas. USDA values were inserted for three which are foreign-made and imported into Russia. Three infant formulas made in Russia had their nutrient contents calculated from the official government recipe book. Further study will be conducted to evaluate the possible impact of missing values, and errors in imputed values. Another important correction involved changing the vitamin C content of raw apples, which was divided by a factor of 10 to correct a decimal point error and bring the recorded nutrient value in line with common knowledge.

To assess the dietary intakes in the population, the distribution of portion sizes of each food consumed was examined, and any portion size five times greater than the median portion size from the survey data was replaced with the median amount. Iron values from the revised nutrient table were then applied to food consumption data from each subject's 24 hour recall in order to obtain iron intakes for each individual. Any iron obtained from dietary supplements was not included in our analyses.
The bioavailability of the iron in the diet was analyzed using methods detailed by Monsen (Monsen 1978, 1982) incorporating separation of heme and non-heme sources of iron and applying adjustments for concurrent consumption of meat or vitamin C as factors enhancing non-heme iron absorption. In order to analyze iron bioavailability, the individual food contributors of heme and non-heme iron were separated. The meat content of all mixed dishes was calculated based on official government recipes. Further adjustments were also made to account for concurrent consumption of phytates and tea.

The proportions of heme and non-heme iron in a particular food were calculated as shown in table 2. Heme iron bioavailability was assumed to be 23%. Non-heme iron absorption was calculated by applying the following algorithm which incorporated adjustments for dietary meat, vitamin C.

EF (enhancing factors): 1 unit = 1 gram meat, fish or poultry or 1 milligram vitamin C consumed in meal

For EF < 75 units, % non-heme absorption = $3 + 8.93 \ln [(EF+100) / 100]$
For EF > 75 units, % non-heme absorption = 8 assigned to each Russian food consumed
(Monsen 1982)

Additional adjustments for the effect of consumption of tea and phytates on iron bioavailability were also made. The algorithm used to adjust the non-heme iron for the antagonizing effects of phytate is based on the work of Hallberg et al. (Hallberg, Brune, and Rossander, 1989). Deviating from the previously employed stepwise correction the original data reported by Hallberg et al. were used to generated a continuous regression equation as given above. The proportion of phytate-containing foods in mixed dishes was determined by official government recipes. The amount of phytate in each specific food source was taken from reference sources (Harland and Oberleas, 1987; Pennington and Church, 1985). Non-heme iron absorption was further reduced by 40 % if the amount of tea consumed in the meal exceeded 225 g (NCHS, 1982). The following regression equation was used to further adjust iron bioavailability for phytate consumed within each meal or snack:

$$\text{fractional availability of non-heme iron} = \exp(10)^{(-0.2869\ [\log 10\ \text{phytate (mg)}]\ +0.1295)}$$

Major food sources of total dietary and bioavailable iron were determined by dividing the total contribution of each food by the population's total intake of dietary or bioavailable iron. In addition, major food group sources of total and bioavailable iron were determined, using food groups created based upon the first and second fields of the Eurocode food coding system assigned to each food (Poortvleit and Kohlmeier, 1993).

TABLE 2. CALCULATION OF BIOAVAILABLE IRON CONTENT OF FOODS

Type of Food	Heme Iron	Non-heme Iron
Meat	40% of total iron	60% of total iron
Non-meat	0% of total iron	100% of total iron
Mixed Food (meat & Non-meat)	40% of meat iron	60% of meat iron 100% of non-meat iron
Total Iron:	Total heme iron 0.23	Total non-heme iron EF adjustm
Mean % Absorbed		
Total Iron Absorbed	Absorbed heme iron	Absorbed non-heme iron

[1] *All bioavailable iron adjustments include heme and vitamin C enhancing factors; additional corrections for phytates and tea are incorporated in adjusted mean intakes reported in the following tables.*

2.2.2 Format of Presentation

For the presentation of most tables the data from rounds 1 and 2 and from rounds 3 and 4 were merged to represent intakes during these two subsequent years. These served to strengthen the validity of intake data, since participants provided single 24 hour dietary recall information at each round which is subject to considerable variation. As will be detailed later another significant source of systematic bias was due to seasonal variation. Merging the two data sets for one year helped to balance those differences and provided a more informative picture of year round intakes. One of the purposes of the analyses for this report was to

determine whether dietary intakes have changed from one year to the next and to assess whether nutritional sufficiency has become more critical for some or all of the participating women and their children.

3. RESULTS

3.1 Iron Intakes

3.1.1 Mean Intakes of Total Iron

Mean intakes of total iron for each age and gender group assessed are presented in table 4. Mean intakes among young children aged 0-6 and women 14-54 were well below recommendations. Young children consumed 83% of the recommended level, while mean intakes among females of reproductive age (14-54 years) reached only 70% of the 18 mg recommendation, which takes into account menstrual losses (an additional 15-20 mg is recommended for pregnant and lactating women). Intakes of total iron among children in the 7-13 age group slightly exceeded the recommended 10 mg level, as did mean intakes among elderly women (65 and over). In both groups of children, total iron intakes were slightly higher among males than females.

Over time (comparison of rounds 1+2 with rounds 3+4) total iron intake fell in all adult women, most distinctly in the elderly women. The mean iron intakes of women was 6% lower during the end of the survey (rounds 3 and 4) than during the first two rounds; the differences for middle-aged and elderly women were -5 and -9%, respectively. With the exception of 0-6 year old boys the same trend was seen for the children.

3.1.2 Intakes of Heme Iron

Table 5 provides information on heme iron consumption. It is worth pointing out that only a small fraction of total dietary iron is consumed as hem. As with total iron, heme iron intakes are highest among women in the 14-54 age group, and lowest among the elderly (women >65). Intake of heme is slightly higher among male than female children. This gender difference in heme intake mirrors that for total iron. Since heme iron is an important determinant of bioavailability, the amounts of heme iron consumed in each age group are reflected by the differences in bioavailable iron intakes described below (section 3.1.3). Relevant reductions in heme iron intakes were noted between the 1992 and 1993 surveys. The heme intakes of children dropped 4-9%, heme iron intakes of women decreased by 7-10%

3.1.3 Bioavailable Iron Adjusted for Vitamin C and Heme Iron Consumption

Intakes of bioavailable iron adjusted for meat and vitamin C consumption are shown in table 6. Iron intakes adjusted only for the effects of iron absorption enhancers in meals were consumed at average levels (means from all four rounds) of less than 1 mg in young children, and less than 1.2 mg in older children and women of reproductive age. These mean intakes fall below recommendations for children and women in their reproductive years and are certainly insufficient for the majority of children and young women with lower than average intakes (table 7). The proportion of total iron consumed which was estimated to be bioavailable is lower than 10% for all age groups over 14 years, and little more than 10% in the younger population. These proportions are provided in table 8. Recommendations for total iron intakes generally assume an absorption rate of 10-15% (RDA, 1989). Given that mean intakes of total iron for this population are already lower than the recommended norms, the low proportion of bioavailable iron among adult women is troubling.

3.1.4 Bioavailable Iron Adjusted for Enhancers and Tea/Phytate Consumption

Tables 6-8 also illustrate the substantial impact of phytate and tea on iron availability in Russia. After adjustment for phytate and tea consumption, the proportion of total dietary iron estimated to be bioavailable was reduced from 11% to about 4% for children aged 0-6 years. Expressed as an absolute amount, adjusting for these inhibiting factors reduced the mean intake of bioavailable iron in the 0-6 age group to about 0.34 mg (table 6). The adjusted estimate represents 84% of the estimate of at least 0.4 mg required for maintenance and growth among children in this age group (see table 7; Fairbanks and Bentley 1988). Table 6 illustrates similar reductions in the estimated amount of bioavailable iron for each age and gender group. In each age and gender group, the amount of dietary iron available after adjusting for the antagonistic effects of phytates and tea was substantially below the estimated requirement for growth and maintenance.

Adjusting for the presence of phytates alone accounts for most of the reduction in iron bioavailability. For example, among children 0-6, bioavailable iron was reduced from 0.94 to 0.33 mg in girls and from 0.95 to 0.34 mg in boys, with negligible additional reductions from tea (table 6). Ignoring phytates, the impact of tea consumption alone (data not shown) had a significant impact on iron bioavailability for some age and gender groups. Nonetheless, dietary phytate appears to be the overriding factor that limits iron availability in the Russian diet.

3.1.5 Total Dietary Iron Intakes in the US and Russia

In comparison to mean iron intakes in the United States as estimated by NHANES III data (National Health and Nutrition Examination Survey, 1988-1991), which are also based on 24 hour recall data, iron intakes

among Russian children are relatively low. According to NHANES III data (Alaimo et al, 1994) for whites, the mean daily intake for infants 2-11 months (not breast feeding) is 15.5 mg; for 1-2 year old children, 9.5 mg; and for 3-5 year old children, 11.9 mg. Each of these exceeds the estimated mean for Russian children aged 0-6 years in 1992-93, which ranged from 8.2 (females) to 8.3 mg (males). The same holds true for older children. The mean total iron intake among 6-11 year old white children in the US is reported to be 13.8 mg, and 16.0 mg among 12-15 year old children. Again, these means are substantially greater than the estimate of 10.7-11.3 mg for Russian children between 7 and 13. The shortfall in intakes during these critical years may have significant implications for impaired growth and development.

Adult females in both countries have comparable intakes of total dietary iron with low mean intake in both groups of women. In the US., mean intakes for white females between the ages of 16 and 50 range from 12.1 mg for 40-49 year old women to 12.7 mg for 30-39 year old women. Russian females between 14 and 54 have mean intakes of 12.5 mg. Average intakes among older white females in the US are 11.8 mg for women 50-59, 13.0 mg for women 60-69, and 12.8 mg for women 70-79. In Russia, average intakes among older women are similar: 12.2 mg for women 55-65 and 10.9 mg for women over 64.

Comparisons of total iron intakes may not reflect differences in the composition of the diet which affect iron availability. For example, it is plausible that meat consumption is higher in the US, and that a greater proportion of the total iron consumed is therefore bioavailable. NHANES III data on bioavailable iron, or on heme vs. non-heme iron intakes have not been published, and consequently no additional comparisons are possible at this time. Based on biochemical data from NHANES II, an estimated 10% of women 18-44 and 4.1 percent of women 45-64 in the US have iron deficiencies (i.e., at least 2 abnormal measures of iron status); 2.6 and 1.9% of these groups have iron deficiency anemia, respectively (Cook et al, 1986). Assuming greater iron bioavailability in the US, it is likely that iron deficiency among adult women in Russia is more prevalent.

3.2 Major Sources of Dietary Iron

3.2.1 Major Sources of Total Iron: Food Groups

Tables 9 (children) and 10 (women) illustrate the major food groups contributing to total dietary iron intakes in males and females.. Seventy-four food groups were analyzed in total. The percentage of total dietary iron provided by the top 25 food groups contributing to intakes in the population as a whole are illustrated in the tables; these foods provide 96 % of total dietary iron. It is clear that intakes of total iron are concentrated in a small number of food groups. Within each of the age and gender groups evaluated, these 25 food groups provide from 94 % to 96 % of total dietary iron.

The top five food groups--wheat breads, other wheat products, rye products, potatoes, roots and tubers, and beef--provide more than half (54 %) of the total dietary iron consumed by the Russian population. The top ten groups contribute 78 % of total iron. Grains (primarily wheat and rye, but also buckwheat, rice and

millet) are the most important sources of total dietary iron, providing 40 %. For total iron, meat and fish sources (excluding milk and cheese, but including eggs and soups) are less important than non-meat sources providing 34 % of total iron consumed. Potatoes, roots and tubers are also important, providing 9% of total iron consumption.

Across age and gender groups, wheat breads and other wheat products are consistently the most important sources of total iron, providing 25 % of the total iron consumed by the population as a whole. Together, these two groups provide from 23 % of the total dietary iron consumed by older women 54-65 years to about 28 % in the 7-13 age group. High consumption of wheat products is also consistent in children of both genders; within each age group, the proportion of total iron provided by wheat is similar for boys and girls.

The relative importance of dietary iron sources other than wheat products varies more notably across age and gender groups. For example, rye products are more important sources of total dietary iron for older than for younger subject. Rye products provide 15% of total iron consumed by women over 65, but only 6% of total iron consumed by 0-6 year old children. Buckwheat products, non-carbonated drinks and malaceous fruit are more important sources of dietary iron for children under 14 than for adults.

The proportion of total iron from meats and fish is shown in table 11. As pointed out earlier, meat consumption is highest among young adult women, and lowest among the elderly over the age of 65. Although the proportion of iron contributed by meat and fish sources is slightly but consistently higher in male than in female children, these data do not provide evidence of important gender differences in heme iron consumption

3.2.2 Bioavailable Iron I, Adjusted for Heme and Vitamin C

Bioavailable iron I was calculated by taking into account the great availability of heme compared to heme iron, and the iron-absorption enhancing effects of meat and vitamin C. Bioavailable iron III adjusted for inhibitors in addition to the enhancers of iron absorption is discussed below. Tables 12 and 13 illustrate the top 25 food group sources of bioavailable iron I (adjusted for concurrent meat and vitamin C intake), which provide 96 % of the population's intakes. Like total iron, bioavailable iron I is concentrated in relatively few dietary sources: the top 5 food groups provide 64 % of bioavailable iron I; the top ten food groups provide 83 %. As with total iron, grain products are the most important sources of bioavailable iron I, followed by beef and other meat products. Approximately 41 % of the Russian population's bioavailable iron I comes from grains. Rye products are the number one population source of bioavailable iron I as well as total iron, contributing 17 %, followed by wheat bread (16 %) and beef (13 %). Wheat breads are the primary source of bioavailable iron I for age and gender groups under age 54, contributing as much as 16 % of bioavailable iron I intakes. For women over 54, rye products are the number one source, contributing 20 % and more to bioavailable iron I intakes.

Meats, which contain heme iron, are a more important source of bioavailable I than of total iron. Depending on the grouping of foods and on the age and gender groups that are evaluated, grains (particularly wheat and rye) contribute the bulk of bioavailable iron I. In the top ten sources of bioavailable iron I, which are almost identical to those for total iron, poultry (804) replaces buckwheat products (609). Both tea and phytate reduce the fraction of non-heme iron that is available for intestinal absorption. Since heme-iron (40 % of total iron in meats) is not affected by these absorption inhibitors the proportion of bioavailable iron I provided by meats actually is higher. Nevertheless, foods that contain no meat provide the bulk of bioavailable iron I. Of the foods shown, meats and fish provide only 39 % of bioavailable iron I in 14-54 year-old women, compared to 61 % from non-meat sources (table 11).

3.3 Mean Iron Intakes by Socioeconomic and Physiologic Status

3.3.1 Poverty

Tables 14-17 illustrate mean intakes of total and bioavailable iron III for each age and gender group categorized by level of poverty, separately for the period 1992-93 (RLMS rounds 1 and 2) and 1993-94 (rounds 3 and 4). There is strong evidence of a trend for lower mean intakes among subjects below the poverty line. In each age and gender group, mean intakes of both total and bioavailable iron were higher for those in the highest income group (200-250 % of the poverty line) than for those in the lowest group (<50% of the poverty line).

Differences between the mean intakes of total iron in the highest vs. lowest poverty group were moderate. In the 0-6 age group, this difference was essentially the same for females (1.67 mg, 18 %) and males (0.88 mg, 20%). Differences in mean intakes for other groups are as follows: 1.20 mg (17 %) for females, 0.38 mg (3%) for males aged 7-13; 1.57 mg (12 %) for females 14-54; 2.41 mg (19 %) for females 55-65; and 2.26 mg (21 %) for females over 65. With the exception of boys aged 7-13 these differences were statistically significant (based on ANOVA test with $p<0.05$).

Individuals with greater economic advantage consumed more meat than poorer women of the same age. They consequently had higher intakes of heme iron, resulting in the greater difference seen in intakes of bioavailable iron compared with total iron.

Greater differences in mean intakes across socioeconomic status were observed for bioavailable iron (adjusted for enhancers and inhibitors in meals), particularly among infants and young girls. With the exception of boys 0-6, each of these differences was statistically significant (at $p<0.05$). The discrepancy in mean bioavailable iron intakes between children in the lowest and highest income groups were: A 41% difference among 0-6 year old girls, and an 8 % difference for 0-6 year old boys; a 22 % difference among 7-13 year old girls and a 24 % difference among boys. Among women, differences in mean intakes of

bioavailable iron were similar to those found among children: a 27 % difference among for 14-54 year olds, a 10 % difference for women 55-65; and a 21 % difference for women over 65.

Changes in iron intake from one year to the next were related to socioeconomic status. Women of child-bearing age were slightly worse off at the end of the two-year survey than at the beginning, since both their total and heme-iron intakes decreased. Middle-aged and elderly women with family incomes below the poverty level tended to increase heme iron intakes over time while their better-off peers experienced a decrease in this highly available form of iron. Due to the effects of concurrent intake of iron absorption modifiers these changes were not fully reflected in bioavailable iron III intake.

3.3.2 Stature (Body Mass Index, Level of Growth)

The available data suggest a fairly consistent pattern. Tables 18 and 19 show mean intakes of both total and bioavailable iron for women categorized by body mass index (BMI). Although there is a statistically significant difference in the mean intakes across BMI categories (based on an analysis of variance, $p<0.05$), no trend in intake levels associated with stature is clear from this data. One reason for apparently higher intakes among underweight women may be underreporting of total food consumption among overweight and obese women. Such underreporting is commonly seen in dietary studies (Heitmann and Lissner, 1995). Indeed, among 14-54 year old subjects, underweight women reported higher caloric intakes than obese women (data not shown). This was not true among older women, where obese women had the highest energy intakes. Among these older women--where the difference in iron intakes was most apparent--underweight women appeared to have had higher concentrations of total and bioavailable iron III. However, the data are not entirely informative due to the small number of women who were underweight.

Change of total iron intake over time was only minimally, if at all, related to stature with a slightly lesser decrease among the overweight women. When reviewing intakes of heme iron, available iron I (adjusted for vitamin C and meat intake) and bioavailable iron III (tables 18 and 19), however, it became quite apparent that women with greater than normal body weight had similar amounts of iron available for absorption throughout the study period, whereas normal- and underweight women had less. This appears to be a combined effect of both lower meat (as reflected by heme iron) and vitamin C intakes.

In this context it worth noting that among women in the younger age group (14-54 years) about one half were classified as moderately overweight or obese, and the other half as normal- or under-weight. The proportion of overweight and obese women was considerably higher in the older age groups. While it is not clear why some women were leaner than others, normal or lower than normal body weight identifies a group of women who had little iron at their disposal at the beginning of the survey and even less towards the end.

Tables 20 and 21 describe total and bioavailable iron intakes for children 0-6 categorized by level of growth as normal, stunted or wasted (only 1 child was both stunted and wasted and was not included in the table).

Within each gender grouping, children in the normal height and weight ranges had consistently higher mean intakes of both total and bioavailable iron than children categorized as stunted or wasted. Mean intakes of total iron in girls of normal stature were 20 % higher than mean intakes for stunted girls, and 14 % higher than mean intakes for girls categorized as wasted. Among boys, the differences in mean intakes were smaller: 3 % and 12 %, respectively. The same pattern is true for bioavailable iron intakes. Girls of normal stature had mean intakes which were 29 % higher than stunted girls, and 6% higher than those who were wasted. The difference in bioavailable iron intakes among boys with normal height and weight vs. those with stunting or wasting was 18 % and 14 %, respectively.

3.3.3 Education

Iron intakes for groups with different levels of education and vocational training are shown in tables 22 and 23. For the 14- 54 age group, mean intakes of bioavailable iron III were slightly but consistently higher among more educated women. Mean intakes were 13 % higher among those with university education vs. those with high school or less. Similarly, there was a 24 % difference in consumption of bioavailable iron among women 55-65 and a 5 % difference for women over 65. These differences in mean intakes of bioavailable iron across education groups are statistically significant (based on an analysis of variance at level $p<0.05$). Differences in total iron intakes were more modest, but remained statistically significant. The contrast in mean total iron intakes between university-educated women and those women with less schooling was 6% for the 14-54 age group, 7 % for the 55-65 age group, and less than 1 % for women over 65.

Changes over time indicated possibly relevant relationships of total iron intakes to the extent of schooling. Among the younger women it was those with the least education that suffered the greatest reduction in iron intakes; they were also the group with the lowest consumption among their peers in 93/94 (table 23). Among the elderly it was the best educated women, in contrast, who had the greatest decrease in total iron consumption, whereas the least educated elderly showed a minor improvement. The change in this latter group was due to a one-third increase in heme consumption which brought them more in line with the other women, at a uniformly low level of iron intakes. Changes in bioavailable iron I after correction for vitamin C and meat intake and after additional correction for inhibitor intake (bioavailable iron III) paralleled those of total iron intake.

3.3.4 Urban/Rural Residence

Intakes of total and bioavailable iron among women and children stratified by urban and rural residence are shown in tables 24 and 25. Children living in urban and rural areas had very similar intakes of total and heme iron, and the amounts of bioavailable iron regardless of adjustment also were comparable.

Women residing in rural areas consistently consumed more total iron than women in urban areas. Mean intakes among rural women aged 14-54 were 15% higher than women in urban zones; among 55-65 year old rural women, mean intakes were 10% higher, and among women over 65, mean intakes were 11% higher in rural areas. Differences in mean total iron intakes among women in each age group were statistically significant (at $p<0.05$).

Differences in mean intakes of bioavailable iron, however, showed an inverse relationship between urban and rural residence: intakes of bioavailable iron I adjusted for concurrent meat and vitamin C consumption were consistently higher among urban dwellers. When finally consumption of phytates and tea also were taken into account (bioavailable iron III area of residence was not important anymore. While there was a tendency for higher heme-iron intakes in younger women living in rural areas this was less obvious in middle-aged women and reversed for elderly women.

Comparison of survey results from 1992-93 and 1993-94 showed that young women in urban areas had 9% lower intakes of bioavailable iron III (adjusted for enhancer and inhibitor intake) during the second year, whereas women of the same age living in rural areas had constant intakes. The main reason for this unfavorable change in urban, but not in rural areas was lower consumption of meat as seen from the decrease in heme-iron intakes. The same was true for children who tended to have nearly stable intakes in rural areas, but not in urban areas. For the older women it did not matter where they lived, since they experienced similarly decerased intakes of heme-iron and consequently of bioavailable iron both in rural and in urban areas.

3.3.5 Seasonal Effects

During the winter months meat consumption increased considerably as can be seen from the higher heme iron intakes during this time (tables 26 and 27). Women and children from all age groups tended to eat more altogether during the cold season as can be seen from reported energy intakes shown in table 38. Even against this background of increased overall food intake the rise in meat consumption (corresponding to more than 30 g per day) is a distinct seasonal adaptation that appears to be influenced by specific socioeconomic and other factors as described in the appropriate sections. The persistence at the warm-season typical low intake levels may be an important reason for poor iron nutriture in some women. It was of interest to observe that a greater proportion of consumed iron was bioavailable (taking into account the effect of enhancers and inhibitors) in winter. The main reason for this appears to have been greatly increased consumption of meat as reflected by higher heme iron intakes, and this is despite decreased consumption of vitamin C (table 32).

There was a distinct trend for women with higher relative body weight to increase total iron intake during the winter months which was absent or much less obvious for leaner women of all ages (data not shown) Women with higher relative body weight did not, however, report a higher seasonal increase in heme intakes than leaner women. After adjustment for the effects of vitamin C and meat and of inhibitors lean women were found to change their diets in very similar way increasing bioavailable iron III consumption in winter.

3.3.6 Smoking

Few (7 %) of the Russian women in this cohort reported smoking, and most of these were in the younger age group. Table 28 illustrates mean iron intakes in smokers and non-smokers. Differences in mean intake levels were generally small, and the direction of these differences was not consistent across age and gender groups. Among older women (55-65), mean intakes were higher among non-smokers. Intakes were higher by 2 % for total (not statistically significant: ns) and 15 % for bioavailable iron III ($p<0.05$). Non-smoking elderly women (>65) also had higher mean intakes than smokers, with 18 % higher mean intakes of total iron ($p<0.05$) and 16% higher bioavailable iron III (ns), and the same was true for women in the 14-54 age group: mean total iron intakes among non-smokers were 6% higher than among smokers (ns); the difference for bioavailable iron III was 3% ($p<0.05$).

3.4 The Role of Child Bearing and Reproductive Behavior

3.4.1 Pregnancy Status

Only 44 of the 3121 women in childbearing years indicated that they were pregnant at the time of round 1 interview. While they had a slightly higher energy intake than the non-pregnant women in the same round, their total, heme and bioavailable iron intake data all pointed to the same conclusion that this group of pregnant women did not increase iron intakes as would be desirable.

A year later these same women had higher energy and calcium intakes and consumed slightly more iron than the other women who had not been pregnant. This change in dietary intake is largely attributable to breast feeding as described below.

3.4.2 Breast Feeding

In round 1 the adult female participants were asked about current breast feeding, and 63 responded in the affirmative. During this period of breast feeding the women tended to get more total iron, heme iron and bioavailable iron (taking into account consumption of meat, vitamin C, phytate and tea in each meal) than the women of the same age group who did not breast-feed (table 31). A year later, the formerly breast feeding women eat much less again, consuming 10.4 % fewer calories, less total and heme iron, and smaller quantities of vitamin C and phytate which was comparable . As a result they got 9.5 % less bioavailable iron than at the time of breast feeding. These differences indicate that many young Russian women know about the importance of adequate nutrition during breast feeding and are likely to be receptive to recommendations for further improvements.

Interestingly, these women had much higher mean calcium intakes while breast feeding than their non-lactating peers, though still hardly more than half the 1200 mg/day recommendation. A year later they consumed again as little calcium as the other women in their age group. Breast feeding women tended to get less vitamin C than the women who did not breast feed.

3.4.3 Number of Children in Household

Households were categorized by number of children permanently residing in this unit at the time of round 1 interview. While almost two out of three adult participants lived in households without children, most of the children (80 %) lived in families with one or two children. Several children living in the same household thus appears to have been the exception in the surveyed locations. Total and bioavailable iron intakes were similar in children from households with three or more children and in those from single-child households (tables 32 and 33). Among adult women iron intakes also did not show a consistent pattern in respect to number of children in the household. A possible exception are women beyond childbearing age living with several children; while the younger women with several children did not fare worse than those without children, the older women with several children had experienced a considerable decrease in heme consumption over time. Due to the very small number of women in the categories in question this observation remains inconclusive, however.

3.4.4 Contraception

Contraceptive methods may influence menstrual losses and therefore affect iron status. Notably, chronic users of intra-uterine devices (IUDs) tend to experience greater menstrual losses, and may therefore be at a disadvantage in comparison to women using other methods (Palomo et al, 1990). In addition, since the use of oral contraceptives generally reduces menstrual losses, women using this method may reduce their external iron losses and improve their iron status (Palomo et al, 1990). Contraceptive use was surveyed in female participants in round 2 only. Tables 34 and 35 illustrate among 1,427 women between the ages of 14 and 54 and mean iron intakes for women using each method. As indicated in these tables, intra-uterine devices (IUDs) were the most commonly used modern method of contraception (46% of the population), followed by condoms (18%), calendar methods (14%) and oral contraceptives (5%). Mean intakes of total iron for women using each of these methods were similar: 12.8 mg among IUD users; 13.7 among condom users; 13.5 mg among women who used the calendar method; and 12.4 mg among oral contraceptive users. Bioavailable iron intakes were also quite similar: 1.19 mg among IUD users; 1.35 among condom users; 1.30 mg among women who use the calendar method; and 1.17 mg among oral contraceptive users. The highest and lowest mean intakes of bioavailable iron consumed by women using differing contraceptive methods differs by 11%. Intakes of both total and bioavailable iron among IUD and oral contraceptive users are virtually the same, differing by less than 3%. Despite similar dietary intakes, however, differences in external losses may give oral contraceptive users an advantage over IUD users.

TABLE 34. MEAN TOTAL IRON CONSUMED BY METHOD OF CONTRACEPTION USED IN LAST 30 DAYS[1]

Method used	N	%	Mean intak (sd)
Oral contraceptives (7)	71	5	12.43 (6.63)
IUD (8)	58	46	12.80 (6.21)
Other:			
Douche w/ water (1)	86	6	12.41 (4.48)
Douche w/ solution (2)	45	3	11.58 (6.04)
Douche--physician (3)	1	0	8.02 (n/a)
Calendar (4)	197	14	13.52 (5.84)
Interruption (5)	97	7	14.39 (8.38)
Condom (6)	255	18	13.65 (6.52)
Pills (7)	71	5	12.43 (6.63)
Diaphragm (10)	1	0	9.84 (n/a)
Ointment, cream/foam, jell	8	0.5	13.18 (5.04)
Other, unspecified (14)	8	0.5	9.95 (3.70)
Total	1427	10	

SOURCE: RUSSIAN LONGITUDINAL MONITORING SURVEY (RLMS), ROUND 2 (DECEMBER 1992-MARCH 1993)

[1]Includes females 14-54 only. *sd standard deviation*

Numbers in parentheses are codes used to identify contraceptive methods.

TABLE 35. MEAN BIOAVAILABLE IRON[1] CONSUMED BY METHOD OF CONTRACEPTION USED, LAST 30 DAYS[2]

Method used	N	%	Mean intak (sd)
Oral Contraceptives (7)	71		1.17 (0.67)
IUD (8)	658		1.19 (0.66)
Other			
Douche w/ water (1)	86	6	1.21 (0.53)
Douche w/ solution (2)	45	3	1.21 (0.78)
Douche--physician (3)	1	0	0.70 (n/a)
Calendar (4)	197	14	1.30 (0.64)
Interruption (5)	97	7	1.32 (0.78)
Condom (6)	255	18	1.35 (0.65)
Diaphragm (10)	1	0	0.71 (n/a)
Ointment, cream/foam, jelly	8	0.5	1.29 (0.77)
Other, unspecified (14)	8	0.5	0.98 (0.46)
Total	1427	10	

SOURCE: RUSSIAN LONGITUDINAL MONITORING SURVEY (RLMS), ROUND 2 (DECEMBER 1992-MARCH 1993)

[1] Bioavailable iron includes adjustments for concurrentmeat,vitamin C, phytate and tea consumption.

[2]Includes females 14-54 only.

Numbers in parentheses are codes used to identify contraceptive methods.

3.5 Intakes of Energy and Selected Nutrients

3.5.1 Russian Recommended Intake Norms

Recommendations for energy and nutrient intakes among adults in Russia have been developed using estimates of expenditures based on work activity as well as age and gender (Ministry of Health Protection, USSR, Recommendation Norms of Physiological Requirements in Nutrients and Energy for Different Groups of the Population USSR, 1991 [in English]). Five employment categories, which range from research to heavy physical activity, have been established. For the purposes of this study, recommended levels for the moderate activity category (employment group II), which includes teachers, salespersons and drivers, will be referenced. This will facilitate comparison with US norms, which are also based on light to moderate activity. The 1991 Ministry of Health Protection report which documents these recommendations includes recommended intakes for subjects under 18 years for minerals, but not for energy or other nutrients. Although data on these recommendations is not currently available to the project, it is likely that they are similar to US levels. Recommended daily allowances (RDAs) from the US are therefore used to evaluate intakes among children (National Research Council, Recommended Daily Allowances, 10th Edition, 1989). Subsequent tables display these intake recommendations for each relevant age group.

3.5.2 Energy

Data on average energy intakes is provided in table 36. Average energy intakes in the 0-6 age group were 1355 kcal for females and 1400 kcal for males. These levels are close to the recommended mean intake of 1300 kcal for children aged 1-3 in the US. (Lower intakes are recommended for infants <1 year [650-850 kcals] and higher intakes for children 4-6 [1800 kcals].) Energy intakes in the 7-13 age group, however, fell below US-recommended norms. The mean intakes of 1621 kcals estimated for 7-13 year old females and 1731 kcals estimated for males were both less than 90% of the US recommended levels. The US RDAs suggest mean intakes of 2000 kcals for 7-10 year old children (both genders), 2500 kcals for 11-14 year old boys and 2200 kcals for 11-14 year old girls.

Mean intakes among females over 14 also were well below recommended levels (table 37). Russia's recommendation for average energy intakes in adult females range from 2100 kcals for women 40-59 to 2200 for those 18-29. Actual mean intakes for females aged 14-54 were 1692 kcals (81% of the 2100 kcal recommendation). The mean caloric intake for females 55-65 was 1599 kcals--nearly 20% below the recommendation of 1975 kcals. Similar shortfalls were found among the elderly (over 65): the recommended mean intake is 1700 kcals for females, 288 kcals above the reported mean of 1412 kcals.

Energy consumption of elderly women decreased slightly between 92/93 and 93/94 (1442 vs. 1381 kcal/day, -4%); during the time of rounds 3 and 4 reported energy intakes of the over 65 year old women met only 75% of estimated energy requirements (table 36). Energy consumption of younger women and their children remained at the same low level during those time periods.

Energy intakes tended to be higher in winter than during the warmer season across all age groups (table 38).

3.5.3 Fats

Unlike energy, fat intakes (table 36) exceeded recommended norms for Russian adults. The mean total fat intake of 77 g for females between 14-54 is 5 g (12%) above the mean recommended level of 72 g for those 18-59. Likewise, the mean intake of 68 g for women 55-65 is slightly above the 66 g recommendation for ages 60-74. Fat consumption among those over 65 conformed more with recommendations (57 g per day). This high fat consumption has to be seen, however, in the light of lower than recommended total energy intakes. Fat is thus an important energy fuel for Russians, particularly in winter when the proportion of fat calories from fat in younger women was 6% higher than in summer and fall. The contribution of fat to the diet of the elderly (36.2 energy %), however, tended to be smaller than in younger women (41.0 energy %) throughout the year.

Over time, fat intake as a proportion of total energy appears to have risen in all age groups (table 36). Since heme iron consumption tended to decrease at the same the underlying reason probably was not a simple increase in meat consumption as one might think at first, but a shift toward both a smaller amount of food and a fattier type of food.

3.5.4 Protein

As with fats, mean protein intakes were substantially higher than the norms recommended for Russian adults. These recommended norms specify a range of 35-36 g for females between the ages of 18 and 59. Females between 14 and 54 consumed an average of 73 g of protein per day, more than twice the recommended amount. The mean protein intake estimated for women 55-65 was 69g (209% of the 33g recommendation) and for women over 75, 59g (197% of the 30g recommended level).

3.5.5 Vitamin C

Average intakes of vitamin C in Russia reached only a fraction of recommended levels (tables 40 and 41). Young children (0-6) had extremely low vitamin C intakes, taking in only 55 % of the 70 mg RDA. Although they tended to have slightly higher absolute intakes, women over 65 also consumed only half of the recommended norm; the recommended intake is higher for individuals over 60. Women in other age groups and children 7-13 have similar levels of intakes, consuming 70-73 % of the recommended level.

During the winter season vitamin C intakes were much lower across all age groups (table 40). This was particularly critical for the youngest children who on average got less than half the recommended amount in winter (table 41). Availability of vitamin C-containing foods may have improved somewhat between the 93/94 vs. 92/93 rounds. Vitamin C intakes among all adult women, however, decreased over time, most markedly among the elderly. Their 25 % decrease in reported vitamin C consumption means that these elderly women got much less than half the recommended amounts (table 41).

Because of its importance in enhancing iron absorption, deficiencies in Vitamin C intakes are particularly relevant for this discussion on iron sufficiency. Given the relatively low bioavailability of the iron consumed by the Russian population, promotion of supplementation and/or increased dietary intakes of vitamin C at meals also rich in iron could be important for improving nutritional status. Finally, the low vitamin C intakes reflect the inadequate consumption of fresh fruits and vegetables which are the main source of many other nutrients and compounds that are beneficial or even essential for human health.

3.5.6 Vitamin E

Mean vitamin E intakes were above recommended levels in all age groups and throughout the four rounds (tables 40 and 41). Young children had mean intakes 9.0-9.5 mg during the summer, and slightly more than this during winter. Older children had vitamin E consumption levels similar to those of adult women between 11 and 15 mg per day.

While means remained above recommended levels in all age groups there was a uniform downward trend (table 40) adult women had 12-20% lower intakes during the second year of the survey, and children showed decreases between 9 and 14%. For women this paralleled decreases in vitamin C intakes, indicating a reduction in antioxidant potential for this group. Elderly women were most distinctly affected with 20% less vitamin E and 25% less vitamin C available to them with the passing of just one year.

Decreased defense against oxygen free radical attack has been implicated as a major risk factor for cardiovascular disease, cancer and other chronic diseases (Kehrer 1993). Vitamin E in cooperation with vitamin C scavenges free oxygen radicals in vivo and is thought to be critical for the body's defense against the damaging actions of free radicals on lipids, proteins, membranes and DNA (Rice-Evans and Diplock, 1993). In a vitamin C-depleted environment, however, vitamin E has the potential to act as a prooxidant and actually enhance free radically activity. While various seeds, nuts and oils are good sources of vitamin E, only fresh fruits and vegetables provide a balanced source of both vitamins. The current intake data suggest a doubly unfavorable trend in the elderly women, in that vitamin E consumption was on the decline, and the smaller amounts may have an increasingly prooxidant potential due to reduced vitamin C intake.

Vitamin E intakes of the children also decreased from one year to the next. Despite the absence of a downward trend in vitamin C intakes the very inadequate vitamin C consumption prompts the same conclusion as for the adult women.

3.5.7 Calcium

Average calcium intakes (tables 40 and 41) in Russia were substantially below the recommended norms for all age groups and both genders. Children of both genders had similarly low intake levels; the 0-6 age group consumed 66% of the 800 mg recommendation, and the 7-13 age group consumed 64% of the RDA. Mean intakes among females between 14 and 65 age group are also 63% of the recommended level, not taking into account that some of them have greatly increased needs due to pregnancy or lactation. Absolute levels of calcium intakes are lowest (480 mg per day) among elderly women whose recommended intakes are higher than those for younger populations. Higher calcium intakes (1000 mg per day) are recommended in later years to help offset bone density losses and reduced ability to retain bone minerals.

Uniformly among all age groups calcium consumption fell distinctly in winter (tables 42 and 43). Since vitamin D production also ceases during the winter months the amount of calcium absorbed from the intestines can be expected to be less than losses. To cover this negative balance calcium is mobilized from bone with potential negative long-term consequences for bone stability. This seasonal accentuation of already low intake levels is most likely related to differences in availability of dairy products, since consumption levels of other foods tended to increase in winter. Over time there were only minor changes in calcium intakes with a tendency to slightly higher intakes.

Although the mechanisms are not known, there is evidence that calcium consumed in the same meal may inhibit iron absorption (Anonymous, Nutrition Reviews 1995; Hallberg 1993). The changes in calcium intakes between season and over time presumably were not large enough to exert a net effect on iron available for absorption. They may be more important in some regional or otherwise distinct group with much higher than average dairy intakes.

4. Conclusions and Policy Implications

4.1 Improved Iron Nutriture of Russian Children

4.1.1 Current Iron Status of Russian Children

The children included in this survey had mean iron intakes close to recommendations. This already implies lower than optimal intakes for many of them. However, estimates of iron sufficiency, at a minimum, must take into account other dietary factors that enhance or hinder iron absorption. Of significant importance in this context is how much meat, vitamin C-containing fruits and vegetables, phytate-rich grains as well as tea each individual child consumes with a particular iron-containing food. Mean heme iron intakes were between 0.8 and 1.2 mg per day, depending on age and gender group. This means that less than 0.1 mg iron were assuredly absorbed, only a fraction of children's minimal requirements. The low intakes of vitamin C, the presence of various phytate-rich grain products and the common consumption of tea have been found to reduce the proportion of non-heme iron that actually is available for intestinal absorption to

3% or less of consumed amounts. It is this minimal absorption fraction much more than the lack of total iron that leads us to predict inadequate iron availability in large segments of this population.

As might be expected, the children from poorer families did least well. They had the lowest total as well as heme iron intakes and the lowest amounts of bioavailable iron. Young children from families with incomes below the poverty line had mean intakes of bioavailable iron that were estimated at less than 0.35 mg per day, those of older children were 0.5 mg or less per day, clearly not enough to provide for adequate iron nutriture in the majority of those below the mean.

Heme iron intake of children was higher in winter than in summer, as in the adults. This increase in highly available iron was partially offset, however, by the low vitamin C intakes during the cold season and the resulting loss of iron absorption enhancement. In the second surveyed year there was a minor improvement of vitamin C intakes in the younger children, but not in those over 6 years of age. Heme iron intakes, however, fell to even lower levels in all age and gender groups. In the end, mean total iron intakes appeared to be fairly constant over the time period studied, while in fact intakes of bioavailable iron (corrected for the presence of iron absorption enhancers and inhibitors) had fallen to even lower levels.

Most adults can tolerate moderate to severe iron deficiency without a major impact on their health, in the second half of their life a moderate iron deficiency may even be beneficial and reduce the risk of hemochromatosis (Edwards and Kushner, 1993), heart disease (Salonen et al., 1992), and cancer (Nelson et al., 1994). In contrast, the health risks from moderate to severe iron deficiency are more likely to be serious in infants and children. The most disconcerting possible consequences of iron deficiency are those that impair mental as well as motoric development (Oski, 1993). Unfortunately, those developmental deficits due to iron deficiency are only partially, if at all, reversible, and vigorous efforts should be made to prevent them.

4.1.2 Options to Improve Iron Status of Russian Children

Iron status has been improved successfully over time in many countries using various strategies. More commonly, iron fortification of widely consumed foods has been implemented to combat iron deficiency. Others have advocated a point-of-delivery approach, targeting specific at-risk groups and providing them with supplements. Educational measures, finally, have been aimed at improving intakes of good sources of iron, such as meats and meat products, and of enhancers of iron absorption, particularly fresh fruits and vegetables.

Grain products are widely consumed in Russia and already contribute more than a third of all bioavailable iron in children. Iron fortification of flour, breads and noodles could provide the critically needed source of iron. One drawback for this strategy is that iron availability in grains is uncertain due to variable amounts of phytate present. Depending on the milling process and source of grains phytate contents must be expected to differ several fold. Unless a degree of uniformity can be assured higher than desirable iron intakes have to be expected. While this would not expected to be a problem in children, long-term intakes

that exceed needs will build up excessive iron stores in adults. This is known to be a significant health hazard for people who are homozygotes (about 1% of most populations) for the hemochromatosis trait (Edwards and Kushner, 1993), and little less so for others (Salonen et al., 1992, Nelson et al., 1994). It is mainly men, and to some extent women after menopause, who may have a net gain of stored iron over the years and may reach the point of iron overload. Particularly in men the risks from iron over load and excessive alcohol intake contribute in combination to chronic liver disease and cardiovascular disease. An increase in cancer risk also has been found by several investigators.

A more indirect approach to improve iron nutriture could be directed at current milling practices. In most western countries the consumption of whole grain and other less refined grain products is considered favorable, because this leaves more minerals, vitamins and dietary fiber for consumption. These products may be less favorable for populations with low heme-iron intake, particularly if they are at heightened risk of iron deficiency. Efforts could be made to increase the availability of white flour products, and to provide families with a choice of different milling products.

Direct targeting of children would avoid the problem of adding to the iron burden of adults that do not need it and may be harmed by iron over load. Ideally, both iron and vitamin C would be provided to ensure optimal availability. Children from families with incomes below the poverty line are particularly in need, but many of the children from more affluent families also have less than optimal iron intakes and would benefit from supplementation.

Many of the children with less than the desirable intake of bioavailable iron have relatively high total iron intakes nonetheless. This indicates to the potential for educating the public and providing families about simple ways to increase availability of total iron. While more meat consumption is a sure way to improve iron nutriture this may not be an option for many families. Measures that improve absorption of none-heme iron are an important alternative. Ensuring that fruit and/or vitamin C-rich vegetables are eaten with each iron-rich meal will increase absorption. The addition of 20 mg of vitamin C to a meal containing 4 mg non-heme iron can be expected (in the absence of phytate or tea in this meal) to increase bioavailable iron by 0.05 mg, or about 25%. Black currents (also in jellies), peppers (fresh or pickled) and fresh cabbage are good local sources of vitamin C which may be also available during the winter. Avoidance of phytate-rich foods or black (and green) tea can produce even more dramatic results. Discontinuation of black (or green) tea use will increase bioavailable iron by two thirds. The elimination of most of the 120 mg phytate from an average meal with 4 mg non-heme iron will double the amount of bioavailable iron in that meal; this corresponds to the additional consumption of about 25 g of beef. Sunflower, poppy and pumpkin seeds, and hazelnuts contain between 100 and 130 mg phytate in a small 6 g portion that may be used for meal preparation or eaten as a dessert. A 40 g slice of rye bread (which contains 120 mg phytate, or more if made from flour with high extraction) provides 0.025 mg of bioavailable iron (out of its 1.44 mg total iron), but reduces bioavailable iron in an otherwise low-phytate meal with 4 mg non-heme iron by 0.12 mg; thus the elimination of this piece of bread from the meal may improve bioavailable iron as much as the addition of a 20 g slice of beef.

4.1.3 Recommendations to Improve iron Status in Russian Children

A large sample of Russian women have repeatedly provided detailed information on dietary intakes and other relevant lifestyle factors of their children. This has provided the basis for an estimate of actually available iron in this particularly vulnerable group and gave some insight seasonal and temporal changes in nutrient intakes. These data have made clear that many of the children get less iron than they need, and that a significant number of must be expected to have manifest iron deficiency. Reasons are low total iron intake, low heme iron intake, insufficient consumption of vitamin C-rich foods and high intakes of phytate-rich foods and tea with many meals. The following points are proposed to address this unfavorable situation.

- Mothers should be encouraged to breasted their infants for several months and should use iron supplements during this time. While human milk has a fairly low iron content the bioavailability of this iron is very high (about 50%). Children that are breast-fed for more than half a year should receive an iron-supplement (1 mg/kg; Oski 1993).

- Infants that are not breast-fed should get an adapted, iron-supplemented formula. Infant formulas should contain 12 mg iron/L. While imported products usually conform to these standards and inform consumers about their iron content, such labeling needs to be introduced for all commercially available infant formulas.

- Families should be provided with information on favorable and unfavorable food combinations for their children's meals. The consumption of vitamin C-rich foods with the main meals (not after a meal) should be encouraged; this includes all fruits, peppers and fresh cabbage. Bread, tea, nuts and seeds should not be consumed together with a main meal or used for the preparation of main meals.

- Families should be alerted to the fact that the short-fall in iron intakes is most severe during the summer and fall. Across all age groups Russians appear to eat less during the warmer season, and in particular, less meat. This creates a sharp drop in consumption of bioavailable iron during a time when growth tends to be at a seasonal high and body iron stores need to expand along with body size.

- Efforts should be made to provide iron and vitamin C supplements to children from families with low incomes. These children have lower intakes of both total and heme iron than their peers and are likely to benefit most from targeted supplementation. It should be recognized, however, that children from families with higher incomes also have relatively low average intakes of bioavailable iron intakes that probably are not sufficient to provide a robust protection against iron deficiency.

- Surveys should be conducted to monitor actual iron status and biochemical and clinical indicators related to iron sufficiency of this particularly vulnerable population. The current data provide evidence that iron intakes of the majority of Russian children is close to or even below optimal levels when dietary enhancers and inhibitors of iron absorption are taken into account. Nutritional survey, however, can provide only estimates and the models for calculating actually absorbed iron have to make generalizing

assumptions. Biochemical and hematological methods are well established that reliably determine individual iron status. A combination of biochemical measurement and nutritional assessment is needed to reexamine the conditions that have been linked in this report with increased risk of iron deficiency.

4.2 Improving Iron Nutriture of Russian Women

4.2.1 Current Iron Status of Russian Women

Russian women consume much less iron than recommended. Women of all age groups tend to get more bioavailable iron, at least temporarily, during the winter months (as also seen in the children), in large part due to increased meat consumption. This adaptation to the cold season seems to be less distinct in lean women (body mass index below 25). It is this same group of women that experienced a more severe decline over time in consumption of bioavailable iron to levels that leave the majority of young women vulnerable for some degree of iron deficiency.

With menstrual blood losses around 20 ml (Guillebaud et al., 1976), Russian women have to replace close to 10 mg of iron every month, but absorb probably only about 15.5 mg from their diet. Thus, two thirds of absorbed iron is offset by regular blood loss, and most or all of the rest is lost with urine, bile or skin. This leaves little to buffer the 1000 mg loss during a normal pregnancy, increased iron requirements during illness or injury, or times of low intake. The women themselves may tire more easily due to iron deficiency anemia, but the most significant risk really is to the developing embryo and fetus when iron-deficient women get pregnant as described above.

4.2.2 Options to Improve Iron Status of Russian Women

Strategies for the improvement of iron deficiency in adults have to meet several challenges. One of them is the difficulty to reach most of those at risk. Since iron-deficiency rarely causes specific symptoms or illnesses, particularly younger women will have little incentive to spend time and resources on diagnostic or preventive measures on their own, or seek medical assistance for that purpose. Point-of-delivery approaches may be tied into existing medical services provided for this group. Opportunities for dietary advice could come from gynecologists who provide most of the medical services to young women, and pediatricians who administer to the women's children. It is important that these and other health providers are well informed about causes of low iron intakes, such as consumption of tea and phytate-rich foods (foods prepared from whole grains or high-extraction flour, nuts and seeds) concurrent with a main meal and the lack vitamin C-rich foods (for instance fruits and fresh cabbage) with the same main meal.

Modification of meal patterns can be a very effective way to improve iron availability of both the women and their children. Iron and vitamin C supplements may be recommended to women with limited access to meat products and vitamin C-rich foods. This information can also be disseminated by the media, targeting

both medical professionals and the general public. A raised level of awareness that optimal iron nutriture is critical for children before and after birth can help to motivate the women to ensure their own and their children's iron intakes. Measure to improve food labeling can then make a significant impact by giving people the basis for choice.

Food fortification strategies have the potential to reach almost everybody, but this is also one of the weaknesses in the case of iron. When habitual consumption exceeds losses the excess is retained, because there are no routes for the elimination of redundant iron. This is seen commonly in men, who increase iron stores linearly with age in most western countries. Once the capacity of ferritin-based iron stores in liver, spleen and bone marrow is saturated iron is deposited in many other tissues in the form of hemosiderin and other unspecifically protein-bound forms. This aberrant storage of excess iron (iron overload) is associated with damaging effects on liver, pancreas, heart and other tissues and is poorly reversible. Most at risk for iron over load are older men, particularly in conjunction with high alcohol intakes. Food consumption patterns of the young women at risk for iron deficiency are not sufficiently different from intake patterns of men at risk of iron overload to specifically target the former. Thus, the benefit of iron fortification for one group will be offset by the presumed detrimental effects to the other group. Currently, there is not sufficient information on the frequencies of iron deficiency and iron overload in the various age, gender, regional and socioeconomic groups that would be needed to make an informed decision about projected net benefits from food fortification.

4.2.3 Recommendations for Improving Iron Status in Russian Women

Information on iron intake levels and its relation to dietary patterns and the presence of modifying food components in meals have been collected in women from various age, regional and socioeconomic groups indicating low consumption of bioavailable iron in many. Normal to low body weight, low family income and the summer and fall season have been identified as variables that are associated with lower than average intakes of bioavailable iron. The following recommendations are put forth to address some aspects of the findings and suggest ways towards improvement of iron nutriture in those of greatest need.

- Information should be disseminated to health professionals which women currently are most likely to have lower than average intakes of bioavailable iron. Women with normal or below normal body weight and those from low-income families are most likely to have low intakes of bioavailable iron. Also, intakes of bioavailable iron tends to be much lower during summer and fall than in winter.

- Health care providers should also be informed that the availability of iron is significantly increased when meat and vitamin C is present in a iron-containing meal and decreased in the presence of phytates and tannins. Tea is the main source of tannins in foods. Large amounts of phytates are contained in whole grain products and in breads and foods made from high extraction flour. Avoidance of nuts and seeds (poppy seeds, pumpkin seeds etc.) and of tea in the main meals can significantly increase the amount of iron that is available for absorption. Inclusion of vitamin C-rich foods (black currants, fresh cabbage etc.) in main meals considerably enhances bioavailability of iron.

- The media can help inform the general public on the importance of iron nutriture for women during their childbearing years and on ways to achieve improved iron intake and availability. This may include the publication of favorable and unfavorable combinations, distribution of locally adapted recipes and ideas.

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TABLE 4: MEAN TOTAL DIETARY IRON INTAKES

Age & Gender Group	(N)	Recom-mended Intake *	Mean Total Iron Intakes (mg/day) All Rounds	1992-93 R1,R2 (25%,75%)	1993-94 R3,R4 (25%,75%)	Mean Temporal Change: %
Children						
0-6 females	*(386)*	10	8.4	8.4 *(6.0, 10.3)*	8.4 *(6.0, 10.2)*	0%
0-6 males	*(360)*	10	8.7	8.6 *(6.3, 10.6)*	8.8 *(6.5, 10.5)*	2%
7-13 females	*(495)*	10	10.8	11.1 *(8.4, 13.1)*	10.5 *(7.6, 12.5)*	-5%
7-13 males	*(523)*	10	11.7	11.9 *(9.1, 14.0)*	11.5 *(8.6, 13.5)*	-3%
Women **						
14-54	*(3188)*	18	11.8	12.6 *(9.4, 15.1)*	11.8 *(8.6, 13.9)*	-6%
55-65	*(814)*	10/18	11.7	12.0 *(8.8, 14.7)*	11.4 *(8.2, 13.5)*	-5%
>65	*(909)*	10	10.4	10.9 *(8.1, 13.2)*	9.9 *(6.9, 12.2)*	-9%

Source, intake data: Russian Longitudinal Monitoring Survey, rounds 1-4.
Source, recommended intakes: USSR Ministry of Health Protection, 1991, and National Research Council, US recommended daily allowances, 1989.

1992-93 = mean of rounds 1 and 2; 1993-94 = mean of rounds 3 and 4.

* *Includes recommended norms for Russian adult women (Ministory of Health Prevention, Moscow 1991), and US recommended daily allowances for children (RDA,10th edition, 1989). The US recommends an additional 2 mg/day for boys 10-17 (during the adolescent growth spurt) and 5 mg for girls with the onset of puberty and menstruation. The Russian recommendation for females is 18mg for women aged18-59 years, and 10 mg for women age 60 and older..*

** *The Russian recommendation for females is 18 mg for women 18-59, and 10 mg for women age 60 and over.*

TABLE 5: MEAN HEME IRON INTAKES ACROSS FOUR RLMS ROUNDS

Age & Gender Group	Mean Heme Iron Intakes (mg/day)			Mean Temporal Change
	All Rounds R1 - R4	1992-93 R1,R2 *(25%, 75%)*	1993-94 R3,R4 *(25%, 75%)*	
Children				
0-6 females	0.80	0.82 *(0.29, 1.07)*	0.77 *(0.59, 0.95)*	-5%
0-6 males	0.83	0.84 *(0.35, 1.06)*	0.81 *(0.34, 1.04)*	-4%
7-13 females	1.08	1.14 *(0.54, 1.44)*	1.03 *(0.44, 1.30)*	-9%
7-13 males	1.20	1.23 *(0.60, 1.66)*	1.16 *(0.62, 1.73)*	-6%
Women				
14-54	1.28	1.34 *(0.61,1.76)*	1.21 *(0.52, 1.56)*	-10%
55-65	1.00	1.03 *(0.36, 1.42)*	0.96 *(0.35, 1.22)*	-7%
>65	0.79	0.82 *(0.20, 1.15)*	0.76 *(0.20, 0.96)*	-8%

Source, intake data: Russian Longitudinal Monitoring Survey, rounds 1-4.
Source, recommended intakes: USSR Ministry of Health Protection, 1991, and National Research Council, US recommended daily allowances, 1989.

1992-93 = mean of rounds 1 and 2; 1993-94 = mean of rounds 3 and 4.

TABLE 6: MEAN INTAKES AND TEMPORAL CHANGE IN BIOAVAILABLE DIETARY IRON (mg/day)

Age & Gender Group	Estimated Required Range **	*Adjustment 1 ** Bioavailable Iron I Intakes Adjusted for Enhancers		Temporal Change in Intakes	*Adjustment 2** Bioavailable Iron II Intakes Adjusted for Phytates		Temporal Change in Intakes	*Adjustment 3 ** Bioavailable Iron III Intakes Adjusted for Phytates/Tea		Temporal Change in Intakes
		92-93 Mean *(25%, 75%)*	93-94 Mean *(25%, 75%)*	% change Mean	92-93 Mean *(25%, 75%)*	93-94 Mean *(25%, 75%)*	% change Mean	92-93 Mean *(25%, 75%)*	93-94 Mean *(25%, 75%)*	% change Mean
Children:										
0-6 females	0.4-1.5	0.91 *(0.62, 1.15)*	0.96 *(0.66, 1.26)*	6%	0.33 *(0.17, 0.43)*	0.33 *(0.19, 0.39)*	-3%	0.33 *(0.17, 0.43)*	0.32 *(0.19, 0.39)*	-3%
0-6 males	0.4-1.5	0.91 *(0.62, 1.15)*	0.99 *(0.66, 1.26)*	8%	0.34 *(0.19, 0.42)*	0.34 *(0.20, 0.43)*	-1%	0.34 *(0.19, 0.42)*	0.34 *(0.19, 0.43)*	-1%
7-13 females	1.0-2.8	1.12 *(0.82, 1.36)*	1.09 *(0.79, 1.36)*	-3%	0.45 *(0.27, 0.55)*	0.42 *(0.25, 0.52)*	-7%	0.45 *(0.27, 0.54)*	0.42 *(0.24, 0.52)*	-6%
7-13 males	1.0-2.0	1.15 *(.82, 1.41)*	1.14 *(0.79, 1.42)*	-1%	0.48 *(0.30, 0.61)*	0.46 *(0.28, 0.60)*	-4%	0.48 *(0.29, 0.60)*	0.46 *(0.27, 0.57)*	-5%
Women:										
14-54	1.7-4.8	1.19 *(0.84, 1.48)*	1.14 *(0.80, 1.43)*	-4%	0.52 *(0.31, 0.66)*	0.48 *(0.28, 0.59)*	-8%	0.51 *(0.30, 0.65)*	0.47 *(0.27, 0.58)*	-8%
55-65	0.6-0.9	1.01 *(0.67,1.28)*	0.99 *(0.69, 1.22)*	-2%	0.43 *(0.23, 0.56)*	0.41 *(0.22, 0.50)*	-6%	0.42 *(0.22, 0.55)*	0.40 *(0.22, 0.48)*	-6%
>65	0.6-0.9	0.91 *(0.60, 0.14)*	0.87 *(0.55, 1.12)*	-4%	0.36 *(0.18, 0.46)*	0.33 *(0.16, 0.41)*	-9%	0.35 *(0.17, 0.46)*	0.32 *(0.16, 0.40)*	-8%

Source, intake data: Russian Longitudinal Monitoring Survey, rounds 1-4.

1992-93 = mean of rounds 1 and 2; 1993-94 = mean of rounds 3 and 4.

* *Adjustment 1: concurrent consumption of enhancers (heme and vitamin C).*
Adjustment 2: concurent consumption of enhancers and 1 inhibitor (heme, vitamin C and phytates).
Adjustment 3: concurrent consumption of enhancers and 2 inhibitors (heme, vitamin C, phytates and tea).

** *Estimates of iron required for maintenance and growth in each age and gender group.*

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TABLE 7: PROPORTION OF MEDIAN METABOLIC REQUIREMENTS AVAILABLE AFTER ADJUSTMENT FOR BIOAVAILABILITY

Age & Gender Group	Estimated Median Requirement**	*Bioavailable iron I* * % Median Requirement Avail.		*Bioavailable iron II** % Median Requirement Avail.		*Bioavailable iron III** % Median Requirement Avail.	
		92-93	93-94	92-93	93-94	92-93	93-94
Children:							
0-6 females	0.95	95.4%	101.5%	35.2%	34.2%	35.1%	34.1%
0-6 males	0.95	96.1%	104.0%	36.1%	35.9%	36.0%	35.8%
7-13 females	1.90	58.9%	57.3%	23.6%	22.1%	23.5%	21.9%
7-13 males	1.50	76.3%	75.9%	32.0%	30.6%	31.8%	30.3%
Women:							
14-54	3.25	36.7%	35.1%	16.0%	14.7%	15.8%	14.5%
55-65	0.75	134.5%	132.2%	57.4%	54.2%	56.1%	53.1%
>65	0.75	121.0%	115.7%	48.0%	43.9%	47.0%	43.1%

Source, intake data: Russian Longitudinal Monitoring Survey, rounds 1-4.

1992-93 = mean of rounds 1 and 2; 1993-94 = mean of rounds 3 and 4.

* *Bioavailable iron I: concurrent consumption of enhancers (heme and vitamin C).*
Bioavailable iron 2: concurent consumption of enhancers and 1 inhibitor (heme, vitamin C and phytates).
Bioavailable iron 3: concurrent consumption of enhancers and 2 inhibitors (heme, vitamin C, phytates and tea).

** *Median based on range of estimated iron requirements for maintenance and growth in each age and gender group.*

TABLE 8: PROPORTION OF TOTAL DIETARY IRON AVAILABLE AFTER ADJUSTMENT FOR BIOAVAILABILITY (BY TIME PERIOD)

Age & Gender Group	*Bioavailable iron I* * % Total Dietary Iron Available		*Bioavailable iron II* % Total Dietary Iron Available		*Bioavailable iron III* % Total Dietary Iron Available	
	1992-93	1993-94	1992-93	1993-94	1992-93	1993-94
Children:						
0-6 females	10.8%	11.5%	4.0%	3.9%	4.0%	3.9%
0-6 males	10.6%	11.3%	4.0%	3.9%	4.0%	3.9%
7-13 females	10.1%	10.4%	4.0%	4.0%	4.0%	4.0%
7-13 males	9.6%	9.9%	4.0%	4.0%	4.0%	4.0%
Women:						
14-54	9.5%	9.7%	4.1%	4.1%	4.1%	4.0%
55-65	8.4%	8.7%	3.6%	3.6%	3.5%	3.5%
>65	8.3%	8.8%	3.3%	3.3%	3.2%	3.3%

Source, intake data: Russian Longitudinal Monitoring Survey, rounds 1-4.

1992-93 = mean of rounds 1 and 2; 1993-94 = mean of rounds 3 and 4.

* *Bioavailable iron I: concurrent consumption of enhancers (heme and vitamin C).*
Bioavailable iron II: concurent consumption of enhancers and 1 inhibitor (heme, vitamin C and phytates).
Bioavailable iron III: concurrent consumption of enhancers and 2 inhibitors (heme, vitamin C, phytates and tea).

TABLE 9. MAJOR FOOD GROUP SOURCES OF TOTAL DIETARY IRON AS A % OF TOTAL INTAKES, CHILDREN (ROUNDS 1-4)

	Entire Population		Males 0-6 yrs		Males 7-13 yrs		Females 0-6 yrs		Females 7-13 yrs	
Food Group Name	Rank	%	Rank	%	Rank	%	Rank	%	Rank	%
WHEAT PRODUCTS (breads)	1	14.4	1	13.7	1	14.6	1	12.9	1	15.2
WHEAT PRODUCTS (cereals,pasta,bakery)	2	10.6	2	13.2	2	13.8	2	12.9	2	12.8
RYE GRAIN PRODUCTS	3	10.2	6	6.2	4	7.9	6	5.9	6	6.6
POTATOES, OTHER ROOTS, & TUBERS	4	10.1	3	8.9	3	9.2	3	8.5	3	8.9
BEEF	5	8.6	5	7.5	5	7.6	4	8.0	4	7.8
SOUPS	6	8.5	4	8.2	6	7.5	5	7.8	5	7.5
CHICKEN EGGS	7	5.2	7	5.4	8	5.2	7	5.8	8	4.6
MEAT PRODUCTS	8	4.8	8	5.1	7	5.8	8	4.3	7	5.0
BUCKWHEAT GRAIN PRODUCTS	9	3.1	9	3.3	9	2.9	9	3.8	10	3.0
PORK/PIGLET	10	2.6	13	1.9	11	2.3	11	2.5	12	2.3
POULTRY	11	2.0	11	2.1	12	2.1	12	2.3	11	2.4
TOMATOES	12	2.0	17	1.2	13	1.8	16	1.5	13	1.9
FRUITING VEGETABLES (w/o tomatoes)	13	1.4	20	1.1	16	1.2	17	1.1	16	1.2
ALL FISH	14	1.4	24	0.7	21	1.0	22	0.9	18	1.2
FRUIT JAMS & MARMALADES	15	1.3	14	1.5	14	1.4	18	1.1	14	1.8
MALACEOUS FRUITS	16	1.3	10	3.2	10	2.5	10	3.6	9	3.0
CABBAGES	17	1.1	23	0.8	20	1.0	24	0.9	20	1.0
RICE GRAIN PRODUCTS	18	1.1	15	1.5	15	1.2	15	1.6	15	1.3
EDIBLE FUNGI	19	1.0	26	0.6	25	0.6	38	0.2	28	0.5
TEA	20	1.0	19	1.1	19	1.0	21	1.1	19	1.1
NON-CARBONATED DRINKS	21	0.9	12	2.1	17	1.2	13	2.0	17	1.2
CHEESE	22	0.9	18	1.2	23	0.8	19	1.1	22	0.9
MUTTON/LAMB	23	0.9	22	0.8	18	1.0	23	0.9	23	0.9
MILK	24	0.8	16	1.5	22	0.9	14	1.7	21	0.9
VEGETABLE SALADS	25	0.6	31	0.4	26	0.5	39	0.4	25	0.7
TOTAL		95.8		93.2		95.0		92.7		94.0

TABLE 10. MAJOR FOOD GROUP SOURCES OF TOTAL DIETARY IRON AS A % OF TOTAL INTAKES, WOMEN (ROUNDS 1 - 4)

	Entire Population		Women 14-54 yrs		Women 55-65 yrs		Women 65+ yrs	
Food Group Name	Rank	%	Rank	%	Rank	%	Rank	%
WHEAT PRODUCTS (breads)	1	14.4	1	14.1	1	14.8	1	14.9
WHEAT PRODUCTS (cereals, pasta, bakery)	2	10.6	2	11.0	5	8.8	5	8.2
RYE GRAIN/MILLER PRODUCTS	3	10.2	4	9.1	2	12.5	2	14.3
POTATOES, OTHER ROOTS, & TUBERS	4	10.1	3	10.2	3	10.6	3	11.1
BEEF	5	8.6	5	8.6	6	7.9	6	7.0
SOUPS	6	8.5	6	7.7	4	9.4	4	9.3
CHICKEN EGGS	7	5.2	8	4.7	7	5.1	7	5.6
MEAT PRODUCTS	8	4.8	7	5.2	8	3.1	9	2.6
BUCKWHEAT GRAIN/MILLER PRODUCTS	9	3.1	9	3.0	9	3.1	8	3.8
PORK/PIGLET	10	2.6	10	2.6	10	2.4	10	2.2
POULTRY	11	2.0	12	2.2	12	1.8	13	1.5
TOMATOES	12	2.0	11	2.2	11	2.1	11	2.0
FRUITING VEGETABLES (w/o tomatoes)	13	1.4	15	1.5	14	1.6	14	1.4
ALL FISH	14	1.4	16	1.4	15	1.5	15	1.4
FRUIT JAMS & MARMALADES	15	1.3	14	1.5	13	1.7	12	1.6
MALACEOUS FRUITS	16	1.3	13	1.5	20	1.0	22	1.0
CABBAGES	17	1.1	17	1.3	17	1.2	21	1.0
RICE GRAIN/MILLER PRODUCTS	18	1.1	18	1.2	19	1.1	18	1.1
EDIBLE FUNGI	19	1.0	20	1.1	16	1.4	17	1.2
TEA	20	1.0	19	1.1	18	1.1	16	1.2
NON-CARBONATED DRINKS	21	0.9	22	0.9	24	0.8	25	0.6
CHEESE	22	0.9	21	1.0	22	0.9	24	0.8
MUTTON/LAMB	23	0.9	24	0.8	23	0.8	23	0.8
MILK	24	0.8	25	0.6	21	0.9	20	1.0
VEGETABLE SALADS	25	0.6	23	0.8	26	0.6	27	0.5
TOTAL		**95.8**		**95.4**		**96.0**		**96.1**

TABLE 11. PROPORTION OF DIETARY IRON FROM MEAT AND FISH SOURCES

Age/Gender Group	% iron intakes from meat & fish	
	% of total iron	% of bioavailable iron
Children		
0-6 F	26.74	38.66
0-6 M	26.29	38.00
7-13 F	27.23	38.91
7-13 M	27.29	39.32
Women		
14-54	28.49	39.40
55-65	26.82	35.76
>65	24.76	33.70

Includes beef, pork, poultry, fish, mutton/lamb, soups, meat products.

TABLE 12. MAJOR FOOD GROUP SOURCES OF ENHANCER-ADJUSTED BIOAVAILABLE IRON AS A % OF TOTAL INTAKES, CHILDREN (ROUNDS 1 - 4)

	Entire Population		Males 0-6 yrs		Males 7-13 yrs		Females 0-6 yrs		Females 7-13 yrs	
Food Group Name	Rank	%	Rank	%	Rank	%	Rank	%	Rank	%
RYE GRAIN PRODUCTS	1	16.88	2	13.70	2	14.57	2	13.12	2	13.36
WHEAT PRODUCTS (breads)	2	16.38	1	16.50	1	17.26	1	16.19	1	17.97
BEEF	3	12.92	4	12.60	4	12.02	3	12.50	4	11.06
MEAT PRODUCTS	4	11.91	3	12.68	3	13.63	4	11.97	3	13.14
WHEAT PRODUCTS (cereals,pasta, bakery)	5	6.15	5	8.53	5	7.78	5	8.65	5	7.57
POTATOES, ROOTS, & TUBERS	6	4.48	6	4.58	7	4.17	7	4.23	7	4.22
POULTRY	7	4.31	7	4.57	6	4.41	6	5.21	6	5.01
PORK/PIGLET	8	4.04	9	2.81	8	3.53	9	3.35	8	3.88
CHICKEN EGGS	9	3.77	8	3.75	9	3.50	8	4.01	9	3.26
SOUPS	10	2.52	10	2.77	10	2.39	10	2.75	10	2.46
ALL FISH	11	2.10	11	1.57	11	1.80	11	1.65	11	1.98
MUTTON/LAMB	12	1.27	15	1.01	12	1.55	14	1.23	12	1.38
TOMATOES	13	1.04	17	0.72	13	0.94	16	0.84	16	0.98
FRUIT JAMS & MARMALADES	14	0.97	16	0.89	17	0.89	18	0.71	13	1.06
BUCKWHEAT GRAIN PRODUCTS	15	0.97	14	1.10	14	0.93	15	1.19	17	0.88
FRUITING VEGETABLES (w/o tomatoes)	16	0.88	18	0.69	18	0.76	20	0.66	18	0.76
CHEESE	17	0.66	19	0.69	20	0.59	21	0.60	21	0.60
CABBAGES	18	0.65	25	0.49	22	0.56	23	0.55	20	0.60
EDIBLE FUNGI	19	0.65	26	0.39	25	0.42	30	0.29	25	0.37
BUTTER	20	0.64	20	0.68	19	0.64	19	0.69	19	0.66
CHOCOLATE, CHOCOLATE GOODS	21	0.57	12	1.39	16	0.90	12	1.44	14	1.04
MALACEOUS FRUITS	22	0.53	13	1.22	15	0.92	13	1.29	15	1.04
SUGAR	23	0.51	24	0.54	23	0.52	24	0.54	24	0.52
RICE GRAIN PRODUCTS	24	0.51	21	0.66	21	0.56	17	0.73	22	0.58
LEEKS, ONIONS, SPROUTS	25	0.47	33	0.26	29	0.31	33	0.25	31	0.33
TOTAL		95.8		94.8		95.5		94.6		94.7

TABLE 13. MAJOR FOOD GROUP SOURCES OF ENHANCER-ADJUSTED BIOAVAILABLE IRON AS A % OF TOTAL INTAKES, WOMEN (ROUNDS 1 -4)

	Entire Population		Women 14-54 yrs		Women 55-65 yrs		Women 65+ yrs	
Food Group Name	Rank	%	Rank	%	Rank	%	Rank	%
RYE GRAIN/MILLER PRODUCTS	1	16.9	2	15.8	1	20.0	1	22.6
WHEAT PRODUCTS (breads)	2	16.4	1	16.1	2	17.3	2	17.1
BEEF	3	12.9	4	12.6	3	12.5	3	11.9
MEAT PRODUCTS	4	11.9	3	12.9	4	8.6	4	7.9
WHEAT PRODUCTS (cereals, pasta, bakery)	5	6.1	5	6.4	6	4.8	6	4.6
POTATOES, OTHER ROOTS, & TUBERS	6	4.5	6	4.5	5	4.8	5	4.9
POULTRY	7	4.3	7	4.4	7	4.2	8	3.8
PORK/PIGLET	8	4.0	8	3.9	8	4.1	9	3.7
CHICKEN EGGS	9	3.8	9	3.4	9	3.9	7	4.4
SOUPS	10	2.5	10	2.3	10	2.8	10	2.9
ALL FISH	11	2.1	11	2.2	11	2.4	11	2.2
MUTTON/LAMB	12	1.3	13	1.1	13	1.2	13	1.3
TOMATOES	13	1.0	12	1.2	14	1.1	15	1.0
FRUIT JAMS & MARMALADES	14	1.0	14	1.0	12	1.4	12	1.3
BUCKWHEAT GRAIN/MILLER PRODUCTS	15	1.0	16	0.9	16	0.9	14	1.1
FRUITING VEGETABLES (w/o tomatoes)	16	0.9	15	1.0	15	1.0	16	0.9
CHEESE	17	0.7	18	0.8	20	0.6	20	0.6
CABBAGES	18	0.6	19	0.7	18	0.7	19	0.6
EDIBLE FUNGI	19	0.6	20	0.7	17	0.8	18	0.7
BUTTER	20	0.6	21	0.7	19	0.7	17	0.7
CHOCOLATE, CHOCOLATE GOODS, &	21	0.6	17	0.8	27	0.3	32	0.2
MALACEOUS FRUITS	22	0.5	23	0.6	25	0.4	23	0.4
SUGAR	23	0.5	25	0.5	22	0.5	21	0.5
RICE GRAIN/MILLER PRODUCTS	24	0.5	24	0.5	24	0.4	24	0.4
LEEKS, ONIONS, SPROUTS	25	0.5	26	0.5	21	0.5	22	0.5
TOTAL		95.8		95.4		95.9		96.2

TABLE 14. MEAN INTAKES OF TOTAL, HEME AND BIOAVAILABLE IRON (MG/DAY) IN 1992-93 BY POVERTY LEVEL: WOMEN

Age/Gender Group	< 50% poverty line	50-100% pov. line	100-150% pov. line	150-200% pov. line	200+% pov. line
	92-93 R1,R2 Mean	92-93 R1,R2 Mean	92-93 R1,R2 Mean	92-93 R1,R2 Mean	92-93 R1,R2 Mean
Women					
14-54 (N)	*(272)*	*(751)*	*(710)*	*(498)*	*(872)*
Total iron	11.1	12.3	12.8	12.7	13.1
Heme iron	1.10	1.26	1.37	1.35	1.46
Bioav. I	0.96	1.10	1.20	1.24	1.31
Bioav. III	0.43	0.49	0.52	0.52	0.55
55-65 (N)	*(28)*	*(164)*	*(230)*	*(126)*	*(256)*
Total iron	9.8	10.9	11.3	12.4	13.3
Heme iron	0.69	0.90	0.94	0.94	1.26
Bioav. I	0.79	0.88	0.94	1.03	1.16
Bioav. III	0.31	0.37	0.39	0.41	0.49
>65 (N)	*(37)*	*(200)*	*(282)*	*(175)*	*(200)*
Total iron	8.5	10.2	11.1	11.4	11.5
Heme iron	0.63	0.77	0.84	0.84	0.87
Bioav. I	0.80	0.84	0.89	0.90	1.04
Bioav. III	0.27	0.33	0.36	0.36	0.37

Source, intake data: Russian Longitudinal Monitoring Survey, rounds 1-4. Categories based on round 1 classification.
92-93 = mean of rounds 1 and 2; 93-94 = mean of rounds 3 and 4.

TABLE 15. MEAN INTAKES OF TOTAL, HEME AND BIOAVAILABLE IRON (MG/DAY) IN 1993-94 BY POVERTY LEVEL: WOMEN

Age/Gender Group	< 50% poverty line	50-100% pov. line	100-150% pov. line	150-200% pov. line	200+% pov. line
	93-94 R3,R4 Mean	93-94 R3,R4 Mean	93-94 R3,R4 Mean	93-94 R3,R4 Mean	93-94 R3,R4 Mean
Women					
14-54 (N)	*(272)*	*(751)*	*(710)*	*(498)*	*(872)*
Total iron	10.9	11.8	12.0	11.8	12.0
Heme iron	1.02	1.20	1.23	1.17	1.27
Bioav. I	0.96	1.08	1.15	1.18	1.23
Bioav. III	0.41	0.46	0.48	0.47	0.50
55-65 (N)	*(28)*	*(164)*	*(230)*	*(126)*	*(256)*
Total iron	10.4	11.0	11.2	11.7	11.8
Heme iron	0.83	0.92	1.00	0.88	1.02
Bioav. I	0.81	0.93	0.92	1.00	1.11
Bioav. III	0.35	0.38	0.40	0.38	0.42
>65 (N)	*(37)*	*(200)*	*(282)*	*(175)*	*(200)*
Total iron	8.4	9.5	10.4	9.9	10.0
Heme iron	0.73	0.83	0.75	0.72	0.73
Bioav. I	0.74	0.82	0.87	0.86	0.95
Bioav. III	0.30	0.33	0.33	0.31	0.32

Source, intake data: Russian Longitudinal Monitoring Survey, rounds 1-4. Categories based on round 1 classification.
92-93 = mean of rounds 1 and 2; 93-94 = mean of rounds 3 and 4.

TABLE 16. MEAN INTAKES OF TOTAL, HEME AND BIOAVAILABLE IRON (MG/DAY) IN 1992-93

BY POVERTY LEVEL: CHILDREN

Age/Gender Group	< 50% poverty line	50-100% pov. line	100-150% pov. line	150-200% pov. line	200+% pov. line
	92-93 R1,R2 Mean	92-93 R1,R2 Mean	92-93 R1,R2 Mean	92-93 R1,R2 Mean	92-93 R1,R2 Mean
Children					
0-6 F (N)	*(46)*	*(113)*	*(89)*	*(63)*	*(69)*
Total iron	7.3	8.3	8.3	8.5	9.5
Heme iron	0.58	0.83	0.84	0.74	0.97
Bioav. I	0.69	0.89	0.89	0.97	1.04
Bioav. III	0.25	0.34	0.34	0.31	0.38
0-6 M (N)	*(52)*	*(102)*	*(82)*	*(50)*	*(69)*
Total iron	7.4	8.3	8.8	9.0	9.8
Heme iron	0.63	0.76	0.86	0.71	1.20
Bioav. I	0.77	0.83	0.97	1.00	1.01
Bioav. III	0.28	0.31	0.35	0.31	0.45
7-13 F (N)	*(57)*	*(131)*	*(137)*	*(62)*	*(100)*
Total iron	9.8	10.9	10.9	11.2	12.3
Heme iron	0.93	1.07	1.13	1.04	1.36
Bioav. I	0.88	1.11	1.11	1.14	1.25
Bioav. III	0.37	0.43	0.44	0.43	0.52
7-13 M (N)	*(60)*	*(173)*	*(105)*	*(73)*	*(98)*
Total iron	12.3	12.1	11.3	11.8	12.1
Heme iron	1.25	1.22	1.15	1.16	1.37
Bioav. I	1.06	1.15	1.11	1.21	1.19
Bioav. III	0.50	0.47	0.45	0.46	0.51

Source, intake data: Russian Longitudinal Monitoring Survey, rounds 1-4. Categories based on round 1 classification.
92-93 = mean of rounds 1 and 2; 93-94 = mean of rounds 3 and 4.

TABLE 17. MEAN INTAKES OF TOTAL, HEME AND BIOAVAILABLE IRON IN 1993-94
BY POVERTY LEVEL (MG/DAY): CHILDREN

Age/Gender Group	< 50% poverty line	50-100% pov. line	100-150% pov. line	150-200% pov. line	200+% pov. line
	93-94 R3,R4 Mean	93-94 R3,R4 Mean	93-94 R3,R4 Mean	93-94 R3,R4 Mean	93-94 R3,R4 Mean
Children					
0-6 F (N)	*(46)*	*(113)*	*(89)*	*(63)*	*(69)*
Total iron	7.6	8.0	8.5	9.1	8.8
Heme iron	0.70	0.72	0.78	0.81	0.87
Bioav. I	0.81	0.92	0.98	1.08	1.02
Bioav. III	0.29	0.31	0.33	0.34	0.36
0-6 M (N)	*(52)*	*(102)*	*(82)*	*(50)*	*(69)*
Total iron	7.8	8.5	8.7	10.1	9.2
Heme iron	0.68	0.69	0.86	1.03	0.89
Bioav. I	0.83	0.91	1.02	1.13	1.09
Bioav. III	0.28	0.30	0.36	0.41	0.37
7-13 F (N)	*(57)*	*(131)*	*(137)*	*(62)*	*(100)*
Total iron	9.4	10.0	10.6	11.7	10.9
Heme iron	0.78	0.95	1.00	1.49	1.01
Bioav. I	0.92	1.03	1.11	1.09	1.19
Bioav. III	0.33	0.39	0.41	0.55	0.42
7-13 M (N)	*(60)*	*(173)*	*(105)*	*(73)*	*(98)*
Total iron	11.1	11.4	11.0	11.8	12.1
Heme iron	1.04	1.13	1.06	1.25	1.32
Bioav. I	1.07	1.14	1.08	1.22	1.18
Bioav. III	0.42	0.45	0.42	0.49	0.50

Source, intake data: Russian Longitudinal Monitoring Survey, rounds 1-4. Categories based on round 1 classification.
92-93 = mean of rounds 1 and 2; 93-94 = mean of rounds 3 and 4.

TABLE 18. MEAN INTAKE OF TOTAL, HEME AND BIOAVALABLE IRON 1992-93 BY BODY MASS INDEX (mg/day)

Age/Gender Group	Underweight	Normal Weight	Overweight	Obese
	92-93 R1,R2 Mean	92-93 R1,R2 Mean	92-93 R1,R2 Mean	92-93 R1,R2 Mean
Women				
14-54 (N)	*(42)*	*(683)*	*(459)*	*(296)*
Total iron	11.4	12.7	12.9	12.8
Heme iron	1.05	1.33	1.28	1.35
Bioav. I	1.08	1.18	1.19	1.16
Bioav. III	0.44	0.51	0.50	0.52
55-65 (N)	*(1)*	*(97)*	*(149)*	*(133)*
Total iron	17.9	12.2	12.5	12.4
Heme iron	0.99	1.07	1.02	1.03
Bioav. I	1.48	1.02	1.05	0.99
Bioav. III	0.50	0.44	0.43	0.43
>65 (N)	*(7)*	*(127)*	*(140)*	*(111)*
Total iron	10.2	11.2	11.2	10.9
Heme iron	0.96	0.67	0.84	0.79
Bioav. I	0.83	0.88	0.90	0.92
Bioav. III	0.38	0.32	0.36	0.35

Source, intake data: Russian Longitudinal Monitoring Survey, rounds 1-4. Categories based on round 1 classification.
92-93 = mean of rounds 1 and 2; 93-94 = mean of rounds 3 and 4.

TABLE 19. MEAN INTAKES OF TOTAL, HEME AND BIOAVALABLE IRON 1993-94 BY BODY MASS INDEX (mg/day)

Age/Gender Group	Underweight	Normal Weight	Overweight	Obese
	93-94 R3,R4 Mean	93-94 R3,R4 Mean	93-94 R3,R4 Mean	93-94 R3,R4 Mean
Women				
14-54 (N)	*(42)*	*(683)*	*(459)*	*(296)*
Total iron	10.8	11.7	12.6	12.3
Heme iron	0.95	1.11	1.28	1.28
Bioav. I	1.01	1.12	1.19	1.12
Bioav. III	0.40	0.45	0.50	0.49
55-65 (N)	*(1)*	*(97)*	*(149)*	*(133)*
Total iron	17.9	11.4	12.0	12.1
Heme iron	0.29	0.96	0.98	1.07
Bioav. I	0.86	1.01	1.02	1.01
Bioav. III	0.25	0.39	0.41	0.43
>65 (N)	*(7)*	*(127)*	*(140)*	*(111)*
Total iron	8.6	10.5	10.6	10.3
Heme iron	0.38	0.71	0.73	0.77
Bioav. I	0.69	0.86	0.90	0.89
Bioav. III	0.21	0.31	0.32	0.33

Source, intake data: Russian Longitudinal Monitoring Survey, rounds 1-4. Categories based on round 1 classification. 92-93 = mean of rounds 1 and 2; 93-94 = mean of rounds 3 and 4.

TABLE 20. MEAN INTAKE OF TOTAL, HEME AND BIOAVAILABLE IRON 1992-93 BY NUTRITIONAL STATUS (mg/day)

Age/Gender Group	Normal	Wasted	Stunted
	92-93 R1,R2 Mean	92-93 R1,R2 Mean	92-93 R1,R2 Mean
Children			
0-6 F (N)	*(214)*	*(10)*	*(30)*
Total iron	8.2	7.0	7.7
Heme iron	0.80	0.71	0.57
Bioav. I	0.89	0.77	0.82
Bioav. III	0.33	0.28	0.26
0-6 M (N)	*(193)*	*(9)*	*(21)*
Total iron	8.1	9.0	8.6
Heme iron	0.77	1.27	0.99
Bioav. I	0.90	0.88	0.83
Bioav. III	0.32	0.44	0.36

Source, intake data: Russian Longitudinal Monitoring Survey, rounds 1-4.
Classification based on round 4.

TABLE 21. MEAN INTAKES OF TOTAL, HEME AND BIOAVAILABLE IRON 1993-94 BY NUTRITIONAL STATUS (mg/day) FOR 1993-94

Age/Gender Group	Normal	Wasted	Stunted
	93-94 R3,R4 Mean	93-94 R3,R4 Mean	93-94 R3,R4 Mean
Children			
0-6 F (N)	*(214)*	*(10)*	*(30)*
Total iron	8.3	8.7	7.2
Heme iron	0.78	1.26	0.62
Bioav. I	0.95	1.18	0.93
Bioav. III	0.33	0.46	0.27
0-6 M (N)	*(193)*	*(9)*	*(21)*
Total iron	8.6	7.5	7.2
Heme iron	0.74	0.77	0.61
Bioav. I	0.97	1.02	0.84
Bioav. III	0.32	0.32	0.26

Source, intake data: Russian Longitudinal Monitoring Survey, rounds 1-4.
Categories based on round 1 classifiaction

TABLE 22. MEAN INTAKES OF TOTAL, HEME AND BIOAVAILABLE IRON 1992-93 BY LEVEL OF EDUCATION (mg/day)

Age/Gender Group	HS Only or Less	HS + Technical	Higher
	92-93 R1,R2 *Mean*	92-93 R1,R2 *Mean*	92-93 R1,R2 *Mean*
Women:			
14-54 (N)	*(477)*	*(998)*	*(1448)*
Total iron	13.2	12.6	12.4
Heme iron	1.40	1.39	1.28
Bioav. I	1.29	1.17	1.14
Bioav. III	0.54	0.52	0.49
55-65 (N)	*(88)*	*(120)*	*(543)*
Total iron	13.2	12.0	12.0
Heme iron	1.15	1.09	1.01
Bioav. I	1.27	1.09	0.96
Bioav. III	0.48	0.44	0.42
>65 (N)	*(42)*	*(130)*	*(659)*
Total iron	10.7	11.6	11.0
Heme iron	0.75	0.96	0.83
Bioav. I	0.97	1.01	0.90
Bioav. III	0.34	0.40	0.36

Source, intake data: Russian Longitudinal Monitoring Survey, rounds 1-4.
Categories based on round 1 classification.

TABLE 23. MEAN INTAKES OF TOTAL, HEME AND BIOAVAILABLE IRON 1993-94 BY LEVEL OF EDUCATION (mg/day)

Age/Gender Group	HS Only or Less	HS + Technical	Higher
	93-94 R3,R4 *Mean*	93-94 R3,R4 *Mean*	93-94 R3,R4 *Mean*
Women:			
14-54 (N)	*(477)*	*(998)*	*(1448)*
Total iron	11.7	12.1	11.8
Heme iron	1.24	1.31	1.17
Bioav. I	1.20	1.16	1.09
Bioav. III	0.49	0.50	0.46
55-65 (N)	*(88)*	*(120)*	*(543)*
Total iron	12.3	11.4	11.4
Heme iron	1.01	1.04	0.96
Bioav. I	1.14	1.06	0.95
Bioav. III	0.43	0.43	0.39
>65 (N)	*(42)*	*(130)*	*(659)*
Total iron	11.0	9.8	9.9
Heme iron	1.01	0.86	0.74
Bioav. I	1.04	0.93	0.84
Bioav. III	0.40	0.36	0.32

Source, intake data: Russian Longitudinal Monitoring Survey, rounds 1-4.
Categories based on round 1 classification.

TABLE 24 . MEAN TEMPORAL INTAKES OF TOTAL DIETARY IRON (mg/day) BY AREA OF RESIDENCE FOR 1992-93 AND 1993-94: WOMEN

Age Group	URBAN 92-93 R1,R2 *Mean*	RURAL 92-93 R1,R2 *Mean*	URBAN 93-94 R3,R4 *Mean*	RURAL 93-94 R3,R4 *Mean*
Women:				
14-54 (N)	*(2633)*	*(555)*	*(2633)*	*(555)*
Total iron	12.3	14.0	11.4	13.8
Heme iron	1.31	1.49	1.14	1.51
Bioav. 1	1.20	1.16	1.15	1.12
Bioav. 3	0.50	0.56	0.46	0.55
55-65 (N)	*(581)*	*(233)*	*(581)*	*(233)*
Total iron	11.6	13.0	11.0	12.2
Heme iron	1.01	1.08	0.97	0.95
Bioav. 1	1.02	0.98	1.01	0.94
Bioav. 3	0.41	0.45	0.40	0.39
>65 (N)	*(644)*	*(265)*	*(644)*	*(265)*
Total iron	10.5	11.8	9.5	10.9
Heme iron	0.85	0.74	0.81	0.62
Bioav. 1	0.92	0.87	0.88	0.83
Bioav. 3	0.36	0.34	0.34	0.29

Source, intake data: Russian Longitudinal Monitoring Survey, rounds 1-4.
Categories based on round 2 classification.
92-93 = mean of rounds 1 and 2; 93-94 = mean of rounds 3 and 4.

TABLE 25 MEAN TEMPORAL INTAKES OF TOTAL DIETARY IRON (mg/day) BY AREA OF RESIDENCE FOR 1992-93 AND 1993-94: CHILDREN

Age/Gender Group	URBAN 92-93 R1,R2 *Mean*	RURAL 92-93 R1,R2 *Mean*	URBAN 93-94 R3,R4 *Mean*	RURAL 93-94 R3,R4 *Mean*
Children				
0-6 F (N)	*(290)*	*(96)*	*(290)*	*(96)*
Total iron	8.5	8.1	8.3	8.6
Heme iron	0.85	0.72	0.72	0.94
Bioav. 1	0.93	0.84	0.97	0.93
Bioav. 3	0.35	0.30	0.31	0.37
0-6 M (N)	*(277)*	*(83)*	*(277)*	*(83)*
Total iron	8.5	9.1	8.8	8.7
Heme iron	0.83	0.87	0.80	0.86
Bioav. 1	0.90	0.95	0.99	0.95
Bioav. 3	0.34	0.35	0.34	0.34
7-13 F (N)	*(377)*	*(118)*	*(377)*	*(118)*
Total iron	11.1	11.0	10.4	10.8
Heme iron	0.85	1.11	0.72	1.09
Bioav. 1	1.14	1.05	1.10	1.04
Bioav. 3	0.45	0.44	0.41	0.43
7-13 M (N)	*(414)*	*(109)*	*(414)*	*(109)*
Total iron	11.8	12.2	11.3	12.2
Heme iron	1.24	1.22	1.15	1.19
Bioav. 1	1.15	1.11	1.15	1.08
Bioav. 3	0.48	0.48	0.45	0.47

Source, intake data: Russian Longitudinal Monitoring Survey, rounds 1-4.
Categories based on round 2 classification.
92-93 = mean of rounds 1 and 2; 93-94 = mean of rounds 3 and 4.

TABLE 26. MEAN INTAKES OF TOTAL, HEME AND BIOAVAILABLE IRON 1992-93 BY SEASON: WOMEN

Age/Gender Group	Recommended Intake	Mean Intakes (mg/day) Fall R1,R3	Mean Intakes (mg/day) Winter R2,R4
Women:			
14-54 (N)		*(3188)*	*(3188)*
Total iron	18,0	11.90	11.80
Heme iron		1.11	1.44
Bioav. I		1.14	1.19
Bioav. III		0.46	0.53
55-65 (N)		*(814)*	*(814)*
Total iron	10/18	11.20	12.20
Heme iron		0.83	1.16
Bioav. I		0.96	1.04
Bioav. III		0.37	0.45
>65 (N)		*(909)*	*(909)*
Total iron	10	10.00	10.80
Heme iron		0.62	0.96
Bioav. I		0.86	0.92
Bioav. III		0.30	0.38

Source, intake data: Russian Longitudinal Monitoring Survey, rounds 1-4.
Categories based on round 1 classification.

TABLE 27. MEAN INTAKES OF TOTAL, HEME AND BIOAVAILABLE IRON 1992-93 BY SEASON: Children

Age/Gender Group	Recommended Intake	Mean Intakes (mg/day) Fall R1,R3	Winter R2,R4
Children			
0-6 females (N)		*(386)*	*(386)*
Total iron	10.0	8.10	8.70
Heme iron		0.67	0.92
Bioav. I		0.88	0.99
Bioav. III		0.30	0.36
0-6 males (N)		*(360)*	*(360)*
Total iron	10.0	8.40	9.00
Heme iron		0.70	0.96
Bioav. I		0.92	0.98
Bioav. III		0.31	0.37
7-13 females (N)		*(495)*	*(495)*
Total iron	10.0	10.70	10.90
Heme iron		0.93	1.24
Bioav. I		1.07	1.14
Bioav. III		0.40	0.47
7-13 males (N)		*(523)*	*(523)*
Total iron	10.0	11.50	11.80
Heme iron		1.06	1.33
Bioav. I		1.10	1.18
Bioav. III		0.44	0.49

Source, intake data: Russian Longitudinal Monitoring Survey, rounds 1-4.
Categories based on round 1 classification.

TABLE 28: MEAN INTAKES OF TOTAL DIETARY IRON (mg/day) BY SMOKING STATUS: 1992-93 AND 1993-94

Age Group	SMOKERS 92-93 R1,R2 *Mean*	NON-SMOKERS 92-93 R1,R2 *Mean*	SMOKERS 93-94 R3,R4 *Mean*	NON-SMOKERS 93-94 R3,R4 *Mean*
Women:				
14-54 (N)	*(265)*	*(2923)*	*(265)*	*(2923)*
Total iron	12.2	12.6	11.1	11.9
Heme iron	1.29	1.35	1.12	1.22
Bioav. 1	1.20	1.19	1.14	1.14
Bioav. 3	0.51	0.49	0.47	0.44
55-65 (N)	*(16)*	*(798)*	*(16)*	*(798)*
Total iron	11.9	12.0	10.8	11.4
Heme iron	1.42	1.02	0.84	0.96
Bioav. 1	1.02	1.01	0.98	0.99
Bioav. 3	0.42	0.50	0.40	0.40
>65 (N)	*(20)*	*(889)*	*(20)*	*(889)*
Total iron	10.0	10.9	7.7	10.0
Heme iron	0.69	0.82	0.56	0.76
Bioav. 1	0.85	0.91	0.80	0.87
Bioav. 3	0.35	0.30	0.32	0.25

Source, intake data: Russian Longitudinal Monitoring Survey, rounds 1-4.
Categories based on round 1 classification.
92-93 = mean of rounds 1 and 2; 93-94 = mean of rounds 3 and 4.

TABLE 30. MEAN INTAKES OF IRON, ENERGY AND SELECTED MICRONUTRIENTS AMONG PREGNANT AND NON-PREGNANT WOMEN OVER TIME

Age Group	PREGNANT * 1992 R1 *Mean*	NON-PREGNANT 1993 R1 *Mean*	PREGNANT * 1992 R3 *Mean*	NON-PREGNANT 1993 R3 *Mean*
Women:				
14-54 (N)	*(44)*	*(3077)*	*(44)*	*(3077)*
Total iron (mg)	12.0	12.4	12.5	11.3
Heme iron (mg)	1.16	1.22	1.15	1.00
Bioav. 1 (mg)	1.08	1.17	1.11	1.11
Bioav. 3 (mg)	0.45	0.49	0.47	0.42
Energy (kcals)	1683	1631	1854	1626
Calcium (mg)	561.00	520.00	621.00	538.00
Vitamin C (mg)	50.3	63.3	50.9	53.8
Vitamin E (mcg)	11.6	14.5	14.2	12.6

Source, intake data: Russian Longitudinal Monitoring Survey, rounds 1 and 3.
Represents intakes in a cohort of women pregnant in round 1, followed up in round 3.

TABLE 31. MEAN INTAKES OF IRON, ENERGY AND SELECTED MICRONUTRIENTS AMONG BREASTFEEDING AND NON-BREASTFEEDING WOMEN OVER TIME

Age Group	BREASTFEEDING* 1992 R1 *Mean*	NON-BRFDG 1993 R1 *Mean*	BREASTFEEDING* 1992 R3 *Mean*	NON-BRFDG 1993 R3 *Mean*
Women:				
14-54 (N)	*(63)*	*(2548)*	*(63)*	*(2548)*
Total iron (mg)	12.4	12.1	10.7	10.9
Heme iron (mg)	1.32	1.18	1.18	0.96
Bioav. 1 (mg)	1.18	1.15	1.08	1.09
Bioav. 3 (mg)	0.50	0.48	0.46	0.40
Energy (kcals)	1772	1603	1587	1575
Calcium (mg)	656	511	487	518
Vitamin C (mg)	57.0	61.4	37.9	53.0
Vitamin E (mcg)	15.4	14.1	10.8	12.5

Source, intake data: Russian Longitudinal Monitoring Survey, rounds 1 and 3.
Represents intakes in a cohort of women breastfeeding in round 1, followed up in round 3.

TABLE 32. MEAN INTAKES OF TOTAL, HEME AND BIOAVAILABLE IRON in 1992-93 BY SIZ OF HOUSEHOLD (# CHILDREN): WOMEN

Age/Gender Group	No Children	1 Child	2 Children	3+ Children
	92-93 R1,R2 *Mean*	92-93 R1,R2 *Mean*	92-93 R1,R2 *Mean*	92-93 R1,R2 *Mean*
Women				
14-54 (N)	*(1521)*	*(1087)*	*(489)*	*(91)*
Total iron	12.6	12.4	12.8	13.1
Heme iron	1.34	1.30	1.46	1.35
Bioav. I	1.19	1.20	1.18	1.07
Bioav. III				
55-65 (N)	*(715)*	*(68)*	*(26)*	*(5)*
Total iron	12.2	10.9	9.8	11.2
Heme iron	1.05	0.81	0.89	1.15
Bioav. I	1.02	0.95	0.91	0.80
Bioav. III				
>65 (N)	*(810)*	*(64)*	*(27)*	*(8)*
Total iron	11.1	9.1	10.3	8.8
Heme iron	0.83	0.58	1.08	1.17
Bioav. I	0.92	0.77	0.89	0.85
Bioav. III				

Source, intake data: Russian Longitudinal Monitoring Survey, rounds 1-4. Categories based on round 1 classification.

TABLE 33. MEAN INTAKES OF TOTAL, HEME AND BIOAVAILABLE IRON CHILDREN) IN 1992-93 BY SIZE OF HOUSEHOLD (# OF CHILDREN): CHILDREN

Age/Gender Group	No Children	1 Child	2 Children	3+ Children
	92-93 R1,R2 *Mean*	92-93 R1,R2 *Mean*	92-93 R1,R2 *Mean*	92-93 R1,R2 *Mean*
Children				
0-6 females (N)		*(164)*	*(167)*	*(54)*
Total iron		8.47	8.43	8.09
Heme iron		0.81	0.87	0.66
Bioav. I		0.92	0.92	0.81
Bioav. III				
0-6 males (N)		*(143)*	*(161)*	*(56)*
Total iron		8.51	8.90	8.26
Heme iron		0.84	0.92	0.65
Bioav. I		0.91	0.93	0.87
Bioav. III				
7-13 females (N)		*(222)*	*(151)*	*(45)*
Total iron		11.2	10.6	11.6
Heme iron		1.15	1.00	1.38
Bioav. I		1.13	1.09	1.12
Bioav. III				
7-13 males (N)		*(236)*	*(170)*	*(43)*
Total iron		11.61	11.75	12.08
Heme iron		1.00	1.25	1.21
Bioav. I		1.06	1.16	0.99
Bioav. III				

Source, intake data: Russian Longitudinal Monitoring Survey, rounds 1-4. Categories based on round 1 classification.

TABLE 34. MEAN INTAKES OF TOTAL, HEME AND BIOAVAILABLE IRON IN 1993-94 BY SIZE OF HOUSEHOLD (# OF CHILDREN): WOMEN

Age/Gender Group	No Children	1 Child	2 Children	3+ Children
	93-94 R3,R4 *Mean*	93-94 R3,R4 *Mean*	93-94 R3,R4 *Mean*	93-94 R3,R4 *Mean*
Women				
14-54 (N)	*(1087)*	*(489)*	*(91)*	
Total iron	11.8	11.6	11.9	12.7
Heme iron	1.19	1.19	1.29	1.24
Bioav. I	1.15	1.14	1.13	1.04
Bioav. III				
55-65 (N)	*(715)*	*(68)*	*(26)*	*(5)*
Total iron	11.4	10.9	10.9	12.9
Heme iron	0.97	0.92	0.92	0.66
Bioav. I	0.99	1.00	0.93	0.84
Bioav. III				
>65 (N)	*(810)*	*(64)*	*(27)*	*(8)*
Total iron	10.1	8.4	8.9	8.4
Heme iron	0.76	0.69	0.76	0.65
Bioav. I	0.88	0.79	0.76	0.72
Bioav. III				

Source, intake data: Russian Longitudinal Monitoring Survey, rounds 1-4. Categories based on round 1 classification.

TABLE 35. MEAN INTAKES OF TOTAL, HEME AND BIOAVAILABLE IRON IN 1993-94 BY SIZE OF HOUSEHOLD (# OF CHILDREN) : CHILDREN

Age/Gender Group	No Children	1 Child	2 Children	3+ Children
	93-94 R3,R4 *Mean*	93-94 R3,R4 *Mean*	93-94 R3,R4 *Mean*	93-94 R3,R4 *Mean*
Children				
0-6 females (N)		*(164)*	*(167)*	*(54)*
Total iron		8.7	8.0	8.4
Heme iron		0.81	0.72	0.83
Bioav. I		1.02	0.92	0.91
Bioav. III				
0-6 males (N)		*(143)*	*(161)*	*(56)*
Total iron		8.9	8.7	8.8
Heme iron		0.86	0.74	0.88
Bioav. I		1.06	0.97	0.87
Bioav. III				
7-13 females (N)		*(222)*	*(151)*	*(45)*
Total iron		10.5	9.7	13.3
Heme iron		0.97	0.82	2.02
Bioav. I		1.09	1.03	1.15
Bioav. III				
7-13 males (N)		*(236)*	*(170)*	*(43)*
Total iron		11.3	11.3	10.3
Heme iron		0.00	1.06	0.84
Bioav. I		1.36	1.15	0.92
Bioav. III				

Source, intake data: Russian Longitudinal Monitoring Survey, rounds 1-4. Categories based on round 1 classification.

TABLE 36. MEAN TEMPORAL INTAKES OF ENERGY AND SELECTED MACRONUTRIENTS

Age/Gender Group (N)	ENERGY (kcals)				FAT (g/day)				PROTEIN (g/day)			
	Mean required level	92-93 Mean *(CI)*	93-94 Mean *(CI)*	% change Mean *(CI)*	Mean required level	92-93 Mean *(CI)*	93-94 Mean *(CI)*	% change Mean *(CI)*	Mean required level	92-93 Mean *(CI)*	93-94 Mean *(CI)*	% change Mean *(CI)*
Children												
0-6 F	650-1300	1366.1 *0.0,0.0*	1344.3 *0.0,0.0*	-2% *0%,0%*	n/a	56.4 *0.0,0.0*	57.7 *0.0,0.0*	2% *0%,0%*	n/a	15.4 *0.0,0.0*	12.6 *0.0,0.0*	-18% *0%,0%*
0-6 M	650-1300	1407.2 *0.0,0.0*	1393.0 *0.0,0.0*	-1% *0%,0%*	n/a	55.1 *0.0,0.0*	57.0 *0.0,0.0*	3% *0%,0%*	n/a	15.6 *0.0,0.0*	13.4 *0.0,0.0*	-14% *0%,0%*
7-13 F	2000-2200	1636.2 *0.0,0.0*	1604.9 *0.0,0.0*	-2% *0%,0%*	n/a	67.8 *0.0,0.0*	70.0 *0.0,0.0*	3% *0%,0%*	n/a	19.7 *0.0,0.0*	15.9 *0.0,0.0*	-20% *0%,0%*
7-13 M	2000-2500	1738.5 *0.0,0.0*	1723.8 *0.0,0.0*	-1% *0%,0%*	n/a	71.7 *0.0,0.0*	75.9 *0.0,0.0*	6% *0%,0%*	n/a	20.7 *0.0,0.0*	15.5 *0.0,0.0*	-25% *0%,0%*
Women:												
14-54	2100-2200	1711.6 *0.0,0.0*	1672.7 *0.0,0.0*	-2% *0%,0%*	70-73	76.4 *0.0,0.0*	78.0 *0.0,0.0*	2% *0%,0%*	35-36	20.4 *0.0,0.0*	15.8 *0.0,0.0*	-23% *0%,0%*
55-65	1975-2100	1592.5 *0.0,0.0*	1604.9 *0.0,0.0*	1% *0%,0%*	66-70	67.2 *0.0,0.0*	69.2 *0.0,0.0*	3% *0%,0%*	33-35	19.1 *0.0,0.0*	15.4 *0.0,0.0*	-19% *0%,0%*
>65	1700-1975	1442.2 *0.0,0.0*	1381.3 *0.0,0.0*	-4% *0%,0%*	57-66	56.1 *0.0,0.0*	57.5 *0.0,0.0*	2% *0%,0%*	30-33	18.2 *0.0,0.0*	12.7 *0.0,0.0*	-30% *0%,0%*

Source, intake data: Russian Longitudinal Monitoring Survey, rounds 1-4. Categories based on round 1 classification.

* *1992-93 = mean of rounds 1 and 2; 1993-94 = mean of rounds 3 and 4.*
** *Requirements for children are based on US mean levels for children < 1 yr (650-850 cals), 1-3 (1300kcals) and 4-6 (1800 kcals).*
Recommended intakes for pregnant and lactating women are increased as follows:
Energy = additional 350 kcalsfor pregnant and 450-500 kcals for lactating women
Fat= additional 12g for pregnant and 15g for lactating women
Protein = additional 20 g for pregnant and 20-26 g for lactating women.

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TABLE 37. PROPORTION OF MEDIAN ENERGY AND MACRONUTRIENT REQUIREMENTS CONSUMED BY TIME PERIOD

Age/Gender Group (N)	ENERGY (kcals)			FAT (g/day)			PROTEIN (g/day)		
	Median required level	92-93 Mean *(CI)*	93-94 Mean *(CI)*	Median required level	92-93 Mean *(CI)*	93-94 Mean *(CI)*	Median required level	92-93 Mean *(CI)*	93-94 Mean *(CI)*
Women:									
14-54	2150	79.6%	77.8%	72	106.8%	109.1%	36	57.3%	44.4%
55-65	2037.5	78.2%	78.8%	68	98.8%	101.8%	34	56.2%	45.4%
>65	1837.5	78.5%	75.2%	62	91.2%	93.5%	31.5	57.8%	40.4%

Source, intake data: Russian Longitudinal Monitoring Survey, rounds 1-4. Categories based on round 1 classification.

* *1992-93 = mean of rounds 1 and 2; 1993-94 = mean of rounds 3 and 4.*

** *Requirements for children are based on US mean levels for children < 1 yr (650-850 cals), 1-3 (1300kcals) and 4-6 (1800 kcals).*
Recommended intakes for pregnant and lactating women are increased as follows:
Energy = additional 350 kcalsfor pregnant and 450-500 kcals for lactating women
Fat= additional 12g for pregnant and 15g for lactating women
Protein = additional 20 g for pregnant and 20-26 g for lactating women.

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TABLE 38. MEAN SEASONAL INTAKES OF ENERGY AND SELECTED MACRONUTRIENTS

Age/Gender Group (N)	ENERGY (kcals)				FAT (g/day)				PROTEIN (g/day)			
	Mean required level*	Fall** Mean (CI)	Winter** Mean (CI)	% change Mean (CI)	Mean required level	Fall Mean (CI)	Winter Mean (CI)	% change Mean (CI)	Mean required level	Fall Mean (CI)	Winter Mean (CI)	% change Mean (CI)
Children												
0-6 F	650-1300	1306.4 *0.0,0.0*	1403.9 *0.0,0.0*	7% *0%,0%*	n/a	54.0 *0.0,0.0*	60.1 *0.0,0.0*	11% *0%,0%*	n/a	14.8 *0.0,0.0*	13.2 *0.0,0.0*	-11% *0%,0%*
0-6 M	650-1300	1370.1 *0.0,0.0*	1430.1 *0.0,0.0*	4% *0%,0%*	n/a	53.6 *0.0,0.0*	58.9 *0.0,0.0*	10% *0%,0%*	n/a	16.0 *0.0,0.0*	13.1 *0.0,0.0*	-18% *0%,0%*
7-13 F	2000-2200	1596.3 *0.0,0.0*	1644.8 *0.0,0.0*	3% *0%,0%*	n/a	63.9 *0.0,0.0*	73.8 *0.0,0.0*	16% *0%,0%*	n/a	20.7 *0.0,0.0*	14.9 *0.0,0.0*	-28% *0%,0%*
7-13 M	2000-2500	1675.3 *0.0,0.0*	1787.0 *0.0,0.0*	7% *0%,0%*	n/a	69.7 *0.0,0.0*	77.9 *0.0,0.0*	12% *0%,0%*	n/a	20.9 *0.0,0.0*	15.2 *0.0,0.0*	-27% *0%,0%*
Women:												
14-54	2100-2200	1632.7 *0.0,0.0*	1751.6 *0.0,0.0*	7% *0%,0%*	70-73	72.2 *0.0,0.0*	82.1 *0.0,0.0*	14% *0%,0%*	35-36	20.3 *0.0,0.0*	15.8 *0.0,0.0*	-22% *0%,0%*
55-65	1975-2100	1536.3 *0.0,0.0*	1661.1 *0.0,0.0*	8% *0%,0%*	66-70	65.9 *0.0,0.0*	70.5 *0.0,0.0*	7% *0%,0%*	33-35	18.7 *0.0,0.0*	15.9 *0.0,0.0*	-15% *0%,0%*
>65	1700-1975	1353.3 *0.0,0.0*	1470.2 *0.0,0.0*	9% *0%,0%*	57-66	53.8 *0.0,0.0*	59.8 *0.0,0.0*	11% *0%,0%*	30-33	16.9 *0.0,0.0*	14.0 *0.0,0.0*	-17% *0%,0%*

Source, intake data: Russian Longitudinal Monitoring Survey, rounds 1-4. Categories based on round 1 classification.

* *Fall = mean of rounds 1 and 3; Winter = mean of rounds 2 and 4.*
** *Requirements for children are based on US mean levels for children < 1 yr (650-850 cals), 1-3 (1300kcals) and 4-6 (1800 kcals).*
Recommended intakes for pregnant and lactating women are increased as follows:
Energy = additional 350 kcalsfor pregnant and 450-500 kcals for lactating women
Fat= additional 12g for pregnant and 15g for lactating women
Protein = additional 20 g for pregnant and 20-26 g for lactating women.

TABLE 39. PROPORTION OF MEDIAN ENERGY AND MACRONUTRIENT REQUIREMENTS CONSUMED BY SEASON

Age/Gender Group (N)	ENERGY (kcals)			FAT (g/day)			PROTEIN (g/day)		
	Median required level*	Fall** Mean *(CI)*	Winter** Mean *(CI)*	Median required level	Fall Mean *(CI)*	Winter Mean *(CI)*	Median required level	Fall Mean *(CI)*	Winter Mean *(CI)*
Women:									
14-54	2150	75.9%	81.5%	72	101.0%	114.8%	36	57.1%	44.6%
55-65	2037.5	75.4%	81.5%	68	96.9%	103.7%	34	54.9%	46.7%
>65	1837.5	73.6%	80.0%	62	87.5%	97.2%	31.5	53.7%	44.6%

Source, intake data: Russian Longitudinal Monitoring Survey, rounds 1-4. Categories based on round 1 classification.

* *Fall = mean of rounds 1 and 3; Winter = mean of rounds 2 and 4.*

** *Requirements for children are based on US mean levels for children < 1 yr (650-850 cals), 1-3 (1300kcals) and 4-6 (1800 kcals).*
Recommended intakes for pregnant and lactating women are increased as follows:
Energy = additional 350 kcalsfor pregnant and 450-500 kcals for lactating women
Fat= additional 12g for pregnant and 15g for lactating women
Protein = additional 20 g for pregnant and 20-26 g for lactating women.

TABLE 40. MEAN INTAKES OF SELECTED MICRONUTRIENTS

Age/Gender Group (N)	VITAMIN C (mg/day)				VITAMIN E (mg/day)				CALCIUM (mg/day)			
	Recom-mended level	92-93 Mean (CI)	93-94 Mean (CI)	% change Mean (CI)	Recom-mended level	92-93 Mean (CI)	93-94 Mean (CI)	% change Mean (CI)	Recom-mended level	92-93 Mean (CI)	93-94 Mean (CI)	% change Mean (CI)
Children												
0-6 F	70	36.8 *(21.9, 46.2)*	38.5 *(20.1, 48.8)*	5%	6-7	10.1 *(4.7, 12.5)*	8.7 *(5.0, 10.7)*	-14%	800	540.6 *(347.2, 723.6)*	514.1 *(333.6, 670.4)*	-5%
0-6 M	70	37.1 *(19.4, 47.4)*	41.8 *(18.9, 54.4)*	13%	6-7	10.1 *(5.4, 12.0)*	9.1 *(5.0, 11.0)*	-10%	800	539.7 *(368.2, 704.0)*	513.2 *(336.4, 654.7)*	-5%
7-13 F	70	48.4 *(25.6, 63.0)*	49.5 *(21.7, 60.5)*	2%	7-8	13.0 *(6.6, 15.8)*	11.3 *(6.6, 14.3)*	-13%	800	499.2 *(307.7, 665.9)*	506.2 *(301.4, 657.7)*	1%
7-13 M	70	49.6 *(26.7, 65.9)*	48.1 *(21.7, 60.5)*	-3%	7-10	13.6 *(7.2, 17.9)*	12.4 *(7.4, 15.3)*	-9%	800	511.0 *(309.4, 673.2)*	524.0 *(335.5, 688.9)*	3%
Women:												
14-54	70/80	52.3 *(29.1, 69.0)*	49.4 *(24.2, 63.9)*	-6%	8	14.8 *(7.4, 19.1)*	13.1 *(7.1, 16.6)*	-12%	800/1000	503.5 *(299.0, 661.9)*	509.0 *(308.2, 649.0)*	1%
55-65	80	49.9 *(26.5, 65.6)*	44.8 *(22.0, 57.5)*	-10%	8/12	14.2 *(6.5, 18.0)*	12.4 *(6.7, 15.7)*	-13%	1000	506.1 *(306.2, 646.7)*	545.1 *(318.9, 703.8)*	8%
>65	80	45.8 *(25.3, 58.4)*	34.5 *(17.5, 45.5)*	-25%	12	13.2 *(5.7, 17.0)*	10.5 *(5.4, 13.8)*	-20%	1000	468.4 *(268.4, 613.0)*	490.4 *(286.4, 642.6)*	5%

Source, intake data: Russian Longitudinal Monitoring Survey, rounds 1-4. Categories based on round 1 classification.

* *1992-93 = mean of rounds 1 and 2; 1993-94 = mean of rounds 3 and 4.*

** *Recommended intakes for women are based on Russian recommendations. For women 55-65, recommendations based on those for women 18-59/60-74. Recommended intakes for pregnant and lactating women are increased as follows:*
Vitamin C = add Vitamin C = additional 20 mg for pregnant and 40 mg for lactating women
Calcium = addit.Calcium = additional 300 mg for pregnant and 400 mg for lactating women
Recommended intakes for children are based on US RDAs

TABLE 41. PROPORTION OF RECOMMENDED INTAKES OF SELECTED MICRONUTRIENTS CONSUMED CONSUMED BY TIME PERIOD

Age/Gender Group (N)	VITAMIN C (mg/day)			VITAMIN E (mg/day)			CALCIUM (mg/day)		
	Recom-mended level	92-93 Mean (CI)	93-94 Mean (CI)	Recom-mended level	92-93 Mean (CI)	93-94 Mean (CI)	Recom-mended level	92-93 Mean (CI)	93-94 Mean (CI)
Children									
0-6 F	70	52.5%	55.0%	7	155.2%	559.4%	800	67.6%	64.3%
0-6 M	70	53.0%	59.7%	7	154.7%	587.7%	800	67.5%	64.1%
7-13 F	70	69.1%	70.7%	8	173.5%	650.6%	800	62.4%	63.3%
7-13 M	70	70.9%	68.7%	9	159.5%	774.9%	800	63.9%	65.5%
Women:									
14-54	75	69.7%	65.8%	8	185.6%	704.5%	900	55.9%	56.6%
55-65	80	62.4%	56.0%	10	141.6%	874.8%	1000	50.6%	54.5%
>65	80	57.2%	43.2%	12	109.6%	955.1%	1000	46.8%	49.0%

Source, intake data: Russian Longitudinal Monitoring Survey, rounds 1-4. Categories based on round 1 classification.

* *1992-93 = mean of rounds 1 and 2; 1993-94 = mean of rounds 3 and 4.*

** *Recommended intakes for children are based on US RDAs. Recommended intakes are high for pregnant and lactating women as follows:*
Vitamin C = addi Vitamin C = additional 20 mg for pregnant and 40 mg for lactating women
Calcium = additi Calcium = additional 300 mg for pregnant and 400 mg for lactating women
Recommended intakes for women 14-54 years are based on recommendations for women 18-59/60-74+

TABLE 42. MEAN SEASONAL INTAKES OF SELECTED MICRONUTRIENTS

Age/Gender Group (N)	VITAMIN C (mg/day)				VITAMIN E (mg/day)				CALCIUM (mg/day)			
	Recom-mended level **	Fall * Mean	Winter * Mean	% change Mean	Recom-mended level**	Fall Mean	Winter Mean	% change Mean	Recom-mended **	Fall Mean	Winter Mean	% change Mean
Children												
0-6 F	70	40.6	34.6	-15%	6-7	9.0	9.7	8%	800	537.4	517.4	-4%
0-6 M	70	44.8	34.1	-24%	6-7	9.5	9.6	1%	800	552.0	500.9	-9%
7-13 F	70	57.3	40.5	-29%	7-8	11.6	12.7	9%	800	535.1	470.3	-12%
7-13 M	70	57.4	40.3	-30%	7-10	12.7	13.2	3%	800	557.7	477.3	-14%
Women:												
14-54	70/80	58.6	43.1	-27%	8	13.5	14.4	6%	800/1000	532.0	480.4	-10%
55-65	80	52.7	42.0	-20%	8/12	12.8	13.7	7%	1000	546.7	504.5	-8%
>65	80	45.1	35.2	-22%	12	11.6	12.1	4%	1000	495.1	463.7	-6%

Source, intake data: Russian Longitudinal Monitoring Survey, rounds 1-4. Categories based on round 1 classification.

* *Fall = mean of rounds 1 and 3; Winter = mean of rounds 2 and 4.*
** *Recommended intakes for women are based on Russian recommendations. For women 55-65, recommendations based on those for women 18-59/60-74. Recommended intakes for pregnant and lactating women are increased as follows:*
Vitamin C = additional 20 mg for pregnant and 40 mg for lactating women
Calcium = additional 300 mg for pregnant and 400 mg for lactating women
Recommended intakes for children are based on US RDAs

TABLE 43. PROPORTION OF RECOMMENDED INTAKES OF SELECTED MICRONUTRIENTS CONSUMED CONSUMED BY SEASON

Age/Gender Group (N)	VITAMIN C (mg/day)			VITAMIN E (mg/day)			CALCIUM (mg/day)		
	Recom-mended level **	Fall * % (CI)	Winter * % (CI)	Recom-mended level **	Fall % (CI)	Winter % (CI)	Recom-mended level **	Fall % (CI)	Winter % (CI)
Children									
0-6 F	70	58,1%	49.4%	7	129.1%	753.5%	800	67.2%	64.7%
0-6 M	70	64.0%	48.7%	7	135.8%	710.0%	800	69.0%	62.6%
7-13 F	70	81.8%	57.9%	9	129.1%	982.5%	800	66.9%	58.8%
7-13 M	70	81.9%	57.6%	9	141.5%	931.0%	800	69.7%	59.7%
Women:									
14-54	75	78.1%	57.4%	1	1354.0%	106.2%	900	59.1%	53.4%
55-65	80	65.8%	52.5%	1	1284.1%	106.7%	1000	54.7%	50.5%
>65	80	56.4%	44.0%	1	1156.6%	104.3%	1000	49.5%	46.4%

Source, intake data: Russian Longitudinal Monitoring Survey, rounds 1-4. Categories based on round 1 classification.

* *Fall = mean of rounds 1 and 3; Winter = mean of rounds 2 and 4.*

** *Recommended intakes for children are based on US RDAs. Recommended intakes are high for pregnant and lactating women as follows:*
Vitamin C = additional 20 mg for pregnant and 40 mg for lactating women
Calcium = additional 300 mg for pregnant and 400 mg for lactating women
Recommended intakes for women 14-54 years are based on recommendations for women 18-59/60-74+