PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

Pakistan Journal of Nutrition 9 (6): 600-604, 2010
ISSN 1680-5194

Estimated Intakes of Iron, Zinc and Selenium of Jordanians as Obtained from Data of Jordanian Household Expenditures and Income Survey (JHEIS) 2006

Ref'at A. Alkurd[1], Hamed R. Takruri[2] and "Mo'ez Al-Islam" E. Faris[1]
[1]Department of Nutrition, Faculty of Pharmacy and Medical Sciences, Petra University, Amman, Jordan
[2]Department of Nutrition and Food Technology, Faculty of Agriculture, University of Jordan, Amman, Jordan

Abstract: This paper evaluates the intakes of the trace elements: iron, zinc and selenium as obtained from food consumption calculations based on the most recent data of JHEIS, 2006. The estimated mineral intake was analyzed using a nutrition analysis software program (Food Processor SQL, 2008). The nutrient intake of these 3 trace elements for different governorates was calculated. The results showed that the means of daily *per capita* intake of iron, zinc and selenium were 21.2 mg, 9.3 mg and 154.4 µg, respectively. Chicken meat was the first animal food among the richest top 10 foods in iron; it provided small amount of iron (0.9 mg, 6% of total consumption). The rest food sources of iron were of plant origin, of which bread topped the list (8.3 mg) followed by molukhyia (*Corchorus olitorius* L.) (1.0 mg). Also results showed that bread provided 2.7 mg zinc (29% of total consumption). Similarly, bread was the first source of selenium (86.7 µg, 56% of consumption). There was a variation in the estimated intake of these nutrients among different governorates. It is obvious that bread is the leading food of the top ten food sources of iron, zinc and selenium; this might be due to the fact that wheat flour is fortified with vitamins and minerals, including iron and zinc. However, it should be noted that bioavailability of minerals such as iron and zinc from plant food sources is low.

Key words: Iron, zinc, selenium, Jordan, JHEIS

INTRODUCTION

The food consumption pattern has changed in Middle Eastern countries, including Jordan in the last half century (Musaiger, 2007; Musaiger, 2010). Studies and surveys conducted, in Jordan, on food consumption in the previous half century have shown that the contribution of different food groups to energy and nutrients has changed (Alwan and Kharabsheh, 2006; FAO, 2003). This trend has been attributed to many factors including change in life style and changes in socioeconomic status leading to nutrition transition for Middle Eastern countries including Jordan (Alwan and Kharabsheh, 2006; Popkin, 2004). The subsidization of basic food commodities by the government has been canceled since 1997 and the poverty line has increased (USAID, 2005). There has been an improvement in health indicators; crude death rate has been decreased to 7/1000 population, the infant mortality rate has been decreased to 24.0/1000 live births and the life expectancy has increased to 71.7 years. As shown in Table 1, the urban population has increased from 46.3% in 1960 to 82.6% in 2006, whereas, the rural and Bedouin population have decreased from 53.7% in 1960 to 17.4% in 2006 (DOS, 2008). The consumption of fast foods as well as the number of meals taken outside home has increased (Musaiger, 2009; FAO/WHO, 2006).

Table 1: Demographic and socioeconomic indicators in Jordan in 2006*

Demographic indicator	Value
Total population (1000)	5,600
Urban (%)	82.6
Rural (%)	17.4
Population growth rate (%)	2.3
Average household size	5.4
Average life expectancy (yr)	71.7
Male	70.8
Female	72.5
Crude birth rate (per 1,000 pop)	29.1
Crude death rate (per 1,000 pop)	7.0
Infant mortality rate (per 1,000 live births)	24.0
Literacy rate (age 15+ yrs)-both sexes	90.7
Male	94.9
Females	86.3
Per capita GDP (JD)	1805.1

*DOS, 2007

Trace element deficiency is a worldwide problem and affects nearly half of humanity (WHO/EMRO, 2009; MOH, 2002; Mason *et al.*, 2001). The WHO (WHO/EMRO, 2009) has identified iron deficiency anemia as a significant health problem in all countries of the Middle East and North Africa including Jordan (Alwan and Kharabsheh, 2006; Faqih *et al.*, 1996; Tukan, 1996; WHO and UNICEF, 1996). To overcome this problem, the Jordanian government in collaboration with world health

Corresponding Author: Hamed R. Takruri, Department of Nutrition and Food Technology, Faculty of Agriculture, University of Jordan, Amman, Jordan

agencies has initiated a national program of fortification of wheat flour with 9 vitamins and minerals (MOH, 2006) besides introducing a school feeding program that included enriched biscuits for almost all schools (Takruri, 2004). Since the launching of wheat flour fortification in April, 2006 (MOH, 2006) there have been no studies concerning the positive potential effect of this fortification.

Iron is needed in the synthesis of hemoglobin and myoglobin, oxidative process and other vital biological functions. Clinical signs of iron deficiency include fatigue, impaired temperature regulation and decreased resistance to infection. Severe deficiency causes iron deficiency anemia (Mahan and Escott-stump, 2008).

Zinc as an important essential trace element participates in biological functions as a cofactor of many enzymes involved in energy metabolism, protein synthesis, immune function, sex maturation and sensation of taste and smell. Prolonged zinc deficiency during growth periods causes retarded physical growth (dwarfism). Other deficiency symptoms include retarded sex maturation (in males), impaired taste and smell and poor wound healing (Prasad, 2003).

Selenium is associated with vitamin E as an antioxidant that prevents oxidative stress due to generation of reactive oxygen species and thus protects lipid in cell membrane (Brenneisen *et al*., 2005). Selenium deficiency causes disease conditions such as Keshan disease, which is manifested by heart muscle failure and Kashin Beck which is, manifested by blood vessel abnormalities (Arthur *et al*., 1994). Selenium is also thought to protect against cancer through its role in induction of apoptosis and enhancement of immune system (Arthur *et al*., 2003; Wolf and Green, 1999).

Zinc deficiency has been reported in many countries of the Middle East (Mason *et al*., 2001) and it has been reported that there is a marginal zinc deficiency in Jordan (Alwan and Kharabsheh, 2006). In this paper, it has been thought important to evaluate the nutritional status of the trace elements, iron, zinc and selenium from food consumption calculations based on the most recent data of Jordanian Household Expenditures and Income Survey (JHEIS, 2006) (DOS, 2008). In addition, the obtained data on these trace elements were compared with the recent DRI recommendations (IOM, 2001; IOM, 2000). Despite the limitations of depending on such surveys for evaluating the per capita food consumption of nutrients, it is used internationally as an indicator of food consumption and nutrient intake when data from nutritional surveys are lacking.

MATERIALS AND METHODS

Data in this paper were based on the JHEIS 2006, which aimed at collecting detailed data on the household expenditures and income and correlating these data with the demographic, social and economic changes in Jordan. The raw data collection of this survey extended from July, 2006 to January, 2007 (DOS, 2008). The annual per capita food consumption data of a representative sample of all Jordanian households was calculated. The included 12768 households were proportionally distributed among the different governorates of the Kingdom using two-stage cluster stratified sampling method in light of the housing census frame, 2004. A questionnaire was distributed to households included in the study. The questionnaire contained data of the expenditure on different food and non food categories. Each category included a number of food items. The data on food items was analyzed using a nutrition analysis software program (Food Processor SQL, 2008) which included details on the contents of energy and nutrients for each food item. In case a food item was not included in the database of the mentioned program, the nutrient makeup of this food was obtained from other food analysis sources such as Food Composition Tables for Use in the Middle East (Pellett and Shadarevian, 1970) and Food Composition Tables of the Gulf Region (Musaiger, 2006). Such foods and their analysis were introduced to the Food Processor database. Then the daily intakes of iron, zinc and selenium were calculated and the daily per capita intakes of these nutrients were obtained using the provided household expenditure data for 6 months. The nutrient consumption values obtained for the different governorates were compared with the highest DRI of the 3 nutrients to assure that needs were met for all age groups (IOM, 2001; IOM, 2000).

RESULTS AND DISCUSSION

Table 2 shows the consumption of iron in the 12 governorates and the whole country (Kingdom). The consumption (mg/day) ranged between 17.3 for Tafilah and 23.5 for both Irbid and Jarash, while the Kingdom consumption was 21.2. When compared to the highest DRI of iron (18 mg/day), 10 governorates had higher consumption than this DRI, whereas the consumption of the other 2 governorates, Tafilah and Aqaba, were lower but close to this DRI. These figures are higher than those reported by Tukan (1996) based on JHEIS 1992 data, who found an average intake of iron for the Kingdom to be about 18.3 mg/day. This difference could be explained by the fact that flour was fortified with iron since 2002.

Based on these statistics, Jordan governorates, except Mafraq, should not suffer from iron deficiency. However, it was documented that some age groups of the Jordanian children suffer from iron deficiency anemia. To combine the fact of the presence of iron deficiency

Table 2: Fe, Zn and Se intakes in different governorates

Governorate	Fe (mg/day)	Zn (mg/day)	Se (µg/day)
Amman	20.7	9.6	148.1
Balqa	21.8	8.7	154.0
Zarqa	20.9	9.0	147.7
Madaba	22.8	9.9	184.9
Irbid	23.5	10.0	166.5
Mafraq	18.5	7.9	152.7
Jarash	23.5	8.9	151.8
Ajlun	22.1	9.2	165.5
Karak	18.9	8.3	163.5
Tafilah	17.3	8.5	140.5
Ma'an	21.6	8.2	149.0
Aqaba	17.9	8.6	148.9
Kingdom	21.2	9.3	154.4

Table 3: The top 10 food sources of Fe in the Jordanian diet

Food item	Consumption (mg/day)
Bread, all types	8.3
Molukhyia	1.0
Chicken	0.9
Thyme	0.8
Parsley	0.8
Spearmint	0.8
Beans	0.7
Rice, all types	0.6
Tomatoes	0.5
Potatoes	0.4
Total	14.8

anemia and the high iron consumption, it is possible that the deficiency is due to the presence of many antinutritional factors that hinder iron bioavailability and the presence of other factors that interfere with the bioavailability of iron such as vitamin C in the diet, heme and nonheme food sources of iron and tannin contents of foods.

Table 3 shows the top 10 food sources of iron in Jordan. It is noticed that these 10 food sources provide 14.8 mg out of 21.2 mg (=70%) of the total iron consumed. Except for chicken, all of the foods in this list (which provide 94% of the consumed iron) are plant foods, thus all of the iron contributed by the plant sources is in the form of nonheme iron. It is also noteworthy that the plant foods which are rich in iron (molukhyia, thyme, parsley, spearmint and legumes) are rich sources of antinutritional factors that hinder the iron bioavailability (Fairweather-Tait and Hurrell, 1996).

Table 2 also shows the consumption of zinc in the different governorates of Jordan. The consumption range (mg/day) was between 7.9 (in Mafraq) and 10.0 (in Irbid) with an average of 9.3 mg/day for the Kingdom. Like iron, the lowest consumption of zinc was in Mafraq. When compared to the highest DRI of zinc (11 mg/day), the estimated zinc intakes of all of the governorates and the Kingdom were below this DRI. The apparently low levels of zinc intake might be important and deserves investigation since marginal zinc deficiency has been reported in the country (Tukan, 1996). It is noticed from Table 4 that the main sources of zinc among the top 10 ones are of plant origin with bread being the highest contributor to the total zinc consumption (29%) and chicken coming next to it. Furthermore, the contribution of zinc from plant foods accounts for 67% of the total zinc; it is well-known that the bioavailability of zinc from plant food sources is low in comparison with animal food sources (Lönnerdal, 2000). The contribution of bread and other cereals is 40% of the total zinc intake in the current study, while their contribution was reported to be 56% in the JHEIS 1992 (Tukan, 1996). This difference could be ascribed to the decrease in bread intake in the recent survey.

The consumption of selenium in the 12 governorates and the Kingdom (µg/day) ranged from 140.5 (Tafilah) to 184.9 (Madaba), while the Kingdom consumption was 154.4 (see Table 2). The highest DRI of selenium is 55 µg/day. It is very clear that Jordan as a whole and all the governorates consumption of selenium exceed the recommended requirements by at least 2.5 folds, therefore the deficiency is unexpected. At the same time, such levels do not reveal any adverse impact on health as the highest UL for selenium is 400 µg/day (IOM, 2000). Table 5 shows the top ten food sources of selenium. Five of these top 10 foods were of plant origin. Bread occupies the leading one and provides 86.7 µg/day which equals 56% of the total consumption of selenium in Jordan. It is well known that wheat is among the high sources of selenium (Rayman, 2000) and wheat bread is the stable food in Jordan (DOS, 2008). Foods of animal origin provide 30.1 µg of selenium per day which equals 19% of the Kingdom consumption and 22% of the total top ten consumption. It is noteworthy that the selenium content fluctuates in the same food depending on the type of soil, soil pH and source of food whether it is of plant or animal origin. Therefore, the apparently high intake of selenium in the Jordanian diet, as estimated in this study, may not reflect the actual nutritional status of this trace element (Navarro-Alarcon and Cabrera-Vique, 2008).

These apparently high levels of selenium intake should be confirmed by studying the selenium content of local food intakes, as well as of imported foods, including wheat which is the stable food in Jordan. This is of paramount importance since selenium deficiency is known to be common in different parts in the world and since selenium status is an important issue in human health.

It is obvious from the present study that bread is the leading food of the top ten food sources of iron, zinc and selenium; wheat flour fortification is the explanation of this finding, in case of iron and zinc. Wheat flour fortification in Jordan has begun in 2006 by adding

Table 4: The top 10 food sources of Zn in the Jordanian diet

Food item	Consumption (mg/day)
Bread, all types	2.7
Chicken	1.1
Rice, all types	1.0
Lamb meat	0.6
Beef meat	0.5
Milk, all types	0.3
Yogurt	0.3
Eggs	0.2
Seeds, dried	0.2
Goat meat	0.1
Total	7.0

Table 5: The top 10 food sources of Se in the Jordanian diet

Food item	Consumption (μg/day)
Bread, all types	86.7
Chicken	16.8
Rice, all types	11.1
Eggs	6.2
Pasta, macaroni	5.0
Flour, all types	3.9
Lamb meat	3.7
Milk	1.9
Luncheon meat	1.5
Beans	1.0
Total	137.8

9 vitamins and minerals, including iron and zinc, to the flour (*Mowahad* type) (MOH, 2006). Deficiencies of these 9 nutrients are the most common in Jordan and many other parts of the world. It is expected that the incidence of deficiencies of the added nutrients will be reduced in the next few years. It is concluded that assessment of flour fortification program is very essential.

REFERENCES

Alwan, A. and S. Kharabsheh, 2006. Nutrition in Jordan: A review of the Current Nutritional Trends and Major Strategic Directions of the National Food and Nutrition Policy. Ministry of Health, WHO and Ministry of Agriculture. Amman-Jordan.

Arthur, J.R., G.J. Beckett and J.H. Mitchell, 1994. The Interaction between selenium and iodine deficiency in man and animals. Nutr. Res. Rev., 12: 55-73.

Arthur, J.R., R.C. McKenzie and G.J. Beckett, 2003. Selenium in the immune system. J. Nutr., 133: 1457S-1459S.

Brenneisen, P., H. Steinbrenner and H. Sies, 2005. Selenium, oxidative stress and health aspects. Mol. Aspects Med., 26: 256-267.

DOS (Department of Statistics), 2008. Household Expenditures and Income Survey 2006. DOS, Amman-Jordan.

Fairweather-Tait, S. and R. Hurrell, 1996. Bioavailability of minerals and trace elements. Nutr. Res. Rev., 9: 295-324.

FAO (Food and Agriculture Organization), 2003. Jordan Nutrition Country Profile. FAO, Rome.

FAO/WHO, 2006. Tech. Cons. On Nutritional Food-based dietary guidelines. WHO Reg. Office, Cairo-Egypt.

Faqih, A.M., S.S. Hijazi and H.S. Qazaq, 1996. Prevalence of iron deficiency anemia in Jordan. Proceedings of the workshop on Micronutrient Deficiencies in the Arab Middle East, held in Amman, Jordan 27-29 June 1995.

Food Processor SQL, 2008. Food Processor nutrition and fitness software. Food Processor SQL Inc., Salem, OR, USA.

IOM (Institute Of Medicine), Food and Nutrition Board, 2000. Dietary reference intakes for vitamin C, vitamin E, selenium and carotenoids. Washington, DC, National Academic Press.

IOM (Institute Of Medicine), Food and Nutrition Board, 2001. Dietary reference intakes for vitamin A, vitamin K, arsenic, boron, chromium, copper, iodine, iron, manganese, molybdenum, nickel, silicon, vanadium and zinc. Washington, DC, National Academic Press.

Lönnerdal, B.O., 2000. Dietary factors influencing zinc absorption. J. Nutr., 130: 1378S-1383S.

Mahan, L.K. and S. Escott-stump, 2008. Krause's Food and Nutrition Therapy. 12th Edn., W.B., Sauders Co., Philadelphia.

Mason, J.B., M. Lotfi, N. Dalmiya, K. Sethuraman and M. Deitchler, 2001. The micronutrient report: Current progress and trends in the control of vitamin A, iodine and iron deficiencies. http://www.tulane.edu/~internut/publications/MI%20REPORT.pdf.

MOH (Ministry Of Health), 2002. A National Survey on Iron Deficiency Anemia and Vitamin A Deficiency. MOH, WHO, UNICEF and CDC. Jordan.

MOH (Ministry Of Health), 2006. Flour Fortification Program in Vitamins and Minerals. A leaflet published by MOH Directorate of Health Safety/Nutrition Division, MOH, Amman, Jordan. (in Arabic).

Musaiger, A.D., 2009. Fast foods. In: Arab Encyclopedia of Food and Nutrition. Academia, Beirut, Lebanon. pp: 710-724.

Musaiger, A.O., 2006. Food Composition Tables for Arab Gulf Countries. Arab Center for Nutrition, Bahrain.

Musaiger, A.O., 2007. Overweight and obesity in the Arab Countries: The need for action, Arab Center for Nutrition.

Musaiger, A.O., 2010. Obesity in the Arab Countries: Prevalence Causes and Control. In: proceedings of the Arab Conference on Obesity and Physical Activity Held in Bahrain, Jan. 19-21, 2010, Musaiger, A.O., Arab Center for Nutrition, Manama, Bahrain, pp: 10-25.

Navarro-Alarcon, M. and C. Cabrera-Vique, 2008. Selenium in food and the human body: A review. Sci Total Environ., 400: 115-141.

Pellett, P.L. and S. Shadarevian, 1970. Food Composition Tables for Use in the Middle East. AUB, Beirut, Lebanon.

Popkin, B.M., 2004. The nutrition transition: An overview of world patterns of change. Nutr. Rev., 62(7 Pt 2): S140-S143.

Prasad, A.S., 2003. Zinc deficiency has been known of for 40 years but ignored by global health organizations. BMJ, 22; 326: 409-410.

Rayman, M.P., 2000. The importance of selenium to human health. The Lancet, 356: 233-241.

Takruri, H., 2004. School Feeding in Jordan. Proceeding of the Workshop on School feeding in the Arab Countries held in Cairo, 5-7 August, 2003.

Tukan, S.K., 1996. Availability of micronutrients in Jordanian diet. Proceedings of the workshop on Micronutrient Deficiencies in the Arab Middle East, held in Amman, Jordan 27-29 June 1995.

WHO and UNICEF, 1996. Guidelines for the Control of Iron Deficiency in Countries of the Eastern Mediterranean, Middle East and North Africa, Verster, A (Ed.). WHO document 177, E-G-11.96-1000 WHO-EMRO, Alexandria, Egypt.

WHO/EMRO, 2009. Regional data on non-communicable diseases risk factors, WHO Regional Office of East Mediteranean. Non-communicable website http/www.emro.who.int.ned.

Wolf, B.B. and D.R. Green, 1999. Suicidal tendencies: Apoptotic cell death by caspase family proteinases. J. Biol. Chem., 274: 20049-20052.

USAID, 2005. http://www.usaid.gov/policy/budget/cbj 2005/ane/jo.html.