Pakistan Journal of Nutrition 6 (4): 355-358, 2007
ISSN 1680-5194

Anemia and Iron Intake of Adult Saudis in Riyadh City-Saudi Arabia

Abdullah H. Al-Assaf
Department of Food Sciences and Nutrition, College of Food Sciences and Agriculture,
King Saud University, P.O. Box 2460, Riyadh 11451, Saudi Arabia

Abstract: The aim of this study was to evaluate iron deficiency anemia among adult healthy Saudi males and adult healthy non-pregnant Saudi females in Riyadh City, Saudi Arabia. 234 healthy adults were recruited of which, 102 were females and 132 were males. Male subjects were reclassified to cigarette smokers (n = 52) and non-smokers (n = 80). Anemia was assessed by dietary iron intake, hemoglobin and hematocrit levels. Iron intake was measured by analyzing the intake of three consecutive days. The results showed that iron intake, hemoglobin and hematocrit levels were significantly higher in males compared to females. Mean iron intake of males (13.6±3.1 mg/day) was adequate compared to DRI recommendation. Mean concentrations of hemoglobin (15.89±0.95 g/dL) and hematocrit (47.7±3.6%) for males were normal. Hemoglobin and hematocrit levels were significantly higher in smokers compared to non-smokers, but both were normal, which suggested that iron deficiency anemia is not found among adult Saudi males. Mean iron intake of females (10.2±2.8 mg/day) was inadequate compared to DRI recommendation. Mean hemoglobin level (13.68±0.83 g/gL) and mean hematocrit level (38.9±3.2%) of females were lower than cutoff values for determining iron deficiency anemia. Based on hemoglobin and hematocrit values, 21.6% and 20.6% of female participants, respectively were anemic. Based on iron intake, 95.1% of female participants had intake lower than the recommendation. Results of this study illustrated that iron deficiency anemia is highly prevalent among adult Saudi women in Riyadh City and suggests actions to eradicate iron deficiency anemia. These actions include increasing nutritional awareness and education for the purpose of changing inappropriate consumption patterns as well as fortification of certain foods in combination with additional intakes of iron from supplements.

Key words: Anemia, hemoglobin, hematocrit, iron intake, food records, adult Saudis, cigarette smoking

Introduction

Iron deficiency anemia is one of most prevalent nutritional diseases in many parts of the world. In Saudi Arabia it affects particularly women and children (Madani *et al*., 2000; Mussaiger, 2002). Al-Naguib and Sadek (1988) examined hematologic profiles in 208 Saudi children aged 2-60 months and found that 38% of the children were anemic, 22.6% were borderline. Al-Fawaz (1993) found that the prevalence of anemia among children in Riyadh City aged 6-24 months was 37%. Similar results were reported by Al-Othaimeen *et al*. (1999) which showed that prevalence of anemia among schoolgirls in Riyadh City, aged 11-18 years, ranged from 48% to 60%. A recent study by Abou-Zeid *et al*. (2006) showed that prevalence of anemia among male and female schoolchildren was 11.6% and 15.5% based on hemoglobin and hematocrit values, respectively. Another study that investigated the prevalence of anemia among Saudi school student in Jeddah City (Abalkhail and Shawky, 2002) found anemia among 20.5% of 800 students. The study reported that anemia was more prevalent among students aged $\geq$ 12 years as compared to younger age. The previous mentioned studies reported that main factor contribute to this anemia is low intake of iron, but no study reported the intake of iron. The only exception is the study of Sawaya *et al*. (1988), which reported low iron intake as measured by 24-hour dietary recall in Saudi preschool children in four different regions in Saudi Arabia.

Among adult women, similar findings were reported. Based on blood hemoglobin level, Mahfouz *et al*. (1994) found 31.9% of sample of 6,539 pregnant women in the Asir region were anemic. Also, among pregnant women, Madani *et al*. (1995) reported anemia of 22.9% in the Taif region whereas Ghaznawi and Hussein (1988) reported anemia of 25.6% in Jeddah City. Studies that evaluated anemia among Saudi males are very limited. A recent study by Alhamdan (2004) evaluated anemia based on hemoglobin levels among adult and elderly males living in nursing home in Riyadh City. The study found 38% and 55% of adult and elderly subjects respectively, were anemic. The major factor that cause anemia is insufficient intake of iron and/or factors that affect its absorption. However, no study until now evaluated iron intake of adult Saudi women. Moreover, there is a lack of studies that evaluate anemia among adult males. Thus, the aim of this study is to evaluate anemia among adult males and females in Riyadh City based on hemoglobin and hematocrit levels in addition to levels of iron intake. Since hemoglobin and hematocrit levels are affected by

Table 1: Mean (±SD) of hemoglobin, hematocrit concentration and iron intake

	Males (n = 132)	Females (n = 102)
Hemoglobin (g/dL)	15.89±0.95[a]	13.68±0.83[b]
Hematocrit (%)	47.7±3.6[a]	38.9±3.2[b]
Iron intake (mg/day*)	13.6±3.1[a]	10.2±2.8[b]

*:Means are the average intake of three consecutive days, Different letters in a given row denote a significant difference, $p \leq 0.05$

Table 2: Mean (±SD) of hemoglobin and hematocrit concentration for male smokers and non-smokers

	Smokers (n = 52)	Non-smokers (n = 80)
Hemoglobin (g/dL)	16.42±0.13[a]	15.27±0.93[b]
Hematocrit (%)	49.6±3.3[a]	44.1±2.7[b]

Different letters in a given row denote a significant difference, $p \leq 0.05$

Table 3: % of subjects below cutoff values of hemoglobin and hematocrit and iron intake below DRI

	Males (n = 132)	Females (n = 102)
Hemoglobin	2.3%	21.6%
Hematocrit	0.0%	20.6%
Iron intake	4.5%	95.1%

cigarette smoking (Gibson, 2005) and smoking is prevalent among Saudi males (Jarallah *et al*., 1999; Siddiquie *et al*., 2001), this study evaluated anemia among male smokers and non-smokers.

Materials and Methods

The study was carried out in 234 healthy Saudi adults who were recruited from Riyadh City. Of which, 102 were female and 132 were males. The males were classified to cigarette smokers (n = 52) and non-smokers (n = 80). The recruitment was done by personal contact and by advertisement. Participants received a questionnaire asked for age, weight, height, exercise and smoking habits, health status, pregnancy-for females-and use of dietary supplements. Non healthy, pregnant women and users of dietary supplements were excluded. Participants received written instructions about keeping three consecutive day's food records. The instructions were explained to each participant individually. In addition, a one-day trial of keeping food records was done to ensure that all participants properly followed the instructions. For each participant, energy requirement (based on his/her physical activity level, weight, height and age) and energy intake (based on his/her food record intake) were determined. Individual (s) for whom their difference between energy requirement and energy intake exceeded 15% were excluded since this difference indicated incomplete food record or poor validity of the food records. On the fourth day, blood sample of 5ml was collected from each participant by venepuncture into EDTA vacnutainer tubes for hemoglobin and hematocrit determinations. All samples were analyzed in duplicate and the average is reported if the difference did not exceed 8%. Hematocrit and hemoglobin were determined using micro hematocrit and cyanmethemoglobin methods respectively, as described by Miale (1977). Food records of three consecutive days, two week days and one weekend day were analyzed by the Food Processor Software, version 7.8 (2001) (ESHA research, Salem, OR U.S.A.). For foods that are not in the software, other tables of food composition were used (Pellett and Shadarevion, 1970; Paul and Southgate, 1978). Iron intake was compared with the recommendation of Dietary Reference Intake (DRI). The statistical analysis included means, standard deviation and t-test comparisons between males and females as well as between cigarette smokers and non-smokers were performed by SPSS version 10. Significance of difference was set at p-value of ≤ 0.05.

Results

Data for hemoglobin, hematocrit concentration and iron intake for male and female participants is shown in Table 1. These parameters were significantly higher in male group compared to female group. Acceptable values for hemoglobin and hematocrit for adult males are 14-18 g/dL and 40-54%, respectively; and for adult female are 12-16 g/dL and 37-47%, respectively (Lee and Nieman, 2003; Gibson, 2005). Results of these two measures for male participants were within these acceptable values whereas for female participants were lower than the acceptable values. Also, hemoglobin and hematocrit values for male participants were within the normal range of hematological values for adult Saudis reported by Scott (1982). For smokers and non-smokers, hemoglobin and hematocrit values were also within the previous normal ranges (Table 2) but the means of both hemoglobin and hematocrit were significantly higher in smokers compared to non-smokers, ($p \leq 0.03$ and ≤ 0.05, respectively). The cutoff values for determining anemia for hemoglobin is <13.7 g/dL and <12.0 g/dL for adult male and female, respectively; and for hematocrit is <39% and <36% for adult male and female, respectively (Gibson, 2005). The percentage of participants with values below these cutoff values is presented in Table 3. Also, percentage of participants with average iron intake below the recommendation of dietary reference intake (DRI, 2000), 8 mg/day and 13 mg/day for adult male and female, respectively is presented in Table 3. Our findings showed inadequate intake of iron for the majority of female participants (95%). However, anemia as determined by hemoglobin and hematocrit concentrations and based on the previous cutoff values were found in nearly 21% of female participants. The previous findings were less notable among male participants. Both hemoglobin and hematocrit of male and female groups were significantly correlated with dietary iron intake, ($r = 0.40$, $p \leq 0.01$)

and ($r = 0.48$, $p \leq 0.01$) for hemoglobin and hematocrit, respectively which indicate completion and high validity of the food records.

Discussion

The mean intake of iron was adequate for male subjects and inadequate for female subjects when compared to DRI. Nearly 95% of female participants and 4.5% of male participants had iron intake below the recommendation. However, anemia as determined by hemoglobin and hematocrit values was found in nearly 21% of female and 2.3% of male participants (Table 3). This is because hemoglobin and hematocrit values are indicators of late stage of anemia since they become abnormally after period of time of iron deficiency and they both considered not good indicators of early iron deficiency (Lee and Nieman, 2003; Gibson, 2005; Rucher, 1991). For the male group, comparison with other data is not possible since this is the first study that evaluates iron intake and hematological parameters for adult healthy Saudi males. However, our findings illustrate that iron intake was adequate and anemia was not found among adult males. This is in agreement with several reports in other countries that reported iron deficiency anemia is prevalent among children and reproductive age female and not found among healthy adult males (Beard and Dawson, 1997). Our results are not in agreement with results of Alhamdan (2004) who found 38% of adult males living in Riyadh nursing home anemic based on their hemoglobin concentration values. Reason for this difference is the difference in sampling. This study recruited healthy adult males by volunteer whereas Alhamdan study recruited males from nursing homes. Subjects living in nursing homes are more likely to be undernourished compared to subjects living in ordinary homes. Among male participants and as expected, smokers compared to non-smokers had significantly higher mean hemoglobin value, which is in agreement with previous reports (Nordenberg *et al*., 1990; Lundman *et al*., 1990). The same trend was observed for the mean hematocrit value, which is also in agreement with previous reports (Girand *et al*., 1995; Lee *et al*., 1987; Vermaak *et al*., 1990). The elevation of hemoglobin and hematocrit by smoking is explained by elevation of carbon monoxide-a major component of cigarette smoke-which reduces oxygen tension in the body. This reduction increases production, maturity and release of erythrocytes from blood forming organs and thus elevates hemoglobin and hematocrit levels (Van Liere and Stickney, 1963). Cigarette smoking is prevalent among adult Saudi males as found in this study (39.4%) and other previous studies; 21.1% (Jarallah *et al*., 1999) and 34.4% (Siddiquie *et al*., 2001). Since both hemoglobin and hematocrit levels elevated by cigarette smoking, smoking must be considered in iron deficiency anemia studies among Saudi males that depend on hemoglobin and hematocrit values. Although this study found significant differences in hematological parameters between smokers and non-smokers, they both were within normal ranges and not anemic. Among female group, this study found high prevalence of inadequate iron intake and prevalence of anemia as determined by hemoglobin and hematocrit levels. This is the first study that evaluate iron intake of adult healthy non-pregnant Saudi females however, inadequacy of iron intake as well as low levels of hemoglobin and hematocrit in consistence with several previous studies (Mahfouz *et al*., 1994; Madani *et al*., 1995; Ghaznawi *et al*., 1988). These previous studies suggested that inadequate iron intake is the major factor of anemia, which is illustrated numerically in this study. Iron deficiency anemia among adult Saudi females found in this study and reported by other previous studies in addition to the prevalence of anemia among Saudi children is result of low iron and vitamin C intake and the high consumption of beverages that contain polyphenols-such as tea and coca-which could inhibit the absorption of non-heme iron. Fortification of some foods such as salts and juices in combination with additional intakes of iron from supplements and some changes in dietary consumption patterns can eradicated iron deficiency. This can be done by increasing the nutritional education and awareness among population as well as by governmental acts that makes iron fortification of some foods mandatory.

In conclusion, the results of this study showed that anemia as measured by hemoglobin and hematocrit levels was not found among adult Saudi males, both cigarette smokers and non-smokers, in Riyadh City. Also, iron intake for this group was adequate. In contrary, inadequacy of iron intake and iron deficiency anemia was prevalent among adult non-pregnant Saudi females in Riyadh City. These findings raise the need for action to eradicate iron deficiency anemia among Saudi females. Increasing public nutritional awareness and food fortification are examples of this action.

References

Abalkhail, B. and S. Shawky, 2002. Prevalence of daily breakfast intake, iron deficiency anaemia and awareness of being anaemic among Saudi school students. Int. J. Food Sci. Nutr., 53: 519-528.

Abou-Zeid, A.H., M.M. Abdel-Fattah, A.S. Al-Shehri, T.M. Hifnawy and S.A. Al-Hassan, 2006. Anemia and nutritional status of schoolchildren living at Saudi high altitude area. Saudi Med. J., 27: 862-869.

Al-Fawaz, I., 1993. Surveillance of iron deficiency anaemia at a well body clinic in Riyadh, Saudi Arabia. Saudi Med. J., 14: 27-31.

Alhamdan, A.A., 2004. Nutritional status of Saudi males living in the Riyadh nursing home. Asia. Pac. J. Clin. Nutr., 13: 373-376.

Al-Naguib, N. and A.A. Sadek, 1988. Child development and iron deficiency anaemia: A screening study on Middle Eastern children using the Denver development screening test. Ann. Saudi Med., 8: 414A.

Al-Othaimeen, A., A.K. Osman and S. Al-Orf, 1999. Prevalence of nutritional anaemia among school girls in Riyadh City, Saudi Arabia. Int. J. Food Sci. Nutr., 50: 237-243.

Beard, J.L. and H.D. Dawson, 1997. Iron In: Handbook of nutritionally essential mineral elements. By: O'Dell, B.L. and Sunole, R.A. Marcel Dekker Ins. U.S.A.

DRI, 2000. Institute of Medicine, Food and Nutrition Board. Dietary Reference Intakes for vitamin A, vitamin K, arsenic, boron, chromium, copper, iodine, iron, magnesium, molybdenum, nickel, silicon, vanadium and zinc. Washington, DC. National Academic Press.

Ghaznawi, H.I. and M.M. Hussein, 1988. Anaemia in pregnancy in Jeddah, Saudi Arabia. An epidemiological study. Bull. High. Int. Publ. Health, 18: 541-553.

Gibson, R.S., 2005. Assessment of iron status. In: principles of nutritional assessment. 2nd Ed. Oxford University Press, pp: 443-476.

Girand, D.W., H.D. Martin and J.A. Driskell, 1995. Erythrocyte and plasma B-6 vitamer concentrations of long-term tobacco smokers, chewers and nonusers. Am. J. Clin. Nutr., 62: 104-109.

Jarallah, J.S., K.A. Al-Rubeaan, A. Al-Nuaim, A.A. Al-Ruhaily and K.A. Kalantan, 1999. Prevalence and determinants of smoking in three regions of Saudi Arabia. Tob. Control, 8: 53-56.

Lee, C.J., G.S. Lawler and M. Panemangalore, 1987. Nutritional status of middle-aged and elderly females in kentucky in two seasons: part 2. Hematological parameters. J. Am. Coll. Nutr., 6: 217-222.

Lee, R.D. and D.C. Nieman, 2003. Standards for nutrient intake and iron status. In: Nutritional assessment, 3rd Ed. McGrwa-Hill Companies. U.S.A.

Lundman, B.M., K. Asplund and A. Norberg, 1990. Smoking and metabolic control in patients with insulin dependent diabetes mellitus. J. Int. Med., 227: 101-106.

Madani, K.A., N.S. Al-Amoudi and T.A. Kumosani, 2000. The state of nutrition in Saudi Arabia. Nutr. Health, 14: 17-31.

Madani, K.A., H.A. Nasrat and Al-Nowaisser, 1995. Low birth weight in Taif region, Saudi Arbia. East. Mediter. Health J., 1: 47-54.

Mahfouz, A.A., M.M. El-Said, W. Alakija, I.A. Badawi, R.A. Al-Erian and M.A. Moneim, 1994. Anemia among pregnant women in the Asir region, Saudi Arabia: an epidemiologic study. Southeast Asian J. Trop. Med. Public Health, 25: 84-87.

Miale, J.B., 1977. Laboratory medicine hematology: serology and immunology, general laboratory technique. The C.V. Moshy Company, pp: 1002 and 1011-1013.

Mussaiger, A.O., 2002. Iron deficiency anemia among children and pregnant women in the Arab Gulf countries: the need for action. Nutr. Health, 16: 161-171.

Nordenberg, D., R. Yip and N.J. Binkin, 1990. The effect of cigarette smoking on hemoglobin levels and anemia screening. JAMA., 264: 1556-1559.

Pellett, L.P. and S. Shadarevion, 1970. Food composition tables for use in the Middle East. American University of Beirut, Lebanon. 2nd Ed.

Poaul, A.A. and D.A.T. Southgate, 1978. The composition of foods. 4th Ed. Ministry of Agriculture, Fisheries and Food Medical Research Council. Special report # 297. Elsevier/North Holland Biomedical Press.

Rucher, R.B., 1991. Nutritional anemias. In: Clinical Nutritiona and Dietetics. 2nd Ed. Macmillan Publishing Company. U.S.A., pp: 683-700.

Sawaya, W.N., R.I. Tannous and A.I. Othaimeen, 1988. Dietary intake of Saudi infants and preschool children. Ecology of Food Nutr., 20: 171-184.

Scott, G., 1982. Pilot study of the reference values for the commoner haematological and biochemical parameters in Saudi nationals. J. Clin. Pathol., 35: 69-73.

Siddiquie, S., D.O. Ogbeide and I. Al-Khaslifal, 2001. Smoking in a Saudi community: prevalence, influencing factors and risk perception. Fam. Med., 33: 367-370.

Van Liere, E.J. and J.C. Stickney, 1963. Effect of hypoxia on the blood. In: Hypoxia. The University of Chicago Press, pp: 31-60.

Vermaak, W.J.H., J.B. Ubbink, H.C. Barnard, G.M. Potgieter, H. Vnjaarsveld and A.J. Groenewald, 1990. Vitamin B-6 nutrition status and cigarette smoking. Am. J. Clin. Nutr., 51: 1052-1061.