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Dietary iron status and health of third trimester pregnant women in Kenya: a cross sectional study

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Abstract

Insufficient dietary iron intake is a concern because most foods eaten in developing countries comprise of cereals which are sources of non-heme iron which become bioavailable when eaten with enhancers of absorption. There is an increased demand of iron, particularly in the third trimester, a time an additional supply is required for the growth of foetus and placenta, and to increase the maternal total red cell mass. This study aimed to carry out a comprehensive assessment of the dietary iron intake using 24-hour recall and food frequency questionnaires. Third trimester dietary iron intake survey was a cross-sectional survey of a representative sample of third trimester pregnant women aged 14 – 48 years. Pregnant women were asked to report all foods eaten in the last 24 hours, guided by a glass and asked to state if the quantity of food eaten filled what fraction of the glass. Glass -full of food has a standard mass of 337.5g. The 24 hour recall was repeated for three consecutive days. Quantity of food eaten was compared with the values in Food Consumption Tables to estimate dietary iron intake of each respondent. The bioavailable iron was calculated at 10% of amount of iron in the food for vegetarian populations as recommended in Food Consumption Tables for use in Africa. Mean daily dietary iron intake was 19.62mg (n=109), which was same as the recommended mean of 21mg per day (standard error of the mean 0.6964, Z= -1.02, $p<0.05$). Furthermore, 15.4% of third trimester pregnant women ate foods with below 19.62mg of iron per. There was no significant correlation between quantity of food eaten and amount of iron in the food ($r = 0.0959$). The mean daily dietary iron intake is indicative that third trimester pregnant women were mildly iron deficient according to WHO/Office of dietary supplements/Sehmi, and is a suitable index to assess iron status in populations or groups.

Key words: dietary iron, iron status, third trimester pregnancy

1. Introduction

Anaemia in pregnancy is a major public health problem in sub-Saharan Africa, where the prevalence can be as high as 75% (Carosi 1994 & Shulman et al. 1999). Anaemia, even when mild, is associated with reduced work productivity. During pregnancy, severe anaemia (haemoglobin [Hb]<7g/dL) may result in circulatory changes that are associated with an increased risk of heart failure (WHO 1979) . During labour, women with severe anaemia are less able to endure even moderate blood loss and as a consequence are at higher risk of requiring blood transfusion during delivery (Harrison, 1982). In addition, severe anaemia in pregnancy is an important direct and indirect cause of maternal death (Hoestermann et al. 1996), and for the foetus, severe maternal anaemia may result in intrauterine growth retardation, stillbirth, and low birth weight (Brabin & Piper 1997).
Most foods eaten in developing countries comprise of cereals. Whole cereals provide a rich source of many essential vitamins, minerals and phytochemicals. The typical cereal food is: low in saturated fat but is a source of polyunsaturated fats, including omega 3. Whole grain cereals are cholesterol free, high in both soluble and insoluble fibre and resistant starch, an excellent source of carbohydrates, a significant source of proteins, a good source of B- complex vitamins including folate, a good source of many minerals such as non-heme iron (Burgess 1994), magnesium, copper, phosphorus and zinc. It is a good source of antioxidants, including vitamin E and selenium as well as phytochemicals including phytoestrogens, phytic acid, flavonoids and phytosterols (which can help lower blood cholesterol level). The 24- hour recall and food frequency questionnaire are the most commonly used indices to assess dietary iron intake for a population or group.

2. Methods

Dietary iron intake among third trimester pregnant women was a cross-sectional survey of a nationally representative sample of third trimester pregnant women aged 14- 48 years conducted in the months of November and December 2009. Pregnant women were categorised in three groups based on clinic card records: early third trimester, middle third trimester, and late third trimester. Respondents were randomly selected from a list of third trimester pregnant women drawn from antenatal register at the district hospital and Katito Health Centre (Ministry of Planning 2007). Nyando District hospital and Katito Health Centre were purposively selected because they are located in the study area, and presumed that many study subjects visit them for medical services. Part of the list was obtained from trained Community Health Workers who used statistical records to identify study subjects not attending antenatal clinic. After informed consent was obtained, a questionnaire was completed to collect information on demographic variables. Information was also obtained on uptake of iron supplements. During 24 hour recall, respondents were asked to report all foods eaten and guided to give detailed description of foods they ate. They were then shown a glass and asked to state if food eaten filled what fraction of the glass. Standard mass of glass was 225g determined during approximation pilot study. The questionnaire was executed for three consecutive 24 hour recalls. The quantity of food eaten was compared with the values in Food Consumption Tables to estimate iron intake of each respondent. The bio-available iron was calculated at 10% of amount of iron in the food for vegetarian populations as recommended in Food Composition Tables for use in Africa. Foods were grouped and summed up into six point dietary score according to the following seven food groups: foods with at least 5mg of iron , 4.0- 4.9mg of iron, 3.0- 3.9mg of iron, 2.0- 2.9mg of iron, 1.0- 1.9mg of iron, and 0.0- 0.9mg of iron in 100g of food eaten. Respondents received a score of 1 if they ate a particular food group during the study. Maximum score in this scheme was 6 (for all six food groups) and minimum score of zero (for no food group). On the basis of cut-off points (Arimond & Ruel 2004), respondents who scored between zero and 2 points were classified as having low iron intake; between 3 and 4 points were classified as having middle iron intake; between 5 and 6 points were classified as having high iron intake. The results were analyzed using SPSS for Windows and presented as percentage (Z score below 2Sd) for respondents with low, middle, and high dietary diversity score. A correlation coefficient was used to compare differences in the amount of food eaten and the amount of iron in the food. The observed mean and expected dietary iron means were compared using t-test ($p<0.05$). More detailed data was on questions including whether the woman received iron supplements during pregnancy.

3. Results

3.1 Demographic characteristics of respondents

The population was characteristically youthful with 80 (73.4%) of the total population falling below 28 years of age. Most respondents (58.7%) had completed primary education. Respondents in age bracket 14-20 years ate a large percentage (3.6%) of foods with high iron content than other age groups. The medium iron rich foods (2.0-3.9mg of iron in 100g of edible food portion) were more eaten by those respondents in age group 21-27 years, at 15.4% of the foods eaten. Respondents in monogamous marriage ate more iron rich foods (4.7% for high iron rich foods; 27.6% for medium iron rich foods; and 36.5% for low iron rich foods) than any other marital group. Those who had completed Primary Education ate more iron rich foods (4.8% for high iron content foods; 22.8% for medium iron content foods; and 29.9% for low iron content foods) than those respondents who had not completed Primary Education. Respondents engaged in farming ate more iron rich foods (2.8%) than those in other occupations.

1.2. Iron content in the food

Three hundred and fifty nine (359) food servings were investigated to approximate iron content in food eaten. The results showed mean daily dietary iron intake at 19.62mg. Seventeen (15.4%) out of 109 ate foods with below 19.62mg of iron per day (standard error of the mean 0.6964, Z= -1.02). the dietary iron intake was same as recommended mean of 21mg per day ($p<0.05$). it was adequate for 92 (84.6%) out of 109 respondents. There was no significant correlation between quantity of food eaten and the amount of iron in the food ($r = 0.0959$). Amount of iron depended on type of food eaten. When content of iron eaten was analyzed against demographic variables, results were as shown in the table below.

Table 1.0 Demographic characteristic by amount of food eaten daily and quantity of iron in the food.

Demographic characteristics	Frequency (f)	Amount of food eaten daily (g)	Mg of iron in 100g of edible food portion
Maternal Age (yrs)			
14-20	37	1205.2(1246.9)a	21.9(23.9)a
21-27	44	1196.6(1298.7)	19.5(21.5)
28-34	22	1365.7(1423)	23.9(24.8)
35-41	5	1174.4(581.1)	18.9(19.9)
41-48	1	1377	21.3
Marital Status			
Married (monogamy)	74	1249.6 (1337.4)	20.9 (22.2)
Married (polygamy)	16	1191.8 (1223.3)	19.8 (20.4)
Widow	5	1133.2 (1258)	25.2 (30.1)
Separated/Divorced	3	908.5 (934.8)	15.3 (16.3)
Single	11	1283.9 (1317.6)	26.2 (29.3)
Maternal Education			
None	1	716.5	10.54
Primary incomplete	44	1284.6 (1342)	21.9 (23.7)
Primary complete	43	1138.4 (1231.1)	22.1 (23.8)
Secondary-incomplete	14	1265.4 (1313.4)	20.7 (20.2)
Secondary complete	7	1444.2 (1501)	18.4 (18.9)
Tertiary	0	-	-
Maternal Occupation			
Salaried	2	1379 (1430)	21.4 924.7)
Farming	37	1274.2 (1358.9)	21.3 (23.1)
Labouring	20	1294.5 (1340.3)	21.7 (22.5)
Trading	20	1234.9 (1270.9)	20.1 ((21.5)
None	30	900.6 (1024.1)	18.7 (18.9)

a-values in parenthesis are standard deviations, r = 0.0959, Z = -1.02, mean daily iron 19.62m, S.E.M =

0.6964mg.

1.3. Iron supplementation

Forty six percent (46%) out of 74 respondents in monogamous marriage were on iron supplements; seven (43.8%) out of 16 in polygamous marriage were on iron supplements, three (60%) out of 5 widows were on iron supplements, and five (45.5%) out of 11 singles were on iron supplements. Generally, 61 (56%) out of 109 respondents were on iron supplements. When uptake of iron supplements were analyzed against level of education of respondents, 23 (52.3%) out of 44 respondents who had not completed primary education were on iron supplements; 22 (52.4%) out of 42 respondents who had completed primary education were on iron supplements; 9 (64.3%) out of 14 respondents who had not completed secondary education were on iron supplements, while 7 (87.5%) out of 8 respondents who had completed secondary education were on iron supplements. It was found that level of education was significantly associated with uptake of iron supplements ($p<0.05$).

2. Discussion

Greater awareness leads ultimately to increased actions to reduce low dietary iron intake (Charlotte et al. 2007). Two key findings emerged regarding education and dietary iron intake that are consistent with the findings of this study. Firstly, there was greater awareness of dietary iron intake in university educated women compared to non-university attendees (96.4% vs 10.1%, $p<0.01$). Secondly, the former groups were also better at identifying causes of low dietary iron intake than the latter group (73.3% vs 54.5%, $p<0.01$). The findings of this study are also consistent with the results of Kenya Demographic and Health Survey (Ministry of Planning 2003). The 2003 results shows that mothers with no education have the highest levels of underweight children (33%), while mothers with some secondary education have the lowest level of underweight children. Maternal education is positively correlated with nutrition knowledge, attitude toward meal planning, and stricter attitudes towards feeding children (Caliendo 1982).

The main sources of iron were vegetables, fruits, cereals and cereal products with low contents of readily available iron and relatively high amount of phytates, a potent inhibitor of iron absorption. Amount of iron eaten depend on type of food (Dwyer 1988 & Sanders 1994), evidence that balanced vegetable diet can maintain an adequate iron status. Household income is positively associated with dietary iron intake (Adebe et al. 2006). This is evident in the results of this study showing that respondents from low paying occupations ate very little iron rich foods. Women who do not eat enough iron rich foods during early pregnancy tend to have babies with lower birth weight. The results were that the higher the total iron intake from food and supplements during the first trimester of pregnancy, the more likely it is for a woman to have a bigger baby. This relationship was stronger in women with adequate intake of vitamin C.

Currently, iron or iron folate supplements are distributed to pregnant women in most developing countries free of charge or at low cost by public authorities. Nevertheless, few data show that coverage is good or that anaemia prevalence rates are declining (INACG 1999). Current iron supplement recommendation for pregnant women who are not anaemic is too high and could lead to birth complications for infants such as premature birth and low birth weight (Diana 2006). This research finding conflicts with recommendations of World Health Organization (WHO) and the Centers for Disease Control and Prevention (CDC). Enrichment and fortification of food items, and dietary changes resulting from education interventions, have met with some success in developed countries, but not often in developing world (Beard 2000). Many people in developing countries exist on monotonous cereal or legume based diets, and they have little access to animal products or a variety of fruits and vegetables. Even when such foods are available, cultural beliefs may deny pregnant women access to these foods (UNICEF 1998), rendering them at risk to micronutrient deficiencies.

3. Conclusions

The dietary iron intake was adequate for 84.6% (92 out of 109) of the respondents, however, 15.4% of the study population were at risk of being iron deficient. To decide which foodstuffs are of greatest iron value, pregnant women need to be provided with information that will reduce or close their knowledge gap about the nutritional value of locally available foodstuffs. Awareness campaign on the benefits of taking iron supplements during pregnancy should be intensified to fill the gap by low dietary iron intake.

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References

Adebe, Y., Bogale, A., Hambidge, K., Soecker, B., Banley, K. & Gibson, R. (2006), "Phytates, Iron, Zinc and Calcium Content of selected raw and prepared foods consumed in Rural Sidima, Southern Ethiopia, and implications for bioavailability", *Journal of Food Composition and Analysis* Vol.20, Issue 3-4, Pp 161-168.

Arimond, M. & Ruel, M.T. (2004), "Dietary Diversity Associated with child nutritional status: evidence from eleven demographic and health surveys". *Journal of Nutrition* 134, 2579-85.

Beard, L.J. (2000), "Effectiveness and Strategies of Iron Supplementation during pregnancy", *American Journal of Clinical Nutrition* Vol.71, No. 5, 1288S-1294s, May

Brabin, B. & Piper, C. (1997), "Anaemia and Malaria-attributable low birth weight in two populations in Papua New Guinea". *Annals of Human Biology* 24,547-555

Burgess, A. (1994), "*Community Nutrition for Eastern Africa"*. Nairobi. AMREF.

Caliendo, M.A., Booth G. & Moser P. (1982), "Iron Intakes and Serum Ferritin Levels in development delayed children. An Assessment of Maternal Knowledge and Attitudes", *Journal of American Dietary Association* October 81 (4), 401-6

Carosi, L.G. (1994), "Malaria and Anaemia in pregnant women in urban Zanzibar, Tanzania" *Annals of Tropical Medicine Parasitology* 88,475-483.

Charlotte, A., Alice C. & Sarah F. (2007), "*Deficiency Anaemia in Ecuador: Does Education matter"*.

Diana, Y. (2006), "*Healthy Pregnant Women's Iron Intake Too High. Archives of Medical Research"*, 01 June-2.00PDT

Dwyer, J.T. (1988), "Health aspects of vegetarian diets". *American Journal of Clinical Nutrition* 48, 712-738

Harrison, K.A. (1982), "Anaemia, Malaria and Sickle Cell disease". *Clinical Obstetrics Gynaecology* 9, 445-477

Hoestermann, C.F., Ogbaselassie, G., Wacker J. & Bastert (1996), "Maternal Mortality in the main referral hospital in the Gambia, West Africa". *Clinical Medicine International Health* 1, 710-717

International Nutritional Anaemia Consultative Group (INACG) (1999), "*symposium*, 2000". 12 March. Durban, South Africa. Washington DC

Ministry of Planning (2007), "*Kenya Integrated Household Budget Survey 2005/2006*". Kenya National Bureau of Statistics

Ministry of Planning (2003), "*Kenya Demographic and Health Survey*". Kenya National Bureau of Statistics

Office of Dietary Supplements (2007), "*Dietary Supplement Fact Sheet: Iron*." USA. National Institute of Health.

Sanders, T.A.B. (1994), "National Aspects of a Meatless diet", *Procurement Nutrition Society* 53, 297-307

Sehmi, J.K. (1993), National Food Composition Tables and the Planning of Satisfactory Diets in Kenya. Nairobi. Government Printer.

Shulman, C.E., Geissier, P.W., Prince, R.J., Levene, M., Poda, C., Beckerieg, S.E., & Mutemi W. (1999), "*Perceptions of soil eating and anaemia among pregnant women on the Kenyan Coast*", March.

UNICEF (1998), "*State of The World's Children."* Oxford, United Kingdom: Oxford University Press.

W.H.O. (1979), "*The prevalence of nutritional anaemia in women in developing countries"*. Document FHE/79.3. Geneva: World Health Organization