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Association between Dietary Iron Consumption and Hemoglobin Levels Among Pregnant Women in Migratory Community, Narok County

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Abstract
Anaemia is believed to be the world's second-leading root cause of disability (Adikari, Sivakanesan, Wijesinghe, & Liyanage, 2016). Globally, WHO estimated the number of persons with anaemia to be about 2 billion and approximately 50% of all cases can be linked to dietary intake that causes iron deficiency (World Health Organisation, 2011). This study sought to determine the association between dietary Iron consumption and Hemoglobin levels among pregnant women in migratory community, Narok County. It was a Cross-sectional study, which was conducted in Ewaso Ng'iro Health centre, at Maji-Moto Naroosura ward in Narok County, Kenya. The study participants were women who tested positive for pregnancy, documented in maternal child health card, and were enrolled at antenatal clinic. It included 192 pregnant women aged 15-49 years who actively attended their antenatal clinic and were willing to voluntarily participate in the study. A 24-hour recall was used to assess dietary intake and the data was cleaned, edited, coded and checked for completeness using Microsoft excel. The 24-hour recall data analysis was carried out using Nutri-survey 2007 statistical software to check for key nutrient consumption. In addition, the blood sample was obtained from the side of the fingertip, for the best blood flow and least pain. Inferential statistics was then used to examine the relationship between the two variables and the significance was accepted at a P-value, of less than 0.05. The results of the Pearson correlation indicated that there was a weak positive association between hemoglobin level for pregnant mothers and maternal dietary iron intake levels r=0.1036, 95% CI (0.002-0.20), p=0.04, r^2=0.014 with the Iron levels explaining 1% of the variation in maternal Iron concentration.

Key words: *Association, Dietary Iron consumption, Hemoglobin levels, pregnant women, migratory community*

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I. Introduction

Globally, Iron Deficiency Anaemia (IDA) has been known to have negative effects on the lives of more than 2 billion people (World Health Organisation, 2011; Saha & Psa, 2017). In addition, studies have reported that anaemia contributes to 20% of all maternal deaths (Tyagi, Kaushik, Khatri, & Ranga, 2016).

According to the World Health Organisation (WHO), anaemia during pregnancy has been defined as a haemoglobin concentration of less than 11 g/dl (World Health Organisation, 2011). Anaemia is considered severe when the haemoglobin concentration is less than 7.0 g/dl, moderate when haemoglobin falls between 7.0 and 9.9 g/dl, and mild when haemoglobin is from 10.0 to 10.9 g/dl (World Health Organisation, 2011).

It is estimated that more than 40% of pregnant women worldwide are anaemic. At least half of this anaemia burden is assumed to be due to iron deficiency (Breymann, 2013). Pregnant women require additional iron and folic acid to meet their own nutritional needs as well as those of the developing foetus. Deficiencies in iron and folic acid during pregnancy can potentially negatively impact the health of the mother, her pregnancy, as well as foetal development. Evidence has shown that the use of iron and folic acid supplements is associated with a reduced risk of iron deficiency and anaemia in pregnant women (Breymann, 2013). Iron is an essential micronutrient, and it is important not only in carrying oxygen but also to the catalytic activity of a variety of enzymes. In the foetus, it is vital to the synthesis of haemoglobin and in brain development. Iron deficiency anaemia in pregnancy is a common problem, even in high-income country settings.

Further, (Addis Alene, & Mohamed Dohe, 2014) found out that, Anaemia has proved to be a universal health problem in both developing and developed countries with major effects on human health as well as to social and economic development. In addition, it is stated that Anaemia is also responsible for about 1 million deaths a year, out of which three-quarters occur in Africa and South-East Asia (Kumar & Cs, 2014). It affects

over half of preschool-age children and pregnant women in developing countries, and at least 30-40% in industrialized countries (Mekonnen, Ambaw, & Neri, 2018).

Nevertheless, it is apparent that the prevalence of anaemia in developing countries is about four times more than in developed countries (World Health Organisation, 2014). Further, it was revealed that almost 90% of all global maternal deaths occur in sub-Saharan Africa (Van Den Broek & Falconer, 2011). Moreover, in Sub-Saharan Africa, iron and folate deficiencies are the most common causes of anaemia among pregnant women (VanderJagt et al., 2007). In addition, the prevalence of anaemia in Africa is estimated to be as high as 66.8% (Okube et al., 2016).

According to the Kenyan Demographic and Health Survey (KDHS, 2014) maternal deaths are approximately 14% among women of reproductive age, and about 1 in 67 women are likely to die during pregnancy, during childbirth, or within two months of childbirth because of iron deficiency anaemia even with iron and folic acid intervention by the government of Kenya.

In addition, IDA in Narok County, among pregnant women remains a major public health concern, because of the various socio-cultural difficulties like illiteracy, poverty, lack of awareness, cultural and religious taboos, poor dietary habits, as well as high prevalence of parasitic infestations. Consequently, most of the population's dietary patterns and diversity worsen, with households concentrating mainly on cereals more than other food groups and a number of households reducing the number of meals consumed per day from the usual three to two times a day (Presidency & Devolution, 2017).This, therefore, predisposes the vulnerable groups (Pregnant women and children under 5 years) to IDA.

Traditionally, during pregnancy Maasai women consumed a modified diet that included restricting caloric consumption during and after 6 months of pregnancy (Brady, Suksiri, Tan, Dodds, & Aine, 2008). The dietary restrictions in the community are believed to guarantee smaller babies, thereby facilitating safe delivery and limiting medical interventions during childbirth (Brady et al., 2008). Moreover, the community elders and the TBAs often enforce this practice in the first pregnancy, and women opt to follow this pattern in subsequent pregnancies. According to a study that was conducted in rural Gambia, a study site with similar social demographic characteristics with the study area, it was noted that the Maasai pregnant women's dietary patterns on average, had a lower intake of carbohydrates, proteins, and fats per day than the recommended daily intakes (Lowe, Chen, & Huang, 2016).

A study in Nigeria, showed that a higher prevalence of anaemia was attributed to differences in dietary habits of the study participants, in which fermented Enset (kocho) contributed more amount of vitamin B12, compared with the maize diet group which was the main staple food in the study area (Gedefaw Lealem, Asrat Ayele, 2013). In addition, the study participants who took tea after meals were found to be 7.8 times more anaemic than those who took tea once or none per day (Gedefaw Lealem, Asrat Ayele, 2013). I would like to agree with the study because; the effect of tea on the absorption of non-heme iron is believed to have been ascribed to the formation of insoluble iron tannate complexes.

However, another study done in Nigeria revealed that traditional beliefs regarding foods to be avoided during pregnancy were considered as a major factor limiting the quality of dietary intake among the Nigerian pregnant women (Lindsay, Gibney, & Mcauliffe, 2012). The most common foods reported to be avoided in pregnancy were 'energy-giving foods', such as cassava, rice and yam, followed by 'body-building foods' (e.g. meat, egg, liver) and various types of fruits (Lindsay et al., 2012). The variety of meats avoided denied pregnant women of some of the cheapest sources of high-quality protein, which may have contributed to Iron deficiency anaemia, as well as malnutrition.

The main reasons reported for avoiding certain foods during pregnancy in Nigeria were taboo, stomach pains, nausea/vomiting and the effect on the baby's size because of fear that the birth of large babies increased the risk for caesarean section (Abrehet Abriha, 2015). Strong aversion to surgical delivery is common in developing countries as a result of social misconception, religious views, and fear of surgical complications and cost, even in the context of obstetric emergencies (Lindsay et al., 2012).

The above results were in agreement with a study that was done in Kenya, at Pumwani Maternity hospital, whereby, one third 86 (33.3%) of the women avoided certain foods such as red meat 28 (32.6%) and green vegetables 26 (30.2%) with the reason of reducing the size of the baby and due to vomiting, while 37 (43.0%) avoided certain foods due to heartburn. Majority of the participants, i.e. 241 (93.4%) of the pregnant women reported to drink beverages (tea, cocoa or coffee) and 66.0% of them drank these beverages in less than 20 minutes before/after meals. More than half 143 (55.4%) of pregnant women ate meals three times per day (Okube et al., 2016).

Further, all women reported that they never smoked cigarettes, and almost all (98.4%) of the women said they never took alcohol. However, the overall prevalence of anaemia (Hb < 11 g/dl) was 57.0%, and in terms of severity, mild anaemia was 26.5%, moderate anaemia was 70.7%, and severe anaemia was 2.7% (Okube et al., 2016). This showed that the dietary habits of pregnant women might have contributed to Iron deficiency anaemia.

On the other hand, another study in Ethiopia revealed that, regarding the feeding habit of the respondents, most 166 (59.5%) of the respondents reported that they modified their food when they became pregnant (Ante et al., 2014). It is believed that the modification and the decrease of food during pregnancy could have contributed to anaemia. This is because modification of food reported by majority 123 (69.1%) of the respondents was by changing the type of food while the least 12 (6.7%) reported modifying their food by decreasing the quantity of food. The type of food items preferred by the majority 57 (44.2%) of the respondents was vegetables. In the study, 9.4% of pregnant mothers were found to be anaemic out of which 64.3%, 32.1% and 3.6% were with mild, moderate and severe Anaemia respectively (Ante et al., 2014). Consequently, I would like to differ with the researcher of the study, because it was not put into consideration if the pregnant women in the community restricted protein foods like meat, eggs and milk which are known to be the rich sources of Iron that is highly bioavailable.

(Lennox et al., 2017), reveals that in a study conducted in southern Tanzania, nearly two-thirds (69%) of the pregnant women avoided fish and farm meats. Further, avoiding eating eggs in parts of Tanzania and in some parts of Africa was related to the animal's characteristics being transferred to the child or causing sterility. Many culturally informed prenatal food restrictions were related to ensuring that the 'baby will not be too big', the head would be normal size, or to avert 'a difficult labour'. Dietary taboos were most often enforced by the elders, mothers-in-law, or husbands and other family members (Lennox et al., 2017).

However, in Kenya a study that was conducted in Mbagathi hospital publicised that, the overall prevalence of anaemia among pregnant women was 36.3%; Mild anaemia was 51%, Moderate anaemia was 48% while severe anaemia cases was 1% (Alemayehu, Gedefaw, Yemane, & Asres, 2016), compared to a study done in West Arsi zone, Oroma region of Ethiopia, the results were almost similar in that, the overall prevalence was found to be 36.6%, Mild anaemia was 32.6%, Moderate anaemia was 3.7% while Severe anaemia was 1% (Gedefaw Lealem, Asrat Ayele, 2013). This indicated that IDA is still a major concern in Kenya.

In Narok County, the Maasai people emphasised on a theme; 'Eating less food lets baby come easier' this theme, was derived from a direct quotation (Lennox et al., 2017). It reflects the belief that a pregnant woman's food intake must be decreased to prevent a large baby. This belief seemed to relate to a number of factors such as the risk of death due to a large infant, concern for lack of specialized care if the baby did not pass naturally, and concern over the health of a big infant (Lennox et al., 2017).

Furthermore, a majority of the pregnant women among the Maasai community travel long distances to clinics and value the tradition of giving birth at home under the supervision of a traditional birth attendant. Thus, delivering at home makes it necessary for women to avoid big babies, which, they believe, increases the risk for a caesarean delivery (Lennox et al., 2017). The use of local herbs and medicine at some point during pregnancy is seen as a means to cleanse or cure the woman's sickness (i.e., nausea and vomiting), fever, or from consumption of 'prohibited foods' (i.e., foods high in fat or sugar). Primarily, mother-in-law or Elders monitor pregnant mothers' diets (Lennox et al., 2017).

Also, the presence of cultural practices and taboos that restricts pregnant women from taking foods like; meat, eggs, green leafy vegetables and even milk, due to the perception of the baby growing huge and the mother being unable to deliver normally at home, is a great problem. In addition, during the 3rd trimester, if a pregnant woman is believed to have overfed, induced vomiting is done by giving plenty of warm water. This is done with the need of making the woman vomits much of what she had already taken, so as to control the growth of the unborn baby. All these practices deny the mother and the baby the right to quality food which may result in severe Iron Deficiency Anaemia and underweight babies.

II. Materials and Methods

24-hour dietary recall is a retrospective method of dietary assessment. A random number of (384/2, n=192) were purposively selected for the 24-hour recall interview, basing on the criteria of their availability to come back for the dietary assessment whereby; they were to recall and give the details of the food and beverages consumed during the last 24 hours. The interview was carried out in person in chronological order of consumption. The Multiple Pass Recall (MPR) was used as a staged approach to the dietary recall.

The study participants were not interrupted as they recalled, and afterwards probing was done on the quantities, ingredients and method of food preparation with a review of everything that was previously recalled. For each item of food or drink in the questionnaire list, the respondents were also asked to provide additional details, including; the time at which the food or drink was consumed, a full description of the food or drink, including the foods or beverages that were taken in combination like milk in tea. The study participants were then asked to give the food frequency, i.e. how many times the food or beverages were taken in the last 24 hours. Food frequency was combined with the 24-hour recall in order to improve the data on food estimation.

On Haemoglobin Assessment the study participants were checked for signs of anaemia, which included paleness of the skin, nails and lips, weakness, shortness of breath, dizziness and irregular heartbeats. The study participants were then informed on the procedure of obtaining the blood sample. They were also notified that the procedure of drawing blood from them was going to be done by a qualified laboratory technician, and therefore there was no need to be anxious.

The sample was obtained from the side of the fingertip and not the Centre, for the best blood flow and least pain. The finger was then punctured using a lancet as slight pressure was applied towards the fingertip. The first 2-3 drops of blood were wiped with a lint-free wipe. Another light pressure was applied towards the fingertip until another drop of blood appeared. About 4 millimeters of blood was obtained using a capillary tube and put in a cuvette. The excess blood was wiped from the outer surface of the cuvette with a lint-free wipe; if there were any air bubbles, another cuvette was filled. The cuvette was then placed in its holder and gently pushed to its measuring position (photometer) on the Mission Plus HB machine after it was turned on and the measurements were read out after 15-60 seconds.

III. Results

Association between Dietary Iron Consumption and Haemoglobin Levels among Pregnant Women after Controlling for Age and Education

Table: Association between Dietary Iron Consumption and Haemoglobin Levels

Outcome	p-value* (95% CI)	r	r^2
Iron levels (mg/day)	0.041	0.1036	1.0732
Age	0.037		
Education	0.034		

*Pearson's Chi-square test
**Binary logistic regression

From the findings, Pearson's correlation was first run to examine the association between Pregnancy Haemoglobin levels in g/dL and maternal dietary Iron intakes in mg/day. It was then followed by multiple regression models that adjusted for the potential confounding factors that included age, education levels and parity. These were excluded from the model, due to their collinearity to age.

A statistical significance level of 5% with 95% confidence intervals was used in the regression model. It was found out that there was a significant positive relationship between Iron Deficiency and maternal age. It showed that, as pregnant women aged, they were more likely to be anaemic compared to those pregnant women who were still young.

The results of the Pearson correlation indicated that there was a weak positive association between haemoglobin level for pregnant mothers and maternal dietary iron intake levels r=0.1036, 95% CI (0.002-0.20), p=0.04, r^2=0.014 with the Iron levels explaining 1% of the variation in maternal Iron concentration. The weak association could be associated with induced vomiting that is considered a cultural practice in the area.

With adjustment for the confounding characteristics (mother's age, and education level), there was still a weak association between the primary exposures (maternal dietary intake and haemoglobin levels (p=0.03). This meant that a very small proportion of the maternal haemoglobin levels is explained by the dietary intake, albeit age and education level.

IV. Discussion

In the present study, there was a significant positive relationship between Iron Deficiency and maternal age advances. These findings were in agreement with the previous studies conducted in Kisumu County in Kenya, Ethiopia , Tanzania and Egypt (Alemayehu et al., 2016) which found that late pregnancy has significantly increased risk of developing anaemia.

It is generally believed that anaemia in pregnancy increases with rising parity as well as maternal age. Besides the general body weakness with advanced maternal age, older women are expected to be multigravida. This is because multigravida may induce anaemia by reducing maternal iron reserves at every pregnancy and by causing blood loss at each delivery.

However, this finding contrasted with those of a study by Soto et al., 2017, which reported that there were no significant associations observed between any of the dietary intake and Haemoglobin levels (Soto, Guilloty, Anzalota, Rosario, & Campus, 2017).

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