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ANEMIA IN THE CONTEXT OF PREGNANCY AND HIV/AIDS: A CASE OF PUMWANI MATERNITY HOSPITAL IN NAIROBI KENYA

Waweru J[1]*, Mugenda O[2] and E Kuria[3]

Joseph Waweru

*Corresponding author email: wajosem@yahoo.com

[1]Department of Foods, Nutrition and Dietetics. Kenyatta University. P.O. Box 27433-00100 Nairobi, Kenya.

[2]Vice Chancellor, Kenyatta University, P.O. Box 43844- 00100 Nairobi, Kenya. Email: vc@ku.ac.ke

[3]Department of Foods, Nutrition and Dietetics, Kenyatta University, P.O. Box 43844-00100 Nairobi, Kenya. Email: enkuriakan@yahoo.com

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ABSTRACT

Anemia is a major public health problem in Africa affecting over 80% of women in many countries. It is more common during pregnancy due to the increased demand for iron at different stages of pregnancy. In Kenya, one out of every two mothers is affected by some form of anemia. Human immunodeficiency virus (HIV) and acquired immune deficiency syndrome (AIDS) among expectant women further increase risk of anemia prevalence and severity. This study was to determine the socio-economic characteristics, dietary pattern of pregnant women and investigate the relationship between iron deficiency anemia (IDA) and HIV/AIDS in pregnancy. A case-control study was conducted in Pumwani Maternity Hospital in Nairobi Kenya. The HIV status was ascertained through HIV-antibody tests using Determine, Uni-Gold and Tie-Breaker reagents. Cases of 57 seropositive and controls of 57 seronegative pregnant women were randomly and co-currently selected. Their hemoglobin (Hb), demographic, socio-economic characteristics were determined. A 24-hour dietary recall and food frequency were used to determine the food consumption pattern. Results showed that both cases and controls were from low socio-economic status and consumed monotonous diets of plant origin particularly *Ugali,* a paste made from maize flour and kales vegetables locally known as *Sukumawiki*. Fruits were rarely consumed. The meals were mainly consumed three times in a day with snacks consumed by an insignificant number of women. With exception of pre-eclampsia, other pregnant-related problems including headache, dizziness, loss of appetite, heartburn and vomiting were more predominant among the cases than in the controls. Iron deficiency anemia was more prevalent and severe among the cases (prevalence=68%, mean Hb=9.551g/dl) than the controls (prevalence=26.3 %, mean Hb=11.974g/dl). The relative risk of being anemic was about two times higher for HIV-infected as of the uninfected pregnant women, (Relative risk=2.33). It is concluded that pregnant women from low socio-economic status consume diets with iron of low biological value, have low Hb and are generally anemic. Moreover, HIV-infected pregnant women have lower Hb and are two times more likely to be anemic than the uninfected. The HIV/AIDS infection is therefore associated with low Hb and higher anemia prevalence and severity among pregnant women. There is, therefore, a need for pre-natal nutrition care system that emphasizes improved consumption of essential nutrients including iron of high biological value and implementation of interventions tailored to check anemia prevalence and severity among pregnant women within the context of HIV/AIDS pandemic and low socio-economic settings.

Key words: anemia, HIV/AIDS, pregnancy, hemoglobin, iron

INTRODUCTION

Iron plays an important role in the production of enzymes, hormones and antibodies that help in regulation of growth activity, development, and the functioning of the immune systems [1]. However, despite the already established importance of the iron, more than two billion people globally are affected by iron deficiency anemia (IDA), with prevalence rates of 23% and 52% recorded in developed and developing countries, respectively [2,3]

In Africa, anemia is a major public health problem affecting over 80% of women in many countries [3, 4]. It is more common during pregnancy due to the increased demand of about 700-850mg of iron at different stages of pregnancy. In Kenya, one out of every two mothers is affected by some form of anemia [5, 6]. Human immunodeficiency virus (HIV) and acquired immune deficiency syndrome (AIDS) infection among expectant women may further increase risks of anemia prevalence and severity due to the synergistic relationship between HIV/AIDS and anemia [14]. An anemic person has a reduced resistance to infections including HIV/AIDS [7]. The risk may even be higher for pregnant women who have suppressed immunity during pregnancy [8, 9]. Human immunodeficiency virus and acquired immune deficiency syndrome on the other hand can cause IDA through cytokine-induced suppression of red blood cell production by antiretroviral drugs, chronic inflammation, opportunistic infections, and/or reduction in dietary iron intake, absorption and retention [10]. Anemia in pregnancy may also be influenced by number of previous pregnancies, birth interval, stage of pregnancy, parity, age, whether single or multiple pregnancy and other infectious diseases such as malaria [4, 11].

Failure to understand the trend of IDA and its consequences among HIV-infected pregnant mothers has contributed to lack of anemia management practices that are specific to HIV-infection in pregnancy. Management of pregnancy anemia without putting into consideration the HIV status may not check the aggravation of anemia and the progression of asymptomatic HIV to symptomatic AIDS [12]. The major aim of the study was to investigate the relationship between iron deficiency anemia (IDA) and HIV/AIDS in pregnancy and the associated socio-economic characteristics and food consumption practices.

METHODOLOGY

A case-control study was conducted at Pumwani Maternity Hospital in Nairobi Kenya. The HIV status of the pregnant women attending antenatal clinic was ascertained through HIV antibody tests using Determine, Uni-Gold and Tie-Breaker reagents by the health personnel. The pregnant women who tested positive with any two reagents were classified as seropostive while those who tested negative as seronegative. Cases of 57 seropositive and controls of 57 seronegative pregnant women were randomly and co-currently selected. The serum hemoglobin level was assessed by health professionals on the day of data collection as part of routine laboratory testing at the hospital, while the demographic and socio-economic characteristics were established by use of a semi-structured interview schedule. A 24-

hour dietary recall and food frequency were used to determine the food consumption pattern and the approximate level of dietary iron intake calculated by the use of food composition tables.

Statistical analysis of the data was done by use of Statistical Package for Social Science (SPSS) and the relationships and differences between the cases and the controls determined at 95% confidence interval, where $p<0.05$ was considered significant. Pearson and Spearman Rho correlations were carried out to determine whether there is significant correlation between continuous variables and categorical variables such respectively. Student *t*-test was used to analyze the significant difference between mean values. Respondent with Hb level of >11g/dl were considered non-anemic while those with Hb level of ≤11g/dl were classified as anemic. .

RESULTS

HIV/AIDS status of pregnant women

The respondents categorized as seropositive or HIV-infected (the cases) in this study tested positive for HIV type 1 (HIV-1) with the three reagents (Unigold, Determine and Tie Breaker) after first and confirmatory tests. While those who tested negative for both HIV types 1 and 2 are categorized as the seronegative or HIV-uninfected (the controls). There were neither cases of HIV type 2 (HIV-2) nor dual infection with HIV-1 and HIV-2 reported in the study. The findings are in conformity with other studies that have indicated that HIV-1 is the dominant virus in East Africa [8].

Socio-economic and Demographic Characteristics

The respondents were drawn from nine different tribes in Kenya, with women from the Kikuyu tribe accounting for the majority 54.4% and 47.4% of the assessed seronegative and seropositive women, respectively. They were followed by women from Kamba tribe who accounted for 17.5% and 19.3% of the assessed seronegative and seropositive women, respectively. The age of respondents ranged between 16-36 years (mean=26) for seronegative and 17-35 years (mean=25) for seropositive. This indicates that the youngest pregnant respondent in the study was 16 years old while the oldest respondent was aged 36 years. The majority of the seronegative (92.8%) and seropositive (82.4%) were married while their household sizes ranged between one to four people (mean=3.1). The findings showed that 31.6% of seronegative and 38.6% of seropositive women were in their first pregnancy while others had one to six previous pregnancies (mean=1.4). A significant relationship was established between number of previous pregnancy and Hb levels of seropositive pregnant women where the higher the number of previous pregnancies the lower the Hb levels ($P<0.05$). The overall birth interval ranged between one to six years (mean= 4.5). On education, most respondents, seronegative (47.4%) and seropositive (35.1%) had up to secondary school level of education. Only two women (a case and a control) had university education while 12.2% of seropositive and 10.5% of seronegative had no formal education.

The largest proportion (86%) of the respondents were either in low profile occupations with low-income earnings such as house help, tea girls, secretaries, kiosk business or totally dependent on their close family members for their daily needs including food. Basing on the Kenya Central Bureau of Statistic's classification, over 70% of both HIV-infected and non-infected pregnant women were from low economic classes, with monthly income below Kenya shillings 10,000 [1, 13, 14]. Slightly above half of the respondents, seronegative (52.6%) and seropositive (50.9%) had no source of income and were economically dependent on their spouses or parents. Only three respondents had a monthly income of over ten thousand Kenya shillings. The monthly income of the respondents is shown in Table 1. Even though the income from the spouses of the married respondents is crucial in the purchase of food and non food items for the household, most respondents in this study did not know the income of their spouses or guardians and hence only the income received directly by the respondent is considered in the analysis. Moreover, past studies have shown that improvements in household welfare depend not only on the level of household income, but also on who earns that income [15]. These studies found out that women, compared to men, tend to spend their income disproportionately on food for the family. In addition, their income is more strongly associated with improvements in children's health and nutritional status than are men's income.

With the exception of respondents' income which was strongly associated ($p<0.05$) with higher dietary consumption of iron and high Hb levels, household size, ethnicity, marital status, education level and age were not ($p>0.05$). This underscores the importance of income as the source of quality and quantity food in urban centres, which in turn impacts directly on the nutritional status.

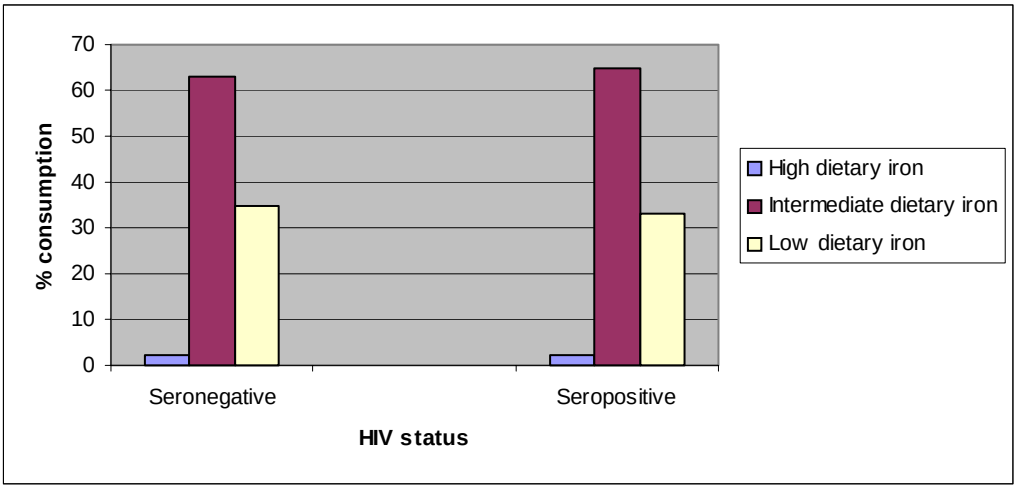
Meal and Dietary Iron Consumption Practice

Despite the high requirements for most nutrients such as iron in pregnancy, the women in this study continued with the same eating habits as practiced before pregnancy. Pregnant women in the study irrespective of their HIV status age, marital status, and ethnicity and education status consumed similar monotonous diet high in plant-based foods (but less in fruits) and low in animal-based foods. Food was mainly taken in three meals per day, distributed in breakfast, lunch and dinner. Less than ten percent of the women (8% seronegative and 9% seropositive) had consumed mid-meal snacks in the preceding 24-hours. Table 2 shows distribution of respondents who had consumed different types of meal. Recommendation for consumption of mid-meal snacks is expected to enhance quality and quantity which may not be met when snacks are not consumed. The stomach capacity of the pregnant women is reduced by the developing fetus and as such expectant women may not take sufficient amount of food from three meals. Nutritive snacks are, therefore, required to meet both quality and quantity of food consumed by pregnant women. The meals consumed in a 24 hour period prior to the assessment lacked variety with *Ugali,* a paste prepared from maize flour and kale vegetables locally known as *Sukumawiki* being the dominant food types consumed by 75.4% of seronegative and 82.5% of seropositive pregnant women.

Within a span of 24 hours before the assessment, only 20% of seronegative and 21.1% of seropositive respondents had taken at least one of the vitamin C rich fruits, such as oranges, lemons, guava and papaya which are estimated to have ≥50mg of vitamin C (ascorbic acid) per 100g of the edible portion of the fruit. A few (<5%) of the remaining women had consumed one of the fruits low in vitamin C such as avocado, banana and pineapple which are estimated to have ≥20mg of vitamin C (ascorbic acid) per 100g of the edible portion of the fruit. The remaining three quarters of the respondents had not consumed any fruit in a 24 hour period before the assessment. There was a significant difference between the Hb levels of the pregnant women who had consumed vitamin C rich fruits (mean Hb =12.3g/dl) and those who had not consumed such fruits (mean Hb=9.6g/dl) $p<0.05$. The habit of consumption of tea and/or coffee with or immediately after meal was common. Most women, 77.2% of seronegative and 78.9% of seropositive had consumed tea or coffee with or immediately after meal. However, there was no significant difference between mean Hb levels of the pregnant women who had consumed tea and/or coffee with or immediately after meal (mean Hb=10.7g/dl) and those who had not consumed (mean Hb =10.8g/dl); ($p>0.05$). Based on FAO/WHO classification, majority of both seropositive 65% and seronegative 63% had intermediate consumption of dietary iron (approximately >50g of flesh/meat, ascorbic acid >30g and high-phytates foods from cereal-based food, mainly maize in form of *Ugali, a* paste made from maize flour or as *Githeri*, a meal made from a mixture of maize and beans [16].

A meal that was predominantly cereal/ legumes-based was considered as high-phytate food [15, 16]. Only two percent of the pregnant women had consumed the recommended high dietary iron (≥100g flesh/meat, ascorbic acid >50g and low phytates content) while the rest had consumed low dietary iron (≤50g meat, ≥30g ascorbic acid, high phytate product). Levels of dietary iron consumption among the respondents are shown in Figure 1. Overall, higher level of consumption of dietary iron that includes vitamin C rich fruits was associated with high mean Hb levels $p\leq0.05$ for both the seronegative and seropositive.

Figure 1: Levels of dietary iron consumption by the respondents in a 24-hour period.



High dietary iron intake is recommended for pregnant women whose need for body iron increases to about 700-850 mg over the pregnancy period [4, 16]

Pregnant related problems

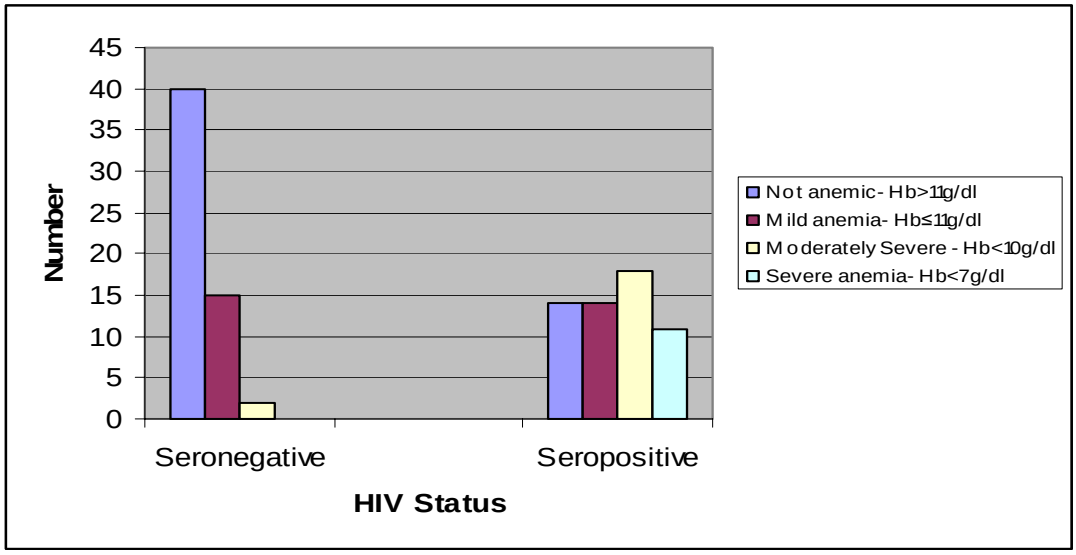
The most prevalent pregnant-related problems reported in the study were headache and dizziness and loss of appetite affecting over 20% of both seronegative and seropositive pregnant women. With the exception of heartburn, these problems were more pronounced among HIV-infected than non-infected pregnant women. Table 3 shows distribution of pregnancy-related problems reported among the respondents Only the respondents who had headache and dizziness showed relatively low hemoglobin levels for both the seronegative and seropositive as compared to their counterparts without these conditions ($p<0.05$)..

Hemoglobin levels and Relationship with HIV Status

The hemoglobin levels after the recommended altitude and trimester specific adjustments for the HIV-non-infected respondents ranged between 10.0 and 18.00g/dl, and a mean of 11.97g/dl [17, 18]. On the other hand, the Hb levels among the HIV-infected ranged between 5.8 and 13.0 g/dl and with a mean of 9.551g/dl. Hemoglobin levels were significantly different among the HIV-infected and non-infected women, ($t=4.921$; $p=0.000$). The results also showed a high variation in distribution of hemoglobin levels among HIV-infected (standard deviation = 2.19) than non-infected (standard deviation = 1.25). Further, results showed a strong positive correlation between HIV status and hemoglobin levels ($r=0.57$, $p=0.000$). Hemoglobin levels of the respondents are shown in Table 4.

Based on WHO classification anemia, Hb≤11g/dl was more prevalent and severe among the cases (prevalence=68%) than the controls (prevalence=26.3 %) [8]. The most predominant form of IDA among the HIV-non-infected (26.3%) was mild anemia (Hb=11g/dl) while among the HIV-infected (31.6%) was moderately severe anemia (Hb>10g/dl). The distribution of various forms of anemia among the seronegative and seropositive respondents is shown in figure 2. Overall, prevalence of anemia in the study was higher (52.6%) and more severe than in the general antenatal population in Kenya reported at 40% [5, 6]. The distribution of various categories of IDA is shown in figure 2. The risks of seropositive pregnant women being anemic was about two times higher than seronegative (Relative Risk=2.33). Age, stage of pregnancy and number of previous pregnancies did not show a significant association with Hb levels in this study. One case each of twin pregnancy and malaria were reported in the study with Hb level of 11g/dl and Hb of 10.4g/dl, respectively. The Hb levels (Hb≤11g/dl) indicate that they were anemic.

Figure 2: Classification of Iron Deficiency Anemia.



Hb-hemoglobin level as taken on the day of data collection

DISCUSSION

Socio- economic characteristics

High (86%) proportion of the pregnant women, both HIV-infected and non-infected, attending antenatal clinic at Pumwani Maternity Hospital were from low economic classes. They were either of low income or totally dependent on their spouses or parents/gurdians for their daily needs including food. The majority of the pregnant women had either a monthly income of less than 10,000 Kenya shillings or no direct income. Low economic status as reflected by the level of income was associated with IDA and is a common characteristic among HIV-infected and non-infected pregnant women. Income level was associated with high consumption of dietary iron and hemoglobin level. Pregnant women with higher income levels had consumed high proportion of flesh-based foods and fruits as compared to those with low income or relying on their parents/guardians or spouses. This exemplifies the crucial role played by income in the hands of the women in influencing the quality and quantity of food consumed and particularly in urban centres where purchase is the main source of food for the households. Lack of significant association between education and dietary consumption may be due to the fact that other factors such as income had more influence on food choice, in spite of knowledge regarding the right food selection. In addition, relatively low education levels (up to primary school) with some women having no formal education may have made women not to secure good employment with corresponding better payment. Urban feeding styles as well as economic constraints may have contributed to similarity in type and pattern of food consumption among different ethnic groups in the study. This is because people in urban centres are exposed to new food types and feeding patterns and hence tend to abandon some of the indigenous practices while income levels often influence the food selection and purchase options.

Dietary/meal intake Practices

Results on food intake showed that despite the high requirements for most nutrients such as iron in pregnancy, the pregnant women in this study continued with the same eating habits as practiced before pregnancy. Pregnant women in the study irrespective of their HIV status age, marital status, and ethnicity and education level consumed similar monotonous diet high in plant foods (but less in fruits) and low in animal-based foods. Food was mainly taken in three meals (breakfast, lunch and dinner) per day by the majority (>90%) of the respondents. Snacks which are recommended to be taken in- between meals were only consumed by a small proportion (<10%) of the respondents.

Consumption of foods rich in vitamin C (ascorbic acid) or its supplementation increases the absorption of iron by reducing ferric iron to a more absorbable ferrous form [3, 16]. This explains why the women who had consumed fruits rich in vitamin C had a significantly higher Hb level than those who had not ($p<0.05$). Regular consumption of food rich in ascorbic acid may have enhanced iron absorption leading to high Hb levels. The consumption of tea and/or coffee with or immediately after meal has inhibitory effects on iron absorption due to the presence of tannin and caffeine in tea and coffee, respectively [5, 16]. However, the consumption of these beverages did not show a significant relationship with Hb levels ($p>0.05$). Overall, women with high dietary consumption of iron as well as vitamin C rich fruits showed high level of Hb as compared to those with low dietary iron consumption. This shows the known direct relationship between the quantity and quality of diet intake with ultimate nutritional status. Further, it shows that the presence of vitamin C enhances iron absorption and hence the higher Hb levels recorded among the respondents who had consumed vitamin C rich fruits. The overall, lack of variety and quantity diet evidenced among the majority of the respondents in the study does not only fail to meet the increased demand for nutrients for the mother and the growing fetus but also fails to build nutrient reserves required for lactation after delivery. The failure to meet nutrient requirements exposes pregnant women to risk associated with micronutrient as well as macronutrient deficiency in the course of pregnancy and thereafter during lactation. The children born by such women are at greater risk of being exposed to malnutrition early in life.

Hemoglobin levels

Hemoglobin levels were significantly different among the HIV-infected and non-infected women with the infected women recording lower levels. The IDA levels varied greatly among HIV-infected than non-infected, with the seropositive women being about two times more likely to be anemic than seronegative (Relative Risk=2.33). The higher variation evidenced among seropositive pregnant women (standards deviation=2.19) than seronegative (standards deviation=1.25) shows that HIV-infected pregnant women are more vulnerable to higher fluctuation of hemoglobin than those not infected, which can be attributed to etiology of HIV/AIDS. Overall, prevalence of anemia for the total sample of 114 pregnant women was higher (52.6%) and more severe than in the general antenatal population in Kenya reported at 40%. The findings are in agreement with Burkina Faso study that showed high

prevalence (78%) of IDA among infected than non-infected pregnant women 64% [10]. The differences in prevalence levels between the two studies can be attributed to the etiology of HIV-related diseases in different communities and other environmental and social-economic factors associated with anemia. These findings are also in agreement with other studies which showed that asymptomatic HIV-infected pregnant women were more likely to be anemic than non-infected women [10]. HIV/AIDS is therefore associated with high prevalence and severity of IDA, possibly through alteration of dietary iron intake, absorption and retention.

It was also evidenced that loss of appetite and other pregnant-related problems were more prevalent among the seropositive pregnant women. The presence of these problems may have further interfered with iron intake and utilization. Other than HIV status which had significant association with Hb level, level of dietary iron consumption was a key determinant of Hb level of pregnant women (R^2=0.108). This shows the importance of dietary composition in influencing the nutritional status of pregnant women. On the other hand, meal composition was influenced by income levels, with pregnant women with better income consuming diversified diet particularly rich in iron and vitamin C (ascorbic acid). This is in agreement with the already documented evidence that have shown that income in the hand of women has a greater influence on food consumption and ultimately the nutritional status [15].

However, there was no significant relationship between hemoglobin levels and age, or household size or the birth interval for both cases and the control ($p>0.05$). This may be explained by the fact that majority of women were not in the age group associated with pregnancy related anemia. Pregnancy before the age of 15 years and after the age of 35 years increases the risks of anemia and other pregnant-related complications [19]. The youngest children of the pregnant women in the study were well spaced with the current pregnancy at the time of data collection, hence reducing risk of anemia due to closely spaced pregnancies. However, a significant relationship was established between the number of previous pregnancies and the hemoglobin levels of seropositive pregnant women ($P<0.05$). Pregnant women with higher number of previous pregnancies had lower Hb as compared to those who had less number of previous pregnancies. The risk of anemia associated with pregnancy increases after the fourth pregnancy [19]. In this study the mean Hb levels of the women decreased significantly with the increase in the number of previous pregnancies. Multiple and frequent pregnancies may have depleted the body iron stores hence the low Hb level. Twin pregnancy and malaria are common factors associated with anemia; in this study there was only one case each of twin pregnancy and malaria which were both anemic Hb≤11g/dl. Given that they were one case each, the influence of malaria and twin pregnancy on Hb level could not be established conclusively.

CONCLUSION

Urban pregnant women in low socio-economic classes irrespective of their HIV status, ethnicity, education levels and age have a similar food consumption pattern characterized by monotonous diet high in plant-based foods. Poor economic status as reflected by low profile occupations and low-income levels is associated with inadequate iron consumption both in quantity and quality and is a common characteristic among both HIV-infected and uninfected pregnant women. High income level among the women increases dietary diversity including the consumption of animal-based foods and fruits, ultimately improving the quality and quantity of nutrient content, particularly iron of high biological value. This improves the iron status of pregnant women. Measures to boost income in the hand of the women may be essential in enhancing quality and in extension the quantity of food.

The seropositive pregnant women exhibit great variance in hemoglobin levels and have relatively more severe IDA levels than the seronegative. They have significantly low hemoglobin levels and are two times more likely to be anemic than the non-infected. The major factors with significant influence on iron status of HIV-infected pregnant women are dietary iron consumption and HIV status.

It can be generally concluded that HIV-1 is strongly associated with low hemoglobin levels and higher anemia prevalence and severity among pregnant women. It also evidenced that dietary iron intake plays an important role in influencing the iron status of both seropositive and seronegative pregnant women. The high prevalence of IDA among the respondents is of great concern given that anemia during pregnancy is associated with multiple adverse outcomes for both mother and infant, including an increased risk of haemorrhage, sepsis, maternal mortality, perinatal mortality, and low birth weight [4]. This calls for the relevant nutrition and health stakeholders to implement intervention strategies that are tailored to enhance the iron status of the HIV-infected pregnant women in low socio-economic environment. These strategies should include efforts to boost dietary intake of all essential nutrients including iron as well as addressing health conditions (HIV or pregnancy related) that may have affected intake, digestion, absorption and utilization of nutrients.

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Table 1: Monthly income levels of the respondents.

Income[a] (Kenya shillings)	Seronegative N	%	Seropositive N	%
No income	30	52.6	29	50.9
<1,999	8	14.0	10	17.5
2,000-4,000	6	10.6	6	10.6
4,001-6,000	4	7.0	4	7.0
6,001-8,000	2	3.5	3	5.2
8,001-10,000	5	8.8	4	7.0
>10,000	2	3.5	1	1.8
Total	**57**	**100.0**	**57**	**100.0**

1 US$~79 Kenya Shillings

a Income represents average money received directly by the pregnant woman from varied sources

Table 2: Distribution of the types of meal consumed by seronegative and seropositive pregnant women.

Type of meal	Seronegative n	%	Seropositive n	%
Breakfast	56	98.2	57	100
Mid-morning snack	2	3.5	4	7.0
Lunch	54	94.7	55	96.5
Afternoon snack	3	5.3	2	3.5
Supper	57	100	57	100

Table 3: Prevalence of pregnancy related problems among the seropositive and seronegative pregnant women.

Pregnancy-related problem	Seronegative n	%	Seropositive n	%
Headaches and dizziness	15	26.3	17	29.8
Loss of appetite	12	21.1	19	33.3
Preeclampsia	7	12.3	10	17.5
Vomiting	6	10.5	7	12.3
Heartburn	5	8.8	1	1.8

Table 4: Distribution of hemoglobin levels of seronegative and seropositive pregnant women.

Hb levels (g/dl)	Seronegative n	%	Seropositive N	%
< 6.0	0	0	1	1.8
6.0-7.0	0	0	9	15.8
7.1-8.0	0	0	6	10.5
8.1-9.0	0	0	5	8.8
9.1-10.0	2	3.5	10	17.8
10.1-11.0	16	28.1	10	17.8
11.1-12.0	22	38.6	9	15.5
12.1-13.0	13	22.8	6	10.5
13.1-14.0	2	3.5	0	0
> 14	2	3.5	0	0
Total	**57**	**100.0**	**57**	**100.0**

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