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Research Article

Does Education Level, Household Income, Budget for Food and Birth Interval Predict the Iron Status of Women of Childbearing age in Nandi County, Kenya?

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Abstract

Women of Childbearing Age (WCA) encounter disproportionately elevated prevalence of iron deficiency caused by increased demand for iron related to pregnancy and menstruation. The study investigated the association between socio-economic and demographic characteristics and normal serum ferritin levels among WCA in Nandi County, Kenya. A cross-sectional analytical design was adopted to conduct the study in Kapsabet Ward. The Ward was divided into 8 clusters and systematic sampling was used to sample a total of 160 respondents proportionately from the clusters. A semi-structured questionnaire was utilized to collect data on the socio-economic and demographic characteristics and health-related information from the respondents. A venous blood sample (2 ml) was drawn from the participants. Serum ferritin (SF) and C-reactive proteins (CRP) were analysed using "Eligance Amplified Enzyme Linked Immunosorbent Assay". Data were entered into SPSS and continuous and categorical variables including demographic and socio-economic characteristics and iron status were analysed using descriptive statistics such as percentages, means, and standard deviations. Binomial regression was conducted to understand the association between socio-economic and demographic factors and iron status. Confounding variables such as iron supplementation, recent major blood losses, and parasitic infections were controlled for during analysis. Most of the respondents were young (aged 15 - 24 years) (53.8%), single women (57.5%), and belonged to households earning < Ksh. 10,000 (38.1%) and budgeted 34.0% of their income for food. The prevalence of iron deficiency (SF < 15 µg/l and CRP < 5 mg/l or SF 15 - 29 µg/l and CRP > 5 mg/l) among WCA was 36.9%. Respondents who belonged to households that made an income of Ksh.10000 - 20000 were 3 times more likely (AOR = 3.163, p = 0.010, CI = 1.320 - 7.577) to have normal stores of iron than those who made less than Ksh. 10000. Respondents with wider birth interval (AOR = 1.705, p = 0.020, CI = 1.089 - 2.670) and high budget for food (AOR = 1.232, p = 0.001, CI = 1.130 - 1.344) were nearly 2-fold and 23.2% respectively, more likely to have normal iron status. Normal SF of WCA were positively predicted by a wider birth interval, higher income and budget for food at the household level.

Keywords: *Serum Ferritin; Women of Childbearing Age; Socio-Economic Status*

Abbreviations

CRP: C-Reactive Proteins; ELISA: Eligance Amplified Enzyme Linked Immunosorbent Assay; IDA: Iron-Deficient Anaemia; KSh: Kenya Shilling; SES: Socio-Economic Status; SF: Serum Ferritin; SPSS: Statistical Packages for Social Sciences; WCA: Women of Childbearing Age

Introduction

Socio-economic and demographic characteristics have been reported to influence iron status of women of childbearing age (WCA). Scientific evidence has shown that WCA with lower income [1] and low profile occupations [2] were more predisposed to suffer from iron

inadequacy [3]. A household with a higher income, is more likely to access iron-rich foods compared to those with low incomes; thus lowering the risk of iron deficiency [4]. The household income is strongly associated with women's anaemia [5,6] and iron-deficient anaemia (IDA) [4]. Studies conducted in third world countries report a strong correlation between the high prevalence of anaemia and low socio-economic status (SES) [7-9]. However, a study conducted in the US reported that iron deficiency does not differ significantly by family income or educational level. Furthermore, the aforementioned study showed that iron deficiency was more prevalent among women with parity" greater than or equal to two [9].

Asiko [1] reported that WCA with higher education levels had more access to a variety of foods as compared to those of lower education levels. A Kenyan study by Waweru., *et al*. [2] demonstrated that there is no significant relationship between age, birth interval or household size and haemoglobin levels. However, there is a paucity of information on the predictors of iron status in Nandi County. The current study therefore explored the relationship between socio-demographic and economic factors and iron deficiency.

Materials and Methods

Study area

The study was conducted in Kapsabet Ward found in Emgwen Sub-county of Nandi County. Nandi County is located in Latitude 0° and 0° 34'', Longitude -34°34''/35°25E and altitude - 1300 - 2500 (Figure 1).

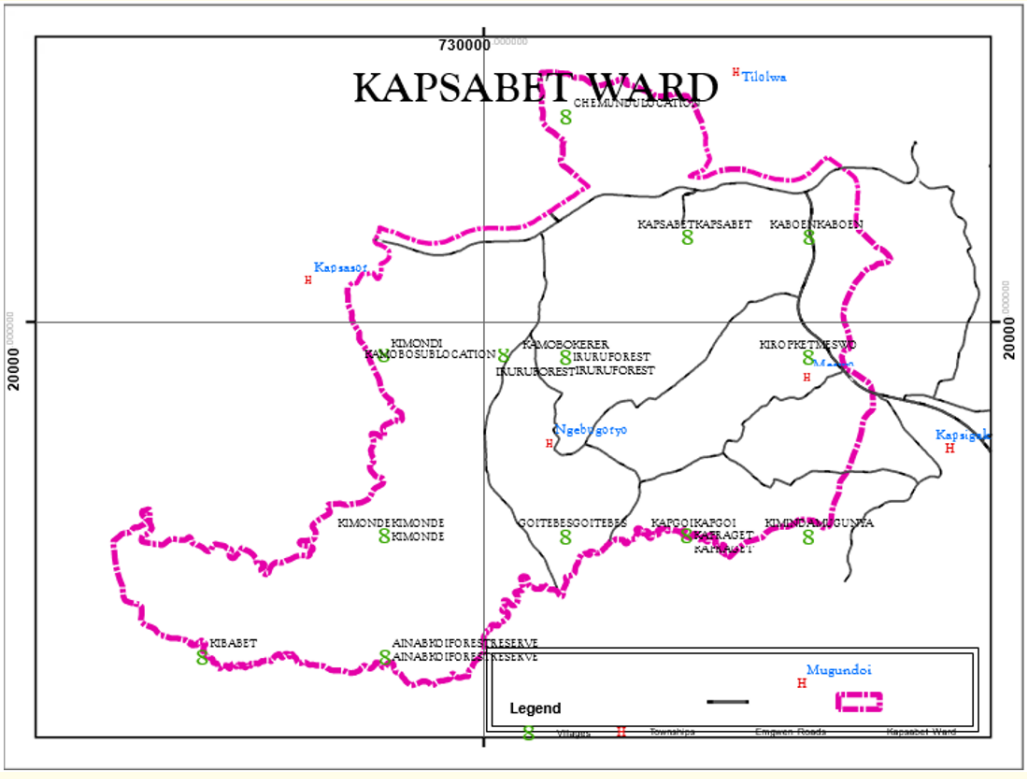

Figure 1: *Showing map of Kapsabet ward.*

Sample size determination and sampling technique

The sample size was determined using G power software version 3.1.9.4. The significance (α) and power (1-β) levels were set at 0.95 and 0.05 respectively. The odds ratio (OR) for failing to reject the alternative hypothesis ((Pr(y=1|x=1)= H1) was 0.65 and OR for rejecting the null hypothesis ((Pr(y=1|x=1)= Ho) was 0.35 [10]. A sample size of 144 was determined. Ten percent was added to make 160 research participants drawn from the All eight villages of Kapsabet Ward; Chemundu (25), Goitebes (20), Kiropretmeswo (19), Kibabet (9), Township (48), Kimundi (17), Kimindamugunya (10) and Kimonde (12). Proportionate samples were determined for each village and a systematic sampling technique was used to select participants from them.

Data collection tools and procedure

A semi-structured questionnaire was used to collect information on the socio-economic and demographic characteristics of WCA. The tool collected data on marital status, religion, age, education level, parity, birth spacing, occupation, source of income, an estimate of household income and source of family food. Sixteen respondents, representing 10% of the sample size [11], were selected from Kapsabet Ward and involved in conducting a pre-testing of study tools. Reliability of tools was ensured through test-retest method. The research team included seven enumerators who were nutrition students trained for five days on data collection. Demonstrations and role-plays were utilized in the training until the principal investigator was satisfied with the enumerators' data collection skills. Three qualified phlebotomists were recruited for the blood collection process.

Informed consent was obtained before the collection of data. The researcher-administered questionnaire was completed by the enumerators while the phlebotomists collected blood on the spot. The skin of the respondents was disinfected with surgical spirit swab and dried. Then, 2 ml of venous blood was obtained from the respondents aseptically by a qualified phlebotomist. The blood was aliquoted into red-top vacutainer tubes for serum separation. The tubes were coded for identification and then packed in a cooler box (15°C) and transported to Chepsoo Medical Centre for serum separation. The separated serum was aliquoted into vials and refrigerated at 4°C. Collected serum was packed in a cooler box at 15°C and transported to the University of Nairobi/Kenyatta National Hospital Paediatric laboratory, under one-week preceding blood collection, and kept at frozen state (below -20°C) until analysis to determine serum ferritin levels and CRP. To retain the sample integrity, repeated cycles of freezing and thawing were avoided.

Biochemical methods of determination of serum ferritin

Serum ferritin was determined using "Eligance Amplified Enzyme Linked Immunosorbent Assay (ELISA)" quantitative method performed on the LIASON® Analyser (DiaSorin S.p.A. - Saluggia- Italy) [13,14]. C-reactive protein was analyzed quantitatively using the immunoturbidimetric method in HumaStar 600 Analyzer (Wiesbaden, Germany). Human serum ferritin ELISA kits (Surgipath Services East Africa Ltd) and C-reactive protein ELISA kits (Chem Labs Ltd) and the standards were stored at a temperature of 2 - 8°C. The serum samples were retrieved from storage and thoroughly mixed using a vortex mixer before running the tests. Lipemic or grossly haemolysed samples, clotted, harbouring alien materials, or demonstrating obvious signs of microbial contamination or amounted below 160 μL were altogether excluded from the analysis. Besides, those samples that were clotted or had an amount below 160 μL *were excluded from the analysis.* Participants were classified iron deficient ((SF < 15 $\mu g/l$ and CRP < 5 mg/l or SF < 30 $\mu g/l$ and CRP > 5 mg/l) otherwise normal ferritin levels [14,15].

Data analysis

Data was cleaned and coded. Data on socio-demographic characteristics and biomarkers data was entered into Statistical Package for Social Sciences (SPSS) software version 22 (Illinois, Chicago). Descriptive statistics, such as percentage, means and standard deviation, were performed on socio-economic and demographic characteristics and iron status. Logistic regression was performed to assess the association between socio-economic and demographic characteristics and iron status of WCA. Confounding variables such as iron supplement, recent blood losses and parasitic infections were controlled for during analysis.

Ethical considerations

Kenyatta University Graduate School permitted conduction of the study whereas ethical approval was sought from the Kenyatta University Ethics Review Committee (PKU/2029/11176). Also, a research permit was sought from the National Commission of Science Technology and Innovation (NACOSTI/P/19/2975). Furthermore, informed consent was obtained from respondents.

Results and Discussion

Socio-demographic characteristics of the study respondents

The household heads in Kapsabet Ward was balanced among gender, with male heading 48.1% of the households whereas females heading 51.9%. Most of the respondents were single women (57.5%) whereas 40.6% were married and less than 2% were both separated

and widowed. The mean age of the respondents was 24.7 years. Overly half (53.8%) of them were young (aged 15 - 24 years) while 35.0% were aged between 25 - 34 years. Most of the respondents (43.1%) had attained secondary level education. Majority of the respondents belonged to households that earning their livelihood from farming (41.3%). Most of the respondents (38.1%) reported that their households earned less than KSh. 10,000 per month. The main source of food for majority (73.1%) of the household was through purchasing. There was a wide variation of the estimated amount of income allocated for food among the households ranging from 5% to 90%. However, most of the households allocated 34.0% of their income for food. The mean birth spacing was 3.6 years among the respondents. The household size ranged from 1 to 11 with an average of 4 persons (Table 1).

Characteristics	n=160 n (%)
Sex of household head	
Male	77 (48.1%)
Female	83 (51.9%)
Marital status	
Singled	92 (57.5%)
Married	65 (40.6%)
Separated	2 (1.3%)
Widowed	1 (0.6%)
Age (years)	
Mean age (SD)	24.7 (7.31)
15-24	86 (53.8%)
25-34	56 (35.0%)
35-44	16 (10.0%)
45-49	2 (1.3%)
Highest education level attained	
No formal education	2 (1.3%)
Primary	48 (30.0%)
Secondary	69 (43.1%)
Tertiary	41 (25.6%)
Maternal Occupation	
Farmer	4 (2.5%)
Casual worker	27 (16.9%)
Salaried/ formal employment	14 (8.8%)
Businessman/woman	44 (27.5%)
Student	67 (41.9%)
Housewife	4 (2.5%)
Income estimate	
Ksh. < 10000	61 (38.1%)
Ksh. 10000 - 20000	46 (28.8%)
Ksh. 20000 - 30000	9 (5.6%)
Ksh. > 30000	8 (5.0%)
Declined/did not know	36 (22.5%)
Source of food	
Farming	17 (10.6%)
Buying	117 (73.1%)
Both buying and farming	26 (16.2%)
Budget for food (Mean % (SD))	34.0 (18.62)
Birth spacing	3.607 (2.52)
Household size mean (SD)	4.19 (1.95)

Table 1: *Socio-demographic characteristics of the study respondents.*

Serum ferritin levels of the respondents

After the adjustment of serum ferritin concentrations for inflammation (CRP > 5 mg/l), 36.9% of the respondents were iron deficient (SF < 15 µg/l and CRP < 5 mg/l or < 30 µg/l and CRP > 5 mg/l) (Table 2).

Iron status indicators	n = 160 n (%)
Inflammation marker Mean [SD]	5.0 [2.1]
C-reactive protein (CRP) levels (mg/l)	
Elevated levels (CRP > 5 mg/l)	49 (30.6%)
Serum Ferritin (SF) levels (µg/l)	
Mean (SD)	35.3 [42.2]
Crude Iron depleted stores (SF < 15 µg/l)	34 (21.3%)
Adjusted* iron stores status	
Iron deficient (ID) (SF < 15 µg/l and CRP < 5 mg/l or < 30 µg/l and CRP > 5 mg/l)	59 (36.9%)

Table 2: *Iron status of study respondents.*

**Adjusted iron stores for inflammation.*

Association between socio-economic and demographic characteristics and iron status among women of childbearing age

Association between socio-demographic characteristics and serum ferritin levels of the respondents is presented in table 3. Respondents who belonged to households that made an income of Ksh.10000 - 20000 were 3 times more likely (AOR = 3.163, p = 0.010) to have higher stores of iron as compared with those of households earning below Ksh. 10000. An increase in the birth spacing predicted nearly 2 times higher chances of having normal iron status among the respondents (AOR = 1.705, p = 0.020). Respondents who belonged to households that had a higher proportion of their income allocated for food were 1.2 more likely (AOR = 1.232, *p* = 0.001) to have normal serum ferritin as compared with those with lower allocation.

Characteristics	n=153 AOR [CI]	*p* **
Sex of household head	0.721 [0.366 - 1.418]	0.343
Marital status		
Singled (ref)		0.947
Married	0.801 [0.390 - 1.646]	0.545
Separated		1.000
Widowed		1.000
Age (years)		
15 - 24 (ref)		0.328
25 - 34	0.931 [0.453 - 1.912]	0.845
35 - 44	4.084 [0.862 - 19.358]	0.076
45 - 49		0.999
Education level		
No formal education (ref)		0.162
Primary	0.154 [0.154 - 52.227]	0.483
Secondary	3.108 [0.174 - 55.350]	0.440

Tertiary	1.273 [0.071 - 22.692]	0.870
Maternal Occupation		
Farmer (ref)		0.995
Casual worker	0.540 [0.049 - 5.962]	0.615
Salaried	0.543 [0.043 - 6.817]	0.636
Businesswoman	0.560 [0.053 - 5.929]	0.630
Student	0.634 [0.62 - 6.493]	0.701
Income estimate		
Ksh. <10000 (ref)		0.083
Ksh. 10000 - 20000	3.163 [1.320 - 7.577]	0.010
Ksh. 20000 - 30000		0.999
Ksh. >30000		0.999
Food sources		
Farming (ref)		0.561
Buying	2.153 [0.741 - 6.253]	0.159
Both	2.195 [0.597 - 8.070]	0.237
Birth spacing	1.705 [1.089 - 2.670]	0.020
% of household income allocated for food	1.232 [1.130 - 1.344]	<0.001

Table 3: *Association between socio-demographic characteristics and iron stores of study respondents.*

***p stands for p-value: significance level at p < 0.05.*

AOR [CI] is an acronym of adjusted odds ratio with their confidence intervals. It was adjusted for parasitic infections, major blood losses and milk and milk products.

Discussion

Kapsabet Ward is found in Emgwen sub-county, Nandi County. Both females and males on almost equivalent proportion headed its households. The proportion of households headed by women is higher than that reported in KDHS (2014), whereby they headed a third of households [16]. However, most of the respondents in the current study were single women followed closely by married ones. Most of them were students and aged between 15 and 24 years. Most of the respondents had attained at least a primary education. A similar study among expectant women demonstrated that most of them had at least a secondary education level not necessary as yours were school girls not pregnant women [17]. Most of the households earned between low and average income, however, some respondents were unable to disclose income information. They were either unaware such as the minors or they perceived the information to be so sensitive to disclose.

The current study investigated the association between socio-demographic characteristics and iron status of WCA. The findings demonstrated that a wider birth spacing, high household income and a high relative budget for food positively predicted the iron status of the study respondents. The household income of Ksh. 10,000 - 20,000 gave the respondents 3 times more chances of having normal iron stores as compared with those whose households earned less than Ksh. 10,000. The finding suggests that when a household has a higher income their likelihood of purchasing iron-rich foods is increased and thus it favours women to consume these foods bettering their chances of having normal iron status [4]. Two previous studies also reported that household income is strongly associated with women's

anaemia [4,5] and IDA [4]. Several studies previously conducted in third world countries reported a strong correlation between the high prevalence of anaemia and low SES [6-8]. Low-income status predisposed women of childbearing age to iron deficiency [1]. On the contrary, a study conducted in the US approximately a decade ago reported that iron status did not differ significantly by family income [9]. Furthermore, the current study established that educational level did not predict iron status among women, which is congruent with the findings established by Mei., *et al* [9].

In the current study, it was also observed that widening of birth spacing nearly doubled the chances of respondents having normal iron stores. A woman who has a healthy birth spacing usually has adequate time to replenish the iron stores, which was utilized during preceding pregnancies [18]. However, a woman with a short birth spacing of fewer than 2 years normally has heavy demand for iron to supply the nutrient to the babies, thus increasing her chances of depleting ferritin. WHO recommends that mothers should practice a healthy live-birth interval of at least 2 years before getting subsequent pregnancy [19]. However, an earlier study conducted in Kenya did not establish a significant relationship between birth interval and iron status [5]. However, the aforementioned study is in agreement with the finding of the current study that iron status did not significantly differ in age and household size. Also, the current study found that respondents belonging to households whereby a higher proportion of their income was allocated for buying food had a 23.2% higher likelihood of developing normal iron stores. The establishment suggests that where more funds are allocated for food, more iron-rich foods are made available increasing the chances of women replenishing their iron stores.

Conclusion

Three in ten WCA in Kapsabet ward are iron deficient. Normal serum ferritins of WCA were positively predicted by a wider birth interval, higher income and budget for food at the household level, however, education level did not predict their iron status. WCA should practice the recommended birth interval and more funds should allocated for purchasing food at households level.

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Conflict of Interest

There is no conflict of interest.

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