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Iron Deficiency, Nutritional Status and Food Consumption Pattern of Apparently Healthy Women of Reproductive Age in a Nigeria Setting

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ABSTRACT

Iron deficiency and nutritional status are major health challenges that confront women of reproductive age (WRA) because the reproductive life represents the major portion of women's life. The study aimed to assess iron deficiency, food consumption pattern, and nutritional status of apparently healthy WRA. Food Consumption Pattern (FCP) was assessed, Body Mass Index (BMI) and Waist-Hip Ratio (WHR) were determined. Haemoglobin (Hb), Serum Ferritin (SF) and C-reactive Protein (CRP) were used as indicators for iron status. One hundred and sixty-one (161) WRA (18-40 years) in Obafemi Awolowo University, Ile-Ife, Nigeria participated in the study.

Mean age and BMI were 24.0±5.32 and 20.4±2.3 respectively. About 22.0% were underweight, 9.3% had WHR of ≥ 0.85. Iron status showed that 31.1% had SF level of <15ug/l, 47.8% had haemoglobin level of <12g/l and 24.8% had intermediate risk of cardiovascular disease judged by CRP. In addition, 64.0% were rated as good in FCP, only 17.4% were rated as poor, while 14.9% were rated as good in specific iron rich food consumption pattern. A significant relationship existed between SF (r = 0.195, p=0.013), CRP (r = 0.173, p=0.029), Waist Circumference (r =0.257, p=0.001) and age. Women aged 26-30 years (OR=2.842, 95%CI=1.058-7.633) and WHR>0.85 (OR=2.038, 95%CI=0.129-1.79) had significant association with haemoglobin level. Interestingly, an association existed between haemoglobin and iron rich foods consumption pattern such as cereal, (OR=0.307, 95%CI=0.129-0.727), Dark Green Leafy Vegetable (DGLV) (OR=3.895, 95%CI=1.370-11.075), Organ meat (OR=8.344, 95%CI=1.808-38.514). It is concluded that among women of reproductive age in the study area, there is a high prevalence of iron deficiency judged by haemoglobin and serum ferritin coupled with moderately high level of underweight. Also, one out of four of the women were at risk of cardiovascular disease. A significant association was found to exist between iron-rich food consumption and haemoglobin level.

Keywords: Haemoglobin; Serum Ferritin; Nutritional Status; Food Consumption Pattern; Women of Reproductive Age

List of abbreviations: WRA: Women of Reproductive Age; FCP: Food Consumption Pattern; BMI: Body Mass Index; WHR: Waist-Hip Ratio; Hb:Haemoglobin; SF: Serum Ferritin; CRP: C-reactive Protein; DGLV: Dark Green Leafy Vegetable; IDA: Iron Deficiency Anaemia; WHO: World Health Organization

Introduction

Globally, Iron Deficiency Anaemia (IDA) is a major public health concern affecting the lives of more than 2 billion people, accounting for over 30% of the world's population [1]. In Sub-Saharan Africa, about 50% of all anaemia cases are due to iron deficiency. IDA has a deleterious effect on health, morbidity, mortality, work capacity, productivity [2,3], mental performance, poor growth, impaired regulation of body temperature, impairment in behavioural and intellectual performance and decreased resistance to infections [4]. It is a major health challenge among women of reproductive age (WRA) from 18-40 years likewise obesity and high blood pressure. The reproductive life represents the major portion of women's life [5]. WRA are susceptible to different nutrient-related deficiency diseases due to various social and biological factors such as gender inequality, adverse dietary practices, menstruation, pregnancy and childbirth [6].

Iron is a component of myoglobin, a protein that provides oxygen to muscles and supports metabolism. Iron is also a component of haemoglobin, the oxygen-transport pigment present in red blood cells. It is necessary for growth, development, normal cellular functioning and the synthesis of some enzymes and connective tissues [7]. It is also a mineral that is naturally found in many foods, it could be added to food products through fortification and it is also available as dietary supplements. Dietary iron exists in two forms; heme and non-heme iron, obtainable from animal and plant sources respectively. Non-heme iron is less bio-available and its food sources include beans, nuts, fortified grains and vegetables.

Obligatory loss of iron in human occurs through faeces, urine, skin and the gastrointestinal tract but greater losses occur during menstruation in women of childbearing age resulting in anaemia [8,9]. Also, women who had donated blood more than five times are likely to have depleted iron stores without supplementation [10]. Iron deficiency anaemia occurs when the body stores of iron are too low to support adequate formation of red blood cells manifesting as a haemoglobin concentration below 12g/dl, hence, the need for adequate intake. Ferritin is an intracellular protein that stores iron and releases it in a controlled fashion. Serum ferritin is a reliable measure of iron stores in the body. Thus it is usually low in cases of iron deficiency and increased in iron overload conditions. It should also be noted that serum ferritin is an acute phase reactant that may be increased in association with inflammatory conditions or cardiovascular diseases even in the presence of iron deficiency. The c-reactive protein level will help in differentiating true iron overload (in which the CRP will be normal) from inflammatory states (in which the CRP will be high). Similarly, in early stages of iron deficiency, the iron stores may be depleted without anaemia. In such cases, the serum ferritin is low but the Hb remains normal [11].

The high prevalence of anaemia among women in developing countries reflects their social and biological vulnerability both within the household and the society [12].

Anaemia has multi-factorial causes involving complex interactions between nutrition, infectious diseases and other factors [13]. Some of the factors include obesity, which is increasing at an alarming rate in many countries with major implications for the increasing prevalence of non-communicable diseases like hypertension and diabetes mellitus which lead to systemic inflammation and cardiovascular dysfunction [14]. Exercise could reduce obesity and improve cardiovascular health which may reduce systemic inflammation and thus improve iron absorption from foods. Similarly, increased consumption of fatty foods may be associated with poor cardiovascular health with increased risk of reduction in iron absorption [15].

Women's health deserves adequate attention, which will enhance the attainment of the third sustainable development goal of good health and wellbeing for all at all ages. Hence, this study was designed to assess the determinants of iron deficiency anaemia among apparently-healthy WRA in Ile – Ife, Nigeria.

Materials and Methods

Study Area and population

This study was carried out at federal government-owned Obafemi Awolowo University (OAU), Ile – Ife, Nigeria, which was founded in 1961 with the latitude of **7.520767**, and the longitude of **4.530315** with the GPS coordinates of 7° 31' 14.7612'' N and 4° 31' 49.1340'' E. The university has 13 Faculties and 2 Colleges with 4 female hostels and 2 mixed hostels. The community has a population of about 40,000 people. The study was conducted among women of reproductive age (18-40 years) residing within the university community.

Sampling Method and Design

This was a cross-sectional study of women of reproductive age. The study was the preliminary selection process for a double-blind, randomized, cross-over trial [16]. One hundred and sixty one (161) women (aged 18-40 years) were randomly recruited based on location within the university campus where women are clustered such as hostels, central market, students' union building area, parks, and gardens. Leaflets were distributed describing the purpose of the study. This was followed by an information face-to-face visit by the study staff. Those who indicated interest were given informed consent forms for the blood draw and study procedure before inclusion in the screening exercise. The eligibility criteria for the women were: age 18–40 years, apparently healthy as judged by a physician, and willingness to participate in the study [15]. Women were excluded if they donated blood, had significant blood loss in the past 6 months, pregnant, lactating, or had known gastrointestinal or metabolic disorders. All the women that were interviewed were included in the analysis.

Research Instrument and Data Collection

A pre-tested structured questionnaire was administered to elicit information on the Personal Characteristics and Food Consumption Pattern (FCP) through face-to-face interviews with the women. Trained study staff were recruited to minimize reporting bias as the respondents were women. A multilayer monitoring system was employed to maintain the quality of data such as spot-checking to avoid discrepancies arising. If any arose, it was resolved through re-interviewing the respective women.

Haemoglobin (Hb) and Serum Ferritin (SF) were used to determine iron deficiency status, while C - reactive protein (CRP) was used as an inflammation marker. Seven (7) ml of blood was drawn through venipuncture from the forearm using a vacutainer needle by the medical team on the day of the interview. Out of this, 3ml of blood was collected in an EDTA tube for the measurement of haemoglobin concentration using the SFRI haematology autoanalyser (SFRI Medical Diagnostics, Saint Jean d'Illac, France). Haemoglobin measurement was done on the day of sample collection within 3hrs after collection. The remaining 4ml of blood was collected in a plain tube, for the analysis of serum ferritin and C-reactive protein by enzyme-linked immunoassay (ELISA). Serum was separated after centrifugation and stored at -20°C until analyses.

Food Frequency Questionnaire was used to assess the FCP, which included 14 food groups on a 4-Point Likert Scale as 'daily' scored as 4 points, 'weekly' scored 3 points, 'rarely' scored 2 points, and 'not at all' scored 1 point. The mean and standard deviation were calculated, maximum and minimum scores obtainable were 56 points and 14 points respectively. Specific iron-rich foods consumption pattern was also assessed using 7 iron-rich foods (Cereals, Dark Green Leafy Vegetables, Organ Meat, Flesh Meat, Egg, Fish, Legumes/Nuts/Seeds) by the same formular as the FCP. For this, maximum and minimum scores obtainable for the iron-rich food consumption pattern were 28 points and 7 points respectively.

Nutritional Status was determined by Body Mass Index, Waist-to-Hip Ratio, and Iron deficiency Anaemia. Body Mass Index was determined by taking the anthropometric measurements of weight, height, waist, and hip circumferences. Weight and height were measured using a bathroom scale and stadiometer respectively according to standard measurement protocol. Body Mass Index (BMI) was calculated by dividing the weight (kg) by square of height (m), which was classified according to World Health Organization (WHO) cut-off points. A tape measure was used to measure the waist circumference midway between the lowest rib and the iliac crest with the women standing upright while the hip circumference was measured at the maximum point below the waist without compressing the skin. Waist to Hip Ratio (WHR) in inches was calculated by dividing the waist measurement by the hip measurement. The classification was also according to WHO cut-off points

Data Analysis

Serum Ferritin (SF) of < 15 µG/L was regarded as iron deficiency, Haemoglobin (Hb) of <12 g/L was classified as anaemia, while C-reactive protein of >3mg/L was regarded as the risk of cardiovascular diseases or inflammation.

For the FCP score, the mean and standard deviation were calculated and were used to categorize the women as poor FCP (<23 points), moderate FCP (23-33 points), and high FCP (>33 points). Also, specific iron-rich food consumption pattern was investigated. The mean and standard deviation were calculated and the scores were used to categorize the women as poor iron-rich food consumption pattern (<11 points), moderate iron-rich food consumption pattern (11-16 points), and good iron-rich food consumption pattern (>16 points).

BMI was classified for adults as Underweight (<18kg/m^2), Normal weight (18-24.99 kg/m^2), Overweight (25-29.99 kg/m^2), and Obese (≥30.0 kg/m^2), while BMI-for-age percentile was used for adolescents and classified as underweight (<5th percentile), Normal weight (5th -85th percentile), overweight (86th -95th percentile) and obese (>95th percentile). WHR for women was classified as 0.80cm and 0.85cm abdominal obesity [16].

Data collected were processed using IBM SPSS Statistics for Windows, version 22 (IBM Corp., Armonk, N.Y., USA) for descriptive and inferential statistical analysis. The frequency and percentage of different parameters were represented in tables and figures. Pearson correlation and logistic regression were used for interferences. All inferences were made at less than 0.05 level of significance.

Ethical Approval

Ethical approval was obtained from the Health Research Ethics Committee of the Obafemi Awolowo University, Ile-Ife, Nigeria (Study number: IPH/0AU/12/548). Written informed consent was obtained from all participants before recruitment into the study.

Results

The biophysical and laboratory characteristics of the 161 Women of Reproductive Age (WRA) were as shown in Table 1, which indicated the mean age to be 24.0±5.32 years, about half of them (51.6%) belonged to the age range of 20–25 years. The overall mean BMI was 20.4±2.3; 21.7% were underweight while 1.9% were overweight. All the women had waist circumference (WC) less than 81cm with a mean value of 28.2±2.0cm. The majority (90.7%) were reported to have WHR of ≤ 0.85 with a mean value of 0.77±0.9.

The haematological characteristics of the women showed that 31.1% had serum ferritin (SF) level of <15µg/l while 47.8% had haemoglobin (Hb) of less than 12g/l. Meanwhile, the C-reactive protein level (CRP) showed that about 24.8% and 2.5% had an intermediate and high risk of cardiovascular diseases respectively.

Characteristics	N	%	Mean±SD
Age (years)			
< 20 (ref)	31	19.3	24.0±5.3
20 – 25	83	51.6	
26 – 30	24	14.9	
>30	23	14.3	
BMI (kg/m)			
Underweight (≤18.5)	35	21.7	20.4±2.3
Normal (18.5-24.99)	123	76.4	
Overweight ≥25	3	1.9	
Waist circumference (inches)			
<81	161	100.0	28.2±2
>81	-		
Hip circumference (inches)			
≤35	69	42.9	35.70±3.4
36-40	63	39.1	
>40	29	18.0	
Waist-to-hip ratio (inches)			
< 0.85 (ref)	146	90.7	0.77±0.9
≥ 0.85	15	9.3	

Characteristics	N	%	Mean±SD
Serum Ferritin (ug/L)			
<15	50	31.1	50.52±57.9
≥15	111	68.9	
Haemoglobin (g/L)			
<12	77	47.8	12.63±9.4
≥12	84	52.2	
C-Reactive Protein (mg/L)			
<1 (Low risk of CVD)	113	67.1	1.9±5.4
1-2.9 (Intermediate risk of CVD)	35	24.8	
≥3-10 (High risk of CVD)	3	2.5	
>10 (Further test required)	10	5.6	

Table 1: Biophysical and laboratory characteristics of women of reproductive age (N = 161)

Additionally, the food consumption patterns of the women were examined using a 14-food group plan. The overall mean score was 28.2±4.8 out of 56 points obtainable with minimum and maximum scores being 17 and 38 respectively. Oils and fats were the most consumed while organ meat was the least consumed (Table 2). The food consumption pattern was rated as indicated in Figure 1, 28 (17.4%) scored below 23 points and were rated as having poor food consumption pattern, 30 (18.6%) scored between 23 and 33 points and were rated as moderate in food consumption pattern, while the majority; 103 (64%) scored above 33 points and were rated as having good food consumption pattern. Specific pattern of consumption of iron rich-foods were investigated; it was found that only 14.9% were rated as having good iron rich food consumption pattern (Figure 2).

Pearson correlation analysis conducted showed a positive significant relationship between Serum Ferritin (r = 0.195, p = 0.013), C-reactive protein (r = 0.173, p = 0.029), Waist Circumference (r = 0.257, p = 0.001), Height (r = 0.165, p = 0.036) and age (Table 3). Interestingly, no significant relationships existed between Body Mass Index, Haemoglobin and Age (p > 0.05). While the binary logistic regression analysis shown in Table 4 indicated variables independently associated with haemoglobin included age 26-30 years (OR = 2.842, 95%CI = 1.058-7.633) and WHR of >0.85 (OR =4.985, 95%CI =1.350-18.411). Further binary logistic regression analysis was conducted and there was no association between food consumption pattern and haemoglobin. Specifically, association between the pattern of consumption of iron-rich foods and haemoglobin as presented in Table 5 showed that those who rarely consumed Dark Green Leafy Vegetables (DGLV) (OR = 3.895, 95%CI = 1.370-11.075), Organ meat (OR = 8.344, 95%CI = 1.808 – 38.514) and Legumes/Nuts/Seeds (OR = 0.424, 95%CI = 0.475 -1.028) were positively associated with haemoglobin as compared to Cereals (OR = 0.307, 95%CI = 0.129 – 0.727).

Discussion

Purposively, all the women in the study area were within the reproductive age of 18-40 years because of the high risk of iron deficiency, which in turn may contribute to maternal morbidity, mortality [11] and iron deficiency anaemia due to blood losses during menstruation and childbirth [17]. Also this age group needs adequate nutrients for fast physical, mental and emotional growth [18].

The nutritional status of the women were assessed using the body mass index (BMI) and the results indicated that one out of five was underweight, which is suggestive of chronic protein-energy malnutrition, while only two out of ten were overweight. This is similar to studies in Nepal [19] and Ethiopia [20] that higher risk of underweight was common among women of reproductive age with lower risk of obesity. In nutrition intervention among WRA, so much attention has been on maternal overweight and obesity with little attention on underweight [21]. African women of reproductive age having BMI lower than normal (under nutrition) are prone to health risk such as heart irregularities, osteoporosis, poor nutritional status and infertility among others(5). Overweight and obesity are predictors of the morbidity and mortality from cardiovascular diseases, diabetes, and other metabolic diseases [22].

The waist circumference (WC) is used to assess abdominal obesity and health status [16], which is normal for all the women in this study. The Waist to Hip Ratio is another way of assessing abdominal obesity, which provides useful indication of the nutritional status of women in under-developed countries [23]. About ten out of hundred had excess abdominal obesity as judged by the WHR,

Food group	Daily N (%)	Weekly N (%)	Rarely N (%)	Not at all N (%)	Mean ± SD
Cereal	83 (51.6)	56 (34.8)	21 (13.0)	1 (0.6)	2.37 ± 0.73
Vitamin A rich Veg. Tubers	51 (31.7)	87 (54)	21 (13)	2 (1.2)	1.79 ± 0.68
White Tubers and Roots	27 (16.8)	64 (39.8)	70 (43.5)	0 (0)	2.27 ± 0.73
Dark Green Veg	28 (17.4)	90 (55.9)	41 (25.5)	2 (1.2)	2.06 ± 0.69
Other Veg	21 (13.0)	49 (30.4)	91 (56.5)	0 (0)	2.43 ± 0.71
Vitamin A Fruits	63 (39.1)	64 (39.8)	29 (18)	5 (3.1)	1.73 ± 0.79
Other Fruits	51 (31.7)	76 (47.2)	30 (18.6)	4 (2.5)	1.82 ± 0.75
Organ meat	93 (57.8)	42 (26.1)	16 (9.9)	10 (6.2)	1.40 ± 0.75
Flesh meat	65 (40.4)	58 (36.0)	36 (22.4)	2 (1.2)	1.80 ± 0.80
Eggs	33 (20.5)	94 (58.4)	32 (19.9)	2 (1.2)	1.97 ± 0.67
Fish	20 (12.4)	81 (50.3)	53 (32.9)	7 (4.3)	2.12 ± 0.79
Legumes Nuts and seeds	29 (18.0)	84 (52.2)	44 (27.3)	2 (1.2)	2.04 ± 0.74
Milk and Products	43 (26.7)	85 (52.8)	31 (19.3)	2 (1.2)	1.90 ± 0.71
Oils and Fats	18 (11.2)	46 (28.6)	96 (59.6)	1 (0.6)	2.47 ±0.71

Total Mean ± SD = 28.16±4.78, Minimum Score = 17, Maximum Score = 38

Table 2: Food Consumption Pattern of Women of Reproductive Age (18-40 years)

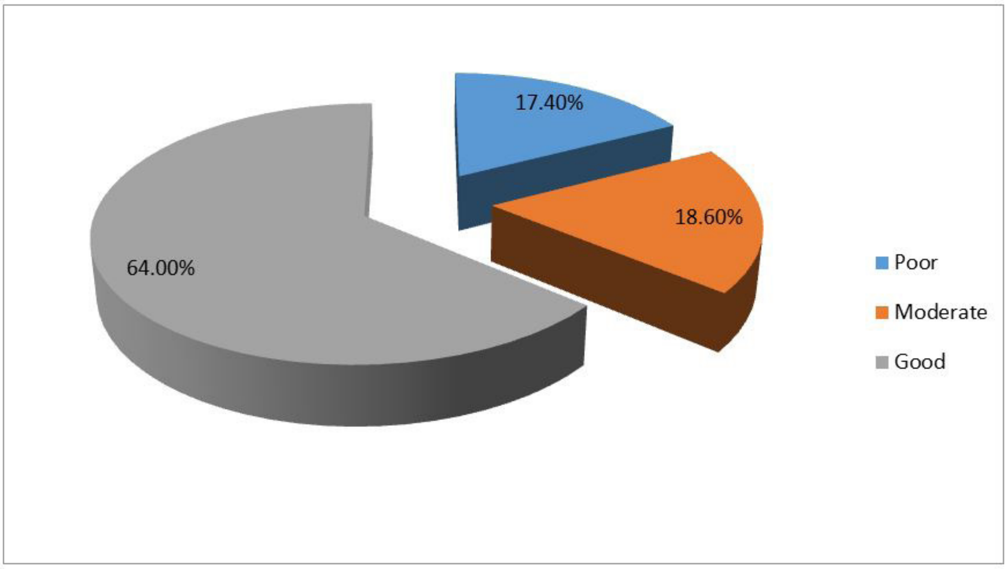

Figure 1: Rating of Food Consumption Pattern of the Women

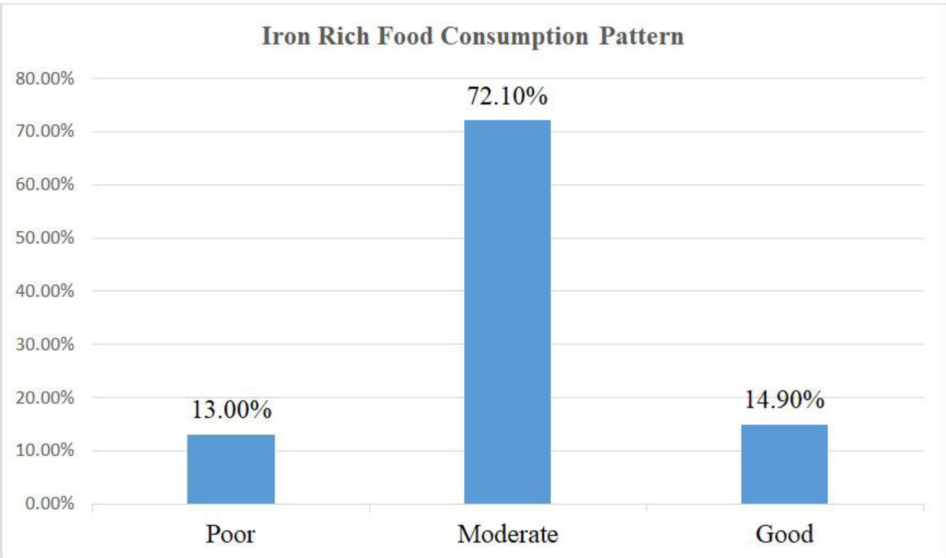

Figure 2: Rating of Iron Rich-Food Consumption Pattern

Variables	r	P value	Decision
Serum ferritin	0.195	0.013*	S
Waist-to-Hip Ratio	0.028	0.721	NS
Body Mass Index	0.106	0.179	NS
Haemoglobin	-0.086	0.276	NS
C-Reactive Protein	0.173	0.029*	S
Waist Circumference	0.257	0.001*	S
Hip Circumference	0.100	0.206	NS
Weight	-0.028	0.723	NS
Height	0.165	0.036*	S

*P<0.05

Table 3: Pearson Correlation analysis showing relationships between age and selected variables

Variables	OR	95% CI	P value
Age (years)			
< 20 (ref)	1.0		
20 – 25	2.776	0.892-8.639	0.078
26 – 30	2.842	1.058-7.633	0.038*
>30	3.200	0.961-10.657	0.580
Body Mass Index (kg/m)			
Underweight (≤18.5) (ref)	1.0		
Normal (18.5-24.99)	0.000	0.000-0.000	0.999
Overweight ≥25	0.000	0.000-0.000	0.999
Waist-to-Hip Ratio(cm)			
< 0.85 (ref)	1.0		
≥ 0.85	4.985	1.350-18.411	0.016*
Serum Ferritin			
<15 (ref.)	1.0		
≥15	0.785	0.402-1.531	0.477
C-Reactive Protein			
<1 (Low risk of CVD) (ref)	1.0		
1-2.9 (Intermediate risk of CVD)	1.582	0.423-5.909	0.495
≥3-10 (High risk of CVD)	2.000	0.478-8.369	0.343
>10 (Further test required)	3.000	0.199-45.244	0.427
Food Consumption Pattern Score			
Poor (≤23) (ref)	1.0		
Moderate (24-32)	0.579	0.203-1.653	0.307
Good (≥33)	0.568	0.246-1.311	0.185

*Significant at p<0.05

Table 4: Binary Logistic Regression analysis of factors associated with haemoglobin among women of reproductive age (18-40 years)

Iron Rich Foods Rarely consumed	OR	95% CI	P value
Cereals	0.307	0.129 - 0.727	0.007*
DGLV	3.895	1.370 – 11.075	0.011*
Organ Meat	8.344	1.808 – 38.514	0.007*
Flesh Meat	1.141	0.401 - 3.246	0.805
Eggs	1.009	0.367 - 2.774	0.986
Fish	0.471	0.206 – 1.080	0.075
Legumes/Nuts/Seeds	0.424	0.475 -1.028	0.058*

*Significant at p < 0.05

Table 5: Binary Logistic Regression analysis of iron-rich foods associated with haemoglobin among women of reproductive age (18-40 years)

which is associated with a range of metabolic abnormalities and cardiovascular diseases. This corroborated studies conducted in Vietnam and a review of body composition and cardio metabolic risk [24,25].

Oil and fats were the most commonly consumed food as judged by the mean value using the food consumption pattern. In African culture, especially the study area, there is virtually no food cooked without adding oil, though this did not negatively impact on the BMI, the quantity consumed could be a factor. The least consumed as judged by the mean value was organ meat [26-28]. A study conducted in Zambia also indicated that women of reproductive age especially lactating mothers had low food consumption [29]. The current study indicated that a quarter of the women were rated low in their food consumption level. Out of the 161 women investigated, 26 indicated that they rarely or don't eat organ meat at all. It is worthy of note that organ meat is a good source of iron. Intra household food allocation could come to bear in this context as the culture demands that quality meats and foods are usually served first, to the husband and second, to the male children, before the mother and female children. Harris-Fry *et al.* 2017 in his study opined that cultural belief is a determinant of food allocation typically showing how these beliefs caused women to receive comparatively less in a systematic review of literatures in Asia [30].

Relationships between age and selected variables indicated that age showed a positive significant relationship with serum ferritin, which is accountable for about 4% of the cases. C-reactive protein is responsible for 3%, which is indicative of individuals or population at risk of iron overload as defined by serum ferritin concentration which may be at greater risk of developing cardiovascular diseases. Women aged 26-30 years were twice likely to have association with haemoglobin, likewise, those with WHR above or equal to 0.85 as indicated in a similar study. A similar study observed a positive association with SF and WHR, that is, increase in WHR increased with increase SF. This may be due to the fact that increased WHR is commonly found in association with cardiovascular disease or diabetes, conditions in which the SF may also be increased due to systemic inflammation. This is in variance with the current study in which increased SF and WHR were associated with age. The differences could be due to dietary differences and the relatively lower socioeconomic status of Nigerian women, which may improve as they grow older.

Interestingly, no significant relationship was observed between food consumption pattern, CRP, Hb, SF and BMI in this current study. However, similar finding was also observed among adolescent Iranian girls. Further, specific iron rich foods (7) were excerpted from the general food group (14) and the findings showed that those who rarely consumed cereal, DGLV and organ meat had association with haemoglobin status. This findings builds on previous studies that found similar associations between pregnancy status, household factors and food consumption, low dietary diversity and haematological indicators among pregnant Ethiopian women [31], age among Dakar women [32], dietary diversity [11,33] and among adolescents girls [34]. A study conducted in Nigeria on decision-making ability in food and household food security has implication on health related issues [35], which could negatively or positively impact health outcome [11]. Though, empowerment was not investigated in the current study, previous studies conducted [35] in the study area observed it to be a challenge when it comes to decision taking on food-related matters.

Conclusion

In conclusion, because of the tremendous health burden associated with iron deficiency among women of reproductive age, it is essential that public health awareness programmes that focus on this vulnerable group should be intensified especially in relation to food consumption. It is also important that waist circumference and waist to hip ratio be monitored and maintained within recommended limits preferably through physical exercise as they can act as confounding factors for iron status among women. There is also evidence that C-reactive protein may moderate the relationship with age, which has implication on risk of cardiovascular disease in later years.

The limitations to the study are that it is a cross sectional study among women of reproductive age in a university community, and was conducted during academic session, hence more people could not participate. Therefore, the sample may not be representative of all the women of reproductive age in the community. Also, self-report on food consumption pattern was relied upon, which may have been subject to response biases, including recall bias and desirable responding. Also, many women were scared of needle pricks and as a result declined to participate in the study.

The knowledge impacted by the study is that there is paucity of data on iron status and addition to database on the iron status, nutritional status and food consumption pattern among women of reproductive age in the study area was contributed. The findings draw attention to the anthropometric and nutritional factors associated with iron status among women in the study area. The study also highlights the importance of developing programmes specifically targeted towards the WRA as a vulnerable group and their pre-conceptional health.

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Conflict of Interest: The authors declare that there is no conflict of interest.

Authorship: MFO conceptualized the study design. TO, KO, EF refined the designed. All authors were actively involved in the conduct of the study. MFO, LB, EF and BP did the statistical analyses. AA conducted the laboratory analysis and interpretation. MFO, EF, BP interpreted the data. BP drafted the initial manuscript. MFO, TO provided substantial revisions of the manuscript. All authors read, edited and approved the final manuscript.

Ethics of human subject participation: This study was conducted according to the guidelines laid down and approved by Health Research Ethics Committee of Institute of Public Health, Faculty of Basic Medical Sciences, College of H, Obafemi Awolowo University, Ile-Ife, Nigeria. Written informed consent form was signed by all participants.

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