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Research Article

SPOUSAL AND CULTURE/RELIGION INFLUENCE ON DIETARY PATTERN AND THE LINKAGE BETWEEN THE DIETARY PATTERN AND SOME BIOCHEMICAL PARAMETERS OF PREGNANT WOMEN UNDER PHCS IN OLUYOLE LGA, IBADAN, OYO STATE

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Abstract

Background: Adequate micronutrient intake during pregnancy is important for best reproductive outcomes. This survey examined the spousal and culture/religion influence on dietary pattern and the linkage between the dietary pattern and micronutrient levels of pregnant women under PHCs in Oluyole LGA, Ibadan. **Methodology:** The investigation was cross-sectional study on eligible and randomly selected pregnant women (20-35years) without any medical history of chronic disease. A validated semi-structured questionnaire was administered and their blood samples were also obtained for biochemical assays using standard methods. **Results:** Sociodemographic characteristics revealed that most (99%) are educated, 67% are self-established, 41.2% earned above N35,000 monthly. The respondents mostly consume fruits and vegetables (47.1% once daily), cereal and its products (54.1% once daily), roots and tubers (55.3% 1-3times weekly), fish and fish products (36.5% 1-3times weekly); for milk and milk products, majority (90.7%) of the respondents do consume this food group at least once a week. Over 70% of the participants are forbidden either by culture or religion in eating some certain foods and 92.9%) do have their spouse support and encouragement to eat well. Prevalence of micronutrient deficiency showed that majority (51.1% for serum iron) and over 98% (for serum copper, magnesium and zinc levels) of the respondents were below the minimum acceptable levels; while almost (90.6%) all the respondents had optimal level of vitamin C status. There was significant association between milk and milk products consumption and serum zinc, vitamin C and copper concentrations ($\chi^2(4)=16.190$, $p=0.003$); 35.3% of the women were anaemic. The study concludes that there is high prevalence of micronutrient deficiency among the pregnant women even though they claimed to feed well and all respondents were recorded to have attained an optimal level of vitamin C and a suboptimal level of magnesium.

Keywords: Dietary Pattern, Micronutrient Levels, Pregnant Women, Anaemia, Spousal Influence.

INTRODUCTION

Pregnancy is associated with physiologic changes which lead to increased plasma volume and decreased red blood cells and decreased concentrations of circulating nutrient-binding proteins and micronutrients (Miller *et al.*, 2015). In many developing countries, these physiologic changes can be aggravated by poor nutrition, leading to micronutrient deficiency states, such as anaemia, Pre-eclampsia, and eclampsia that can have disastrous consequences for both mothers and newborn infants (Dominguez-Bello *et al.*, 2019).

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Micronutrients are vitamins and minerals required in small amounts that are essential to the body's health, development and growth. They can be found naturally in a variety of plant- and animal-based foods(Wilson *et al.*, 2018). A varied well-balanced diet typically provides all of the vitamins and minerals necessary for human health. In many settings, however, such foods are not available and provide a major threat to the health and development of populations around the globe and these are also the places where micronutrient deficiencies cause the greatest harm (Sanna *et al.*, 2018). Although the required amounts of micronutrients are very small, micronutrient deficiency can have wide-range negative health impacts that will ultimately result in death if untreated

(Marles, 2017). Micronutrient deficiencies often occur as part of a cycle of malnutrition and may be coupled with protein or energy malnutrition (Olayiwola *et al.*, 2015). Pregnant women and under 5 Children are the most vulnerable population subgroups, while most micronutrient deficiencies disorders can be reversed with provision of missing micronutrients, some deficiency disorders result in irreversible, lifelong consequences (Adinma *et al.*, 2017). Micronutrient deficiency in women of reproductive age is recognized as a major public health problem in many developing countries (UNICEF, 2012). Pregnant women are particularly vulnerable to nutritional deficiencies because of the increased metabolic demands imposed by pregnancy involving a growing placenta, fetus, and maternal tissues, coupled with associated dietary risks (Uji *et al.*, 2017). Micronutrient deficiency may predispose a mother to poor health, including infection, preeclampsia/eclampsia, and adverse pregnancy outcomes such as preterm birth and intrauterine growth retardation (Oluleke *et al.*, 2018). Micronutrient deficiencies tend to coexist in impoverished settings in part because of uniformly low consumption of foods rich in multiple micronutrients (Pathak *et al.*, 2008).Because of the lifelong influences of micronutrient deficiencies on reproductive outcomes, adequate micronutrient intake during pregnancy is important for best reproductive outcomes; hence the need have an established data on the spousal and culture/religion influence on dietary pattern and the linkage between the dietary pattern, packed cell volume and micronutrient levels of pregnant women under PHCs in Oluyole LGA, Ibadan, Oyo state.

METHODOLOGY

Research Design

The investigation was cross-sectional, carried out in three (Odo Ona Elewe, Adaramagbo and Ajofeebo) primary health care facilities in Oluyole LGA, Ibadan of Oyo State.

Study Area

The investigation was done in Oluyole LGA, under Ibadan in Oyo State, south-western Nigeria; with geographical coordinate of 10˚ 23˚ 0˚ N, 12˚ 5’ 0” E. It is reputed to be the largest city in Africa.Its population is estimated to be about 3,800,000 according to 2006 estimates and Yoruba tribes are the principal inhabitants of the city.

Study Population

Pregnant women (20-35 years) in their first, second and third trimesters without any medical history of chronic disease, attending any of the three PHCs were included in this research.

Sample Size

The prevalence of micronutrient deficiency and allowable error(precision) of 5% were used to derive the sample size using Dobson formula ($n=t^2\frac{(pXq)}{d^2}$) (Schäfer *et al.*, 2016).

n = Sample size; t =Error risk where t=1.96 at 95% confidence interval; p = Expected prevalence using 21.4%; d =absolute desired precision of 5%

$$n = \frac{1.96^2(0.214)(1-0.214)}{(0.05)^2} = 330$$

Sampling

A list of all the PHCs in theOluyole LGA was obtained from Oyo state government Secretariat. The selected PHCs and eligible respondents were then randomly selected using arandom number generator.

Ethical Considerations

Ethical approval was sought and obtained from the ethical committee, Ministry of Health, Oyo State(MofH/OyS/ HREC/DPRSD/09/2016) while each respondent willingly gave their consent prior to blood sample collection and the administration of questionnaire.

Field Data Collection

The pretested semi- structured questionnaire was administered to the selected pregnant women who gave self-report of their socioeconomic characteristics, pregnancy related variable, medical history and dietary lifestyle in the study area. The semi structured questionnaire was translated into Yoruba language for those who cannot read English language and two support staff were also recruited for the study.

Blood Sample Collection and Biochemistry Analysis

The blood sample (5mls) was collected from the respondents, after thorough sterilization of the site with 70% of alcohol using sterile disposable plastic syringe. A portion of blood sample was transferred into plain sample bottle and the serum separated after centrifugation 3000rpm/15 minutes prepared for mineral analysis by atomic absorption spectrophotometry using Varian AA240 Atomic Absorption Spectrophotometer (AAS)(AOAC, 1990).The remaining portion of the blood was used for packed cell volume (PCV) determination.

Estimation of PCV was determined following the method described by Jones (1961).

Determination of Vitamin C using Dinitrophenyl hydrazine was determined by the colorimetric method of Roe and Kuether (1943).

Statistical Analysis

All data were analyzed using Statistical Package for Social Science (SPSS) version 23 and presented as absolute numbers, frequency and percentages. Data were also presented in Tables and Figure. One way analysis of variance was used to test for significant differences in means of various groups, Post hoc Test was used for multiple comparisons across trimesters. Phi and Cramers V test was also used to test the strength of association. All reported $P < 0.05$ was considered statistically significant.

RESULTS

Sociodemographic Features of Pregnant Women in Oluyole PHCs

The sociodemographic features as presented in Table 1 shows that60.0% of the respondents were Christians; for parity, 82.4% of the participants have given birth to at least one child before their present pregnancy while 17.6% had no prior birth

experience; husband's occupation shows that64.7% were self-employed, 22.4% were Civil servants, while only13% were engaged in other activities while the respondents having majority (67%) also self-employed and 11.8% are full housewives. Majority (67.1%) of the respondents' spouses earned above the country's minimum wage monthly; while only 5.9% earned between N5,000 - N10, 000. A larger percentage of the respondents had a touch of education at various levels, with 94.1% having formal education while 4.7% had an informal education (adult education) and only 1.2% had no form of education at all.

Dietary Pattern of Pregnant Women Attending Primary Healthcare Centres in Oluyole Local Government Area of Ibadan, Nigeria

Figure 1 shows respondents' dietary pattern (percentage distribution) of the selected food groups; 98.8% of the respondents do consume fruits and vegetables everyday while all the respondents do consume fruits at least once every week. Just as the case of fruits, all the respondents do consume cereals and its products with majority (54.1%) consuming it at least once daily. The consumption of roots and tubers was peaked at 1-3 times weekly (55.3%); 42.4% of the respondents do consume meat and meat products at least once daily. All the respondents do also eat fish and fish products; for milk and milk products, majority (90.7%) of the respondents do consume this food group at least once a week. However, 9.4% of the participants do not consume milk and milk products at all.

Table 1. Sociodemographic Features of Pregnant Women Attending PHCs in the Oluyole LGA, Ibadan

Characteristics	Frequency	Percentage (%)
Religion		
Christian	51	60
Islam	34	40
Educational Status		
None	1	1.2
Primary	8	9.4
Secondary	31	36.5
Tertiary	41	48.2
Adult Education	4	4.7
Respondent occupation		
Civil servant	7	8.2
Self employed	57	67.0
Full housewife	10	11.8
Others (Unemployed)	11	13
Respondent monthly income		
<N5, 000	6	7.1
N5, 000 - N10, 000	5	5.9
N11, 000 - N25, 000	17	20.0
N 26,000 - N35, 000	22	25.9
> N35, 000	35	41.2
Husband occupation		
Civil servant	19	22.4
Self employed	55	64.7
Others	11	13.0
Parity		
Nil	15	17.6
One	36	42.4
Two	25	29.4
Three/Four	9	10.6
Total	85	100

Spousal and cultural/religion influences on dietary pattern of pregnant women attending primary healthcare centres in Oluyole local government area of Ibadan

Considering the influence of culture and religion on the choice of food consumed (in Table 2), 74.1% of the respondents are forbidden either by culture or religion in eating some certain foods while only a small fraction 22 (25.9%) were not forbidden by religion or culture from eating any certain foods. Culture and/or religion forbid some of the participants from consuming beans, eggs, plantain, fish and okra. A greater percentage of the respondents (92.9%) do have their spouse support and encouragement to eat well. More than half (60.0%) of the respondents do eat more than three (3) times in a day.

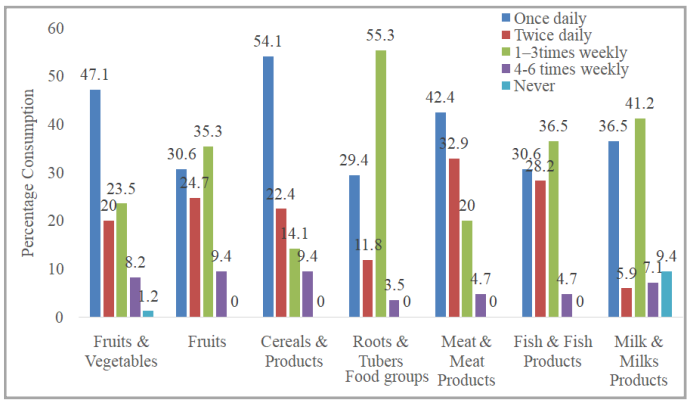


Figure 1. Percentage Distribution of Dietary Pattern of Pregnant Women in the Study Area

Table 2. Influences on the Dietary Pattern of Pregnant Women Attending Primary Healthcare Centresin Oluyole Local Government Area of Ibadan

Characteristics	Freq	Percent
Culture/Religion (Food Forbidden during Pregnancy)		
Beans	4	4.7
Eggs	6	7.1
Plantains	1	1.2
Fish	2	2.4
Okra	26	30.6
Spouse Influence		
Spouse encourages eating well	79	92.9
Personal Preference		
Poultry meat or fish in place of red meat	39	45.9
No of Times Respondents Eat Daily		
Once	2	2.4
Twice	6	7.1
Thrice	26	30.6
More than three times	51	60.0

Prevalence of Micronutrient Deficiency of Pregnant Women Attending Primary Healthcare Centre in Oluyole Local Government Area of Ibadan

Table 3 shows that majority (51.1% for serum iron) and over 98% (for serum copper, magnesium and zinc levels) of the respondents were below the minimum acceptable levels of the investigated micronutrients; while almost (90.6%) all the respondents had optimal level of vitamin C status.

Table 4 is a summary of mean serum micronutrient status of pregnant women attending primary healthcare centres in Oluyole local area of Ibadan based on trimester.The output of one-way analysis of variance of means of serum micronutrients of pregnant women at different trimesters. There was no significant difference in the mean serum iron, zinc, copperand vitamin C concentrations of pregnant women across trimesters; there was significant ($P<0.05$) difference in the means of serum magnesium concentration of pregnant women across trimesters ($p = 0.01$).

Table 3. Micronutrient status of pregnant women attending primary healthcare centre in Oluyole local government area of Ibadan

Variable	Micronutrient Status/Level			
Micronutrients	Suboptimal level	Optimal level	Elevated level	Total
Iron (Fe)	46 (51.1%)	39 (45.9%)	0 (0%)	85 (100.0%)
Copper (Cu)	84 (98.8%)	1 (1.2%)	0 (0%)	85 (100.0%)
Magnesium (Mg)	85 (100.0%)	0 (0%)	0 (0%)	85 (100.0%)
Zinc (Zn)	84 (98.8%)	1 (1.2%)	0 (0%)	85 (100.0%)
Vitamin C.	0 (0%)	77 (90.6%	8 (9.4%)	85 (100.0%)

Table 4a. Serum micronutrient status of pregnant women attending primary healthcare Centresin Oluyole local area of Ibadan

Trimester	Fe	Cu	Mg	Zn	Vit. C
First	0.42 ± 0.17	0.37 ± 0.12	2.82 ± 0.44	0.08 ± 0.06	6.91 ± 3.52
Second	0.51 ± 0.21	0.41 ± 0.13	2.30 ± 0.31	0.08 ± 0.13	5.29 ± 3.52
Third	0.51 ± 0.30	0.35 ± 0.10	3.13 ± 0.24	0.04 ± 0.04	4.78 ± 2.72

Fe- Iron, Cu- Copper,Mg- Magnesium, Zn- Zinc, Vit. C- Vitamin C,

Table 4b. Serum iron status of pregnant women attending primary healthcare Centresin Oluyole local area of Ibadan

	Trimester	N	Mean	Minimum	Maximum	F-value	*p*– value
Iron	First	23	0.42 ± 0.17	0.20	0.84	1.254	0.291
	Second	35	0.51 ± 0.21	0.25	1.20		
	Third	27	0.51 ± 0.30	0.14	1.37		
	Total	85	0.49 ± 0.24	0.14	1.37		
Zinc	First	23	0.08± 0.05	0.00	0.18	1.623	0.204
	Second	35	0.08± 0. 31	0.00	0.79		
	Third	27	0.04± 0.04	0.00	0.17		
	Total	85	0.07± 0.10	0.00	0.79		
Magnesium	First	23	2.82±0.44	1.23	3.28	5.414	0.01
	Second	35	2.30±0.31	2.21	3.65		
	Third	27	3.13± 0.24	2.28	3.41		
	Total	85	2.30 ±0.35	1.23	3.65		
Copper	First	23	0.38± 0.12	0.14	0.60	1.755	0.179
	Second	35	0.41± 0.14	0.20	0.88		
	Third	27	0.35± 0.10	0.16	0.56		
	Total	85	0.38± 0.12	0.14	0.88		
Vitamin C	First	23	6.91± 3.52	1.00	16.00	2.836	0.06
	Second	35	5.29± 3.52	1.00	15.00		
	Third	27	4.78± 2.72	1.00	9.00		
	Total	85	5.57± 3.36	1.00	16.00		

Table 4c. Multiple Comparisons Table (Post Hoc Test) For Serum Magnesium Status of Pregnant Women in the Study Area

(I) Trimester of pregnancy	(J) Trimester of pregnancy	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
First	Second Trimester	-.17112	.08895	.138	-.3834	.0412
	Third Trimester	-.30937*	.09403	.004	-.5338	-.0849
Second	First Trimester	.17112	.08895	.138	-.0412	.3834
	Third Trimester	-.13825	.08488	.239	-.3409	.0644
Third	First Trimester	.30937*	.09403	.004	.0849	.5338
	Second Trimester	.13825	.08488	.239	-.0644	.3409

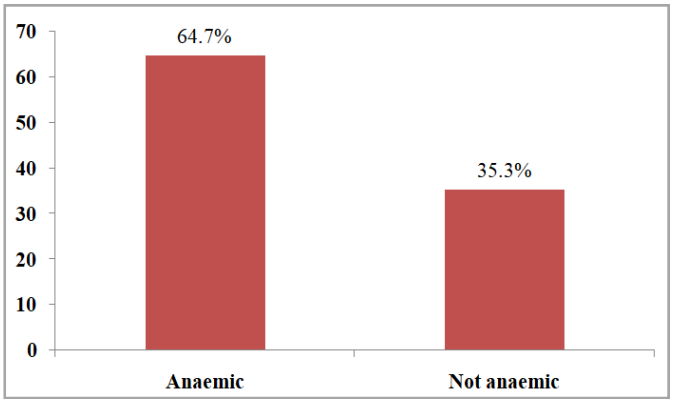
*. The mean difference is significant at the 0.05 level.

Multiple comparison (Table 4c)(Post-Hoc Test) shows significant difference in mean serum magnesium concentration across the first and third trimester (p = 0.004).There was a significant difference between serum magnesium concentration of pregnant women across trimester as determined by one-way ANOVA (F (2,82) = 5.414, p = 0.006). Tukey post hoc test revealed that the mean serum magnesium concentration during the third trimester (3.13 ± 0.24 mg/l, p = 0.004) was significantly higher compared to the first trimester (2.82 ± 0.44 mg/l, p = .004).

Relationship between dietary pattern and Micronutrient status of Pregnant WomenAttending Primary Healthcare Centre in Oluyole Local Government Area of Ibadan

Table 5 shows the results of the "Pearson Chi-Square Cross tabulation between dietary pattern and serum micronutrient status. Fruits and vegetables, fruits, cereals, roots and tubers, meat and meat products, and milk and milk products all had no significant (p>0.05) association between them and serum iron concentration; only Fish and fish products has significant

association (χ^2 (3) = 8.668, p = 0.034) between it and serum iron concentration. The dietary pattern showed significant association between milk and milk products consumption and serum zinc, vitamin Cand copper concentrations (milk and milk products: χ^2 (4) = 16.190, p = 0.003). Using Phi and Cramer's V test, the strength of association between the variables (consumption of fish and fish products and serum iron concentration) is very weak (0.319); also, consumption of milk and milk products in relation to serum zinc, vitamin C and copper concentrations) has very weak (0.436) relationship. No measure of association/relationship can be computed for the Pearson Chi-square cross tabulation of respondent's dietary pattern (food group consumption) and their Serum magnesium concentration, because one of the variables of interest in the 2-way table upon which measures of association are computed is a constant (serum magnesium concentration) i.e. it only has one category (suboptimal), while the other categories are constant (zero).



Reference Value: Packed Cell Volume: 33%–38% (Non-Anaemic); ≤ 32% (Anaemic) (Fairbanks &Tefferi, 2000)

Figure 2. Prevalence of Anaemia using Packed Cell Volume levels of Pregnant Women Attending Primary Healthcare Centres in Oluyole LGA, Ibadan

Table 5a. Relationship between dietary pattern and Serum Iron and Copper status of Pregnant Women Attending Primary Healthcare Centre in Oluyole Local Government Area of Ibadan

		Serum Iron Percentage of consumption							Serum Copper Percentage of consumption						
Food groups	Status	Once daily	Twice daily	1-3 times weekly	4-6 times weekly	Never	χ^2 value	*p-value*	Once daily	Twice daily	1-3 times weekly	4-6 times weekly	Never	χ^2 value	*p-value*
Fruits & Vegetables	Suboptimal	50.0	15.2	26.1	8.7	0.0	2.815	0.589	47.6	20.2	22.6	8.3	1.2	3.289	0.511
	Optimal	43.6	25.6	20.5	7.7	2.6			0.0	0.0	100	0.0	0.0		
Fruits	Suboptimal	32.6	15.2	41.3	10.9	0.0	5.040	0.169	31.0	23.8	35.7	9.5	0.0	3.084	0.379
	Optimal	28.2	35.9	28.2	7.7	0.0			0.0	100	0.0	0.0	0.0		
Cereals	Suboptimal	58.7	21.7	10.9	8.7	0.0	1.209	0.751	54.8	22.6	13.1	9.5	0.0	6.156	0.104
	Optimal	48.7	23.1	17.9	10.3	0.0			0.0	0.0	100	0.0	0.0		
Roots & Tubers	Suboptimal	34.8	13.0	50.0	2.2	0.0	2.153	0.541	28.6	11.9	56.0	3.6	0.0	2.429	0.488
	Optimal	23.1	10.3	61.5	5.1	0.0			100	0.0	0.0	0.0	0.0		
Meat & Meat products	Suboptimal	43.5	34.8	17.4	4.3	0.0	0.502	0.919	42.9	32.1	20.2	4.8	0.0	2.060	0.560
	Optimal	41.0	30.8	23.1	5.1	0.0			0.0	100	0.0	0.0	0.0		
Fish & Fish products	Suboptimal	23.9	30.4	45.7	0.0	0.0	8.668	0.034	31.0	28.6	35.7	4.8	0.0	1.763	0.623
	Optimal	38.5	25.6	25.6	10.3	0.0			0.0	0.0	100	0.0	0.0		
Milk & Milk Products	Suboptimal	34.8	4.3	52.2	2.2	6.5	7.703	0.103	36.9	4.8	41.7	7.1	9.5	16.190	0.003
	Optimal	38.5	7.7	28.2	12.8	12.8			0.0	100	0.0	0.0	0.0		

Table 5b. Relationship between dietary pattern and Serum Zinc and Vitamin C status of Pregnant Women Attending Primary Healthcare Centre in Oluyole Local Government Area of Ibadan

		Serum Zinc Percentage of consumption							Serum Vitamin C Percentage of consumption						
Food groups	Status	Once daily	Twice daily	1-3 times weekly	4-6 times weekly	Never	χ^2 value	*p-value*	Once daily	Twice daily	1-3 times weekly	4-6 times weekly	Never	χ^2 value	*p-value*
Fruits & Vegetables	Suboptimal	47.6	20.2	22.6	8.3	1.2	3.289	0.511	47.6	20.2	22.6	8.3	1.2	3.289	0.511
	Optimal	0.0	0.0	100.0	0.0	0.0			0.0	0.0	100.0	0.0	0.0		
Fruits	Suboptimal	31.0	23.8	35.7	9.5	0.0	3.084	0.379	31.0	23.8	35.7	8.5	0.0	3.084	0.379
	Optimal	0.0	100.0	0.0	0.0	0.0			0.0	0.0	100.0	0.0	0.0		
Cereals	Suboptimal	54.8	22.6	13.1	9.5	0.0	6.156	0.104	54.8	22.6	13.1	9.5	0.0	6.156	0.104
	Optimal	0.0	0.0	100.0	0.0	0.0			0.0	0.0	100.0	0.0	0.0		
Roots & Tubers	Suboptimal	28.6	11.9	56.0	3.6	0.0	2.429	0.488	28.6	11.9	56.0	3.6	0.0	2.429	0.488
	Optimal	100.0	0.0	0.0	0.0	0.0			100.0	0.0	0.0	0.0	0.0		
Meat & Meat products	Suboptimal	42.9	32.1	20.2	4.8	0.0	2.060	0.560	42.9	32.1	20.2	4.8	0.0	2.060	0.560
	Optimal	0.0	100.0	0.0	0.0	0.0			0.0	0.0	100.0	0.0	0.0		
Fish & Fish products	Suboptimal	31.0	28.6	35.7	4.8	0.0	1.763	0.623	31.0	28.6	35.7	4.8	0.0	1.763	0.623
	Optimal	0.0	0.0	100.0	0.0	0.0			0.0	0.0	100.0	0.0	0.0		
Milk & Milk Products	Suboptimal	36.9	4.8	41.7	7.1	9.5	16.190	0.003	36.9	4.8	41.7	7.1	9.5	16.190	0.003
	Optimal	0.0	100.0	0.0	0.0	0.0			0.0	100.0	0.0	0.0	0.0		

Socioeconomic variables against Serum micronutrients Status of Pregnant Women Attending Primary Healthcare Centre in Oluyole Local Government Area of Ibadan

The socioeconomic variables against respondents' serum micronutrients status as presented in **Table 6** showed that none of the variables had no significant association with all the serum micronutrients (Fe, Cu, Zn and vitamin C) levels of pregnant women that participated in the study.

Table 6a. Socioeconomic Variables against Serum Iron & Copper Statuses of Pregnant Women Attending Primary Healthcare Centre in Oluyole LGA, Ibadan

Religion	Christianity	29 (63.0)	22(56.4)	0.387	0.534	51 (60.7)	0 (0.0)	1.518	0.218
	Islam	17(37.0)	17(43.6)			33(39.3)	1 (100)		
Parity	Nil	9 (19.6)	6 (15.4)	0.623	0.891	15 (17.9)	0 (0.0)	1.377	0.711
	One	20 (43.5)	16 (41.0)			35 (41.7)	1 (100)		
	Two	13 (28.3)	12 (30.8)			25 (29.8)	0 (0.0)		
	Three/Four	4 (8.7)	5 (12.8)			9 (10.7)	0 (0.0)		
Husband occupation	Artisan	11 (23.9)	12 (30.8)	2.298	0.681	22 (26.2)	1 (100)	2.728	0.604
	Civil servant	13 (28.3)	6 (15.4)			19 (22.6)	0 (0.0)		
	Self employed	17 (37.0)	15 (38.5)			32 (38.1)	0 (0.0)		
	Applicant	1 (2.2)	1 (2.6)			2 (2.4)	0 (0.0)		
	Others	4 (8.7)	5 (12.8)			9 (10.7)	0 (0.0)		
Respondent occupation	Artisan	10 (21.7)	15 (38.5)	5.676	0.339	25 (29.8)	0 (0.0)	1.676	0.892
	Civil servant	6 (13.0)	1 (2.6)			7 (8.3)	0 (0.0)		
	Self employed	18 (39.1)	14 (35.9)			31 (36.9)	1 (100)		
	Applicant	4 (8.7)	3 (7.7)			7 (8.3)	0 (0.0)		
	Full housewife	5 (10.9)	5 (12.8)			10 (11.9)	0 (0.0)		
	Others	3 (6.5)	1 (2.6)			4 (4.8)	0 (0.0)		
Spouse monthly earning	<#5,000	2 (4.3)	4 (10.3)	5.301	0.258	6 (7.1)	0 (0.0)	4.048	0.400
	#5,000 - #10,000	2 (4.3)	3 (7.7)			5 (6.0)	0 (0.0)		
	#11,000 - #25,000	13 (28.3)	4 (10.3)			16 (19.0)	1 (100)		
	#26,000 - #35,000	12 (26.1)	10 (25.6)			22 (26.2)	0 (0.0)		
	>#35,000	17 (37.0)	18 (46.2)			35 (41.7)	0 (0.0)		
Highest educational qualification	None	0 (0.0)	1 (2.6)	2.254	0.689	1 (1.2)	0 (0.0)	1.086	0.896
	Primary	5 (10.9)	3 (7.7)			8 (9.5)	0 (0.0)		
	Secondary	17 (37.0)	14 (35.9)			31 (36.9)	0 (0.0)		
	Tertiary	21 (45.7)	20 (51.3)			40 (47.1)	1 (100)		
	Adult Education	3 (6.5)	1 (1.2)			4 (4.8)	0 (0.0)		
Household size	2 – 4	40 (87.0)	36 (92.3)	0.638	0.424	75 (89.3)	1 (100)	0.120	0.729
	5 – 8	6 (13.0)	3 (7.7)			9 (10.7)	0 (0.0)		
	Total	46 (100)	39 (100)			84 (100)	1 (100)		

Table 6b. Socioeconomic variables against Serum Zinc & Vitamin C Statuses of Pregnant Women Attending Primary Healthcare Centre in Oluyole Local Government Area of Ibadan

Variables	Categories	Serum Zn Status, n (%)				Serum Vit. C status, n (%)			
		Sub-optimal	Optimal	χ^2 value	*p*-value	Sub-optimal	Optimal	χ^2 value	*p*-value
Religion	Christianity	51 (60.7)	0(0.0)	1.518	0.218	44 (57.1)	7(87.5)	2.783	0.095
	Islam	33(39.3)	1(100)			33(42.9)	1(12.5)		
Parity	Nil	15 (17.9)	0 (0.0)	1.377	0.711	14 (14.2)	1 (12.5)	0.409	0.938
	One	35 (41.7)	1 (100)			33 (42.9)	3 (37.5)		
	Two	25 (29.8)	0 (0.0)			22 (28.6)	3 (37.5)		
	Three/Four	9 (10.7)	0 (0.0)			8 (10.4)	1 (12.5)		
Husband occupation	Artisan	22 (26.2)	1 (100)	2.728	0.604	21 (27.3)	2 (25.0)	0.994	0.911
	Civil servant	19 (22.6)	0 (0.0)			18 (23.4)	1 (12.5)		
	Self employed	32 (38.1)	0 (0.0)			28 (36.4)	4 (50.0)		
	Applicant	2 (2.4)	0 (0.0)			2 (2.6)	0 (0.0)		
	Others	9 (10.7)	0 (0.0)			8 (10.4)	1 (12.5)		
Respondent occupation	Artisan	25 (29.8)	0 (0.0)	1.676	0.892	21 (27.3)	4 (50.0)	2.99	0.702
	Civil servant	7 (8.3)	0 (0.0)			6 (7.8)	1 (12.5)		
	Self employed	31 (36.9)	1 (100)			30 (39.0)	2 (37.6)		
	Applicant	7 (8.3)	0 (0.0)			7 (9.1)	0 (0.0)		
	Full housewife	10 (11.9)	0 (0.0)			9 (11.7)	1 (12.5)		
	Others	4 (4.8)	0 (0.0)			4 (5.2)	0 (0.0)		
Spouse monthly earning	<#5,000	6 (7.1)	0 (0.0)	4.048	0.400	6 (7.8)	0 (0.0)	6.785	0.148
	#5,000 - #10,000	5 (6.0)	0 (0.0)			3 (3.5)	2 (25.0)		
	#11,000 - #25,000	16 (19.0)	1 (100)			15 (19.5)	2 (25.0)		
	#26,000 - #35,000	22 (26.2)	0 (0.0)			20 (26.0)	2 (25.0)		
	>#35,000	35 (41.7)	0 (0.0)			33 (42.9)	2 (25.0)		
Highest educational qualification	None	1 (1.2)	0 (0.0)	1.086	0.896	0 (0.0)	1 (12.5)	12.85	0.012
	Primary	8 (9.5)	0 (0.0)			6 (7.8)	2 (25.0)		
	Secondary	31 (36.9)	0 (0.0)			29 (37.7)	2 (25.0)		
	Tertiary	40 (47.1)	1 (100)			38 (49.4)	3 (37.5)		
	Adult Education	4 (4.8)	0 (0.0)			4 (5.2)	0 (0.0)		
Household size	2 – 4	75 (89.3)	1 (100)	0.120	0.729	68 (88.3)	8 (100)	0.120	0.729
	5 – 8	9 (10.7)	0 (0.0)			9 (11.7)	0 (0.0)		
	Total	84 (100)	1 (100)			77 (100)	8 (100)		

Important Variables against Micronutrients of Pregnant Women Attending Primary Healthcare Centre in Oluyole Local Government Area of Ibadan

Table 7 presents the other important variables and their relationship to pregnant women micronutrient profile.Pearson Chi square test showed that only occurrence of convulsion or seizure during pregnancy is significantly associated with serum copper status of the examined participants; its Pearson correlation test shows a negative relationship with correlation coefficient of – 0.339. For the serum zinc status of pregnant women, the result of the Pearson Chi square test showed that intake of herbal supplements/concoction and occurrence of convulsion or seizure during pregnancy are statistically significant with a negative correlation between serum zinc status and intake of herbal supplements/ concoction (– 0.211); and occurrence of convulsion or seizure during pregnancy (– 0.339).

Table 7a: **Important Variables against Serum Iron and Copper Statuses of Pregnant Women Attending Primary Healthcare Centre in Oluyole LGA, Ibadan**

		Serum Iron status, n (%)				Serum copper status, n (%)			
Variables	Categories	Optimal	Elevated	χ^2-value	p-value	Optimal	Elevated	χ^2-value	p-value
Trimester	First	14 (30.4)	9(23.1)	0.878	0.645	23 (27.4)	0(0.0)	1.446	0. 485
	Second	17(37.0)	18(46.2)			34(40.5)	1(100)		
	Third	15 (32.6)	12 (30.8)			27 (32.1)	0 (0.0)		
Number of Antenatal visits	Once	18 (39.1)	11 (28.2)	3.354	0.500				
	Twice	11 (23.9)	12 (30.8)						
	Thrice	11 (23.9)	7 (17.9)						
	Four times	6 (13.0)	8 (20.5)						
	>4 times	0 (0.0)	1 (2.6)						
Feeding pattern	feed very well	45 (97.8)	36 (92.3)	1.433	0.231				
	barely eat well	1 (2.2)	3 (7.7)						
Family history of any disease	Yes	2 (4.3)	1 (2.6))	0.197	0.657	4 (3.6)	0 (0.0)	0.037	0.847
	No	44 (95.7)	38 (97.4)			81 (96.4)	1 (100)		
Fe supplement	Yes	36 (78.3)	22 (56.4)	4.649	0.031	57 (67.9)	1 (100)	0.471	0.493
	No	10 (21.7)	17 (43.6)			28 (32.1)	0 (0.0)		
Zn supplement	Yes	2 (4.3)	1 (2.6)	0.197	0.657	4 (3.6)	0 (0.0)	0.037	0.847
	No	44 (95.7)	38 (97.4)			81 (96.4)	1 (100)		
Mg supplement	Yes	1 (2.2)	1 (2.2)	0.014	0. 906	3 (2.4)	0 (0.0)	0.024	0.876
	No	45 (97.8)	38 (97.4)			82 (97.6)	1 (100)		
Folic Acid supplement	Yes	26 (56.5)	23 (59.0)	0.052	0.820	48 (57.1)	1 (100)	0.743	0.389
	No	20 (43.5)	16 (41.0)			37 (42.9)	0 (0.0)		
Herbal supplements /concoction	Yes	12 (26.1)	6 (15.4)	1.448	0.229	18 (20.8)	1 (100)	3.767	0.052
	No	34 (73.9)	33 (84.6)			67 (79.8)	0 (0.0)		
Health insurance	Yes	11 (23.9)	12 (30.8)	0.503	0.478				
	No	35 (76.1)	27 (69.2)						
Falling since pregnancy onset	Frequently	26 (60.9)	24 (61.5)	0.438	0.803	51 (60.7)	1 (100)	0.642	0.725
	Always	4 (8.7)	2 (5.1)			7 (7.1)	0 (0.0)		
	Never	14 (30.4)	13 (33.3)			27 (32.1)	0 (0.0)		
Malaria	Yes	37 (80.4)	28 (71.8)	0.876	0.349	64 (76.2)	1 (100)	0.311	0.577
	No	9 (19.6)	11 (28.2)			21 (23.8)	0 (0.0)		
Typhoid	Yes	0 (0.0)	2 (5.1)	2.416	0.120	3 (2.4)	0 (0.0)	0.024	0.876
	No	46 (100.0)	37 (94.9)			82 (97.6)	1 (100)		
Body pain	Yes	16 (34.8)	8 (20.5)	2.121	0.145				
	No	30 (65.2)	31 (79.5)						
Diarrhea	Yes	1 (2.2)	2 (5.1)	0.541	0.462	4 (3.6)	0 (0.0)	0.037	0.847
	No	45 (97.8)	37 (94.9)			81 (96.4)	1 (100)		
Gestational Diabetes	Yes	1 (2.2)	1 (2.6)	0.014	0.906				
	No	45 (97.8)	38 (97.4)						
Pregnancy Induced Diabetes	Yes	1 (2.2)	1 (2.6)	0.014	0.906				
	No	45 (97.8)	38 (97.4)						
Occurrence of convulsion or seizure?	Yes	4 (8.7)	4 (10.3)	0.060	0.806	8 (8.3)	1 (100)	9.740	0.002
	No	42 (91.3)	35 (89.7)			77 (91.7)	0 (0.0)		
	Total	46 (100.0)	39 (100.0)			85 (100)	1(100)		

Table 7b. Important Variables against Serum Zinc Concentration of Pregnant Women Attending Primary Healthcare Centre in Oluyole Local Government Area of Ibadan

		Serum Zn status, n (%)				Serum Vitamin C status, n (%)			
Variables	Categories	Sub-optimal	Optimal	χ^2-value	p-value	Optimal	Elevated	χ^2-value	p-value
Trimester	First	23 (27.4)	0(0.0)	1.446	0. 485	24(28.2)	4(50.0)	4.690	0.096
	Second	34(40.5)	1(100.0)			34(40)	4(50.0)		
	Third	27 (32.1)	0 (0.0)			27 (31.8)	0 (0.0)		
Family history of any disease	Yes	5 (4.7)	0 (0.0)	0.037	0.847	1 (1.3)	2 (25.0)	11.957	0.001
	No	81 (95.3)	1 (100.0)			84 (98.7)	6 (75.0)		
Fe supplement	Yes	57 (67.5)	1 (100.0)	0.471	0.493	53 (62.4)	5 (62.5)	0.134	0.714
	No	29 (32.1)	0 (0.0)			32 (37.7)	3 (37.5)		
Zn supplement	Yes	4 (3.6)	0 (0.0)	0.037	0.847	10 (11.8)	1 (12.5)	2.087	0.149
	No	81 (96.4)	1 (100.0)			75 (88.2)	7 (87.5)		
Mg supplement	Yes	3 (2.4)	0 (0.0)	0.024	0.876	10 (11.8)	0 (0.0)	0.213	0.645
	No	82 (97.6)	1 (100.0)			75 (88.2)	8 (100)		
Folic Acid supplement	Yes	48 (57.1)	1 (100.0)	0.743	0.389	55 (64.7)	4 (50.0)	0.212	0.646
	No	37 (42.9)	0 (0.0)			35 (35.3)	4 (50.0)		
Herbal supplements /concoction	Yes	18 (20.2)	1 (100.0)	3.767	0.052	18 (23.4)	0 (0.0)	2.373	0.123
	No	67 (79.8)	0 (0.0)			59 (76.6)	8 (100)		
Health insurance	Yes	23 (26.2)	1 (100.0)	2.728	0.099				
	No	62 (73.8)	0 (0.0)						
Falling since pregnancy onset	Frequently	51 (60.7)	1 (100.0)	0.642	0.725				
	Always	7 (7.1)	0 (0.0)						
	Never	27 (32.1)	0 (0.0)						
Malaria	Yes	64 (76.2)	1 (100.0)	0.311	0.577	59 (76.6)	6 (75.0)	0.011	0.918
	No	21 (23.8)	0 (0.0)			18 (23.4)	2 (25.0)		
Typhoid	Yes	4 (2.4)	0 (0.0)	0.024	0.876	2 (2.6)	0 (0.0)	0.213	0.645
	No	81 (97.6)	1 (100.0)			75 (97.4)	8 (100)		
Diarrhea	Yes	4 (3.6)	0 (0.0)	0.037	0.847	3 (3.9)	0 (0.0)	0. 323	0.570
	No	81 (96.4)	1 (100.0)			74 (96.1)	8 (100)		
Occurrence of convulsion or seizure?	Yes	9 (8.3)	1 (100)	9.740	0.002	8 (10.4)	0 (0.0)	0.918	0.338
	No	77 (91.7)	0 (0.0)			69 (89.6)	8 (100)		
	Total					77(100)	8 (100)		

Vitamin C status of pregnant women's result of the Pearson Chi square test showed that number of antenatal visits, family history of any disease, diagnosis of gestational diabetes and pregnancy induced hypertension during pregnancy had associations; with the Pearson correlation test, there was a positive (correlation) relationship between serum Vitamin C status and number of antenatal visit (coefficient of 0.417); family history of any disease shows a negative (correlation) association (coefficient of - 0.375); and the diagnosis of gestational diabetes and pregnancy induced hypertension during pregnancy also showed a negative correlation (coefficient of – 0.482) for both variables

DISCUSSION

This research assessed the association between dietary pattern and serum micronutrient status of pregnant women attending three PHCs in Oluyole LGA, Ibadan. Minerals and vitamins are referred to collectively as micronutrients and they have vital impact on the health of pregnant women and the growing foetus. Good nutrition is said to be the most powerful factor that can be used to reduce the burden of diseases and death across the life span around the world (Bailey *et al.*, 2015). The global prevalence of anaemia in pregnant women is said to have fallen only slightly since 1995 from 43% to 38% in 2013 (Stevens *et al.*, 2013)which is lower than the prevalence of 64.7% recorded in this study and quite in line with the 69% prevalence recorded by(Osuorah *et al.*, 2017) in a study carried out in the south eastern part of Nigeria. Iron deficiency is said to be the most common micronutrient deficiency in the world, this corroborates the 51.1% suboptimal level obtained in this study. Certain factors can be responsible for anaemia in pregnancy such as malaria-induced hemolytic anaemia, high fetal demand for iron, underlying maternal disease; untreated anaemia in early pregnancy is likely to get worse as pregnancy advances. In addition, deficient or absent antenatal care and not receiving any iron/folic acid supplements and malaria chemoprophylaxis, both of which are routinely used for the prevention of anaemia in pregnancy in Nigeria maybe other contributing factors (Anorlu *et al.*, 2006). Ibeawuchi *et al.* (2017)also recorded a 92% prevalence of zinc deficiency among pregnant women in Nigeria and this also goes in line with the 98.8% prevalence of zinc deficiency recorded in this study. Zinc (Zn) is a structural constituent that is essential for cell growth, development and differentiation (Maxfield *et al.*, 2021). Zinc deficiency (ZD) is one of the most common micronutrient deficiencies worldwide, affecting around 2 billion people,especially in developing countries. Several earlier reports demonstrate that maternal zinc deficiency during pregnancy is linked with adverse pregnant outcomes including abortion, preterm delivery, stillbirth and fetal neural tube defects (Choi *et al.*, 2018).

This study recorded a very high percentage of the respondents were at suboptimal level of serum copper. Copper has been shown to be involved in the function of several cuproenzymes that are essential for life. It is known to be a cofactor of the antioxidant enzyme superoxide dismutase (Wilson *et al.*, 2018). Copper deficiency during embryonic and fetal development can result in numerous gross structural and biochemical abnormalities even though it is needed in small amount. Also, the study shows that all respondents attained an optimal level of vitamin C which is quite in contrast with previous study by Ugwa *et al.* (2015) where a 79.5% prevalence of vitamin C deficiency among pregnant women was recorded in northwest Nigeria. Respondent's level of education could be suggestive for their optimal level of vitamin C. The findings of this study indicated that respondent's consumption of fish and fish products had an impact or association with their iron status although not a strong association which is quite contrary to previous study of Ndife *et al.* (2019)which reported that fish and fish products and milk and milk products contain some amount of iron. Only milk and milk products showed an association with the respondent's serum copper, zinc and vitamin C this might be as a result of the fact that milk contains a good amount of calcium and has a divalent nature with calcium and also with good absorption properties. Studies have shown that copper is required for the proper uptake of iron and zinc, with excessive zinc in the body resulting in decreased copper absorption. On the other hand, deficient zinc is said to skew the copper-zinc balance, with zinc supplementation actually restoring plasma levels of copper (Nwagha *et al.*, 2011). This is also why copper deficiency can cause anemia and low levels of white blood cells that fight infection and this may be the reason for the high prevalence of anaemia recorded in this study(Ziaei *et al.*, 2008).

The study revealed that all the respondents were deficient of magnesium which is quite contrary to the prevalence of 16.25% recorded in a previous study in south-south Nigeria by Enaruna *et al.* (2013). Previous studies have associated magnesium deficiency with conditions like preeclampsia and preterm delivery (Enaruna *et al.*, 2013). Magnesium is reported to induce relaxation of the muscles, calcium stimulates muscle contractions. The right levels of magnesium can also keep the uterus from contracting until 35 weeks of pregnancy. This suggestively accounts for the 2.4% of pregnancy induced hypertension and 9.4% occurrence of seizure among the respondents. The study also revealed a negative correlation between copper and occurrence of convulsion or seizure and this explains the 8.3% variation in occurrence of seizure. Copper prevents anaemia by regulating iron levels and it's essential in order to produce energy (Grzeszczak *et al.*, 2020). These could be quite suggestive of the high prevalence of iron and copper recorded in this study. Dietary insufficiency of copper during pregnancy can leave the baby with a whole host of problems, including cardiovascular disease, abnormal brain development, and impaired growth and development of the baby as a whole(Aronsson *et al.*, 2013).

Herbal medicine usage has been on the increase in many developing and industrialized countries and studies have showed that between 65 and 80% of the world's population use herbal medicines as their primary form of health care (Fakeye *et al.*, 2009; Frawley *et al.*, 2015). Despite the fact that knowledge of potential side effects of many herbal medicines in pregnancy is limited (Fakeye *et al.*, 2009), and that some herbal products may be teratogenic in human and animal models(Bruno *et al.*, 2018), data on the extent of women's use of herbal medicines during pregnancy is scanty especially in sub-Sahara Africa, where the legislation for distribution and purchase of herbal medicines is not as stringent as it is for conventional medicines(Adisa and Fakeye, 2006). Vitamin C showed a weak association with milk and a milk product which also goes in line with study of (ŢIFREA and TIŢA, 2011)which revealed a weak association between milk consumption and respondents' vitamin C status. In conclusion, the present study in the three primary healthcare centres in

Oluyole LGA of Oyo State reveals high prevalence of micronutrient deficiency among the pregnant women though they majority claim to feed well and all respondent were recorded to have attained an optimal level of vitamin C and a suboptimal level of magnesium. Hence, we recommend that proper mode of food preparation and good nutritional practices should be encouraged during pregnancy; this will enhance optimization of nutrients in the food eaten and also promote good nutrition to help go through the phase of pregnancy without complication.

Conflicts of interest

In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work.

Other relationships

All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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