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Effect of lactation on the lipid profile and body mass index (BMI) of lactating women

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Abstract
The aim of this study was to assess the effect of lactation on the lipid profile and body mass index (BMI) of lactating mothers. Serum samples were collected from 100 apparently healthy participants: 68 lactating women (Test group) and 32 non-lactating women (Control group), aged between 21-40 years. Biochemical parameters including: Total Cholesterol (TCHL), Triglycerides (TG), High density lipoprotein (HDL) and Low density lipoprotein (LDL) were analyzed using standard laboratory methods. A standard Height and Weight measurement Unit was used to measure the height (m) and weight (Kg) of the participants and their BMI thereafter calculated using the formula (Kg/m^2). The mean and standard deviation values of TCHL, TG, HDL, LDL, Weight, Height and BMI for the Test and Control groups were: 155.40±47.74 and 127±33.90 mg/dl, respectively, 99.88±32.34 and 91.65±28.17 mg/dl, respectively, 93.13±38.20 and 82.29±38.20 mg/dl, respectively, 61.08±6.57 and 64.79±9.50 Kg, respectively, 1.65±0.08 and 1.68±0.09 m, respectively, 22.47±3.50 and 22.99±2.96 Kg/m^2, respectively. TCHL, TG, HDL and LDL were significantly ($P<0.05$) higher in the lactating women than in the Control group, except Weight which was significantly ($P<0.05$) lower in the former. There was no significant difference in the height and BMI of the Test and Control groups. Also, from the study, there was no significant correlation between TCHL, TG, HDL and LDL when compared against BMI. Furthermore, a significant correlation ($P<0.05$) was observed in TG when compared to Weight, but other parameters like TCHL, HDL and LDL were insignificant against weight. The outcome of this study shows that lactation increases the lipid profile of lactating women, but not their body mass index (BMI).

Keywords: Lactation, Cardiovascular risk, Lipid profile, Body mass index

1. Introduction
Cardiovascular disease is the leading cause of death worldwide [1] and serum lipid concentrations are often used to evaluate the risk of cardiovascular disease. Previous studies have shown that low serum concentrations of high density lipoproteins (HDL) together with high serum concentrations of total cholesterol (TC), triglycerides (TG) and lipoproteins are associated with an increased risk of coronary heart disease [2]. There is growing body of evidence showing that hyperglycaemia and hyperlipidemia are linked to increased cardiovascular risk [3]. It has been demonstrated that high levels of serum TC, triglycerides, LDL, VLDL, micro-albuminuria, low concentration of HDL and increased body mass index (BMI) are significantly associated with coronary heart disease. Since BMI is proportional to weight from its standard formular; weight/square height, it is therefore expected that factors such as blood glucose which influence weight will ultimately affect BMI.
Hypertension, dyslipidemia and excess body weight are among the most potent accepted risk factors for cardiovascular disease (CVD). Weight loss has beneficial effects on BP, lipid and glucose control. In addition, weight loss in a range of 5-10% of initial weight can offer significant improvement of these variables [4]. Elevation of total cholesterol (TC), triglycerides (TGs) and low density lipoprotein (LDL-C) are documented as risk factors for atherogenesis. The latter is the primary carrier of cholesterol. It has been reported that a 1% reduction in a person's serum TC level yields a 2-3% reduction in the risk of CHD [5]. The risk of atherosclerosis and CHD increase by 20-30% for every 1 mg/dl decrease in the blood level of high density lipoprotein (HDL-C) [6].
Breastfeeding is recommended by many health agencies as the best method to feed infants for at least one year after birth, because of its multiple immediate and long-term benefits for both child and mother particularly against infectious diseases, obesity, immune-related diseases and breast cancer [7, 8]. Lactation has been identified as a factor unique to women that may be associated with dyslipidaemia and obesity, and several studies have shown that it may affect them favourably [9, 10]. One of the important benefits of breast feeding is reduced cardiovascular risk in adulthood [11]. However, a study has suggested that the beneficial effect of breastfeeding on cardiovascular risk exist, only if weaning is performed prior to one year of age, prolonged breast-feeding might actually increase the cardiovascular risk [12]. Lipids have been observed to be high or elevated during prolonged lactation and abnormal level of total level cholesterol and triglyceride predisposes an individual to the development of atherosclerotic coronary artery disease [13].
Lack of extensive studies on the effect of lactation on lipid profile in relation to body mass index, particularly among lactating women dwelling in Ekpoma, Edo state, necessitates this study. The aim of this study is therefore to determine the effect of lactation on lipid profile and body mass index of lactating mothers. It is hoped that, the outcome of this study will make a valuable contribution to previous studies in order to have a more efficient and appropriate respond to the health needs of the growing population.

2. Materials and Methods

2.1 Study Area and Population

This prospective cohort study was carried out in an immunization clinic at a Health center in Ekpoma, the administrative headquarters of Esan West Local Government Area of Edo state, Nigeria, The area lies between latitude 6º43' and 6º45' north of the equator and longitude 6º8' East of the Greenwich meridian [14]. Ekpoma area falls within the rain forest/savanna transitional zone of south western Nigeria. The area has a population of 89 628 and 127 718 at the 1991 and 2006 population census, respectively [15], majority of which are civil servants, traders, businessmen/women, transporter, farmers, teachers/lecturers and students by occupation.

2.2 Sample Size

A total number of one hundred (100) blood samples were randomly collected from apparently healthy participants: 68 lactating women (Test group) and 32 non-lactating women (Control group) attending Immunization clinic at a Primary Healthcare Center in Ekpoma, Edo state. All subjects were between the ages of 21-40 years and were women residing in Ekpoma, Edo state, Nigeria.

2.3 Duration of the Study

The study was carried out between the month of July and September, 2015.

2.4 Ethical Consideration

Ethical approval was sought for and obtained from the Ambrose Alli University Health Research Ethics Committee. Also, administrative permission for the study was obtained from the Management, Primary Healthcare Center, Ekpoma, Esan-West Local Government Area, Edo state.

2.5 Informed Consent

Informed consent was obtained from each patient and all participants were requested to voluntarily sign the consent forms in their own handwriting as proof of willingness to provide samples for the tests. The objective and the method of this study were explained to all participants to gain their acceptance.

2.6 Exclusion Criteria

Women with history of steroids and anti-hyperlipidaemia drugs use in the preceding two weeks of the study were excluded from the study.

2.7 Data Collection

Information was obtained from the participants through administration of a structured questionnaire. Interpreter was provided for translation in local dialect where necessary. The first part of the questionnaires contained the biodata of the patients e.g. Personal Identification Number (PIN), Age etc. Second part includes: lactation, history of anti-hyperlipidaemia drugs use etc. For reasons of privacy, all data were kept confidential in accordance with World Medical Association declaration of Helsinki [16].

2.8 Measurement of Height and Weight

A standard Height and Weight measurement Unit (HWMU) was used to measure the height (m) and weight (Kg) of the participants. The participants wearing light clothes were instructed to stand on the Unit without shoes, heels together and the head in the horizontal plane. Afterwards, measurements were taken and recorded appropriately.

2.9 Calculation of Body Mass Index (BMI)

The BMI of the individual participant was calculated using the formula:

Weight/Square Height (Kg/m^2).

2.10 Specimen Collection

The arm of each participant was tied with a tourniquet to make the veins prominent. The median antecubital vein was then selected and the area was disinfected with 70% alcohol. 5 ml venous blood was then collected with the aid of syringe and needle. This was transferred into a lithium heparin container. The blood sample was centrifuged at 2000 resolution per minutes (rpm) for 5 minutes and serum was immediately separated from the cells into plain container with label corresponding to intial blood sample bottle. The serum samples were stored frozen at -20ºC until use.

2.11 Laboratory Analysis

2.11.1 Total Cholesterol (TC)

The serum total cholesterol level was estimated using enzymatic endpoint method as described by [17]. Briefly, 10 µl of distilled water, standard and samples were dispensed into tubes labelled blank, standard and sample, respectively. 1 ml of cholesterol reagent was added into the respective test tubes and the contents were mixed and incubated at 37ºC for 5 minutes. The absorbance of the standard and samples were measured against blank at a wavelength of 500nm using a spectrophotometer.

2.11.2 Triglyceride (TG)

The serum triglyceride level was estimated using colorimetric method as described by [18]. Briefly, 10 µl of distilled water, standard and samples were dispensed into tubes labelled blank, standard and sample, respectively. 1 ml of triglyceride reagent was added into the respective test tubes and contents were mixed and incubated at 37ºC for five minutes. The absorbance of standard and samples were measured against blank at a wavelength of 500nm using spectrophotometer.

2.11.3 High Density Lipoprotein (HDL)

The serum high density lipoprotein (HDL) was estimated using precipitation method as described by [19]. Briefly, stage 1: 200 µl of standard/sample was dispensed into test tube labelled standard/sample. 500 µl of precipitant was added into the test tubes and mixed well. The contents were allowed to stand for 10 minutes at room temperature and centrifuged for 10 minutes at 4000 rpm. The supernatant was separated and the cholesterol content was centrifuged 4000 rpm. The supernatant was separated and the cholesterol content was then estimated. Stage 2: 100 µl of distilled water, standard supernatant and sample supernatant was added into test tubes labeled blank, standard and sample, respectively. 1ml of cholesterol reagent was added into respective test tubes. The contents were mixed and incubated at 37ºC for 5 minutes in the water bath. The absorbance of standard and sample were measured against blank at the wavelength of 500 nm using spectrophotometer.

2.11.4 Very Low Density Lipoprotein (VLDL)

The serum very low density lipoprotein (VLDL) was calculated using the formular as described by [20]:

LDL-Cholesterol (mg/dl) = Total cholesterol – HDL cholesterol – TG/5

2.12 Statistical Analysis

Data generated in this study are presented as mean±SD and analyzed with one way analysis of variance (ANOVA) using SPSS-18.0 (Statistical packages for social Scientists – version 18.0) statistical program. P values<0.05 were considered significant [21].

3. Results and Discussion

The lipids profile of the lactating (test group) and non-lactating women (control group) is presented in Table 1. The mean±S.D serum Total Cholesterol (TCHL), Triglyceride (TG), High density lipoprotein (HDL) and Low density lipoprotein (LDL) of the lactating women were: 155.40±47.74 mg/dl, 99.88±32.34 mg/dl, 93.13±38.20 mg/dl and 48.47±9.94 mg/dl, respectively. While, the mean±S.D serum Total Cholesterol (TCHL), Triglyceride (TG), High density lipoprotein (HDL) and Low density lipoprotein (LDL) of the non-lactating women were: 127±33.90 mg/dl, 91.65±28.17 mg/dl, 82.29±38.20 mg/dl and 43.58±7.45 mg/dl, respectively. Statistical analysis shows that the lipid profile of the lactating women is significantly higher (P<0.05) than that of the non-lactating women.

The weight, height and body mass index of the lactating (test group) and non-lactating (control group) women is presented in Table 2. The weight, height and body mass index of the lactating women were: 61.08±6.57 Kg, 1.65±0.08 m and 22.47±3.50 Kg/m^2, respectively. While, the weight, height and body mass index of the non-lactating women were: 64.79±9.50 Kg, 1.68±0.09 m and 22.99±2.96 Kg/m^2, respectively. There were no significant differences (P>0.05) in the height and the body mass index of the lactating women when compared to those of the non-lactating women. Howbeit, the weight of the former was significantly (P<0.05) lower than that of the later.

Table 1: Lipids profile of lactating and non-lactating women

Parameters	Test Mean±S.D (n=68)	Control Mean±S.D (n=32)	T-Cal	p-value	Remark
TCHL (mg/dl)	155.40±47.74	127±33.90	4.80	0.00	S
TG (mg/dl)	99.88±32.34	91.65±28.17	2.10	0.04	S
HDL (mg/dl)	93.13±38.20	82.29±38.20	2.34	0.01	S
LDL (mg/dl)	48.47±9.94	43.58±7.45	4.059	0.00	S

Keys: *TCHL = Total Cholesterol, TG = Triglycerides, HDL = High density lipoprotein, LDL = Low density lipoprotein, S.D = Standard deviation, n = Number of subjects, S = Significant.*

Table 2: Weight, Height and Body Mass Index of lactating and non-lactating women

Parameters	Test (n=68)	Control (n=32)	T-Cal	p-value	Remark
Weight (Kg)	61.08±6.57	64.79±9.50	-2.327	0.03	S
Height (m)	1.65±0.08	1.68±0.09	-1.215	0.23	NS
Height^2 (m^2)	2.72±0.01	2.82±0.01	-1.215	0.23	NS
BMI (Kg/m^2)	22.47±3.50	22.99±2.96	-1.212	0.23	NS

Keys: *Body Mass Index = BMI, S.D = Standard deviation, n = Number of subjects, S = Significant, NS = Non-Significant.*

Table 3 shows the correlation between the lipids profile and body mass index (BMI) of lactating women. There was a weak negative correlation between TCHL, TG against BMI, while HDL and LDL correlate positively with BMI, but none was found to be significant (P>0.05).

Table 3: Correlation between lipids profile and Body Mass Index of lactating women

Lipid profile		BMI (Kg/m^2)	r-value	p-value	Remark
TCHL (mg/dl)	155.40±47.74	22.99±2.96	-0.098	0.43	NS
TG (mg/dl)	99.88±32.34	22.99±2.96	-0.070	0.573	NS
HDL (mg/dl)	93.13±38.20	22.99±2.96	0.015	0.905	NS
LDL (mg/dl)	48.47±9.94	22.99±2.96	0.090	0.465	NS

Keys: *Total Cholesterol = TCHL, Triglycerides = TG, High density lipoprotein = HDL, Low density lipoprotein = LDL, BMI = Body Mass Index, r = Correlation coefficient, S.D = Standard deviation, NS = Non-Significant*

Table 4 shows the correlation between the lipids profile and body weight of lactating women. TCHL, TG, HDL and LDL had weak negative correlation against weight, but with a significant p-value (P<0.05) against TG, while other parameters were insignificant (P>0.05).

Table 4: Correlation between lipids profile and Body weight of lactating women

Lipid profile		Weight (Kg)	r-value	p-value	Remark
TCHL (mg/dl)	155.40±47.74	61.08±6.57	-0.137	0.27	NS
TG (mg/dl)	99.88±32.34	61.08±6.57	-0.237	0.04	S
HDL (mg/dl)	93.13±38.20	61.08±6.57	-0.066	0.59	NS
LDL (mg/dl)	48.47±9.94	61.08±6.57	-0.030	0.81	NS

Keys: *Total Cholesterol = TCHL, Triglycerides = TG, High density lipoprotein = HDL, Low density lipoprotein = LDL, r = Correlation coefficient, S.D = Standard deviation, S = Significant, NS = Non-Significant.*

The outcome of this study shows that the lipid profile (TCHL, TG, HDL and LDL) were significantly ($P<0.05$) higher in the test than in the control groups. On one hand, this result is consistent with the work of [22, 13, 23]. According to [13], lipids level was observed to be high or elevated in lactating mothers who extensively breast fed their babies for over a period of eleven months [23] reported that blood triglycerides and lipoprotein lipase activity were greatly increased in mammary tissue during the period of lactation. While, according to [22], during pregnancy, no milk is produced by the breast because prolactin is prevented from acting on milking producing cells by higher level of circulating sex hormones (estrogen and progesterone). These hormones are responsible for preparing the breast for lactation by their action on the duct and gland and that these hormones have an increase effect on TG, HDL and Cholesterol levels, whereas progesterone decreases it.

On the other hand, the significant increase observed in the lipid profile of lactating women in this present study did not agree with the findings of [9] who suggested that lactation provides a route for physiologic excretion of large amounts of cholesterol, which could explain the more speedy return of blood lipids to pre-pregnancy levels observed in lactating mothers. Furthermore, the outcome of this study shows that there was no significant difference between the height and body mass index of the lactating women when compared to those of non-lactating women. This agrees with the work of [24], who reported no association between breastfeeding and maternal height and BMI.

Howbeit, the weight of the lactating women was significantly ($P<0.05$) reduced when compared to those of non-lactating women. This agrees with works of [25, 26, 27], who reported that women gain total body weight and accrue body fat during pregnancy, howbeit, lactation tend to accelerates loss of the excess weight gained during pregnancy postpartum.

4. Conclusion

The outcome of this current study shows that lactation increases the lipid profile of lactating women, but not their body mass index (BMI). The molecular mechanism behind this effect remains unclear and requires further investigation. It also underscores the need for regular monitoring of lipid profile of lactating women to avoid the risk of developing cardiovascular diseases.

Competing Interests

Authors have declared that no competing interests exist.

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