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Original Article

Dyslipidaemia-related cardiovascular risk among pregnant women attending Aminu Kano Teaching Hospital Kano: A longitudinal study

Muhammad A. Saliu, M.Sc, Aliyu Salihu, Ph.D *, Sanusi B. Mada, Ph.D and Olumuyiwa A. Owolabi, M.Sc

Department of Biochemistry, Faculty of Life Sciences, Ahmadu Bello University, Zaria, Nigeria

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الملخص

أهداف البحث: خلل شحميات الدم وخصائص الدهون في الشرايين لهما آثار غير مرغوب فيها على صحة الأم والجنين طوال فترة الحمل. تبحث هذه الدراسة في التغيرات في مستوى الدهون في الدم، وانتشار عسر شحميات الدم وخطر الإصابة بأمراض القلب والأوعية الدموية بين النساء الحوامل اللائي يترددن على وحدة الرعاية السابقة للولادة في مستشفى أمينو كانو التعليمي، كانو.

طرق البحث: تم تجنيد ما مجموعه ١١٢ امرأة حامل، في الثلث الثاني من الحمل عند زيارة مستشفى أمينو كانو التعليمي، ومتابعتهم حتى الثلث الثالث من الحمل. تم تقييم الخصائص الديموغرافية ونمط الاستهلاك الغذائي اليومي والملف الدهني لجميع النساء باستخدام الطرق القياسية.

النتائج: أظهرت النتائج أن متوسط عمر المرأة الحامل وعمرها الحملي كان حوالي ٢٩ ± ٦ سنوات و٢٠ ± ٣ أسابيع على التوالي. كانت معظم النساء الحوامل متعددات الولادة (٧٦) ومتعددات الحمل (٩٣). أظهر نمط الاستهلاك الغذائي اليومي لدى النساء الحوامل أن ٢٠.٥٪ و٦٣.٤٪ و١٣.٤٪ و٨.٠٪ استهلكوا المكسرات وزيت النخيل والزبدة والسردين ما لا يقل عن ١-٣ مرات على التوالي. علاوة على ذلك، أظهر تحليل الدهون في الدم أن انتشار عسر شحميات الدم، فرط كوليسترول الدم، ارتفاع الدهون الثلاثية، ارتفاع البروتين الشحمي الخفيض الكثافة وانخفاض البروتين الشحمي المرتفع الكثافة بين النساء الحوامل خلال الثلث الثاني من الحمل كانت ٦٩.٦٪، ١٩.٦٪، ٣٦.٦٪، ١٨.٨٪ و٤٩.١٪ على التوالي. زادت كل هذه العلامات بشكل ملحوظ إلى ٩١.٨٪، ٥٤.١٪، ٣.٧٥٪، ٤٠.٠٪ و٦٢.٤٪ على التوالي في الثلث الثالث. وأظهرت النساء الحوامل مخاطر عالية للإصابة بأمراض القلب والأوعية الدموية في الثلث الثاني (٨١.٠٪) والثالث (٨٥.٠٪).

الاستنتاجات: التقدم من منتصف الحمل إلى الولادة يرتبط بزيادة خطر الإصابة بعسر شحميات الدم لدى الأمهات وأمراض القلب والأوعية الدموية بين النساء الحوامل.

الكلمات المفتاحية: قبل الولادة؛ أمراض القلب والأوعية الدموية؛ عسر شحميات الدم؛ مستوى الدهون؛ حمل

Abstract

Objective: Maternal dyslipidaemia and atherogenic lipid profiles have undesirable effects on maternal and foetal well-being throughout gestation. This study investigates the changes in serum lipid profiles, the prevalence of dyslipidaemia, and the risk of cardiovascular disease among pregnant women attending the antenatal care unit of the Aminu Kano Teaching Hospital (AKTH), Kano.

Methods: A total of 112 pregnant women visiting AKTH in their second trimester were recruited and followed up within their third trimester. The demographic characteristics, daily dietary consumption patterns, and lipid profiles of all women were assessed using standard methods.

Results: The results revealed that the mean age and gestational age of the pregnant women were approximately 29 ± 6 years and 20 ± 3 weeks, respectively. Most pregnant women were multiparous (76) and multigravida (93). Regarding daily dietary consumption patterns, 20.5%, 63.4%, 13.4%, and 8.0% of the pregnant women consumed nuts, palm oil, butter, and sardines at least one to three times, respectively. Moreover, the serum lipid profiles revealed that the prevalence of dyslipidaemia, hypercholesterolaemia, hypertriglyceridaemia, increased low-density lipoprotein levels, and decreased high-density lipoprotein levels among pregnant women during the second trimester were 69.6%, 19.6%, 36.6%, 18.8%, and

* Corresponding address: Department of Biochemistry, Ahmadu Bello University, Zaria, Nigeria.

E-mail: aliyu.salihu@gmail.com (A. Salihu)

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49.1%, respectively. All these parameters significantly increased to 91.8%, 54.1%, 75.3%, 40.0%, and 62.4%, respectively, in the third trimester. Pregnant women showed a high risk of cardiovascular disease in both the second (81.0%) and third (85.0%) trimesters.

Conclusion: Progression from mid-pregnancy to delivery is associated with an increased risk of maternal dyslipidaemia and cardiovascular diseases among pregnant women.

Keywords: Antenatal; Cardiovascular disease; Dyslipidaemia; Lipid profile; Pregnancy

Introduction

Changes in lipid metabolism during pregnancy is associated with foetal growth and development[1,2] and the major characteristics are increased tissue lipolysis, maternal hyperlipidaemia and fat accumulation.[3,4] These alterations are essential and correspond to clinical manifestations resulting in consistent elevation of maternal lipid levels from conception to delivery.[5]

During pregnancy, there are no specific requirements for lipid consumption; instead, they are similar to those of the general population and should not exceed 30% of the total calorie intake, with mono- and polyunsaturated fatty acids being the major components of consumed fats.[6] Polyunsaturated fatty acids are required for brain function and cell growth, as well as assisting in reducing the risk of arrhythmia, lowering blood pressure, and slowing down the accumulation of plaque.[7] Kaaja[8] reported that lipogenesis and fat storage are encouraged during the anabolic phase of early pregnancy in preparation for rapid foetal growth, which occurs in the late stage of pregnancy. A maternal atherogenic lipid profile has been implicated in perinatal morbidity and mortality,[2] while the presence of atherogenic dyslipidaemia elicited by high triacylglycerol levels and reduced low-density lipoprotein (LDL) and high-density lipoprotein (HDL) levels in early gestation indicate a high risk for cardiovascular diseases (atherosclerosis and coronary heart disease) with a possibility of undesirable pregnancy outcomes[9,10] such as preterm delivery, preeclampsia, gestational diabetes, maternal morbidity, and mortality.[2,5]

Singh et al.[11] reported a strong association between dyslipidaemia and pregnancy-induced hypertension, as well as intrauterine growth restriction, intrahepatic cholestasis, macrosomia, and foetal death.[12] Thus, determination of the lipid profile is greatly recommended to introduce rapid management approaches to prevent the damaging effect of dyslipidaemia associated with pregnancy.[13] Dyslipidaemia has a high global prevalence in all populations (including pregnant women) ranging from 21.7% to 87.7%[14–17] and 11.9%–45.7% in Africa.[18] In Nigeria, the prevalence of dyslipidaemia was reported to be 71.1%,[19] while in Kano State specifically, the prevalence was found to be approximately 40%.[20,21]

Despite the high prevalence of dyslipidaemia in Nigeria, data regarding its prevalence and its association with cardiovascular risk during pregnancy are scarce. Dyslipidaemia is an established risk factor for cardiovascular disease; however, the available studies on pregnant women in Kano, Nigeria are insufficient, especially considering the issue across trimesters. Therefore, this study aimed to longitudinally investigate the changes associated with lipid profiles, the prevalence of dyslipidaemia, and the risk for cardiovascular disease among pregnant women in Kano. This study could help design policies and programme-based decisions by relevant stakeholders toward preventing potential consequences of dyslipidaemia for both the mother and the developing foetus.

Materials and Methods

Study area

This study was carried out at Aminu Kano Teaching Hospital (AKTH), in Kano, Nigeria. This is a government tertiary hospital located at 11.9634° N, 8.5504° E, Zaria Road, Kano, Nigeria. The core functions of the hospital are service delivery, teaching, and research. Antenatal and delivery services for pregnant women and other services related to general healthcare are provided by the Obstetrics and Gynaecology Department of the hospital.

Study design

The work was designed as a longitudinal study to evaluate the changes in the serum lipid profiles, prevalence of dyslipidaemia, and risk of cardiovascular disease among pregnant women attending the antenatal care unit at AKTH, Kano, Nigeria. Blood samples were collected from pregnant women (who consented to participate in the study) in their second trimester upon confirmation of the ultrasound scanning results. After 12 weeks, blood samples were collected from the same pregnant women in their third trimester. Three millilitres of blood was collected from each subject (during the two periods) by a trained phlebotomist using venepuncture which was immediately transferred to a plain tube. The blood was allowed to clot and then centrifuged at 3000 rpm to obtain serum and preserved at −20 °C for the lipid profile assay, which was conducted at the Chemical Pathology Laboratory Unit, Murtala Muhammad Specialist Hospital, Kano.

Study participants and sampling

A total of 112 pregnant women aged 15–49 years in their second trimester attending the antenatal care unit of AKTH at the time of the study were recruited. Simple random sampling was used for selection within 4 weeks.

Exclusion criteria

Pregnant women with medical complications such as diabetes, hypertension, cardiovascular diseases, HIV/AIDS, cancer, sickle cell anaemia, and haemoglobinopathies were excluded to reduce the effect of confounders which could affect the expected results. These were confirmed from their medical histories archived in the hospital records and the responses obtained from the pregnant women to questions asked during recruitment. Pregnant women who refused to provide consent were excluded.

Data collection

Demographic and dietary consumption pattern data collection

A validated semi-structured questionnaire containing two sections was administered to the pregnant women by trained interviewers to collect data on their demographic characteristics and their daily consumption of lipid-rich foods.

Determination of total cholesterol, triacylglycerol and high-density lipoprotein

Total cholesterol and triacylglycerol levels were determined by the methods of Allain et al.[22] and Jacobs and VanDemark,[23] respectively. Ten microlitres each of sample, standard, and distilled water was added to 1000 µL of each specific reagent in separate tubes and incubated at 37 °C for 5 min. HDL was estimated through quantitative precipitation of LDL and very low-density lipoprotein (VLDL) and chylomicron fractions by the addition of phosphotungstic acid in the presence of magnesium ions, as described by Assmann.[24] Three hundred microlitres of sample was added to 300 µL of HDL reagent (phosphotungstate and magnesium chloride) and centrifuged for 10 min at 4000 rpm. After centrifugation, the clear supernatant from the precipitate was used to determine the HDL cholesterol concentration as described by Allain et al.[22] using 50 µL of HDL standard as the reference.

Calculation of low and very-low-density lipoprotein and atherogenic index

LDL was calculated according to Friedewald et al.[25]:

$$LDL = Total\ cholesterol - HDL - Triacylglycerol/5$$

VLDL was derived using the formula determined by Crook[26]:

$$VLDL = Triacylglycerol/2.2$$

The atherogenic index was derived using the formula as estimated by Dobiasova and Frohlich[27]:

$$Atherogenic\ index = Log\ (Triacylglycerol/HDL)$$

Determination of dyslipidaemia

Dyslipidaemia was determined according to the guidelines set by the National Cholesterol Education Program-Adult Treatment Panel (NCEP-ATP III).[28] Total cholesterol, triacylglycerol, and LDL values were considered above normal levels if $\geq$ 200 mg/dL, $\geq$150 mg/dL, and $\geq$130 mg/dL, respectively, while HDL values < 50 mg/dL were considered below normal levels. Dyslipidaemia was recorded when at least one of the above parameters were affected.

Statistical analysis

Data were analysed using the Statistical Package for Social Sciences (SPSS) IBM software version 21. Data were presented as frequency/percentage or mean ± standard deviation, as appropriate. Descriptive statistics were used to summarise the demographic and dietary consumption pattern data. A paired sample t-test was performed to compare the data (independent variable: second and third trimesters; dependent variable: cholesterol, triacylglycerol, HDL, LDL, VLDL, and atherogenic index) and an *Eta* coefficient test was conducted to determine the association between lipid-rich foods (independent variable) and the lipid profile of the participants (dependent variable). Differences were considered statistically significant at $P \leq 0.05$.

Results

Demographic characteristics and daily consumption of lipid-rich foods by pregnant women at AKTH, Kano

This study recruited a total of 112 pregnant women in their second trimester, although only 85 (~76%) were followed up within the third trimester due to dropouts and exclusions. The mean age and gestational age of the pregnant women were approximately 29 ± 6 years and 20 ± 3 weeks, respectively, and the average number of children was 2 (Table 1). The results revealed that 76 and 93 of the pregnant women considered in this study were multiparous and multigravida, respectively, while 46 of them had experienced abortion/miscarriage as indicated in Table 1.

Table 1: Demographic characteristics of pregnant women at AKTH, Kano.

Demographic Characteristics	Frequency (n = 112)
Age (years)	28.88 ± 5.66*
Number of children	2.29 ± 1.93*
Household size	5.69 ± 3.51*
Occupation	
Housewife	56
Artisan/Skilled worker	14
Civil servant	21
Student	13
Others	8
Gestational age (weeks)	19.96 ± 3.28*
Parity	
Nulliparous	23
Primiparous	13
Multiparous	76
Gravidity	
Primigravida	19
Multigravida	93
Abortion/Miscarriage	
Yes	46
No	66

Values with an asterisk (*) are presented as Mean ± Standard deviation.

Table 2: Lipid profile and atherogenic index of pregnant women at AKTH, Kano.

Lipid Parameters	Second Trimester	Third Trimester
Cholesterol (mg/dL)	175.40 ± 39.20[a]	199.84 ± 37.84[b]
Triacylglycerol (mg/dL)	134.29 ± 44.24[a]	178.71 ± 48.20[b]
High Density Lipoprotein (mg/dL)	48.77 ± 11.57[a]	46.86 ± 11.29[b]
Low Density Lipoprotein (mg/dL)	99.71 ± 43.97[a]	117.22 ± 41.67[b]
Very Low-Density Lipoprotein (mg/dL)	61.06 ± 20.13[a]	81.25 ± 21.90[b]
Atherogenic Index	0.43 ± 0.20[a]	0.58 ± 0.19[b]

Values are expressed as the mean ± SD (n = 85). Values with different superscript letters for the lipid parameters across the trimesters are significantly different at $p < 0.05$.

Moreover, analysis of daily consumption patterns of the pregnant women showed that 20.5%, 60.7%, 63.4%, 36.6%, 13.4%, and 8.0% consumed nuts, vegetable oil, palm oil, milk, butter, and sardines at least one to three times respectively, as shown in Figure 1.

Changes in lipid profile and atherogenic index across trimesters among pregnant women at AKTH, Kano

The results of the lipid profiles and atherogenic indices among pregnant women attending the antenatal care unit in AKTH (Table 2) indicated that the concentrations of cholesterol, triacylglycerol, LDL, VLDL, and atherogenic index were significantly ($p < 0.05$) higher in the third trimester than in the second trimester among the pregnant women investigated. However, a significant ($p < 0.05$) decrease in high-density lipoprotein levels was observed in the third trimester among the pregnant women (Table 2).

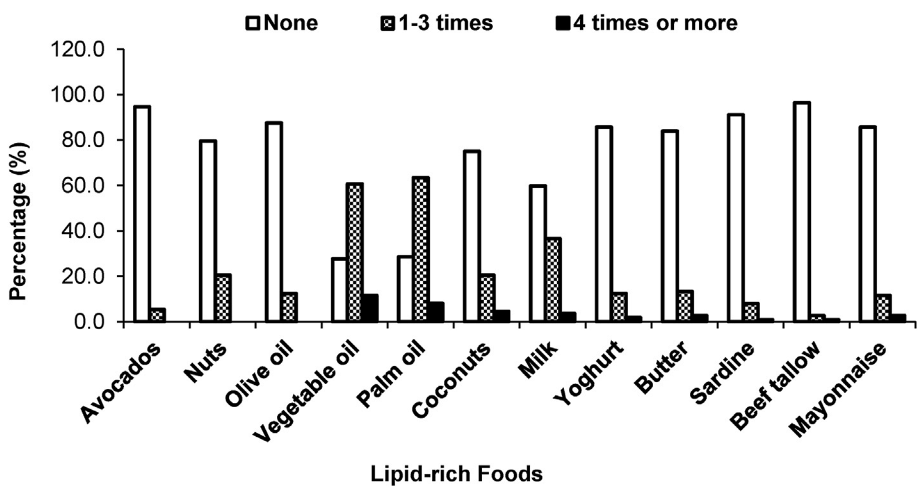

Figure 1: Daily consumption of lipid-rich foods among pregnant women at AKTH, Kano.

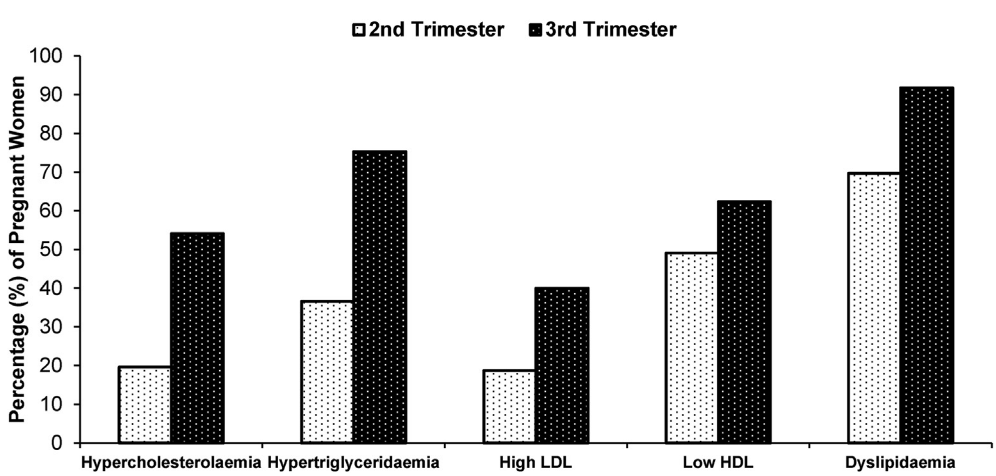

Figure 2: Prevalence and patterns of dyslipidaemia among pregnant women at AKTH, Kano. Values are expressed as percentages of pregnant women with dyslipidaemia (n=112 and 85 in the second and third trimesters, respectively; the missing patients from the third trimester did not affect the pattern of results). Classification of dyslipidaemia was based on the NCEP-ATP III guidelines.[28] **HDL** = High density lipoprotein; **LDL** = Low density lipoprotein.

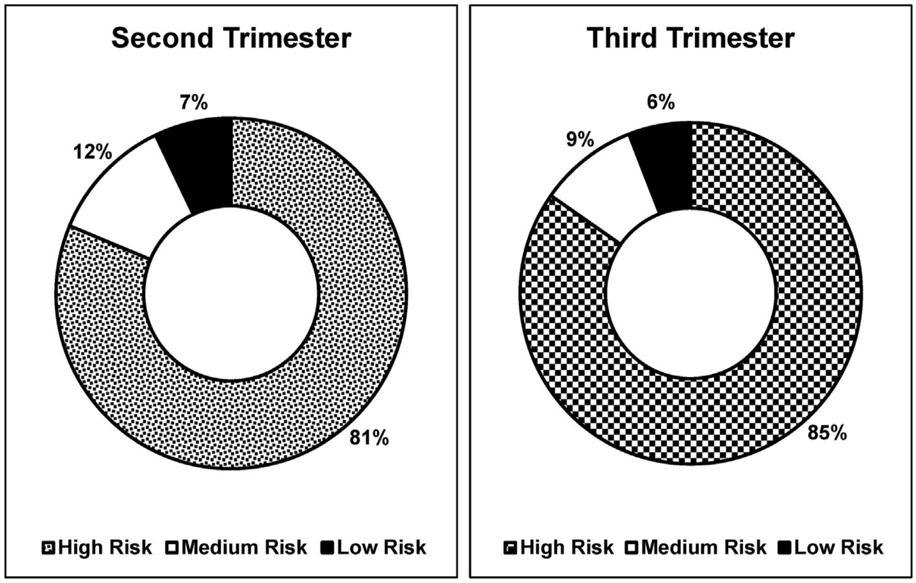

Figure 3: Risks for cardiovascular diseases among pregnant women at AKTH, Kano. Values are expressed as percentages of pregnant women with a risk of cardiovascular diseases (n=112 and 85 in the second and third trimesters, respectively; the missing patients from the third trimester did not affect the pattern of results). The classification of the atherogenic index was based on the work of Dobiasova[29]: High risk = 0.24 and above; Medium risk = 0.10 − 0.24; Low risk = -0.3 − 0.099.

Prevalence of dyslipidaemia and risk of cardiovascular disease among pregnant women at AKTH, Kano

The prevalence and pattern of dyslipidaemia during the second and third trimesters among pregnant women at AKTH, Kano, is presented in Figure 2. The prevalence of dyslipidaemia, hypercholesterolaemia, hypertriglyceridaemia, high LDL, and low HDL among pregnant women during the second trimester was 69.6%, 19.6%, 36.6%, 18.8%, and 49.1%, respectively, which subsequently increased to 91.8%, 54.1%, 75.3%, 40.0%, and 62.4%, respectively, during the third trimester, as shown in Figure 2.

Of the pregnant women, 81.0%, 12.0%, and 7.0% had high, medium, and low risk for cardiovascular diseases, respectively, in the second trimester. In the third trimester, these changed to 85.0%, 9.0%, and 6.0%, respectively (Figure 3).

Table 3: Association between lipid profile and daily consumption pattern of lipid-rich foods among pregnant women at AKTH, Kano.

Food	Lipid profile					
	CHOL	TG	HDL	LDL	VLDL	AI
Avocados	0.01	0.03*	0.00	0.00	0.03*	0.01
Nuts	0.06*	0.02*	0.00	0.04*	0.02*	0.01
Olive oil	0.00	0.00	0.07*	0.01	0.00	0.03*
Vegetable oil	0.04*	0.01	0.01	0.02*	0.01	0.01
Palm oil	0.01	0.02*	0.01	0.02*	0.02*	0.02*
Coconuts	0.01	0.01	0.02*	0.02*	0.01	0.01
Milk	0.00	0.02*	0.00	0.00	0.02*	0.00
Yoghurt	0.00	0.04*	0.01	0.00	0.04*	0.04*
Butter	0.03*	0.08*	0.05*	0.04*	0.07*	0.08*
Sardines	0.00	0.01	0.02*	0.00	0.01	0.01
Beef tallow	0.00	0.01	0.01	0.00	0.01	0.01
Mayonnaise	0.01	0.04*	0.02*	0.02*	0.04*	0.04*

Values are *Eta* squared showing the association/effect size of a nominal and interval variable on each other. Values with asterisks (*) have small association/effect with the corresponding vertical and horizontal variable (*Eta* test: 0.26 and above = Large association/effect; 0.13−0.25 = Medium association/effect; 0.02−0.12 = Small association/effect). **CHOL**, cholesterol; **TG**, triacylglycerol; **HDL**, high-density lipoprotein; **LDL**, low-density lipoprotein; **VLDL**, very-low-density lipoprotein; **AI**, atherogenic index.

Association between lipid profile and daily consumption pattern of lipid-rich foods among pregnant women at AKTH, Kano

The association between lipid profile and consumption pattern of lipid-rich foods was established using the *Eta* test, as presented in Table 3. There was a small association/effect (*Eta* test = 0.02−0.12) between some foods and lipid profile indices. Specifically, butter showed a small association (average *Eta* test = 0.06) with all the lipid indices determined, likewise for mayonnaise (average *Eta* test = 0.03), except for cholesterol (Table 3). In addition, nuts and palm oil showed a small association (average *Eta* test = 0.02) with triacylglycerol, LDL, and VLDL levels, as presented in Table 3.

Discussion

Lipid metabolism during gestation is associated with consistent alterations which are essential for foetal wellbeing. These alterations in lipid levels of normal and healthy pregnant women are caused by multiple physiological changes associated with pregnancy.[30] The present study investigated the dyslipidaemia associated with risks for cardiovascular disease among the pregnant women attending the antenatal care unit of AKTH, Kano. The demographic characteristics revealed that the mean age of the pregnant women was approximately 29 years, and the majority of the women were multiparous and multigravida. Such obstetric factors have been reported to significantly influence pregnancy outcomes[31] and could further contribute to and increase the risk associated with the adverse effects of dyslipidaemia on pregnancy.

As there are no specific requirements for lipid consumption during gestation, it was recommended that mono- and polyunsaturated fatty acids should be the major components of consumed fats.[6] Most of the pregnant women in this study consumed vegetable oil, palm oil, nuts, and milk at least one to three times daily, while consumption of sardines and olive oil was low. Lipid consumption from sources such as vegetable oil, palm oil, and mayonnaise during pregnancy should be moderate because they contain saturated lipids, excessive intake of which could be harmful to health.[32,33] The frequent consumption of saturated lipids may be responsible for the high prevalence of dyslipidaemia recorded among pregnant women in both trimesters (Figure 2). Similarly, the small association/effect of lipid-rich foods on the levels of the serum lipid profiles (Table 3), coupled with the increased synthesis of lipids in the body during pregnancy,[2] may also be responsible for high dyslipidaemia, which further increases the risk of cardiovascular disease.

The study reported a significant ($p < 0.05$) increase in the mean levels of cholesterol, triacylglycerol, LDL, VLDL, and the atherogenic index in the third trimester when compared with the mean levels recorded during the second trimester. These alterations have been reported as important and are associated with persistently high maternal lipid requirements from early gestation to delivery.[5] Increased levels of hormones such as oestrogen and progesterone might be responsible for the elevations in serum lipid concentrations recorded in this study.[34,13] High levels of maternal insulin during pregnancy also leads to increased synthesis of lipids with reduced lipolysis.[2] In this study, the increase in concentration of triacylglycerol was similar to that reported by Wang et al.,[35] who stated that serum levels of cholesterol, triacylglycerol, LDL, and HDL were significantly elevated from early to mid-pregnancy, with elevations in serum triacylglycerol levels being the most noticeable feature. The significant increase observed in triacylglycerol levels could be attributable to the high consumption of saturated lipids by these pregnant women, as evidenced by the daily consumption pattern as well as the little association/effect of lipid-rich foods on the levels of serum lipid profile (Table 3). The elevation in the levels of triacylglycerol might also be due to reduced activity of lipoprotein lipase and enhanced activity of hepatic lipase, which aid in raising the synthesis of triacylglycerol in the liver and reduces its breakdown in adipose tissue.[36] However, the high levels of triacylglycerol are subsequently utilised for maternal metabolic needs, sparing glucose for the foetus.[13]

The concentration of HDL was significantly lower in the third trimester than in the second trimester ($p < 0.05$) for the pregnant women investigated, which was in accordance with the findings of Brizzi et al.[37] where the levels of HDL during pregnancy initially increased and then decreased in the third trimester. Other studies have also reported similar changes in maternal lipid concentrations during pregnancy.[2,38] The increase in serum lipid levels during pregnancy plays a vital role in foetal development because studies have shown that lipid concentrations fall back to pre-pregnancy levels after delivery.[39,40] However, sustained elevation of lipid levels could lead to dyslipidaemia, which is associated with undesirable birth outcomes and risk of cardiovascular disease.

In recent times, there has been an increasing global prevalence of dyslipidaemia, which is a public health concern. The prevalence of dyslipidaemia varies extensively based on the physiological state of the body, ethnic group, dietary pattern, socio-demography, cultural practices, and economic status.[14] To the best of our knowledge, this study is the first to report the prevalence and pattern of dyslipidaemia among pregnant women in Kano State. The prevalence found in the third trimester (91.8%) in this study was higher than 83% reported in other studies on dyslipidaemia among pregnant women.[16,41] Similarly, the prevalence of hypertriglyceridaemia, low HDL, and elevated LDL found in this study were higher than that reported by Feitosa et al.[16] and Sharami et al.,[41] whereas that of hypercholesterolaemia was similar, with a prevalence of approximately 54%. The higher prevalence of dyslipidaemia reported in this study could be attributed to the fact that most pregnant women consume food containing saturated lipids coupled with lipid accumulation and the occurrence of hyperlipidaemia associated with pregnancy.

Upon establishing dyslipidaemia, the risk factors for cardiovascular disease were further assessed among pregnant women using the atherogenic index, a marker which predicts the risk of atherosclerosis and coronary heart disease. The observed high risk for cardiovascular disease among the pregnant women in both trimesters could be further linked to the high prevalence of dyslipidaemia, which was probably caused by the frequent consumption of saturated lipids. Several studies have reported a significant correlation between atherogenic lipid profile, dyslipidaemia, and risk of cardiovascular disease.[42,43] It is also worth mentioning that the atherogenic lipid profile during pregnancy has been linked to an increased risk of negative pregnancy outcomes such as preterm delivery, maternal morbidity, and mortality.[2]

Conclusion

The prevalence of dyslipidaemia among the pregnant women studied was high in both trimesters (69.6% and 91.8%). This could be linked to a high risk for cardiovascular disease in both the second (81.0%) and third (85.0%) trimesters. The study also reported that consumption of lipid-rich foods by women had a small association with the amount of serum lipid parameters estimated. Progression from mid-pregnancy to delivery is associated with an increased risk of maternal dyslipidaemia and cardiovascular diseases among pregnant women.

Recommendations

Considering the proportion of pregnant women with dyslipidaemia who are at high risk of cardiovascular disease, the relevant stakeholders should consider including lipid profiling as part of regular antenatal care in clinics, especially in low- and middle-income countries, so that appropriate management, as well as preventive and therapeutic measures, can be implemented as early as possible.

Source of funding

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Conflict of interest

The authors have no conflict of interest to declare.

Ethical approval

This study was performed in accordance with the principles of the Declaration of Helsinki. Ethical approval for the study was obtained from the institutional ethics committees of AKTH, Kano on 10 July 2019 (Number: AKTH/MAC/SUB/12A/P-3/VI/2650) and Ahmadu Bello University (ABU), Zaria on 26 February 2020 (Number ABUCUHSR/2020/015).

Consent

Informed written and/or verbal consent was obtained from each subject before inclusion in the study.

Authors' contributions

All authors contributed to the conception and design of the study. Data acquisition, data collection, and analysis were performed by MAS, AS, OAO, and SBM. All authors contributed to the interpretation of data. The first draft of the manuscript was written by MAS and all authors commented and revised the manuscript; all authors have critically reviewed and approved the final draft after revision and are responsible for the content and similarity index of the manuscript.

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