Ethnic differences in lipid and lipoprotein metabolism in pregnant women of African and Caucasian origin

E Koukkou, G F Watts, J Mazurkiewicz, C Lowy

Abstract

***Aims*—To investigate differences in serum lipid, lipoprotein and apolipoprotein concentrations in pregnant women of different ethnic origin.**

***Methods*—Serum lipid, lipoprotein and apolipoprotein concentrations were measured in 232 women (114 Caucasians, 118 Africans/Afro-Caribbeans), who presented consecutively for screening for gestational diabetes in the third trimester of pregnancy.**

***Results*—African/Afro-Caribbean pregnant women had lower serum concentrations of total cholesterol, low density lipoprotein cholesterol, triglycerides, and apolipoprotein B and higher high density lipoprotein cholesterol and Lp(a) lipoprotein concentrations compared with Caucasian women. Apolipoprotein A1 concentrations were similar in the two groups. The differences were not attributable to differences in weight, age, parity, or postload plasma glucose levels.**

***Conclusion*—Ethnic origin is an important determinant of serum lipid, lipoprotein and apolipoprotein concentrations during pregnancy.**

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Introduction

Coronary heart disease occurs less frequently in Africans/Afro-Caribbeans than in Caucasians.[1 2] Increased serum lipid and lipoprotein concentrations are recognised risk factors for coronary heart disease and atherosclerosis. Differences in the prevalence of dyslipoproteinaemia have been found among different ethnic groups, and this may account for the variation in the incidence of cardiovascular disease.[3 4] In common with other reports, we recently showed that pregnancy induces changes in lipoprotein metabolism.[5–8]

In this follow up study we examined whether the changes in lipid, lipoprotein and apolipoprotein concentrations during pregnancy differ between women of African and Caucasian origin.

Methods

The study population comprised 232 women, 114 of Caucasian and 118 of African origin (61 Afro-Caribbeans and 57 Africans), who presented consecutively for screening for gestational diabetes in the third trimester of pregnancy. They were selected for screening because of predisposing risk factors for diabetes in their previous medical, obstetric or family history. All subjects had normal glucose tolerance according to the European Association for the Study of Diabetes criteria[9]: blood glucose < 9 mmol/l 120 minutes after a 75 g oral glucose load, and all were on an ad libitum diet before testing.

Maternal age, gestational age, parity, height, and weight were measured on the day of the test. A body mass index (BMI (kg/m^2)) was calculated for each subject.

Fasting blood was drawn, with minimal venous stasis, for measurement of serum total cholesterol, high density lipoprotein (HDL) cholesterol, triglycerides, Lp(a) lipoprotein, and apolipoproteins AI and B concentrations. Subjects then underwent the 75 g oral glucose tolerance test and further blood samples for measuring blood glucose were taken after 60 and 120 minutes.

Total cholesterol and triglyceride concentrations were measured using enzymatic analysis on a DAX-96 analyser (Bayer Diagnostics, Basingstoke, UK); interassay coefficients of variation (CV) for cholesterol and triglycerides were < 1·9 and < 2·8%, respectively. HDL cholesterol was measured after dextran sulphate/magnesium chloride precipitation of apolipoprotein B containing lipoproteins (Bayer Diagnostics, Basingstoke, UK), with an interassay CV of < 6·4%. Apolipoproteins AI, B and Lp(a) lipoprotein were assayed using immunoturbidimetry with antiserum from Immuno (Immuno Ltd, Sevenoaks, UK), with interassay CVs of < 2·5, < 1·5 and 6·1%, respectively. These analyses were performed on Cobas Fara or Cobas Bio analysers (Roche Diagnostic Systems, Welwyn Garden City, UK). Low density lipoprotein (LDL) cholesterol was calculated using the Friedewald equation, excluding specimens (n = 13; 12 Caucasians, one African/Afro-Caribbean) with triglyceride levels higher than 4·5 mmol/l.[10] Triglyceride and Lp(a) lipoprotein concentrations were log transformed because of their positively skewed distributions.

Comparisons were carried out using the unpaired *t* test and values were expressed as mean (1 SD) or mean with 95% confidence intervals (CI) for log transformed data. Analysis of covariance was used to test whether the apparent ethnic variation in lipid concentrations was explained by differences in postload plasma glucose concentrations.

Department of Endocrinology and Chemical Pathology, St Thomas's Hospital (UMDS), London
E Koukkou
G F Watts
J Mazurkiewicz
C Lowy

Correspondence to:
Dr E Koukkou,
Diabetic Day Centre,
St Thomas's Hospital,
Lambeth Palace Road,
London SE1 7EH

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Table 1 Clinical characteristics of Caucasian and African/Afro-Caribbean women

	Caucasians (n = 114) mean (SD)	*Africans/Afro-Caribbeans (n = 118) mean (SD)*	*p value*
Age (years)	29·8 (5·5)	29·1 (5·3)	NS
Gestational age (weeks)	30·3 (4·0)	30·2 (4·7)	NS
Parity	3·0 (2·1)	3·0 (1·9)	NS
BMI (kg/m²)	29·7 (6·8)	30·5 (8·1)	NS
Fasting plasma glucose	4·8 (0·5)	4·7 (0·5)	NS
Mean plasma glucose (0 to 60 minutes)	6·3 (0·8)	5·9 (0·8)	<0·01

Results

All women were in the third trimester of pregnancy at presentation. Their mean age was 30 years and patients had had an average of three previous pregnancies. There were no differences in BMI between Caucasian and African/Afro-Caribbean women. There was no difference in fasting plasma glucose concentrations between the two groups, but Caucasian women had a higher mean plasma glucose value (0 to 60 minutes) compared with African/Afro-Caribbean women (table 1).

The mean (SD) and 95% CI of the mean for log transformed data, for all lipids, lipoproteins and apolipoproteins for both groups are presented in table 2. African/Afro-Caribbean women had significantly lower serum concentrations of total cholesterol, LDL cholesterol, triglycerides, and apolipoprotein B, as well as lower LDL/HDL cholesterol and apolipoprotein B/apolipoprotein AI ratios than Caucasian women. Serum concentrations of HDL cholesterol and Lp(a) lipoprotein were, however, higher in African/Afro-Caribbean women than in Caucasian women. Apolipoprotein AI concentrations were similar in the two groups. Analysis of covariance revealed that these differences were independent of the postload plasma glucose concentration.

Discussion

This is the first study to demonstrate racial differences in serum lipid, lipoprotein and apolipoprotein concentrations among pregnant women. Pregnant African/Afro-Caribbean women had a more favourable lipid and lipoprotein profile compared with Caucasian women, with higher HDL and lower LDL cholesterol, apolipoprotein B, and triglyceride concentrations. Age, obesity and parity did not appear to be responsible for this difference. Previous reports have found racial differences in serum lipid concentrations in both children and adults.[11-14] The differences between adults of African and Caucasian origin are more pronounced in men and premenopausal women, while they are not as clinically important in postmenopausal women.[4 12 15] Racial differences have also been found among non-insulin dependent diabetic patients, with Africans having a more favourable lipid profile than Caucasians.[16]

We have also found that pregnant African/Afro-Caribbean women have significantly higher Lp(a) lipoprotein concentrations compared with Caucasian women. Individuals of African origin are reported to have higher plasma Lp(a) lipoprotein concentrations than Caucasians.[17-20] Although still in dispute,[8 21] plasma Lp(a) lipoprotein concentrations are reported to be raised during pregnancy. Our findings suggest that the effect of pregnancy on Lp(a) lipoprotein concentrations only exacerbates what is already a genetically determined profile.

This was a cross-sectional study of selected patients. All subjects included were regarded as having predisposing risk factors for diabetes, which itself is a risk factor for coronary heart disease. Although these women were not by definition glucose intolerant, we found a significant difference in the mean (0 to 60 minutes postload) plasma glucose concentration in Caucasian compared with the African/Afro-Caribbean women. This suggests that the Caucasian women had greater insulin resistance, which is associated with raised triglyceride and low HDL cholesterol concentrations.[22 23] It is unlikely, however, that insulin resistance accounts for the findings in our study, as the difference in triglycerides and HDL cholesterol concentrations persisted after adjusting for plasma glucose. We have not controlled for family history of coronary heart disease and lifestyle characteristics known to influence lipoprotein metabolism, such as physical exercise or alcohol consumption. As the women in this study were in the third trimester of pregnancy, however, they were unlikely to have been participating in excessive physical exercise or consuming large quantities of alcohol. Previous studies have failed to explain the racial differences in lipid concentrations on the basis of different lifestyle characteristics[24] and no association has been observed between parental history of myocardial infarction and serum lipid and lipoprotein concentrations in children (eight to 17 years of age) of different races.[17] In the present study we also did not assess dietary intake. Dietary assessment data collected from diabetic patients attending our clinic reveal that Africans/Afro-Caribbeans consume more fruit, vegetables and refined carbohydrates than Caucasians, whose diet is higher in fat and lower in carbohydrates. Given that this also applies to our non-diabetic women, we cannot entirely exclude that a difference in saturated fat intake partially explains the difference in cholesterol and LDL cholesterol concentrations between the two groups described here.[26] However, as a

Table 2 Serum lipid, lipoprotein and apolipoprotein concentrations in Caucasian and African/Afro-Caribbean women in the third trimester of pregnancy

	Caucasians (n = 114) mean (SD)	*Africans/Afro-Caribbeans (n = 118) mean (SD)*	*p value*
Cholesterol (mmol/l)	7·07 (1·45)	6·37 (1·34)	<0·001
Triglycerides* (mmol/l)	2·50 (2·29, 2·72)	1·86 (1·73, 1·99)	<0·001
HDL cholesterol (mmol/l)	1·76 (0·46)	1·96 (0·46)	<0·01
LDL cholesterol (mmol/l)	4·10 (1·29)	3·52 (1·21)	< 0·001
Lp(a) lipoprotein* (g/l)	0·25 (0·20, 0·30)	0·45 (0·38, 0·53)	<0·001
Apolipoprotein B (g/l)	1·39 (0·37)	1·20 (0·35)	<0·001
Apolipoprotein AI (g/l)	1·89 (0·32)	1·97 (0·31)	NS
LDL/HDL	2·47 (1·10)	1·92 (0·90)	<0·001
Apo B/Apo AI	0·76 (0·29)	0·38 (0·23)	<0·001

*Geometric mean (95% CI). Apo B = apolipoprotein B; Apo AI = apolipoprotein AI.

high carbohydrate diet induces an increase in triglyceride concentrations, differences in nutrient intake between the two groups would not account for the lower triglyceride concentrations in Africans/Afro-Caribbeans.[25]

That hyperlipidaemia occurs during pregnancy is well established.[5-8] The significance of this for the fetus and the mother has been discussed previously.[8] Menopause is known to have an adverse effect on lipid and lipoprotein concentrations in both races, the effect being more prominent in women of African origin.[26-28] Racial differences in the lipid profile are not as pronounced during menopause. The reason for this is not clear, but may be because lipid metabolism in Africans is more sensitive to changes in oestrogen levels. This may explain the favourable effect of pregnancy on lipid and lipoprotein concentrations in African/Afro-Caribbean women compared with Caucasian women as observed in this study.

In conclusion, our findings suggest that racial differences in serum lipid, lipoprotein and apolipoprotein concentrations persist during pregnancy. These differences may have a genetic component. As pregnancy exaggerates racial differences and abnormalities in lipid metabolism, it may provide a sensitive test for identifying women at risk of developing coronary heart disease and atherosclerosis. Prospective studies are needed to test this hypothesis.

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1 Hames CG. Evans County cardiovascular and cerebrovascular epidemiologic study: Introduction. *Arch Intern Med* 1971;**128**:883–9.
2 Keil JE, Loadholt CB, Weinrich MC, Sandifer SH, Boyle E Jr. Incidence of coronary heart disease in blacks in Charleston, South Carolina. *Am Heart J* 1984;**108**: 779–86.
3 Tyroler HA, Hames CG, Krishan I, Heyden S, Cooper G, Cassel JC. Black and white differences in serun lipids and lipoproteins in Evans County. *Prev Med* 1975;**4**: 541–9.
4 Glueck CJ, Gartside P, Laskarzewski PM, Khoury P, Tyroler HA. High density lipoprotein cholesterol in blacks and whites. Potential ramifications for coronary heart disease. *Am Heart J* 1984;**108**:815–26.
5 Cramer K, Aurell M, Pelirson S. Serum lipids and lipoproteins during pregnancy. *Clin Chim Acta* 1964;**10**:470–2.
6 van Stiphout WA, Hofman A, de Bruijn A. Serum lipids in young women before, during and after pregnancy. *Am J Epidemiol* 1987;**126**:922–8.
7 Jimenez DM, Pocovi M, Ramon-Cajal J, Romero MA, Martinez H, Grande F. Longitudinal study of plasma lipids and lipoprotein cholesterol in normal pregnancy and puerperium. *Gynecol Obstet Invest* 1988;**25**:158–64.
8 Mazurkiewicz JC, Watts GF, Warburton FG, Slavin BM, Lowy C, Koukkou E. Serum lipids, lipoproteins and apolipoproteins in non-diabetic pregnancy. *J Clin Pathol* 1994;**47**:728–31.
9 National Diabetes data Group. Classification and diagnosis of diabetes mellitus and other categories of glucose intolerance. *Diabetes* 1979;**28**:1039–57.
10 Friedewald WT, Levy RI, Fredrickson DS. Estimation of the concentration of low-density lipoprotein cholesterol in plasma without use of the preparative ultracentrifuge. *Clin Chem* 1972;**18**:499–502.
11 Slack J, Noble N, Meade TW, North WR. Lipid and lipoprotein concentrations in 1604 men and women in working populations in northwest London. *BMJ* 1977; **2**:353–7.
12 Morrison JA, DeGroot I, Kelly KA, Mellies MJ, Khoury P, Edwards BK, *et al.* Black-white differences in plasma lipids and lipoproteins in adults. The Cincinnati Lipid Research Clinic population Study. *Prev Med* 1979; **8**:34–9.
13 Donahue RP, Jacobs DR Jr, Sidney S, Wagenknecht LE, Albers JJ, Hulley SB. Distribution of lipoproteins and apolipoproteins in young adults: The CARDIA Study. *Arteriosclerosis* 1989;**9**:656–64.
14 Srinivasan SR, Wattigney W, Webber LS, Berenson GS. Race and gender differences in serum lipoproteins of children, adolescents and young adults—emergence of an adverse lipoprotein pattern in white males: the Bogalusa Heart Study. *Prev Med* 1991;20:671–84.
15 Anderson RA, Burns TL, Wallace RB, Folsom AR, Sprafka JM. Genetic markers associated with high density lipoprotein cholesterol levels in a biracial population sample. *Genet Epidemiol* 1992;**9**:109–21.
16 Summerson JH, Konen JC, Dignan MB. Racial differences in lipid and lipoprotein levels in diabetes. *Metabolism* 1992;**41**:851–5.
17 Srinivasan SR, Dahlen GH, Jarpa RA, Webber LS, Berenson GS. Racial (black-white) differences in serum Lp(a) lipoprotein distribution and its relation to parental myocardial infraction in children. Bogalusa Heart Study. *Circulation* 1991;**84**:160–7.
18 Levitsky LL, Scanu AM, Gould SH. Lp(a) lipoprotein levels in black and white children and adolescents with IDDM. *Diabetes Care* 1991;**14**:283–7.
19 Cobbaert C, Kesteloot H. Serum Lp(a) lipoprotein levels in racially different populations. *Am J Epidemiol* 1992; **136**:441–9.
20 Marcovina SM, Albers JJ, Jacobs DR Jr, Perkins LL, Lewis CE, Howard BV, *et al.* Lp(a) lipoprotein concentrations and apoLp(a) lipoprotein phenotypes in Caucasians and African Americans. The Cardia Study. *Arteriosclerosis Thrombosis* 1993;**13**:1037–45.
21 Zechner R, Desoye G, Schweditch MO, Pfeiffer KP, Kostner GM. Fluctuations of plasma Lp(a) lipoprotein concentrations during pregnancy and postpartum. *Metabolism* 1985;**35**:333–6.
22 Reaven GM. Role of insulin resistance in human disease. *Diabetes* 1988;**37**:1595–607.
23 Zavaroni I, Bonora E, Pagliara M, Dall'Aglio E, Luchetti L, Buonanno G, *et al.* Risk factors for coronary artery disease in healthy persons with hyperinsulinaemia and normal glucose tolerance. *N Engl J Med* 1989; **320**:702–6.
24 Sprafka JM, Norsted SW, Folsom AR, Burke GL, Luepker RV. Life-style factors do not explain racial differences in high-density lipoprotein cholesterol: the Minnesota Heart Survey. *Epidemiology* 1992;3:156–63.
25 Grundy SM, Denke MA. Dietary influences on serum lipids and lipoproteins. *J Lipid Res* 1990;**31**:1149–72.
26 Hjortland MC, McNamara PM, Kannel WB. Some atherogenic concomitans of menopause. The Framingham Study. *Am J Epidemiol* 1976;**103**:304–11.
27 Colditz GA, Willett WC, Stampfer MJ, Rosner B, Speizer FE, Hennekens CH. Menopause and the risk of coronary heart disease in women. *N Engl J Med* 1987; **316**:1105–10.
28 Jensen J, Nilas L, Christiansen C. Influence of menopause on serum lipids and lipoproteins. *Maturitas* 1990;**12**: 321–31.