66th Inaugural Lecture

BODY FUELS IN HEALTH AND DISEASES.

PROFESSOR OLUWOLE OLANREWAJU ADEDEJI,

PROFESSOR OF CHEMICAL PATHOLOGY

BSc(Hons.)Ib.,MBBS,MSc,Lag.,FMCPath.Nig.,MNIM., D.Phil(Oxon).,CSR(UK).

INTRODUCTION

With gratitude to the Almighty God, I stand before you to deliver my Inaugural Lecture at the Lagos State University. I joined the Lagos State University on the 15th October, 2008. The University has been experiencing positive changes in recent time under the able leadership of the current indefatigable Vice-Chancellor, Professor Olanrewaju A Fagbohun.

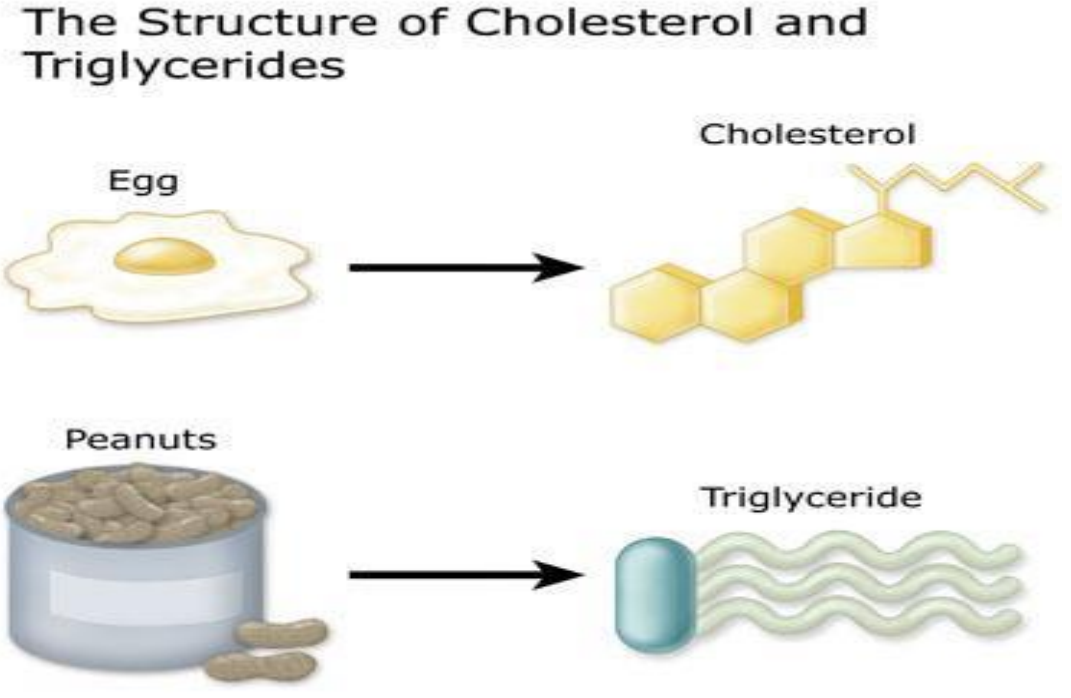
The Inaugural Lecture is designed as an account of stewardship to the academic community and the public. It is an exposition of the work of the Professor. I thank the Vice-Chancellor for giving me the opportunity to deliver this Inaugural Lecture.

This verse from the bible summarises today's lecture: '….FEED ME WITH THE FOOD THAT IS NEEDFUL FOR ME' (PROV. 30, 8).

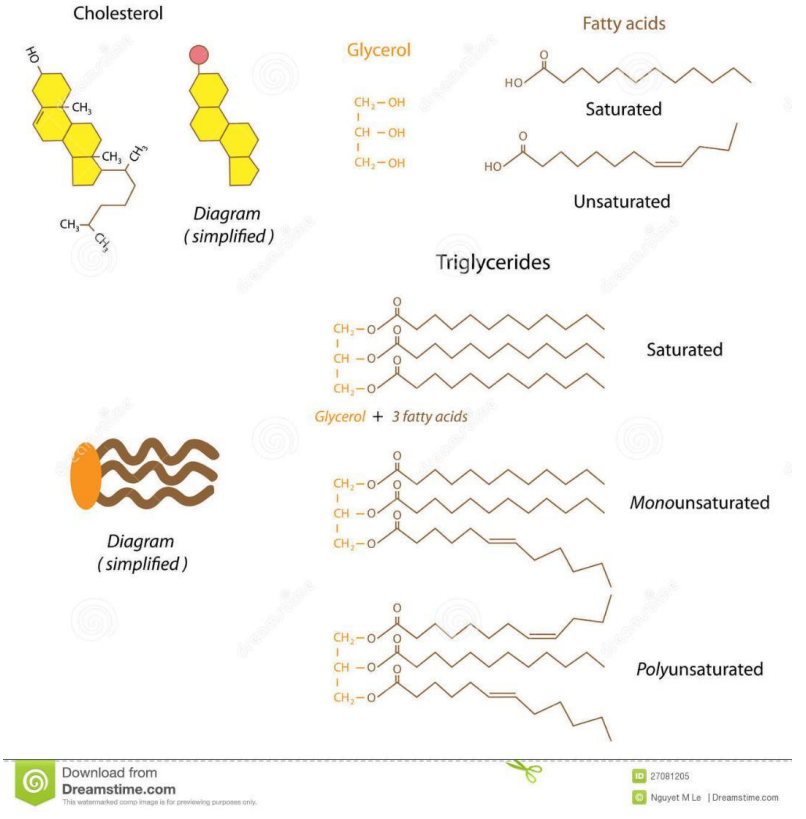
Lipids (Fats) and Carbohydrates (Sugars) are the major sources of energy needed by the body for daily activities and wellbeing. Alterations in the metabolisms (handling by the body) of these fuels can portend severe health conditions with adverse economic consequences. The disorders of lipid and carbohydrate metabolisms result in diseases such as hypertension, coronary heart disease, obesity, stroke and diabetes mellitus.

STUDIES ON LIPIDS AND DISEASES

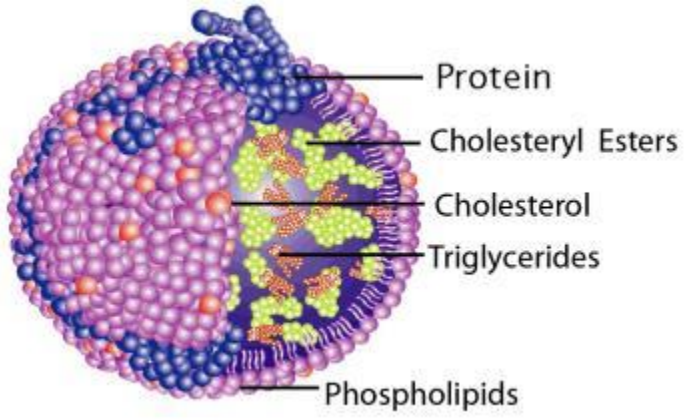
Lipids or fats are found in diets e.g. egg yolks, dairy products, red meat and cooking oil. In the human body, they are found as components of cells, tissues and organs. The major lipids include fatty acid, cholesterol, triglyceride, and phospholipid.



Fatty acids could be saturated (no double bond) or unsaturated (with one or more double bonds).



Lipids are, also, found in blood/plasma where they are bound to proteins as complexes known as lipoproteins. These include Chylomicrons, Very low density lipoproteins (VLDL), Intermediate density lipoproteins (IDL), Low density lipoproteins (LDL, atherogenic), and High density lipoproteins (HDL, cardio-protective).



We investigated the associations between abnormal lipid metabolism (resulting in dyslipidaemia) and the development of diseases such as hypertension, obesity, diabetes mellitus, infertility and foetal growth in pregnancy.

Hypertension

Lipid deposition in the arterial walls, due to its increased level in blood, produces lesion (atheroma), which causes damage and reduction of the lumen (or inner diameter) of the artery (fig.1). This reduces blood flow.

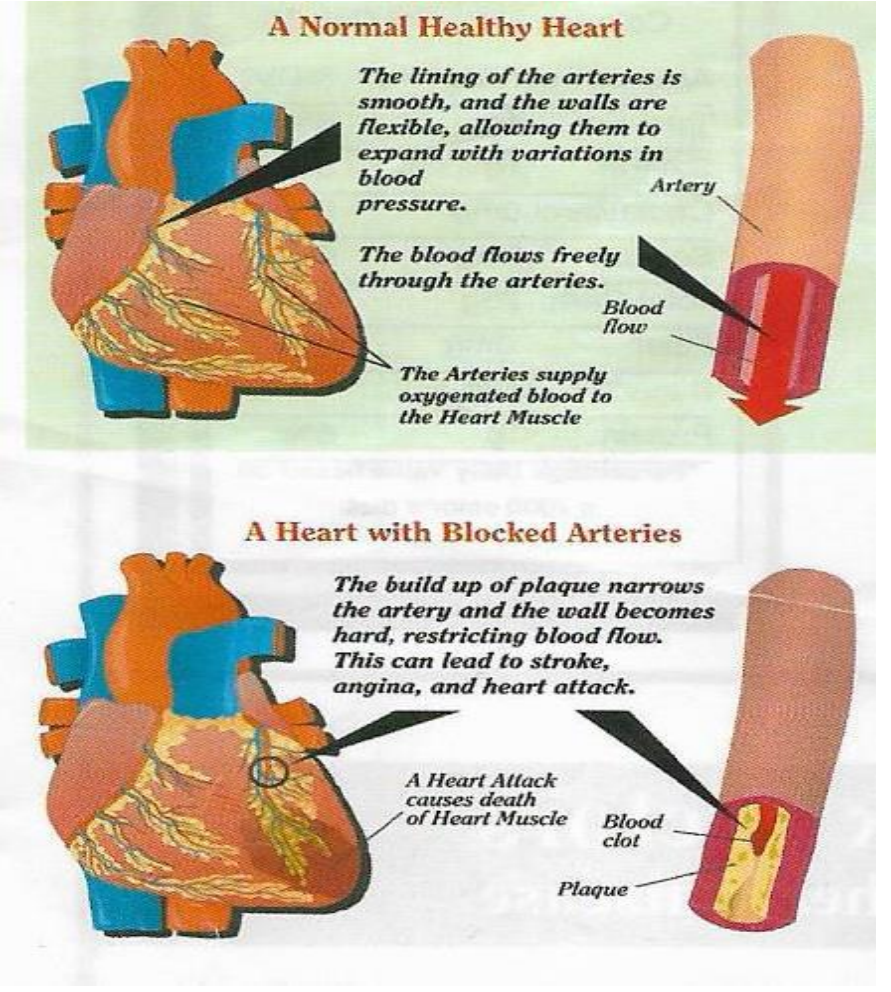
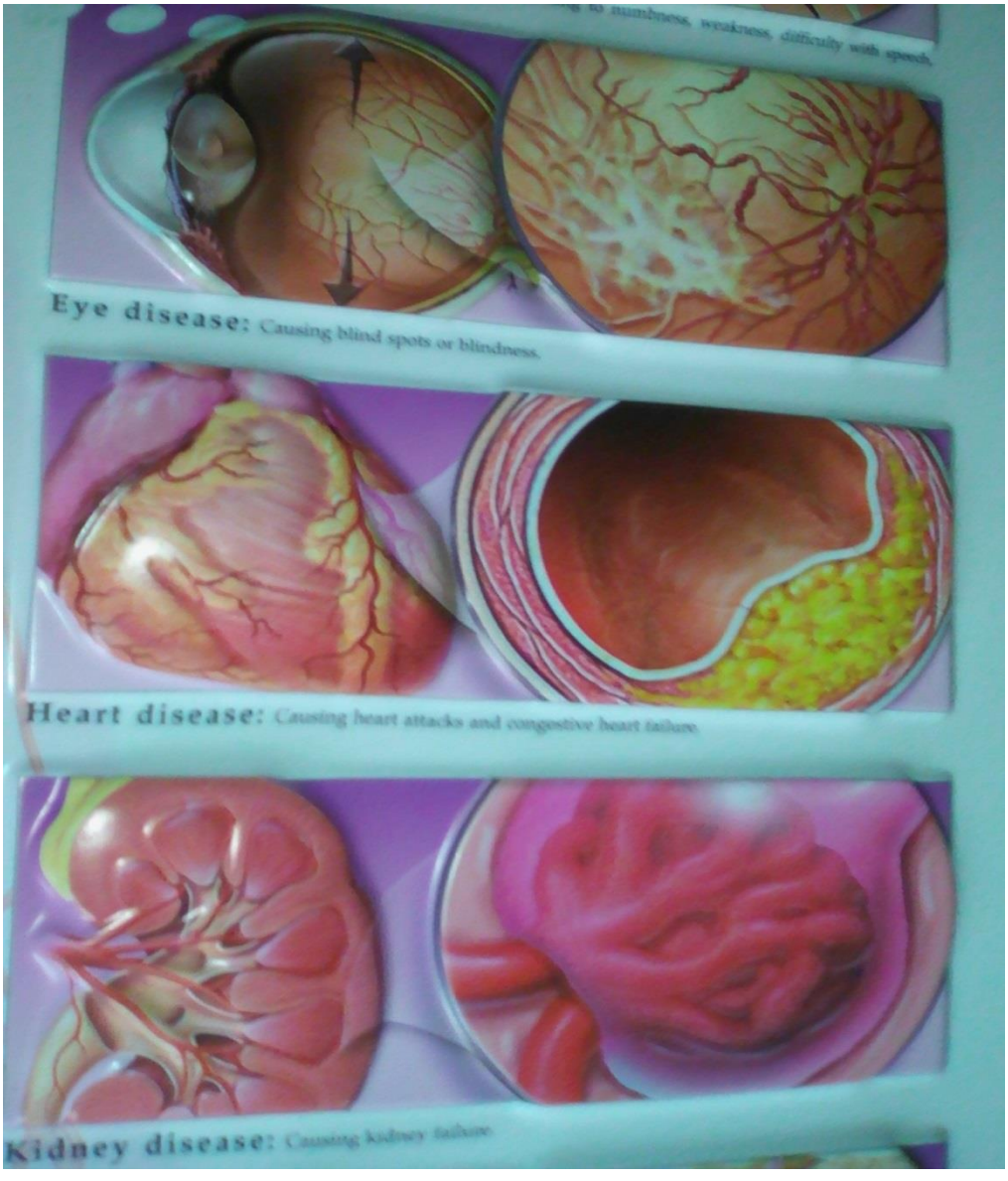

A Normal Healthy Heart
The lining of the arteries is smooth, and the walls are flexible, allowing them to expand with variations in blood pressure.
Artery
The blood flows freely through the arteries.
Blood flow
The Arteries supply oxygenated blood to the Heart Muscle
A Heart with Blocked Arteries
The build up of plaque narrows the artery and the wall becomes hard, restricting blood flow. This can lead to stroke, angina, and heart attack.
A Heart Attack causes death of Heart Muscle
Blood clot
Plaque

Figure 1.

Resulting increase in the peripheral resistance to blood flow leads to the development of hypertension.
This is represented by the equation below:
MAP= CO×TPR
MAP = Mean Arterial Pressure
CO=Cardiac Output
TPR= Total Peripheral Resistance

Complete blockage of the arterial lumen can occur as in coronary heart, eye and kidney diseases (Fig.2).


Eye disease: Causing blind spots or blindness.
Heart disease: Causing heart attacks and congestive heart failure.
Kidney disease: Causing kidney failure.
Figure2.

In our publication (Adedeji, O.O. and Onitiri, A.C.1990) (1), we showed that the mean plasma lipid levels of Nigerian hypertensive patients were significantly higher than those of healthy individuals. The results suggest a causal relationship between high lipid level and hypertension. We reported, also, that the lipoprotein remnant, derived from triglyceride rich lipoproteins, play a role in the development of atheroma which results in hypertension. Therefore, we advised that triglyceride measurement might be a better discriminant of hypertension than cholesterol (tables1&2).

Table 1. The characteristics of controls and subjects

	Controls	Subjects	*P*-values
%weight	105.8 ± 3.6	109.2 ± 3.1	> 0.05
Age (years)	42.1 ± 1.7	42.4 ± 1.7	> 0.05
Systolic pressure (mmHg)	115.0 ± 1.0	159 ± 2.0	< 0.001
Diastolic pressure (mmHg)	74.0 ± 4.0	105 ± 1.0	< 0.001

Values represent means ± s.e.m.

Table 2. Plasma lipids concentrations of controls and subjects

Plasma lipids	Controls	Subjects	*P*-values
Total cholesterol (mg/dl)	174.0 ± 6.0	181.0 ± 4.5	> 0.05
Triglyceride (md/dl)	77.9 ± 3.6	121.3 ± 5.0	< 0.001
LDL (mg/dl)	296.2 ± 14.0	382.2 ± 19.0	< 0.001
LDL–cholesterol (mg/dl)	102.1 ± 5.0	137.2 ± 6.3	< 0.001
HDL–cholesterol (mg/dl)	56.1 ± 5.2	48.8 ± 3.4	> 0.05

Values represent means ± s.e.m.

Obesity

Hypertension was shown to be positively correlated to the degree of obesity (Adedeji, O.O. 1991, 1992)(2,3). Further, abnormal plasma lipid levels (dyslipidaemias) were shown to be associated with both conditions (fig 3).

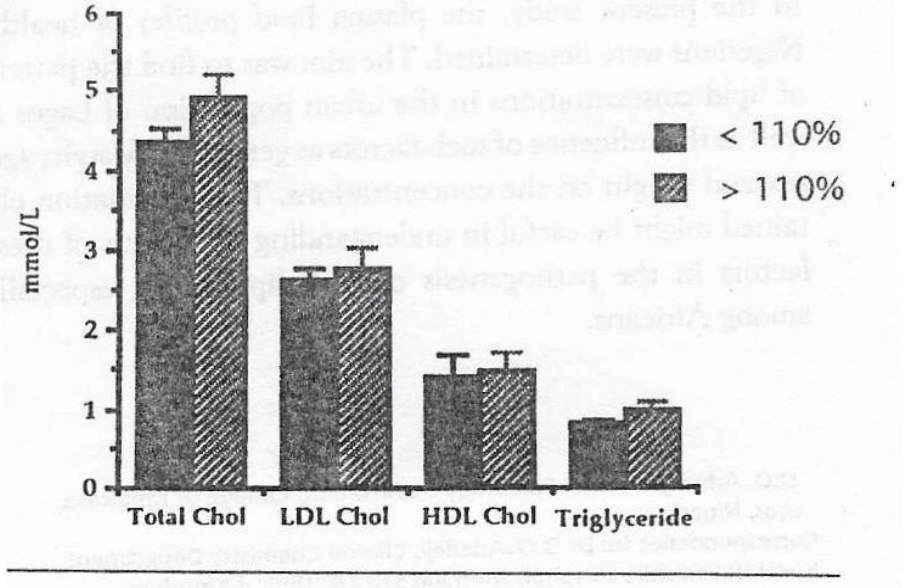


Figure 3. Effect of relative body weight (%) on plasma lipids.

The explanation was that obese individuals have excess lipid which could be deposited in their arterial walls. This could be responsible for the increased risk of hypertension among the obese individuals.

In addition, our findings showed that weight reduction had dual effects of lowering plasma lipid and blood pressure (fig.4).

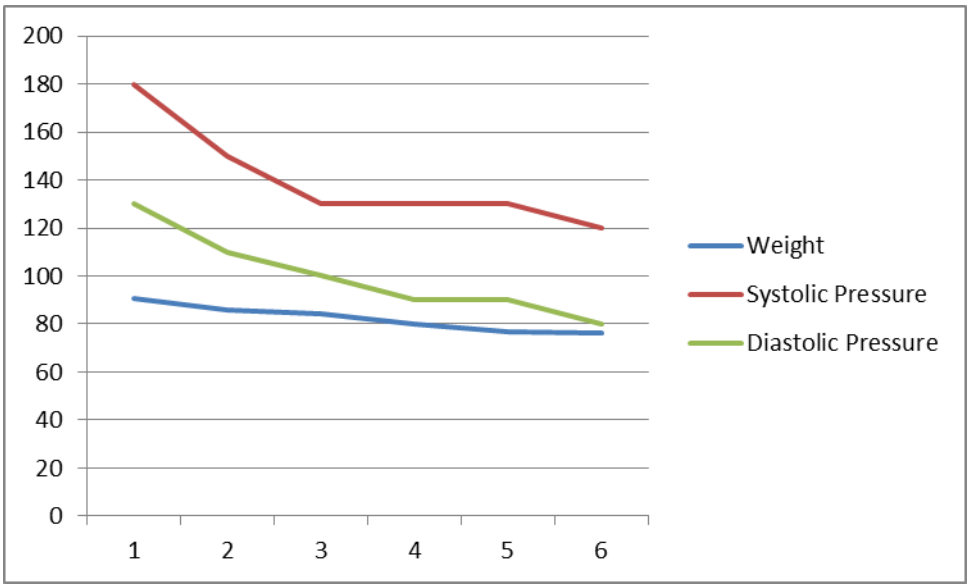


Figure 4.

Diabetes Mellitus

A positive association was found between the lipid levels of non - insulin dependent or type 2 diabetics and their glucose levels (Adedeji, O.O. 1991)(4). It was shown that improved glycaemic control in type 2 diabetics reduced the lipid levels of these patients as well as their cardiovascular risk (Adedeji, O.O.1997)(5).

TABLE 3. The effect of fasting plasma glucose concentrations on plasma lipids.

Number of Patients	n = 16	n = 19	P value
Blood Glucose	<10 mmol/L	>10 mmol/L	
Total Cholesterol mmol/L	4.89 ± 0.46	5.20 ± 0.60	> .05
LDL Cholesterol mmol/L	2.72 ± 0.30	3.39 ± 0.42	< .05
HDL Cholesterol mmol/L	1.56 ± 0.25	1.36 ± 0.25	> .05
Triglycerides mmol/l/L	1.07 ± 0.25	1.32 ± 0.28	> .05

Lipid and Infertility

We reported the association between plasma lipid level and vitamin E. Low level of plasma lipid resulted in reduced vitamin E level. We found an association between the occurrence of infertility among Nigerian women in their reproductive years and low vitamin E level in their plasma (Adedeji O.O. and Makinde A. 1992)(6).

TABLE 4. Plasma vitamin E levels in fertile and infertile women

Age group (years)	Fertile women (controls) n	Fertile women (controls) Vitamin E (μmol l^{-1})	Infertile women n	Infertile women Vitamin E (μmol l^{-1})	p-value
18–21	30	13·41 ± 0·16	30	13·18 ± 0·07	< 0·05
22–24	30	15·57 ± 0·14	30	15·47 ± 0·14	< 0·05
25–29	30	22·18 ± 0·79	30	19·09 ± 0·19	< 0·05
30–33	30	20·28 ± 0·09	30	13·22 ± 0·02	< 0·05
Mean ± SE		17·84 ± 0·35		15·24 ± 0·25	< 0·05

The differences were significant in the 25–29 and 30–33 year age groups ($p < 0·05$). Further, there was a greater decline in the vitamin E levels in infertile women than fertile women between the 25–29 and 30–33 year age groups.

Lipid and Foetal Growth

Lipid was found to play a significant role in the foetal development during the first trimester of pregnancy among Nigerian women (Ola, R. and Adedeji, O.O. 1997)(7).

Table **5.**

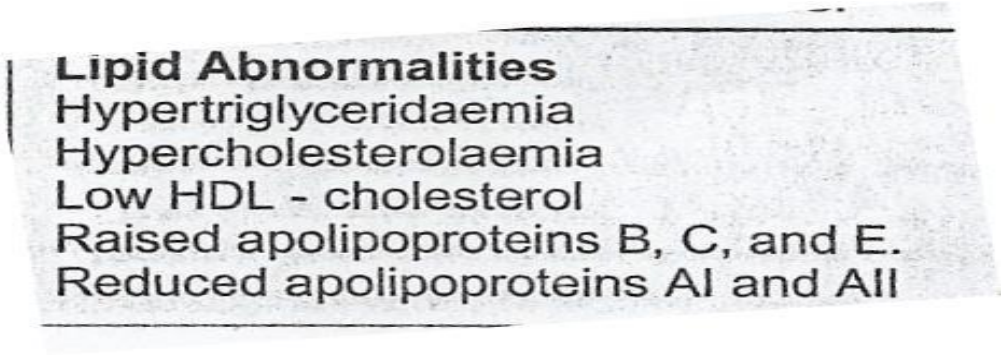
The Plasma Lipid levels of pregnant women and of their controls

Subjects (n)	Total Cholesterol mmol/L ± SEM	HDL–Cholesterol mmol/L ± SEM	Triglyceride mmol/L± SEM
Pregnant Women (22)	4.28 ± .65	1.56 ± .40	0.81 ± .22
Controls (28)	4.95 ± .87	1.84 ± .31	0.76 ± .23
P values	P < .05	< .05	< .05

We reported that during the first trimester, pregnant women exhibited decrease in cholesterol level which was attributed to increased utilisation of cholesterol in pregnancy. We, also, observed low HDL cholesterol level in the pregnant women. This might be due to the compensatory mechanism which ensures production of steroid hormones to support foetal growth and development. However, we found increased triglyceride in these women, which could be due to increased triglyceride flux resulting from increased fat mobilisation in pregnancy.

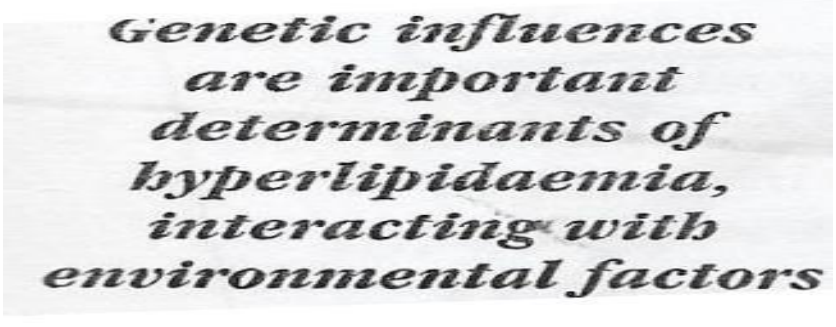
Lipid abnormalities in kidney diseases

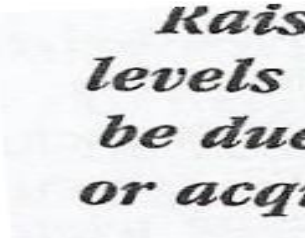
A review of the lipid abnormalities in kidney diseases with the discussion of appropriate management of renal patients was published by (9). (Adedeji, O.O; 2003). The lipid abnormalities highlighted are listed below:



Hyperlipdaemia (High Blood Lipid)

Another review article on Hyperlipidaemia was published (Adedeji, O.O. 2004)(9). It discusses the aetiology of high levels of blood lipid and provides an understanding of the subject. The review provides the following information that:





Effects of Diets and Lifestyle Habits on Lipid Level

The findings from the studies on diet, alcohol consumption and physical exercise as determinants of plasma lipid levels (Adedeji, O.O. 2000)(8), provided the evidence that changes in life style and habits could reduce high blood lipid level, blood pressure and weight. Prudent dietary patterns and exercise were associated with lower blood lipid levels (table 5 &fig.5).

Table 5. Extent of involvement of subjects in different lifestyle

Diet	%	Alcohol Quantiry	%	Smokinge Degree	%	Exercise Daily Frequency	%
Mixed (Carbohydrate Protein and Fats)	33.0	Nil	50.0	Nil	87.5	Nil	69
		Occasional	12.5	Light	6.25	Once	22
		Mild	12.5	Heavy	6.25	Twice	6
Mainly carbo-hydrates	67.0	Moderate	25.0	(>10 Sticks Per Day)		Thrice	3

Subjects were mainly on Carbohydrates diets, Alcohol Consumption was low, most of them were non-smokers and physical exercise was not popular. (author's classification).

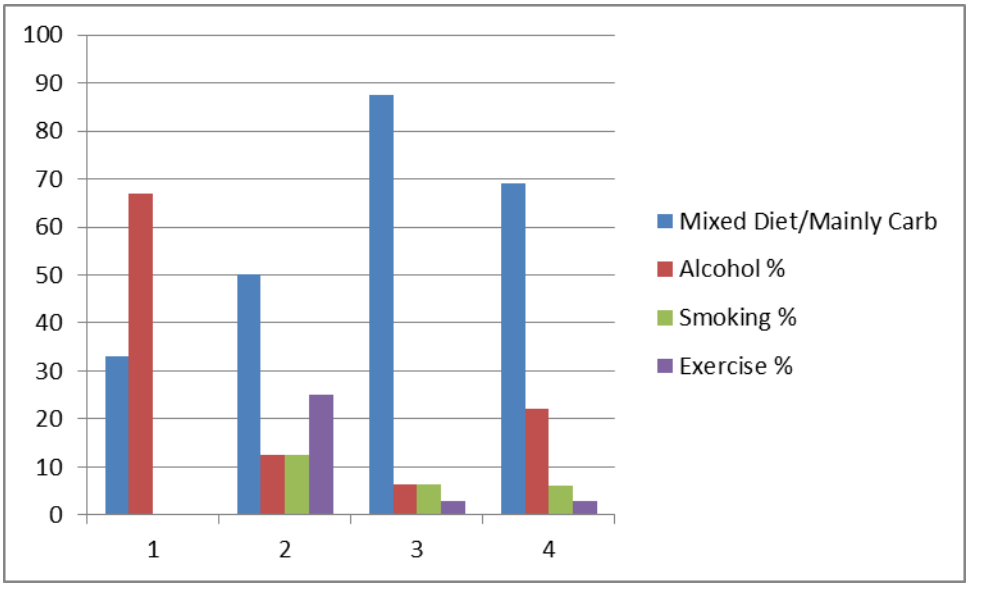

100
90
80
70
60
50
40
30
20
10
0
1
2
3
4
Mixed Diet/Mainly Carb
Alcohol %
Smoking %
Exercise %

Figure 5.

LIPID OF HEALTHY NIGERIANS

The lipid level of healthy Nigerians was found to be relatively much lower than those of Caucasians and White Americans (Adedeji, O.O. 1994)(10)(table5). These findings were associated to the Nigerian life style of low fat intake, involvement in some degree of physical activity coupled with their weak genetic predisposition to hyperlipidaemia (fig.4).

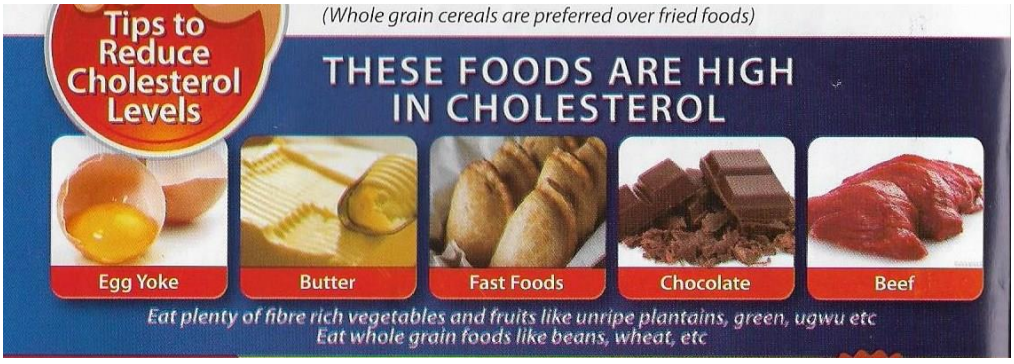
Table 5. Comparison of Nigerian, American and British Lipid Levels

Countries	Total Cholesterol	LDL Cholesterol	HDL Choles.	Triglyceride
Nigeria	4.58±.47	2.69±.20	1.52±.22	.80±.70
USA*	4.57±.96	3.05±.88	1.27±.31	.97±.53
Great Britain'	5.90±1.20	3.17±.02	1.49±.04	1.80±1.40

Sacks et al *[9]

Thorogood et al +[10]

Presently, the trend in the Nigerian population is changing. Many people have imbibed the cultures, diets, life styles and habits of the Caucasians and Americans. The consequences include increased incidence of cardiovascular diseases, such as hypertension, coronary heart disease (CHD), stroke, cancer and other conditions in our population.



Plasma lipid of Nigerians attending lipid Clinic in 2014

	Male	Female
Tchol mmol/l	6.99 ± 3.10	6.72 ± 3.11
LDLchol mmol/l	4.74 ± 2.69	4.40 ± 2.78
HDL chol mmol/l	1.80 ± 0.59	1.85 ± 0.59
Trig.mmol/l	1.51 ± 1.60	1.41 ± 1.14
Tchol/HDLchol mmol/l	3.82 ± 1.33	4.23 ± 6.05

THE EFFECTIVENESS OF INTERVENTION

The effectiveness of intervention to reduce coronary heart disease (CHD) risk was investigated (Adedeji, O.O. Oyakhire G.K. et al. 2011)(11). Lipid lowering intervention was shown to be equally effective in reducing the incidence of coronary heart disease in developing populations as it was in the developed world. We established that diets and increasing physical activity/ exercise are the two cornerstones of lipid management. Although, drug therapy, including the use of statins to lower cholesterol and fibrates to reduce triglyceride, could be necessary in some instances.

TABLE 6. *Effectiveness of Lipid Reduction Therapy*

Risk Factors	Reference Ranges (mmol/L)	Males (n=47) Before Rx	Males (n=47) After Rx	P value	Females (n = 53) Before Rx	Females (n = 53) After Rx	P value	Total (n = 100) Before Rx	Total (n = 100) After Rx	P value
Fasting Glucose	3.6-6.7	9.49 ± 1.69	8.23 ± 3.11	0.001	7.41 ± 3.35	7.27 ± 3.19	0.14	8.29 ± 3.96	7.75 ± 3.17	0.03
% Reduction			13.28			1.89			6.51	
Cholesterol	1.3-6.2	6.22 ± 1.69	4.80± 1.24	0.00	5.43 ± 1.41	4.92 ± 1.23	0.00	5.81 ± 1.59	4.86 ± 1.22	0.00
% Reduction			22.83			9.39			16.35	
LDL- Cholesterol	2.5-3.3	3.14 ± 1.13	2.99 ± 1.08	0.00	3.12 ± 1.25	2.97 ± 1.1	0.00	3.12 ± 1.19	2.97 ± 1.13	0.00
% Reduction			4.78			4.81			4.81	
HDL- Cholesterol	0.9-1.4	1.07 ± 0.30	0.93 ± 0.3	0.16	1.24 ± 0.31	1.13 ± 0.35	0.98	1.17 ± 0.31	1.04 ± 0.34	0.18
% Reduction			13.08			8.87			11.11	
Triglyceride	0.3-1.5	3.92 ± 3.01	2.14 ± 1.55	0.00	2.92 ± 2.31	2.24 ± 2.07	0.00	3.37 ± 2.68	2.19 ± 1.84	0.00
% Reduction			45.41			23.29			35.01	
BMI	<30	31.49± 5.16	30.97 ± 5.31	0.03	32.61 ± 6.30	31.00 ± 5.84	0.07	31.83±5.95	30.98 ±5.56	0.01
% Reduction			1.65			4.94			2.67	
Systolic Pressure (mmHg)	140	128.51 ± 29.69	122.88 ± 20.34	0.18	135.68 ± 19.72	128.00 ± 21.85	0.4	132.01±25.48	127.99± 21.85	0.12
% Reduction			4.43			1.82			3.05	
Diastolic Pressure (mmHg)	90	82.09 ±11.22	78.97 ±10.01	0.10	80.91 ±10.51	77.33 ±13.01	0.4	81.51 ±0.87	77.33±13.01	0.01
% Reduction			3.80			6.45			5.13	

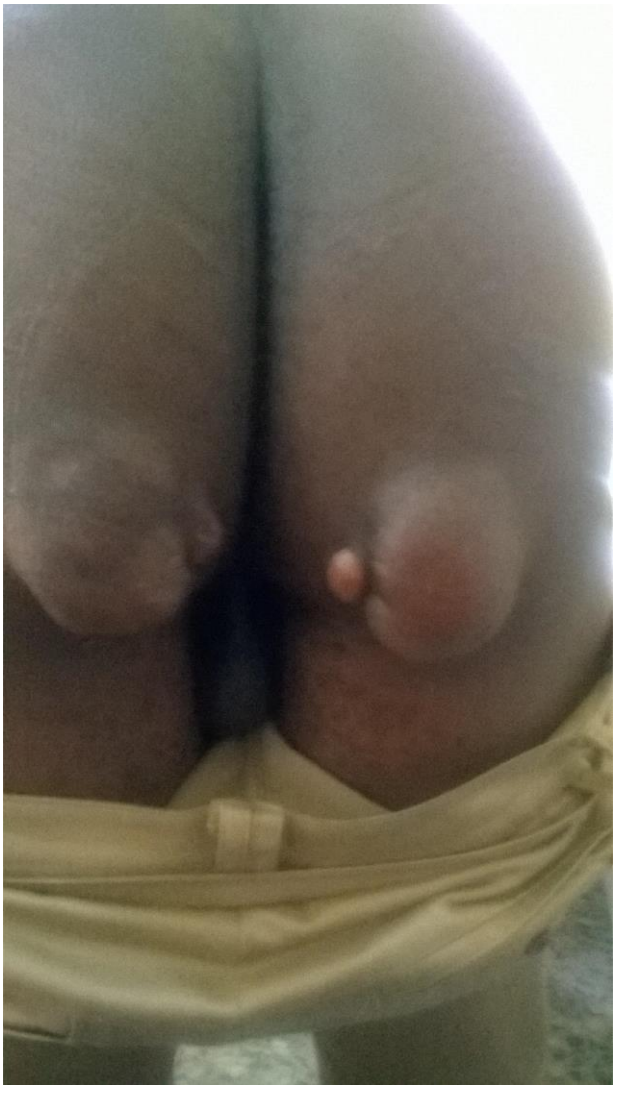
TABLE 6b *Coronary Heart Disease Risk Reduction*

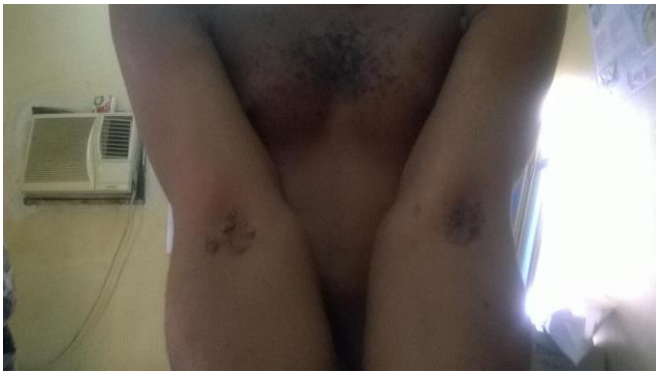
	Males (n = 47)		*Females (n—53)*		*Total (n = 100)*	
Risk Categories	*Before Rx*	*After Rx*	*Before Rx*	*After Rx*	*Before Rx*	*After Rx*
1. (≥ 30 %)	46.8	25.5	28.3	13.2	37.0	19.0
% absolute risk reduction		45.51		53.36		48.65
2. (≥ 20 %)	21.3	14.9	20.8	11.3	21.0	13.0
% absolute risk reduction		30.05		45.67		38.10
3. (≥ 10 %)	31.9	59.6	50.9	75.5	42.0	68.0
Total	100.0	100.0	100.0	100.0	100.0	100.0

Lipid and Obesity Clinics.

Our findings have shown the benefits of establishing Lipid and Obesity (or Metabolic Medicine) Clinics in our hospitals. The benefits include reduction of economic loss, morbidity and mortality due to cardiovascular diseases and other complications of high lipid level (hyperlipidaemia) and obesity. Following my experience in the UK hospitals, I started the lipid and obesity clinics in two health facilities, King Abdullah Hospital, Bisha, Saudi Arabia and Lagos State University Teaching Hospital, Ikeja, Nigeria.

Presently our team is working tirelessly to reduce the burden of dyslipidaemias and obesity in order to prevent cardiovascular diseases and other complications in the populations of Lagos and its environs.





What Causes High Cholesterol?

Uninterrupted blood flow is essential to good health, bringing required quantities of nutrients to the body cells and removing waste products. In general, blood cholesterol levels tend to rise with age.

The amount of cholesterol in the blood is influenced primarily by diet, hereditary factors, and diseases such as diabetes.
Smoking, obesity, lack of exercise, stress and high blood pressure (hypertension) can also contribute to hyperlipidemia.

Diagnosing high Cholesterol

A laboratory blood test is necessary to give an accurate check of cholesterol levels. Generally, a blood sample is taken from the arm, after the patient has fasted (gone without food) for at least 12 hours.In some cases, an automated system may be available which can test a sample from a single pinprick of the finger.

A blood sample will be taken for laboratory testing

Treatment

For those people with an inherited tendency towards high levels of cholesterol in the blood (hyperlipidemia), lipid-lowering drugs may be recommended.

This may also apply to those with a pre-existing condition, such as diabetes. A change of lifestyle may also be required to accompany any drug treatment.

MEDICATION

All drugs can be grouped together by how they work (ie, their specific mode of action). The list below includes all the different types of drugs approved for use in the treatment of this condition at the time of publication. (Updated information is also available online at: www.diseases-explained.com.)

Always consult your healthcare provider if you have any questions or concerns about the medication you have been prescribed.

Drug Type (in alphabetical order)	*Effect*
Bile Acid Sequestrants	Act within the digestive system to reduce the level of bile salts in the blood. This triggers the liver to convert more *Cholesterol* into bile salts which is then excreted from the system.
Fibrates (Fibric Acid Derivatives)	Act on the liver to reduce *triglycerides*, raise HDL, and reduce LDL levels.
HMG-CoA Reductase Inhibitors (Statins)	Inhibit an enzyme in the liver which produces *Cholesterol*. Lower LDL. May increase HDL and total *Cholesterol*. Moderately reduces *triglycerides*.
Nicotinic Acid Derivatives	Act on the liver to prevent the conversion of fatty acids into lipids, thereby lowering levels of both *Cholesterol* and *triglycerides*.
Other Drugs	***Effect***
Marine Triglyceride (Fish Oils)	May reduce levels of *Cholesterol* and *triglycerides* by preventing buildup of LDL levels in the liver.
Soluble Fibers	May reduce *Cholesterol* levels by preventing absorption into the digestive system and promoting the excretion of bile salts.

Self Help

Follow a healthier lifestyle, eat foods low in fat, salt, and sugar, and high in fiber.

This, combined with a regular exercise program as determined by your healthcare provider, will help to reduce your cholesterol levels.

'Moderation' is the key - limiting consumption of alcohol, high-fat foods, and reducing stress will improve mental well-being.

Smoking and excessive alcohol consumption are particularly high risk factors and should be avoided.

Always read the food labels

Reading the labels on food packaging may help you regulate your own intake - particularly of saturated fats, cholesterol, sugars and salt.

Nutrition Facts

Serving Size 1/4 cup (30g)
Calories 132 Fat Cal. 35

Amount / serving		%DV*
Total Fat	4g	6%
Sat Fat	1g	5%
Cholesterol	0mg	0%
Sodium	9mg	0%
Total Carb.	23g	8%
Fiber	0mg	0%
Sugars	12g	
Protein	1g	5%

*Percentage Daily Value based on a 2000 calorie diet.

Other Risk Factors
for developing heart disease

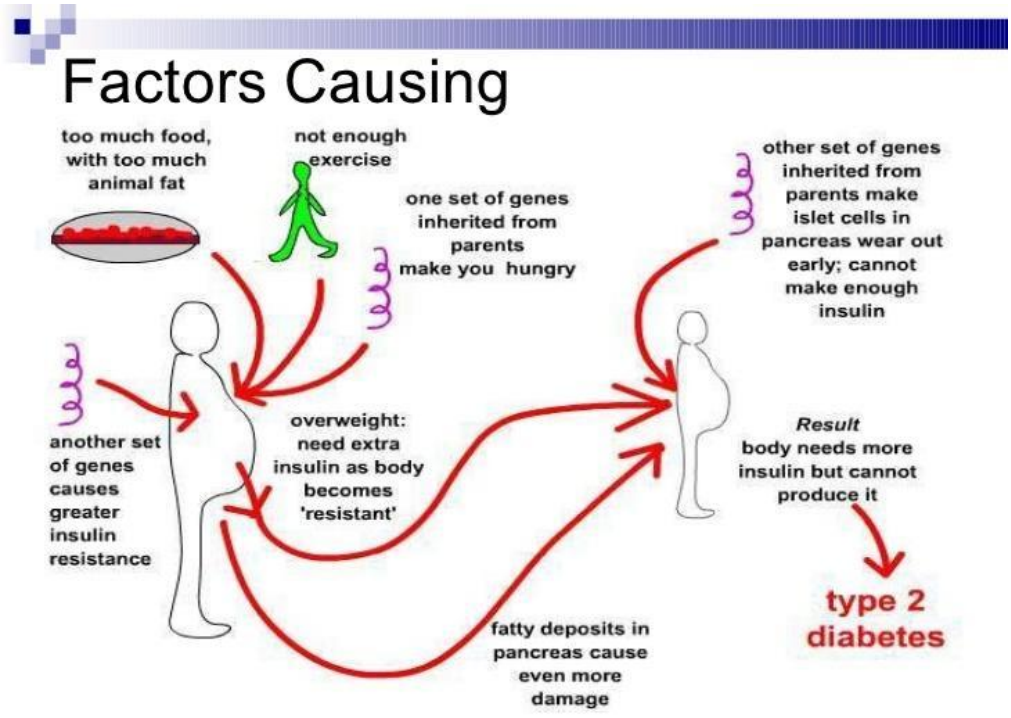
- ***High blood pressure*** - *hypertension*
- ***Excessive alcohol***
- ***Smoking***
- ***Family history of heart disease***
- ***Diabetes***
- ***Lack of exercise***
- ***Obesity***
- ***Increased age***
  Male - 45 years or older
  Female - 55 years or older

AstraZeneca

www.diseases-explained.com

STUDIES ON CARBOHYDRATE AND DIABETES MELLITUS

Diabetes mellitus is a major contributor to the global disease burden. It is associated to a range of adverse health outcomes, including eye, kidney and heart diseases as well as stroke.



Non-dialysable urinary glucoconjugate.

The glucoconjugate is a molecule consisting only of glucose units. It is found in the urine after dialysis across polythene semi permeable membrane which was immersed in deionized water. The molecule was investigated as a possible biomarker of Diabetes Mellitus.

Its excretion rate was determined by using glucosyl/galactosyl ratio in the urine after acid hydrolysis (breaking down the molecule by heating it in acid solution). A mean value of 0.27 was obtained for the normal individuals (Adedeji, O.O. 1991)(12)(table7).

Table 7. Acid hydrolysis of glycogen and non-dialysable urinary glucoconjugates of normal men (200 mg of urine powder were obtained from 1 l of urine; results given are $\bar{x}$ ± standard error of the mean)

Sample	Glucose*/ mmol g^{-1}	Conversion† (%)	Galactose*/ mmol g^{-1}	Glucosyl : galactosyl ratio‡
Glycogen	5.60 ± 0.10	90.76 ± 3.00	—	—
Subjects§				
1(*a*)	61.33 ± 8.78	—	217.44 ± 68.46	0.28 ± 0.04
1(*b*)	58.21 ± 6.16	—	185.27 ± 23.13	0.31 ± 0.03
Over-all $\bar{x}$ ($n = 10$)	56.56 ± 6.51	—	204.98 ± 27.02	0.27 ± 0.03
Range	43.4–64.2	—	160.2–258.1	0.23–0.31

The urine from the diabetics was equally treated, and the mean values of glucosyl /galactosyl ratio were higher than for normal individuals, ranging between 0.4 and 10.1(table 8).

Table 8. (GlucosyL) / (GalactosyL) for Diabetics (D) or Normals (N)

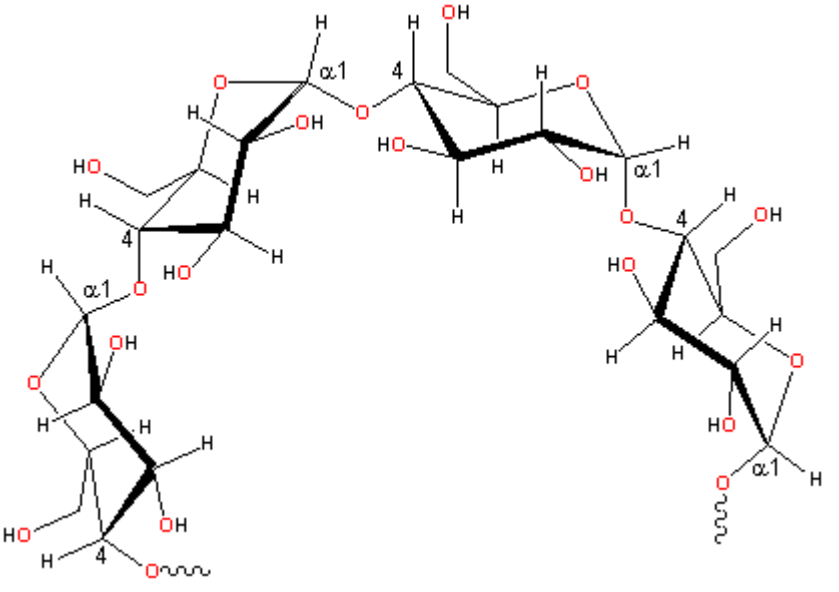
	D1	D2	D3	D4	D5	D6	D7	N1	N2
Urine Powder	10.1 ± .04	7.3 ± 0.5	5.3 ± .05	1.0 ± .06	0.9 ± .05	0.7 ± .05	0.4 ± .04	0.24 ± .04	0.27 ± .04
Amyloglucosidase(% of glucose released)	5.1 ± 2.5	0	2.4 ± 1.5	0	0	67 ± 3.02	73 ± 3.05	76 ± 4.8	12 ± .07
Amyloglucosidase after partial acid hydrolysis (% of glucose released)	0 (5*) ± 0.0	0 (7*) ± 0.0	80 (20*) ± 2.05	-	-	-	-	-	-

No release of free glucose or galactose from diabetic sssamples was detected using alpha or β – glucosidases, or cellulase; and no release of maltose was detected with alpha -β - amylase.

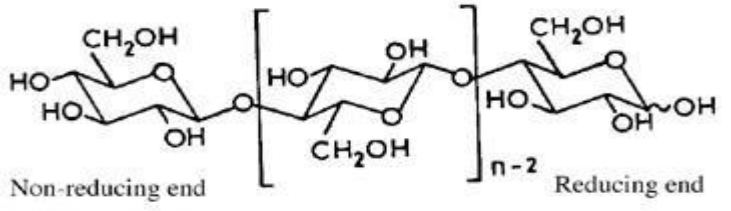
Because of the increase in the excretion rate of the glucocojugate in urines of diabetics, it was suggested that the molecule could be used as a bio-marker of diabetes mellitus.

STRUCTURE OF THE URINARY GLUCOCONJUGATE

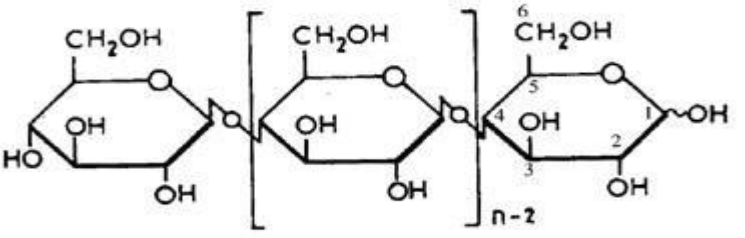
Following the specific actions of glycolytic enzymes (break only linkages between glucose units) on the molecule, it was shown that the glucose units were arranged in 2 fractions, which are branched alpha-glucan (with 1,4 and 1,6 glucosidic bonds},similar to the structure of glycogen,(the storage form of excess glucose in human body)(table 9).



The second fraction is a beta-glucan (with 1,4 glucosidic bond only)(table 9b), as in cellulose(which is found in plants)(Adedeji O.O.1992)(12).



Sometimes shown as



Cellulose

Table 9b.
Action of B–D glucosidase and cellulase on non–dialysable urinary glucoconjugate and amyloglucosidase resistant fraction.

Experiments	*Acid hydrolysis	B–D–glucosidase & cellulase	% Conversion
Non–dialysable glucoconjugate	54.60	25.15+.73	46.06+1.30
Amyloglucosidase resistant fraction	34.04	30.12+.49	86.80+1.40

% conversion was based on acid hydrolysis values.

The dialyzed urine of a diabetic patient was, also, subjected to methylation and analysed by gas chromatography and mass spectrometry method (13) to confirm its composition and structure. (table10). The result agreed with that of the enzymic actions on the urine sample.

TABLE 10· Gas Chromatography/nass spectrometry of methylated alitol acetates from urinary glucoconjugates and amyloglucosidase resistant fraction

Assigned structure	Urinary glyconconjugates (A)		Amyloglucosidase resistant fraction (B)		Ratio B/A
	KT (s)	RMC (%)	RT(s)	RMC (%)	
1 - fucose	7.325	6.955	7.353	4.525	0.65
1 - glucose	9.150	1.966	9.227	8.734	4.46
1 - mannose	9.316	0.848	9.363	2.084	2.42
1 - galactose	9.522	4.489	9.553	2.807	0.63
2 - mannose	10.765	6.250	10.800	6.299	1.00
4 - glu/4-gal	11.033	2.564	11.044	1.156	0.45
3 - galactose	11.239	13.852	11.246	8.833	0.64
6 - glu/6-manm	11.317	1.678	11.343	1.288	0.77
6 - galactose	11.908	3.936	11.933	2.874	0.73
2, 3 - glucose	12.421	1.936	12.435	2.508	1.29
2, 4 - mannose	12.486	2.579	12.503	1.428	0.55
2, 6 - mannose	13.036	1.597	13.060	2.184	1.37
3, 6 - mannose	13.288	3.548	13.312	3.015	0.85
3, 6 - galactose	13.577	1.287	13.780	2.077	1.61
3, 4, 6 - mannose	13.988	1.096	14.000	0.925	0.85
Total, these peaks (%)		54.58		50.71	

RT, retention time: RMC, relative molar concentration. In the notation used the methylated alditol acetates derived from oligosaccharidase are assumed to be unmethylated at carbon 1.

Origin of the non-dialyzable urinary glucoconjugate

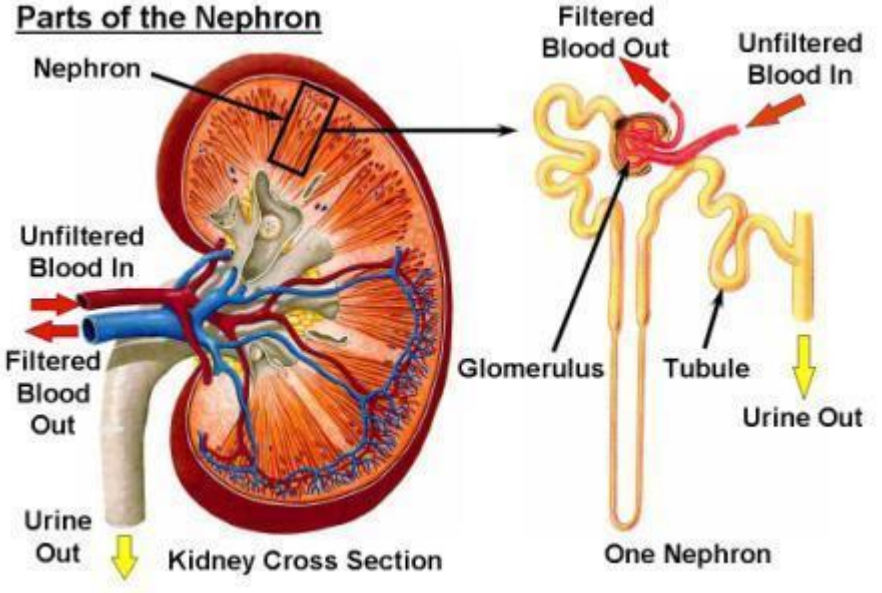
The Origin of the molecule in human body was investigated using gel exclusion chromatography method. The molecule was found to exist in different sizes (table 11), which have molecular weights ranging from 1,605 to 141,000 kd (Adedeji, O.O. 1992)(14) .

Table 11. Approximate molecular weight distribution of the glucoconjugates eluted from Sephadex G100 column

Fraction	*Elution volume*	*Kilodalton range*	*Molecular weight range*
1	48-64	0·2-0·325	141 000-70 000
2	64-80	0·325 0·525	73 000-23 900
3	80-96	0·525 0·725	23 900-7500
4	96-114	0·725-1·00	7500-1605

The range of molecular weight of the urinary glucoconjugates were computed from calibration curve of the standard dextran solutions.

Based on these results, it was concluded that the low molecular weight forms are in the urines of normal individuals, while the high molecular weight forms constitute the molecule in the urines of diabetics.
The forms in the urines of diabetics are probably post-glomerular in origin because the glomerular basement can only allow molecules equal or less than 40,000 kd in size.



These larger forms might be degraded in vivo by glucosidases (enzymes which break glucose bonds)which are present in urine (table11b) .Their actions produce lower molecular weight forms that were found in normal individuals(Adedeji .O.O 1992)(14).

Table 11b. Hydrolysis of glycogen by alpha-glucosidases in fresh urine by time tenporah

Time	mmol maltose equivalent/g			
	4°C		30°C	
(hours)	Maltose/g	% Conversion	Maltose/g	% Conversion
2	0.23 ± 0.01	7.88 ± 0.34	0.43 ± 0.00	14.73 ± 0.00
24	0.64 ± 0.03	21.92 ± 1.03	1.27 ± 0.01	43.49 ± 0.34
48	0.66 ± 0.01	22.60 ± 0.34	1.78 ± 0.01	60.96 ± 0.34
72	0.65 ± 0.02	22.26 ± 0.68	1.84 ± 0.02	63.01 ± 0.68

Mean ± sem for 2 observations. % conversion was based on acid hydrolysis value of 2.92mmol maltose/g of glycogen.

Furthermore, it was found that the activities of the glucosidases were reduced in diabetics. This could be the reason for the higher molecular mass of the glucoconjugate in the urine of the diabetics studied.

This finding has significant implication. Paradoxically, anti – glucosidase is used in the treatment of diabetes mellitus. The drug inhibits the activities of the glucosidases which are capable of breaking the bonds between glucose units in the glucoconjugate and cause the release of glucose. Thus, the drug reduces blood glucose level by stopping its release from the glycogen which is the storage form of glucose.

Glucose-reactant or inert molecule in the pathogenesis of diabetic complications ?

Our studies have shown that Glucose is a reactant molecule in the body. Glucose reacts with other bio-molecules, cells, tissues and organs of the body. Glucose exerts toxic effect on the cells and affects their functions adversely.

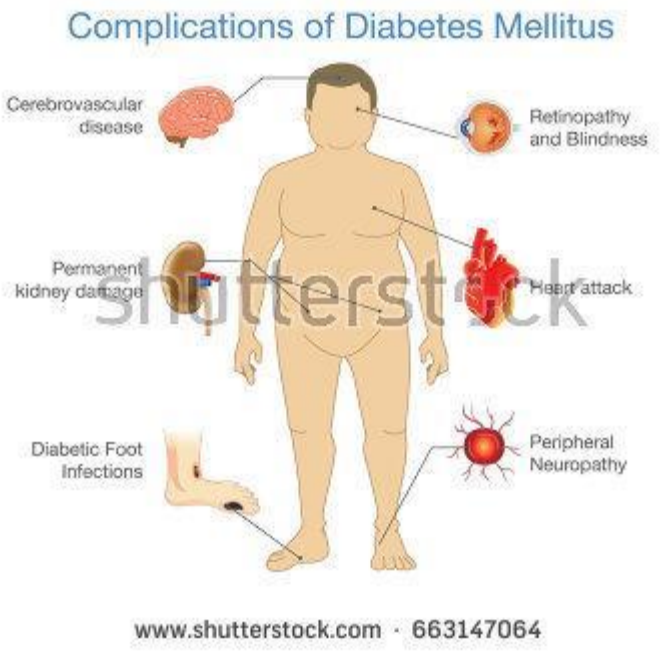
For example, altered cellular glucose metabolism generates products, such as the glucoconjugate, that cause damage to tissues and organs, including eye lens and kidney. In fact, the body homeostasis is generally disturbed in hyperglycaemic state (high blood glucose) (Adedeji .O.O 2001)(15).

Comparative Study of end–products of carbohydrate metabolism in the urines of normal individuals and diabetics.

In the study comparing the urinary non dialyzable glucoconjugate with advanced glycosylated end – product(AGE), it was shown that the two molecules have structural and compositional differences (Adedeji, O.O. 2009)(15). However, the two molecules contribute to the development of pathological complications in diabetes mellitus, including kidney damage by causing glycosylation of the glomerular basement membrane and the mesangial matrix (Adedeji, O.O. 2010)(16).

Table **12** *Role of glucose in the pathogenesis of diabetic complications*

Processes	Sites
Glycosylation	Circulating proteins (e.g. haemoglobin), tissues (e.g. collagen)
Glucose toxicity	Cells
Polyol pathway	Lens, retina, glomerular basement membrane
Glucoconjugation	Kidney



The role of lipase in glucose and lipid metabolisms.

The study of the relationship between glucose and lipid revealed that their metabolic pathways were complimentary. The action of Lipase on lipid (it breaks lipid to release fatty acids) affects glucose metabolism. The fatty acids or other lipid intermediates generated during lipolysis(breakdown of lipid) serve as signalling molecules that are linked to insulin secretion (for glucose utilization)(Adedeji O.O. 2007)(17)(table 13). It was shown that in fasting humans, the efficient glucose stimulated insulin secretion is absolutely dependent on elevated free fatty acids

TABLE 13. Correlation between glucose, lipid and lipase activity.

Analytes	Diabetics (n=52) mean ± SD	Controls (n=118) mean ± SD	*P* value	Correlation coefficient (r) with lipase
Glucose mmol/l	12.47 ± 3.32	5.64 ± 0.82	<0.05	+0.305
Total cholesterol mmol/l	5.21 ± 1.40	4.84 ± 1.12	<0.05	+0.055
Triclyceride mmol/l	2.13 ± 1.18	1.43 ± 0.70	<0.05	+0.200
LDL-cholesterol mmol/l	2.73 ± 1.12	2.67 ± 0.98	<0.05	-0.029
HDL-cholesterol mmol/l	1.40 ± 0.46	1.53 ± 0.45	<0.05	-0.070
Lipase U/l	39.32 ± 17.85	30.18 ± 1078	<0.05	-

LDL - low density lipoprotein. HDL - high density lipoprotein.

Based on these results, we provided information about the mechanism that links lipid and glucose utilization in the human body. We, also, suggested that the determination of lipase activity in the blood could be used for diagnosing diabetes mellitus (Adedeji O.O. 2007)(17).

NewsRx™

Search our medical news database

Search

Advanced Search

- Register
- Login

Hot Topics Kidneys Orthopedics Diet and Nutrition Surgery Arthritis More

Home Newsletter for Purchase Medical Topics Products About Us Contact VerticalNews

Medical News Article on *Diabetes* Return to Search Results on *o.o.adedeji*

Research from O.O. Adedeji et al has provided new information about diabetes

2007 OCT 8 -- In this recent study, researchers in Bisha, Saudi Arabia conducted a study "To investigate the role of lipase in glucose and lipid metabolisms. A prospective study involving 52 diabetics (28 mates and 24 females, mean age 47.67 +/- 15.63 years) and 118 normoglycemic controls (39 males and 79 females, mean age 38.91 +/- 16.61 years) was conducted, between February 1st and August 31st, 2006, at King Abdullah Hospital, Bisha, Saudi Arabia."

"After 10-12 hours fasting, blood was taken from subjects and controls for the determination of glucose, total cholesterol, triglyceride, low-density lipoprotein (LDL)-cholesterol, high density...

In order to view the entire article, please read your options to the right

Purchase this Article

Price: $3.00

ADD TO CART

NewsRx Customer?

If you have an account with NewsRx and have purchased either a *NewsRx Bundled* package or a *NewsRx Pass*, you can log into your account below to access this article.

Email:

Password:

Login

New to NewsRx?

If you are new to NewsRx, you may also take advantage of cost-saving options such as those below to view this article.

Purchase a NewsRx Pass

View an unlimited number of articles for a day, week, month, etc.

Purchase NewsRx Bundled

Purchase a bundle of article-viewing-credits that never expire and receive a *discount of up to 50%*!

NewsRx is Social

Follow us on your favorite social network by clicking on a button below:

Top Medical Newsletters

- Vaccine Weekly
- AIDS Weekly
- Blood Weekly
- Cancer Weekly
- Hepatitis Weekly
- TB & Outbreaks Week
- Women's Health Weekly
- Medical Letter on the CDC & FDA
- Gene Therapy Weekly
- Obesity & Diabetes Week
- **More Medical Newsletters**

Awards

eHealthcare Leadership Awards 2013 WINNER

Best Site Design, 2012
Best Health/Healthcare Content, 2012
Best Health/Healthcare Content, 2011
Best e-Business Site, 2010
Best e-Business Site, 2009
Best e-Business Site, 2008
Best e-Business Site, 2007
Best e-Business Site, 2006
Best Healthcare Content, 2005
Best Overall Internet Site, 2005
Best Interactive Site, 2005

OTHER STUDIES

GROWTH HORMONE

Inter-relationship of growth hormone, glucose and lipid metabolism.

The study of the role of Growth hormone on glucose and lipid metabolisms showed the importance of this hormone in health (Adedeji. O. 0. et al. 2009) (18). Increased growth hormone in fasting state would lead to increased blood lipid oxidation (body use of lipid for energy) resulting in reduction of plasma total cholesterol, LDL- cholesterol and triglyceride.

Our results, also, showed that growth hormone could cause reduction of blood glucose level, probably due to the inhibition of gluconeogenesis (as part of its sparing effect). Growth hormone could, also, cause increase in obesity (Adedeji, O.O. 2009)(18). Thus, a negative correlation was obtained between growth hormone and hormone sensitive lipase. This is consistent with the role of the enzyme as a mediator of the lipolysis (breakdown of body lipid)(table 14).

Table 14. Correlations of Parameters with Growth Hormone.

Patients	Age	BMI	FBS	TC	TGI	LDL	HDL	LIPASE
Male	0.252	-.0560	-0.597	0.240	-0.333	-0.337	0.307	-0.075
Female	-0.558	-0.014	-0.729	-0.151	-0.421	-0.246	0.227	-0.181
All	-0.321	0.016	-0.551	-0.065	-0.295	-0.162	0.351	-0.087

THYROID HORMONE

Thyroid hormone plays an important role in the body metabolisms including lipid and carbohydrate.

We found an association between low thyroid hormone level in women and the presence of fibromyalgia, a debilitating disease causing severe muscle pain (Adedeji. O.O. et al 2005)(19)(table 15).

Table 15. Thyroid function in FMS patients and control

Thyroid function	*FMS patients (n=34)*	*Controls (n=52)*	*P value*
Normal thyroid function (n,%)	25 (73.5%)	48 (92.3%)	< 0.05
Abnormal thyroid function (n,%)	9 (26.5%)	4 (7.7%)	< 0.05
Hypothyroidism (n,%)	8 (23.5%)	3 (5.77%)	< 0.05
Clinical (overt) hypothyroidism (n,%)	2 (5.88%)	0	NS
Subclinical hypothyroidism (n,%)	6 (17.7%)	3 (5.77%)	NS
Hyperthyroidism (n,%) Clinical	1 (2.94%)	1 (1.92%)	NS
hyperthyroidism (n,%)	0	0	NS
Subclinical hyperthyroidism (n,%)	1 (2.94%)	1 (1.92%)	NS

NS : non significant $p < 0.05$: significant

THYROID STIMULATING HORMONE

Further, maternal and foetal thyroid stimulating hormone (which is responsible for the secretion of thyroid hormone) was reported to contribute to the maturation, growth and development of foetus (Adedeji,O.O et al 2007)(20)(table 16).

Table 16. Correlations between maternal and fetal thyroid stimulating hormone levels and the fetal indices.

Parameters	Maternal (Mean ± SEM)	Fetal (Mean ± SEM)	*P*-value
Maternal parameters (n=101)			
TSH* (n=101) (mU/L)	4.01 ± 0.36	8.16 ± 0.51	0.000
Glucose (mmol/L)	5.05 ± 0.23	3.51 ± 0.26	0.001
Albumin (g/dl)	30.4 ± 0.68	33.40 ± 0.42	0.521
Total protein (g/dl)	59.10 ± 1.26	52.62 ± 1.10	0.000
Calcium mmol/L	2.26 ± 0.02	2.70 ± 0.02	0.000
Albumin/glucose ratio	1.08 ± 0.02	1.78 ± 0.04	0.005
Fetal parameters (n=101)	Maternal TSH R = value	Fetal TSH R = value	
TSH	0.08	1.0	
Gestation age	-	0.08	
Weight	0.04		
Apgar Score		0.20	
1 minute	0.10	0.03	
5 minutes	0.01	0.20	
Glucose	0.46	0.28	
Calcium	0.96	0.40	
Total protein	0.59	0.61	
Albumin	0.78	0.88	
Albumin/glucose ratio	0.64	0.47	

*Preterm (25) (<30 weeks), thyroid stimulating hormones (6.38 ± 0.90), term (75), TSH - thyroid stimulating hormones (6.39 ± 0.79) (p=0.996)

ZINC STUDY

We reported the presence of zinc (an essential trace element in diets which is necessary for the activities of metabolic enzymes) deficiency in a semi urban Nigerian community. Zinc deficiency is a risk factor for developing metabolic diseases (Awobusuyi, J.O, Adedeji, O.O et al. 2014)(21).

People with zinc deficiency tend to increase their salt intake which can lead to increased blood pressure. They are at risk of insulin resistance, glucose intolerance, diabetes mellitus , atherosclerosis and coronary artery disease. Zinc deficiency was ranked as the 11th highest risk factor for morbidity and 12th highest risk for disease burden. Mixed diets of cereals contain phytates which inhibit zinc absorption.

We found negative correlations between serum zinc level and serum total cholesterol and glucose. However, serum zinc was positively correlated to triglyceride. The clinical significance of this result is that it reflects the association between zinc deficiency and dyslipidaemia (abnormal blood lipid level) as well as glucose intolerance(diabetes mellitus).

Table17. Comparison of mean serum zinc levels in studied subjects (n=212)

Variable	Serum zinc levels	p Value	Significance
	Mean (µmol/l)±1 SD		
Age (years)			
0–39	11.49±6.96		
40–59	11.75±9.62	$p<0.05$	Significant
≥60	17.52±12.92		
Gender			
Males	12.52±9.74	$p>0.05$	N/S
Females	12.43±8.58		
Socioeconomic class			
Class 1	12.69±6.92		
Class 2	13.78±9.93		
Class 3	11.84±8.73	$p>0.05$	N/S
Class 4	12.33±8.56		
Class 5	12.58±9.61		
BMI(kg/m^2)			
<18.5	22.69±26.99		
18.5–25	12.52±7.62		
>25 <30	12.85±10.10	$p<0.05$	Significant
≥30 kg	11.09±7.31		
Blood pressure (mmHg)			
<140/90	12.25±9.92	$p>0.05$	N/S
≥140/90	13.03±9.52		

NORMAL REFERENCE ZINC LEVEL 20 UMOL/L
Class 1 Professionals
Class 2 Managerial and Technical occupations
Class 3 Skilled occupations
Class 4 Partly skilled occupation
Class 5 Unskilled occupations

VITAMIN D

This hormone is responsible for bone growth and it plays an important role during pregnancy. The outcome of pregnancy was shown to be dependent on the maternal plasma level of vitamin D.

The prevalence of vitamin D deficiency among the pregnant women was 29% (Gbadegesin A, Sobande A, Adedeji O.O. et al 2017)(22). The results showed positive associations between vitamin D deficiency, preeclampsia, preterm delivery and caesarean section. Vitamin D deficiency has been shown to predispose to diabetes mellitus(Mathieu et al, 2005).

Table 18. Pregnancy complications and mode of delivery.

Complication, *n* (%)	Group 1 *N* = 134 (%)	Group 2 *N* = 48 (%)	Group 3 *N* = 279 (%)	Significance
None	113 (84.3)	43 (88.8)	247 (88.6)	$p > .05$
Preeclampsia	10 (7.4)	0 (0.0)	11 (3.9)	
SROM	0 (0)	0 (0.0)	6 (2.2)	
Anaemia	0 (0.0)	5 (11.2)	0 (0)	
Preterm delivery (<37 wks)	11 (8.3)	0 (0.0)	13 (4.6)	
Gestational diabetes	0 (0)	0 (0)	2 (0.07)	$p > .05$
Caesarean section	31 (23.1)	11 (22.3)	112 (37.8)	$p > .05$

Table 19. Neonatal outcomes.

Characteristic, *n* (%)	Group 1 *N* = 134 (%)	Group 2 *N* = 48 (%)	Group 3 *N* = 297 (%)	Significance
Apgar score <7 at 10mins	0 (0)	0 (0.0)	30 (9.4)	$p > .05$
Outcome				
Alive	134 (100)	48 (100)	279 (94.0)	$p > .05$
Stillbirth	0 (0)	0 (0)	12 (4.0)	
Neonatal death	0 (0)	0 (0.0)	6 (2.0)	
Sex of baby				
Male	49 (36.3)	32 (66.6))	129 (43.3)	$p > .05$

Recommendations:

1. There is need for government policy and population health intervention targeting reduction of unhealthy food consumptions and unhealthy life styles, including lack of exercise.
2. There should be state sponsored wide spread media publicity of the dangers of hypertension, obesity, and diabetes mellitus.
3. Regular laboratory check –ups of health parameters by individuals should be encouraged to prevent diseases or allow timely intervention that could ameliorate or cure of disease conditions.
4. Funding of the health sector should be improved to achieve WHO objective of health for all in 2020 (including maternal and child health).

Acknowledgement:

First, I am grateful to the Almighty God for His grace towards me and my family. I was fortunate to have been favoured with different scholarship awards for all my university education.
My Late wife, Mrs Bosede Olufunmike Adedeji (nee Amosun) was a pillar of encouragement and support to me. I thank my children, Tolu, Tunde and Tomi for their inspiration. I thank my wife, Mrs Adetutu Adedeji (nee kujore) for her understanding and support.

My Late father, Chief J.O. Adedeji, cherished education and he was very supportive. My mother, Chief Elizabeth Olabisi Adedeji, (102 years), believes in me and supports my aspiration. I appreciate members of my larger family, friends and associates.

Late Professor Akintunde Cole Onitiri was my teacher in Chemical Pathology and mentor at the CMUL/LUTH between 1980 and 1984. He was particularly interested in health problems caused by disturbed metabolism of lipids/fats in the human body. His health awareness campaign slogan was KYB (KNOW YOUR BODY). He introduced me to lipid research.

I, also, pay tribute and express my profound gratitude to my PhD supervisor and mentor at the University of Oxford, England (1984-1987), Late Sir Professor P.J. Randle(the successor of Sir Hans Krebs in the Nuffield Department of Clinical Biochemistry, University of Oxford(founder of Krebs Cycle and a Nobel Laureate). He was, also, a giant in the field of biochemistry and a world renowned researcher on carbohydrate and lipid metabolisms. He discovered the Fatty Acid cycle (known as the Randle's cycle), which is an important metabolic pathway for fuel utilization in the human body. He introduced me to the research studies on disorders of carbohydrate metabolism including diabetes mellitus.

I thank you all for coming.

REFERENCES.

1. Plasma lipids in Nigerian hypertensive. Adedeji.O.O, Onitiri A.C. Afri. J. Med. Sci. 1990; 19:281-284.

.

2. Hypertension and obesity. Adedeji O.O.Nig.Med.J.1991; 21: 11-12.

3. Metabolic consequence of obesity. Adedeji O.O Nig. Qrtly J. Hosp.Med. 1998;8 (3):185-186.

4. Plasma lipids in Nigerian non-insulin dependent (type 2) diabetic patients. Adedeji O.O. Nig.Med.J.1991;2: 45-47.

5. Comparative study of vitamin E levels of Nigerian men and age matched fertile and infertile women. Adedeji O.O, Makinde K.A. J. Nutritional Medicine 1994;1:39-42.

6. Plasma lipids during first trimester in pregnant Nigerian women. Adedeji O.O, Ola R. Nig. Qrtly J. Hosp. Med. 1997;7(2):111-113.

7. Diet, alcohol consumption, smoking and physical exercise as determinants of plasma lipid levels. Adedeji O.O. West African J. Med. 2000 ;(4):283-285.

8. Lipid abnormalities in renal diseases. Adedeji O. O. Middle- East Laboratory J. 2003; 6:16-18.

9. Hyperlipidaemia. Adedeji O.O. Post-graduate Doctor J.

2004;26 20-5.

10. Plasma lipid concentrations of healthy Nigerians. Adedeji O.O. J.Tropical and Geographical Medicine 1994;

46(1):23-26.

11. Effectiveness of intervention to reduce coronary heart disease risk. Adedeji O.O. and Oyakhire G. K. West African Journal of Medicine 30 (3):197-20, 20.

12. The methylation of non-dialyzable urinary glucoconjugates and analysis by gas chromatography and mass spectrometry. Adedeji O.O. Nig.Med.Sci.J.1999; 2: 81- 83.

13. Structural analysis of non-dialysable urinary glucoconjugates of normal men. Adedeji O.O. Analyst.

1992;117: 1753-1756.

14. The origin of non-dialysable urinary glucoconjugates
Adedeji O.O. J . Clin. Pathology 1993.46:93-94.

15. Glucose: a reactant or inactive molecule in the pathogenesis of diabetic complications. Adedeji O.O. Diabetes International J.2002; 12:10-11

16. Studies on end-products of carbohydrate metabolism in the urines of normal individuals and diabetics. Adedeji O.O. Nig. J. Health and Biomedical Sciences. 2009; 8, 2:12-14.

17. The role of Lipase in glucose and lipid metabolism. Adedeji O.O. et al. Saudi Medical Journal 2007; 28:1296-1298.

18. Interrelationship of Growth Hormone, Glucose and Lipid Metabolisms. Adedeji O.O Nig. Qrtly J. Hosp. Med 2010;19(3): 155-57.

19. High rates of hypothyroidism among women with fibromyalgia syndrome. Adedeji O.O et al. Tanta Medical Journal 2005;33: 1223-1232.

20. Maternal and fetal thyroid stimulating hormones and the fetal indices of maturation, growth and development
Adedeji O.O. and Oyakhire G.K. Saudi Medical Journal 2007;28:149-152.

21. Zinc deficiency in semi urban Nigerian community: prevalence and relationship with socioeconomic status and indices of metabolic syndrome. Awobusuyi J.O. Adedeji O.O. Kukoyi O Ibrahim A. Daniel F.A. J. Public Health 20014;22(5) : 455-59.

22. Maternal serum vitamin D levels and pregnancy outcomes: from Lagos Nigeria. Gbadegesin, A, Sobande A, Adedeji O. et al. J. Obst.& Gynae.2017; 37,1:25-38.

.