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EFFECTS OF ADIPONECTIN ON GLUCOSE AND LIPID METABOLISM IN PORT HARCOURT RESIDENTS

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Abstract

Purpose: The study determined the effects of adiponectin on glucose and lipid metabolism in Port Harcourt residents, Rivers State, Nigeria.

Methodology: The study was conducted in the Medical Outpatient Clinic and Chemical Pathology Department of the University of Port Harcourt Teaching Hospital (UPTH), among 384 individuals who presented with metabolic disorders or for routine medical screening, using a sample size of 50% prevalence for insulinemia and employing the formula; $N= Z^2pq/d^2$. 5ml of venous blood was taken from the median cubital vein into an EDTA bottle for the laboratory analysis, while data analysis was done using SPSS version 22 and the results presented in tables as frequencies and percentages.

Results: The socio-demographic characteristics was mostly 31-40 years, 273(82.0%) old, mainly females, 204(61.3%), mostly married, 182(54.7%), Christians, 333(100.0%) and had secondary education, 166(49.8%). Triglyceride level was mostly normal, 309(92.8%), HDLc was mostly low, 177(53.2%), LDLc was mostly good, 326(97.9%) and total cholesterol was mainly high, 322(96.7%). Fasting Blood Sugar was mostly normal, 197(59.2%) and high, 134(40.2%), Body Mass Index was mostly normal, 232(69.7%), Blood Pressure was mostly normal and high (138(41.4%) and 104(31.2%), and adiponectin level was mostly normal, 286(85/9%).

The association between adiponectin and plasma lipids was not statistically significant for all the lipids (triglycerides, HDLc, LDLc and total cholesterol) at 0.780, 0.616, 0.556 and 0.172 respectively, while the relationship between adiponectin and glucose metabolism shows that BMI was not statistically significant, 0.129, but FBS was weakly significant, 0.069. Similarly, there is a strong correlation between adiponectin and nutrients like glucose and lipids.

Unique Contribution to Theory and Practice: It is important to undertake routine medical checks, as certain deviations in nutrient metabolism may not manifest immediately, but transient changes can be revealed by routine investigation and early interventions initiated to either remedy or avert occurrence.

Keywords: *adiponectin, metabolism, glucose, lipids, triglycerides, insulin*.

INTRODUCTION

Adiponectin is an adipose tissue hormone (adipokine) that mainly increases insulin sensitivity towards glucose (Lee & Shao, 2012). Its action mobilizes the required energy for other tissues of the body. It may additionally sensitize other sources of energy through gluconeogenesis and glycogenolysis. Broadly, its action involves metabolism of glucose and its distribution for utilization by cells. Other adipokines include leptin and resistin, but these differ from adiponectin by its circulating levels (Arita *et al*., 1999; Hu *et al*., 1996). Adiponectin bore medical significance for its role in metabolic disorders like diabetes mellitus type 2, dyslipidemia, hypertension and atherosclerosis (Yamauchi & Kadowaki, 2013), with their co-existence termed, metabolic syndrome, except atherosclerosis. Adiponectin activity is counteracted by insulin, which is produced and secreted from the liver. Thus, reduced adiponectin results in reduced insulin sensitivity, especially, in pre-diabetic individuals (Stefan *et al*., 2002). It is reported that, hypoadiponectinemia may lead to onset of insulin resistance in obese individuals and others with type 2 diabetics (Zhu *et al*., 2004; Krakoff *et al*., 2003; Lindsay *et al*., 2002; Stefan *et al*., 2002). Lee and Shao (2012) further posit that adiponectin also enhances triglyceride catabolism, fatty acid uptake and biogenesis of mitochondria, leading to regulation of lipids in skeletal muscles. Persistent elevated insulin sensitivity can also result in the development of cancers, dyslipidemia, fatty liver and Alzheimers's disease (Yamauchi & Kadowaki, 2013).

Glucose and lipid are vital nutrients obtained from food, but can be derived from other (synthetic) sources. They provide energy for metabolic activities, physical input and maintenance of good health. The availability and utilization of these nutrients optimally benefits the body and any deviation may result in a disorder. However, nutrients, such as, vitamins D and K does not produce significant change in the concentration of serum adiponectin (Suksomboon *et al*., 2017; Dinca *et al*., 2016), but is stimulated by glucose and lipids, while carotenoids have effect on adiponectin, by preventing the incidence of atherosclerosis (Kishimoto *et al*., 2016) and exercise also enhances adiponectin production and release too (Yoshida *et al*., 2010). Supplementation of tomato juice to exercise also significantly increased serum adiponectin levels by reducing body weight, body fat, waist circumference and body mass index (Li *et al*., 2015).

Adipose tissue, previously considered a passive storage for triglycerides, is now understood to possess hormonal and metabolic roles on tissues, with the discovery of adiponectin (Yanai & Yoshida, 2019). Adiponectin facilitates the clearing of glucose, triglycerides and free fatty acids from plasma, decreases gluconeogenesis, decreases insulin resistance and increases insulin sensitivity (Kadowaki *et al*., 2006). It also induces an increase in serum high density lipoprotein level and lowers serum triglyceride levels (Christou & Kiortsis, 2013).

When insulin sensitivity is reduced, obesity and metabolic disorders will arise. This is heralded by infiltration of the adipose tissue by inflammatory cells, such as macrophages, leading to production of pro-inflammatory adipokines that include tumor necrosis factor alpha (TNF-α), monocyte chemo-attractant factor- 1 (MCF-1), lipocalin-2, resistin and interleukin- 6 (IL-6), and further induces atherosclerosis (Zhang *et al*., 2009). Circulating adiponectin is reduced in obesity (Ghadge *et al*., 2017) and the reduction is crucial to the pathogenesis of atherosclerosis and cardiovascular disease associated with obesity and metabolic syndrome (Arita *et al*., 1999), thus, being protective against development of cardiovascular diseases (Ouchi *et al*., 2003; Okamoto *et al*., 2000).

Adiopnectin is thus, observed as a crucial component of energy metabolism and insulin sensitivity, and its role in insulin sensitivity could be employed in the management of metabolic disorders such as diabetes mellitus type-II and obesity, as well as, cardiovascular anomalies.

METHODOLOGY

The study was conducted in the Medical Outpatient Clinic and Chemical Pathology Department of the University of Port Harcourt Teaching Hospital (UPTH), Rivers State, Nigeria. It is located along the East-West road, with the host communities being Choba, Alakahia and Aluu, all in Obio/Akpor Local Government Area. It is a purposive descriptive study which recruited individuals presenting with metabolic disorders, such as diabetes mellitus type 2, cardiovascular disease or obesity, or for routine medical screening, and fit the inclusion criteria. The sample size for this study was determined using 50% prevalence for insulinemia, since there were no available figures from literatures, and using the sample size determination formula; $N= Z^2pq/d^2$, where N is the number of sample, Z is a standard (1.96), p is the prevalence or proportion, q is 1 minus the prevalence and d is the degree of freedom (set at 0.05). This gave a sample size ≈ 384

All the subjects donated 5ml of venous blood, taken at the median cubital vein into an EDTA bottle. The blood was centrifuged and the serum preserved for the required assays. Serum levels of adiponectin were assessed by enzyme-linked immunosorbent assay (ELISA) technique. Adiponectin levels were measured with AssayMax Human Adiponectin (Acrp30) ELISA Kit (catalogue EA2500-1, Lot 7250521) using ELISA method, while glucose was assayed using semi-auto-analyzer and same for the analysis of the lipoproteins. The data was analyzed with statistical package for social sciences (SPSS) version 22, with descriptive statistics determined by frequencies, percentage and analysis of variance (ANOVA), while inferential statistics was determined by Chi-square. Ethical Approval for the study was obtained from the Legal Unit of the University of Port Harcourt Teaching Hospital, while Consent was obtained from individual participant who either signed or thumb-printed before enrolment.

RESULTS

Table 1 Socio-demographic characteristics

Variable	Frequency (n)	Percent (%)
Age (years)		
20-30	27	8.1
31-40	273	82.0
41-50	24	7.2
51-60	9	2.7
Sex		
Female	204	61.3
Male	129	38.7
Marital status		
Married	182	54.7
Single	135	40.5
Divorced	2	0.6
Widow/widower	12	3.6
Separated	2	0.6
Level of education		
Primary	64	19.2
Secondary	166	49.8
Graduate	100	30.0
Post-graduate	3	0.9
Religion		

Christianity	333	100.0

Table 1 shows they were mostly aged 31-40 years, 273(82.0%), with the least being aged 51-60 years, 9(2.7%), there were more females, 204(61.3%), mostly married, 182(54.7%), followed by singles, 135(40.5%), all Christians, 333(100.0%) and had secondary education, 166(49.8%).

Table 2 Lipid profile of respondents

Variable	Frequency (n)	Percent (%)
Triglycerides		
Normal	309	92.8
Borderline	21	6.3
High	3	0.9
High density lipoprotein cholesterol		
Normal	52	15.6
Borderline	103	30.9
Poor	177	53.2
High	1	0.3
Low density lipoprotein cholesterol		
High	2	0.6
Good	326	97.9
Fair	5	1.5
Total cholesterol		
Normal	322	96.7
Borderline	11	3.3

The lipid profile of the respondents presented in table 2 above shows that triglyceride was mostly normal, 309(92.8%), but high in 3(0.9%) respondents, while HDLc was mostly poor, 177(53.2%) and borderline, 103(30.9%), LDLc was mostly good, 326(97.9%) and Tc was mainly high, 322(96.7%).

Table 3 Metabolic characteristics

Variable	Frequency (n)	Percent (%)
Fasting blood sugar		
Normal	197	59.2
High	134	40.2
Low	2	0.6
Body mass index		
Under weight	32	9.6
Normal weight	232	69.7
Over weight	56	16.8
Obese	13	3.9
Blood pressure		
Low	64	19.2
Normal	138	41.4
High	104	31.2
Very high	17	5.1
Overtly high	10	3.0
Adiponectin		
Normal	286	85.9

High	47	14.1

Table 3 shows that FBS was mostly normal, 197(59.2%) and high, 134(40.2%), BMI was mostly normal, 232(69.7%), with 13(3.9%) obese and 32(9.6%) underweight, while BP was mostly normal and high, (138(41.4%) and 104(31.2%) respectively and adiponectin was mostly normal, 286(85/9%).

Table 4 Association between adiponectin and plasma lipids

Variable	**Range**				**Chi-square**	**df**
Adiponectin	**Normal**	**Poor**	**Borderline**	**High**		
Triglyceride	265		18	3	0.780	2
HDL cholesterol	43	150	92	1	0.616	3
LDL cholesterol	279	2	5		0.556	2
Total cholesterol	275		11		0.172	1

The association between adiponectin and plasma lipid in table 4 above shows that none of the plasma concentrations of triglycerides, HDLc, LDLc and Tc were statistically significant, values of 0.780, 0.616, 0.556 and 0.172 respectively.

Table 5 Association between adiponectin and glucose metabolism

Variable	**Range**				**Chi-square**	**df**
Adiponectin	**Low**	**Normal**	**High**	**Very high**		
Fasting blood sugar	2	176	108		0.069	2
Body mass index	26	203	44	13	0.129	3

The relationship between adiponectin and glucose metabolism above indicates that BMI was not statistically significant, 0.129, but FBS was weakly significant, 0.069.

DISCUSSION

Lipid profile

The study showed that triglyceride was mostly normal, 309(92.8%), but high in 3(0.9%), while HDLc was mostly low, 177(53.2%) and borderline, 103(30.9%). This observation conforms with that of Rizzo *et al*. (2009). HDL is usually low in good health and its majority feasibility shows that most subjects were healthy. Health is universal, but for slight variations among individuals occasioned by environment, genetics, lifestyle and nutrients. The LDLc was mostly good, 326(97.9%), while total cholesterol was mainly high, 322(96.7%). This finding contrasts the reports by Yamauchi *et al*. (2003).

Fasting blood sugar

This study observed that FBS was mostly normal, 197(59.2%) and high, 134(40.2%). This does not disregard the fact that adiponectin is implicated in regulation of body weight and development of metabolic energy-related disorders, such as diabetes mellitus type 2 (Zou & Shao, 2008). Though the finding of this study does not agree with that of Zou and Shao (2008), the difference may have originated from the nature of subjects recruited, as well as environmental and practical factors. It should not erase the fact that adiponectin has been widely proven to affect glucose metabolism (Wu *et al.*, 2003: Berg *et al.*, 2001: Combs *et al.*, 2001: Fruebis *et al.*, 2001). BMI in this study was mostly normal, 232(69.7%), with 13(3.9%) obese and 32(9.6%) underweight. This finding correlates with the mostly normal FBS reported in this study and is in tandem with the observations of Wu *et al.* (2003) and Berg *et al.* (2001) that individuals with normal body mass index are mostly likely to present with normal blood sugar levels, which is better expressed using FBS. This study further observed that blood pressure of respondents was mostly normal and high (138(41.4%) and 104(31.2%), but 10(3.0%) were overtly high, while adiponectin concentration was mostly normal, 286(85/9%). These observations agree with those of Marques-Vidal *et al*. (2012) and Mirza *et al*., (2012) who reported in their respective studies that the blood pressure of individuals with normal body weight and fasting blood sugar tends to be usually normal, but may be slightly high.

Relationship between adiponectin and plasma lipids

The association between adiponectin and plasma lipids was not statistically significant for triglycerides, HDLc, LDLc and total cholesterol at values of 0.780, 0.616, 0.556 and 0.172 respectively. The findings contrasts the reports by Christou-Tellis *et al*. (2012), Shetty *et al*. (2004) and Kazumi *et al*. (2004) which found statistical significance between adiponectin and plasma lipids. The difference is expected, as most subjects in our study had normal FBS, BP and BMI. However, the difference from other studies could have arisen from difference in setting of study, as well as, subjects and protocol employed.

Relationship between adiponectin and glucose metabolism

The relationship between adiponectin and glucose metabolism shows that BMI was not statistically significant, 0.129, but that of FBS was weakly significant, 0.069. FBS may vary in accordance to energy requirements and expenditure, while this is not a frequent occurrence for BMI. This agrees with the findings by Christou *et al*. (2012) and Ezenwaka *et al*. (2004).

SUMMARY/CONCLUSION

The socio-demographic characteristics was mostly 31-40 years, 273(82.0%) old, mainly females, 204(61.3%), mostly married, 182(54.7%), Christians, 333(100.0%) and had secondary education, 166(49.8%). Triglyceride level was mostly normal, 309(92.8%), HDLc was mostly low, 177(53.2%), LDLc was mostly good, 326(97.9%) and total cholesterol was mainly high, 322(96.7%). FBS was mostly normal, 197(59.2%) and high, 134(40.2%), BMI was mostly normal, 232(69.7%), BP was mostly normal and high (138(41.4%) and 104(31.2%), and adiponectin level was mostly normal, 286(85/9%).

The association between adiponectin and plasma lipids was not statistically significant for all the lipids (triglycerides, HDLc, LDLc and total cholesterol) at 0.780, 0.616, 0.556 and 0.172 respectively, while the relationship between adiponectin and glucose metabolism shows that BMI was not statistically significant, 0.129, but FBS was weakly significant, 0.069. Similarly, there is a strong correlation between adiponectin and nutrients like glucose and lipids. This is usually associated with the interplay between adiponectin and similar hormones, leptin and insulin. It is important to undertake routine medical checks, as certain deviations in nutrient metabolism may not manifest immediately, but transient changes can be revealed by routine investigation.

Conflict of interest: There is no conflict of interest among the authors or any other individual or corporate body regarding this work.

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