Original Research Article

PREVALENCE OF INSULIN RESISTANCE AMONG CIGARATTE SMOKERS IN SOKOTO METROPOLIS

ABSTRACT

Introduction: Cigarette smoking (CS) is a well-known risk factor for the development of metabolic diseases, various forms of cancer as well as insulin resistance (IR). IR is considered as an underlying derangement which very commonly aggravates metabolic syndrome.

Aim: This study assessed the prevalence of IR in cigarette smokers in Sokoto metropolis using selected surrogate markers

Methodology: This cross sectional study was conducted in Sokoto among 108 subjects. Fasting venous blood samples were collected for plasma glucose, triglycerides and insulin estimation. Plasma glucose and serum triglycerides were analysed using enzymatic methods while insulin was assayed using ELISA method. Homeostasis model of assessment-IR (HOMA-IR), Quantitative insulin sensitivity check index (QUICKI), Mc Auley (McA) and fasting IR index (FIRI) were calculated using standard formula and IR cut-off of >2.5, <0.339, >5.8 and >2.3 respectively were used.

Results: Based on the cut off mark, the prevalence of IR for HOMA-IR, QUICKI, McA, FIRI indices were 62(57.4%), 66(61.1%), 39(36.1%) and 60(55.6%) respectively. There was a significant correlation between HOMA-IR and FIRI ($p< 0.05$, $r = 0.999$). HOMA-IR also had a significant correlation with McA ($p<0.05$ $r = -0.506$). QUICKI had a significant correlation with McA ($p<0.05$ and $r = 0.243$).

Conclusion: This study established a significantly high prevalence of IR among CS. Importantly, it can be concluded that cigarette smokers may be predisposed to the development of metabolic disease.

Keywords: HOMA-IR, QUICKI, Mc AULEY, FIRI.

1.0 INTRODUCTION

Cigarette smoking (CS) remains a huge health burden and is still one of the leading preventable causes of morbidity and mortality globally (1). It is a very wide spread activity and it consumption has reached the level of global epidemic (2). It has been associated with an extensive list of disorder as well as reduction of life expectancy (3, 4). On average, cigarette smokers lose about 15 years of their life and an estimated 4 million cigarette smokers die worldwide annual (5). CS kills more Americans than alcohol, car accidents, HIV, guns, and illegal drugs combined (6)

Globally, the World Health Organization (WHO) reported that nearly 47% and 12% of men and women respectively smokes cigarettes (7). Although cigarette smoking is the most commonly used form of tobacco in the U.S, the prevalence of cigarette smoking amongst adults has been declining in recent years. The prevalence of cigarette smoking has declined in the developed world while it is increasing rapidly throughout the developing world and is a major threat to current and future global health (8).

According to the 2015 National Health Interview Survey, the percentage of adults aged ≥18 years who smokes cigarettes was 15.1% in 2015, a decrease from 20.9% in 2005 (9). In Nigeria, the percentage of current smokers has been put at 7.2% and 0.3% for men and women respectively (8). However, Kaoje *et al.* (2015) reported the prevalence of cigarette smoking in Sokoto North Western Nigeria to be 7.1%.(10)

CS affects the human body in myriad of ways, causing the development of chronic metabolic diseases like diabetes, heart disease, cancer because it induces insulin resistance (IR) and hypertriglyceridemia. The effect of cigarette smoking on health of an individual depends on smoking duration over the years and exposure to cigarette smoke. Exposure to free radicals leading to increased oxidative stress, inflammation, and DNA damage are the possible mechanism by which cigarette smoke causes adverse health challenges (11).

IR is a condition characterized by lack of physiological response of peripheral tissues to insulin action (12). It prevalence in the general population varies with the criteria used for its definition and the measurement adopted (13). Govindarajan *et al.* (2006) reported an estimate that IR is prevalent in 30% of the adult population but acknowledges that IR is greater in metabolic diseases such as diabetes and cardiometabolic syndrome (14). Accurate assessment of insulin sensitivity helps to identify individuals at increased risk of diseases, and may help

target preventive and therapeutic efforts more effectively. The gold standard method is hyperinsulinemic euglycemic clamp**.** For epidemiologic and clinical studies surrogate markers are employed (12) which include measurement of Homeostasis model assessment-insulin resistance (HOMA-IR), Quantitative insulin sensitivity check index (QUICKI), McAuley (McA) index and Fasting insulin resistance index (FIRI).

2. MATERIALS AND METHODS

2.1 Subjects

In this cross sectional study, a total of 108 cigarette smokers of 18-59 years were recruited from different locations within Sokoto metropolis between May and August, 2019.

2.2 Ethical Consideration and Consent

Ethical approval was obtained from the Sokoto State Ministry of Health (SKREC/037/018). Written informed consent was obtained from all participants prior to the sample collection by filling a standard informed consent form by themselves or through an interpreter.

2.3 Sample Collection and Analysis

After an overnight fast for 8-12 hours, 5ml of venous blood sample was collected aseptically. About 3ml and 2ml of the samples were dispensed into plain and fluoride oxalate containers for triglyceride (TG), insulin and glucose estimation respectively. The samples were spurned at 3000rpm for 5 minutes and unhaemolyzed plasma and serum were obtained respectively. These were harvested into labelled cryo-vials and then stored at -20^{o}C in a refrigerator until required for analysis.

Serum TG and plasma glucose were analysed using enzymatic methods (15), and serum insulin was assayed using ELISA (16).

2.4 Calculation of Selected Surrogate Markers of Insulin Resistance

2.4.1HOMA-IR

HOMA-IR is calculated with the following mathematical expression;

$IR_{HOMA} =$ [Fasting insulin (mU/l) × Fasting glucose (mmol/l)]/22.5

Normal value = < 2.5

Subjects were considered IR with value above the cut-off 2.5 (17).

2.4.2 QUICKI

QUICKI = 1/[(log fasting plasma insulin (μU/ml) + log fasting plasma glucose (mg/dl)]

Normal value = 0.382±0.007

Subjects were considered IR when the cut-off is ≤ 0.339 (12).

2.4.3 McA Index

McA = $e^{(2.63-0.28\ln(\mathrm{Io})-0.31\ln(\mathrm{TGo}))}$

Normal value = > 5.8

Subjects were considered insulin resistance with cut-off value less than 5.8 (12).

2.4.4 Fasting Insulin Resistance Index (FIRI)

The fasting insulin resistance index (FIRI) was formulated (18)

FIRI is calculated as = (fasting glucose × fasting insulin)/25.

Normal value = < 2.3

Subjects were considered insulin resistance if the cut-off value is greater than 2.3 (19).

2.5 Statistical analysis

The data generated were analyzed using SPSS Software Version 25. The results were expressed as MEAN±SD. p-value ≤ 0.05 was considered statistically significant. Pearson's correlation was used to determine the strength of relationship between insulin resistance surrogate markers and other variables. Frequency distribution was used to determine the percentage prevalence of the variable in the study participants.

3.0 RESULTS

Table1: Sociodemographic distribution of the study participants.

Variables	Frequency (n=108)
Gender	n (%)
Male	102 (94.4%)
Female	6 (5.6%)
Age group	
<20	1 (0.9%)
20-29	52 (48.1%)
30-39	35 (32.4%)
40-49	13 (12%)
50>	7 (6.5%)
Ethnicity	
Hausa	84 (77.8%)
Yoruba	6 (5.6%)
Igbo	3 (2.8%)
Others	15 (13.9%)
Occupation	
Farming	3 (2.8%)
Petty trader	47 (43.5%)
Civil service	36 (33.3%)
Unemployed	7 (6.5%)
Student	15 (13.9%)
Age of onset of smoking	
18-20	63 (58.3%)
21-24	32 (29.6%)
25-30	13 (12%)

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Table2: Prevalence of insulin resistance.

Surrogate Markers	Insulin resistance (n=108)	Non- insulin resistance (n=108)
HOMA-IR	62 (57.4%)	46 (41.8%)
QUICKI	66 (61.1%)	42 (38.9%)
Mc AULEY	39 (36.1%)	69 (63.9%)
FIRI	60 (55.6%)	48 (44.4%)

Table3: Correlation between the biomarkers of insulin resistance.

	HOMA-IR	QUICKI	McAuley	FIRI

HOMA-IR	r-value	1	0.059	-0.506**	0.999**
	P-value		0.542	0.000	0.000
QUICKI	r-value	0.059	1	0.243*	0.062
	P-value	0.542		0.011	0.525
McAuley	r-value	-0.506**	0.243	1	-0.504**
	P-value	0.000	0.011		0.000
FIRI	r-value	0.999**	0.062	-0.504**	1
	P-value	0.000	0.525	0.000	

r=Pearson correlation;
**Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

4. Discussion

IR is increasing not only in African population but globally due to sedentary lifestyle including cigarette smoking, a major health concern and a well-known risk factor for metabolic disease.

This study showed a high prevalence of IR base on calculation of HOMA-IR, FIRI, and QUICKI using the standard cut off point, while a lower prevalence rate was observed in McA index with 39 (36.1%) of participants. This is in contrast to the result (20) who reported higher prevalence of IR in type 2 diabetes mellitus base on McA (81%), and HOMA-IR and QUICKI (93%).

The differences might be due to different study participants and there seems to be paucity of published data on the prevalence of insulin resistance in cigarette smokers. This could also be due to the fact that the prevalence of insulin resistance in the general population varies with the criteria used for its definition and the measurement adopted.

The result further shows that HOMA-IR had a significant negative correlation with McA and a significant positive correlation with FIRI ($p< 0.05$, $r = -0.506$ and $p< 0.05$, $r = 0.999$) respectively. QUICKI had a significant positive correlation with McA ($p<0.05$, $r = 0.234$), while McA has shown to have a significant negative correlation with FIRI index ($p<0.05$, $r = -0.505$)

5.0 CONCLUSION

There is high prevalence of insulin resistance in cigarettes smokers in Sokoto metropolis. Hence, it can be deduced that cigarette smoking is one of the risk factors in the development of T2DM, and also associated with the prediction of cardiovascular disease.

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