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Association of HOMA-IR with Lipid Profile in Male Cab Drivers in Thi-Qar Governorate, Iraq

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ABSTRACT

Background & Objective: The Homeostatic Model Assessment of Insulin Resistance (HOMA-IR) is a widely used indicator for assessing insulin sensitivity and predicting early metabolic dysfunction. Dyslipidemia characterized by abnormal levels of triglycerides, cholesterol, and lipoproteins often accompanies insulin resistance and further contributes to cardiometabolic risks. Occupational groups with prolonged sedentary behavior, such as cab drivers, face increased vulnerability to metabolic disturbances due to limited physical activity, irregular eating habits, long working hours, and heightened stress levels. In the Thi-Qar Governorate of Iraq, male cab drivers represent a population at potential risk of developing metabolic abnormalities; however, limited research has investigated the relationship between insulin resistance and lipid profile in this group. Understanding this association is essential for identifying early markers of metabolic risk and guiding preventive health strategies for this underserved occupational population.

Materials & Methods: Eighty apparently healthy male cab drivers aged 20–61 years were enrolled in this cross-sectional study. Clinical evaluations included lipid profile analysis, measurement of body mass index (BMI) and waist-to-hip ratio (WHR), and fasting blood sampling to calculate HOMA-IR. These variables were assessed to determine potential relationships between insulin resistance and lipid metabolism.

Results: A considerable proportion of participants showed elevated HOMA-IR values, along with increased levels of LDL-c, triglycerides, and total cholesterol above normal reference limits. Many individuals also exhibited high BMI and WHR values and reported extended daily work hours. HOMA-IR demonstrated significant positive correlations with WHR, triglycerides, LDL-c, and total cholesterol, while showing an inverse relationship with HOMA-IR and high-density lipoprotein cholesterol levels.

Conclusion: Significant alterations in anthropometric measures and lipid profiles were observed even among individuals without clinically evident disease. Elevated lipid levels were strongly associated with increased insulin resistance and higher blood insulin levels. The findings suggest that insulin resistance plays a key role in the development of dyslipidemia in seemingly healthy working populations. To help prevent metabolic complications, our findings emphasize the importance of maintaining overall physical health, particularly by keeping BMI and WHR within healthy ranges.

Keywords: HOMA-IR, Insulin Resistance, Lipid Abnormalities, Metabolic Risk, Taxi Drivers

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1. Introduction

Dyslipidemia, a collection of abnormal lipid levels, is commonly linked to insulin resistance. When insulin resistance develops, it affects nearly all major lipid components. This metabolic alteration is typically characterized by increased fasting triglycerides, a buildup of triglyceride-

rich remnant lipoproteins after meals, decreased high-density lipoprotein (HDL) cholesterol, and a shift toward smaller, denser low-density lipoprotein (LDL) particles (1). An atherogenic profile is a term used in this manner and closely linked to an increased risk of cardiovascular disease and type 2 diabetes mellitus due to major changes in the lipid parameters. If it was recognized and managed for any changes early, it will participate enormously in reducing the likelihood and probability of developing serious metabolic and cardiovascular complications (2). However, it also appears in a variety of other medical conditions, including hypertension, polycystic ovary syndrome (PCOS), non-alcoholic fatty liver disease (NAFLD), certain malignancies, and obstructive sleep apnea (OSA). In fact, some experts consider OSA to be an integral component of the metabolic syndrome (2). Moreover, insulin resistance can arise as a secondary consequence in various clinical contexts, such as acute illness, liver cirrhosis, renal impairment, pregnancy, and hormonal disorders like hyperthyroidism.

In less common endocrine disorders such as Cushing's disease, Cushing's syndrome, acromegaly, and pheochromocytoma it is also observed. In many of these conditions, insulin resistance results from increased levels of counter-regulatory hormones that antagonize insulin action. β cells of islets of Langerhans secret Insulin hormone which is a peptide hormone that controls the metabolism of various molecules like carbohydrates, proteins and fats. The absorption of glucose from blood to different tissues like skeletal muscles, and liver is stimulated due to insulin action (3). Impaired signaling within the insulin receptor substrate (IRS)/ phosphoinositide-3-kinase (PI3K)/protein kinase B (PKB/AKT) cascade, a pathway essential for mediating insulin's metabolic effects was the primarily causative factor that could drive the insulin resistance. Consequently, any disarrangement of this pathway is always associated with systemic inflammation, compensatory hyperinsulinemia, and lipid toxicity (4). A notable alteration in lipid metabolism also occurs as insulin action decreases, accordingly, glucose homeostasis deteriorates resulting in hyperglycemia and other metabolic changes in lipids. A common metabolic disturbance in individuals with diabetes is dyslipidemia, which characterized by abnormal levels of circulating lipids irrespective of whether the underlying mechanism and the etiology involves insulin deficiency or related to its resistance (4).

Insulin plays critical and essential role in regulating lipid metabolism through several mechanisms: it prevents the breakdown and dissociations of fats a process called lipolysis, enhancing the storage of triglycerides in fat tissue, and reducing the liver's production of very low-density lipoprotein (VLDL) cholesterol. Additionally, by modulating key enzymes, including lecithin–cholesterol acyltransferase (LCAT) and hepatic lipase, insulin influences the metabolism of high-density lipoprotein (HDL) cholesterol (5). Lipid abnormalities often manifest as elevated triglyceride levels alongside lower HDL cholesterol, while increases in total cholesterol are less frequently observed in patients with diabetes mellitus. Even in the presence of insulin resistance, the elevation in triglycerides frequently parallels the coexistence of high blood sugar and compensatory high insulin levels. Decreased sensitivity to insulin causes the pancreas to produce more insulin, which then drives the liver to generate more VLDL particles and triglycerides when glucose tolerance is impaired (6). The Homeostatic Model Assessment method is used widely to assess insulin resistance. To estimate insulin resistance and evaluate the function of pancreatic beta cells, HOMA-IR index, derived from fasting glucose and insulin measurements, is valued for being a simple, cost-effective, and reproducible tool (7).

The precise and exact relationship between HOMA-IR and lipid abnormalities remains insufficiently characterized, although the physiological links between insulin resistance and lipid metabolism are well recognized. Consequently, this study was undertaken to explore variations in key biochemical and clinical markers among a group of healthy male taxi drivers, with particular emphasis on analyzing the associations among serum insulin levels, HOMA-IR values, lipid profile components, and anthropometric measures.

2. Materials and Methods

2.1 Data Collection Sources

Eighty male subjects, of the age range of 20 – 61 years, cab-drivers at AL Nasiriya main terminal, south of Iraq, were enrolled in this study. The study carried out during the period of December 2023 to April 2024. All laboratory analyses and data processing were conducted at the Clinical Chemistry Laboratory within the Department of Clinical and Laboratory Sciences, College of Pharmacy, University of Thi-Qar, Iraq and in Clinical Pharmacy Department in Jabir Ibn Hayyan University.

2.2 Inclusion and Exclusion Criteria

Male cab drivers aged between 20 and 61 years were enrolled in the study following the provision of written informed consent. Individuals with known endocrine or metabolic disorders such as hypothyroidism, type 1 or type 2 diabetes mellitus, Cushing's syndrome as well as those with diagnosed renal or hepatic diseases were excluded. Female participants were also excluded from the study to maintain population homogeneity and control for gender-specific metabolic variations.

2.3 Sample Collection

From each participant and following an overnight fast of approximately 12 hours, a quantity of 6.0 mL of venous blood was collected using standard phlebotomy procedures. Samples were allowed to proper clot formation and serum separation. After centrifugation, the obtained serum was used for biochemical analysis. By using the glucose oxidase–peroxidase (GOD-POD) enzymatic method, a widely accepted and highly specific technique for glucose estimation the fasting blood glucose was determined accordingly. This reaction includes the

oxidation of glucose by the enzyme glucose oxidase, after that by an enzymatic reaction including a peroxidase-catalyzed colorimetric reaction, which produce a measurable chromogen in accordance and proportional to the glucose concentration in reaction assay. All measurements were performed and assayed using Randox RX to ensure standardized processing, minimal operator variability, and high analytical accuracy. By using a standard enzymatic colorimetric assays CHOD-POD for total cholesterol, GPO-POD for triglycerides, and CHO-POD for HDL-c, serum total cholesterol, triglycerides, and high-density lipoprotein cholesterol were measured. These methods rely on enzymatic reactions which generate a colored end-product proportional and consistent to the concentration of each lipid component. After that, VLDL and LDL cholesterol levels were calculated using the Friedewald equation, a reliable lipid estimates equation in fasting individuals and is widely used in clinical and research settings.

A commercially available enzyme-linked immunosorbent assay (ELISA) kit, which detects insulin based on antigen antibody binding and reaction and subsequent color development proportional and consistent to hormone concentration, the serum insulin concentrations were measured. Finally, by using the HOMA-IR, which is calculated from fasting glucose and fasting insulin values using the formula:
HOMA-IR = [Fasting glucose (mg/dL) × Fasting insulin (mU/mL)] / 405 insulin resistance was assessed accordingly

2.4 Statistical Analysis

The Statistical Package for the Social Sciences (SPSS) software, version 20 was applied in this study for all statistical analysis. Descriptive data are presented as mean ± standard deviation (SD). And by using Pearson's bivariate correlation coefficient all associations between variables were assessed accordingly. As indicative of statistical significance, a p-value less than 0.05 was considered. Demographic and lifestyle information such as name, age, dietary habits, personal medical history, medication use (if applicable), smoking and alcohol consumption, socioeconomic status, occupation, and daily working hours were all collected in a structured questionnaire form.

3. Result

3.1 Descriptive parameters

The basic characteristic of clinical and biochemical features of the 80 male cab drivers included in the study were represented in Table 1. As average, all the participants in this study exhibited a HOMA-IR value slightly above 3, with wide variation, which indicate that despite not being diagnosed with diabetes, many of them already have signs of early insulin resistance. Their mean fasting glucose level stayed within the normal limits, whereas, fasting insulin was relatively elevated, suggested that any compensatory hyperinsulinemia may contributes to the increased and elevation in HOMA-IR value.

The lipid profile also reflects and illustrates a pattern always seen and detected in individuals with sedentary lifestyles' levels was in the borderline-high range, HDL was generally low, and triglycerides were markedly elevated. Total cholesterol also showed a broad spread; but tended to lies near the upper normal range. Further support to the presence of metabolic risk factors is the anthropometric measures, as the average BMI approached and reached the obesity threshold and the waist-to-hip ratio indicated a tendency and proximity toward central fat accumulation (i.e., central obesity). The participants also reported and showed working almost ten hours per day, which highlights the prolonged sedentary nature of their occupation and may explain many of the metabolic findings observed. Overall, and consequently and due to this combination of elevated insulin, dyslipidemia, increased body weight, and long working hours give increased risk for metabolic and cardiovascular complications which is an exact representation of this occupational group.

3.2 Correlations

The correlation analysis in Table 2 explains that HOMA-IR was directly associated with LDL-c, triglycerides, total cholesterol, and waist-to-hip ratio, on the other hand, it was inversely associated with HDL-c. LDL-c and demonstrated a strong positive correlation with triglycerides and total cholesterol, and an inverse correlation with HDL-c. HDL-c, in turn, showed consistent negative correlations with all atherogenic lipids. Modest positive correlations with waist-to-hip ratio with triglycerides and total cholesterol which were strongly interrelated for both parameters. No meaningful correlations were shown between BMI and metabolic variables. A moderate correlation between daily job duration with triglycerides and total cholesterol, but on the other hand no significant relationship with HOMA-IR were presented. Overall, a more atherogenic lipid profile in this group due to this pattern which indicates that insulin resistance and long working hours are linked together.

Figures 1, 2, 3 and 4 showing scatter plots association between HOMA-IR with lipid parameters, BMI, WHR and daily job duration respectively in male participants. Other lifestyle variables (smoking, alcohol use, working hours) were recorded but not significantly correlated with HOMA-IR (data not shown).

Table 1. The clinical and biochemical characteristics of the enrolled participants are presented as mean values accompanied by their respective standard deviations (mean ± SD).

No.	Descriptive Data Parameters (N = 80)	Results
1	HOMA-IR	3.1655 ± 2.523
2	Fasting Glucose (mg/dL)	95.42 ± 12.36
3	Fasting Insulin (mU/mL)	13.43 ± 5.52
4	LDL-c (mg/dl)	126.0088 ± 57.031
5	HDL-c (mg/dl)	37.4875 ± 14.609
6	Triglycerides (mg/dl)	246.3625 ± 107.847
7	Total Cholesterol (mg/dl)	215.8125 ± 73.056
8	BMI (kg/m^2)	28.9703 ± 4.191
9	Waist/hip ratio	0.8926 ± 0.124
10	Daily job duration (hours)	9.7375 ± 2.282

Table 2. Pearson's correlation coefficients evaluating the relationship between HOMA-IR and various clinical and biochemical parameters in the study population.

Parameters and correlations		HOMA-IR	LDL-c	HDL-c	Triglycerides	Total Cholesterol	BMI	Waist/hip ratio	Daily job duration
HOMA-IR	Pearson Correlation	1	0.496**	-0.337**	0.450**	0.542**	-0.095	0.307**	0.172
	P-value	---	0.000	0.002	0.000	0.000	0.401	0.006	0.128
LDL-c	Pearson Correlation	0.496**	1	-0.667**	0.761**	0.929**	-0.159	0.365**	0.187
	P-value	0.000	---	0.000	0.000	0.000	0.159	0.001	0.097
HDL-c	Pearson Correlation	-0.337**	-0.667**	1	-0.637**	-0.568**	0.211	-0.180	-0.112
	P-value	0.002	0.000	---	0.000	0.000	0.060	0.111	0.321
Triglycerides	Pearson Correlation	0.450**	0.761**	-0.637**	1	0.849**	-0.130	0.250*	0.334**
	P-value	0.000	0.000	0.000	---	0.000	0.251	0.025	0.002

Parameters and correlations		HOMA -IR	LDL-c	HDL-c	Triglyceri-des	Total Cholesterol	BMI	Waist/hip ratio	Daily job duration
Total Cholesterol	Pearson Correlation	0.542**	0.929**	-0.568**	0.849**	1	-0.124	0.358**	0.310**
	P-value	0.000	0.000	0.000	0.000	---	0.275	0.001	0.005
BMI	Pearson Correlation	-0.095	-0.159	0.211	-0.130	-0.124	1	-0.081	-0.077
	P-value	0.401	0.159	0.060	0.251	0.275	---	0.475	0.498
Waist/hip ratio	Pearson Correlation	0.307**	0.365**	-0.180	0.250*	0.358**	-0.081	1	0.035
	P-value	0.006	0.001	0.111	0.025	0.001	0.475	---	0.755
Daily job duration	Pearson Correlation	0.172	0.187	-0.112	0.334**	0.310**	-0.077	0.035	1
	P-value	0.128	0.097	0.321	0.002	0.005	0.498	0.755	---

N = 80 * Correlation is considered statistically significant at the 0.05 level (two-tailed).
** Correlation is considered highly statistically significant at the 0.01 level (two-tailed).

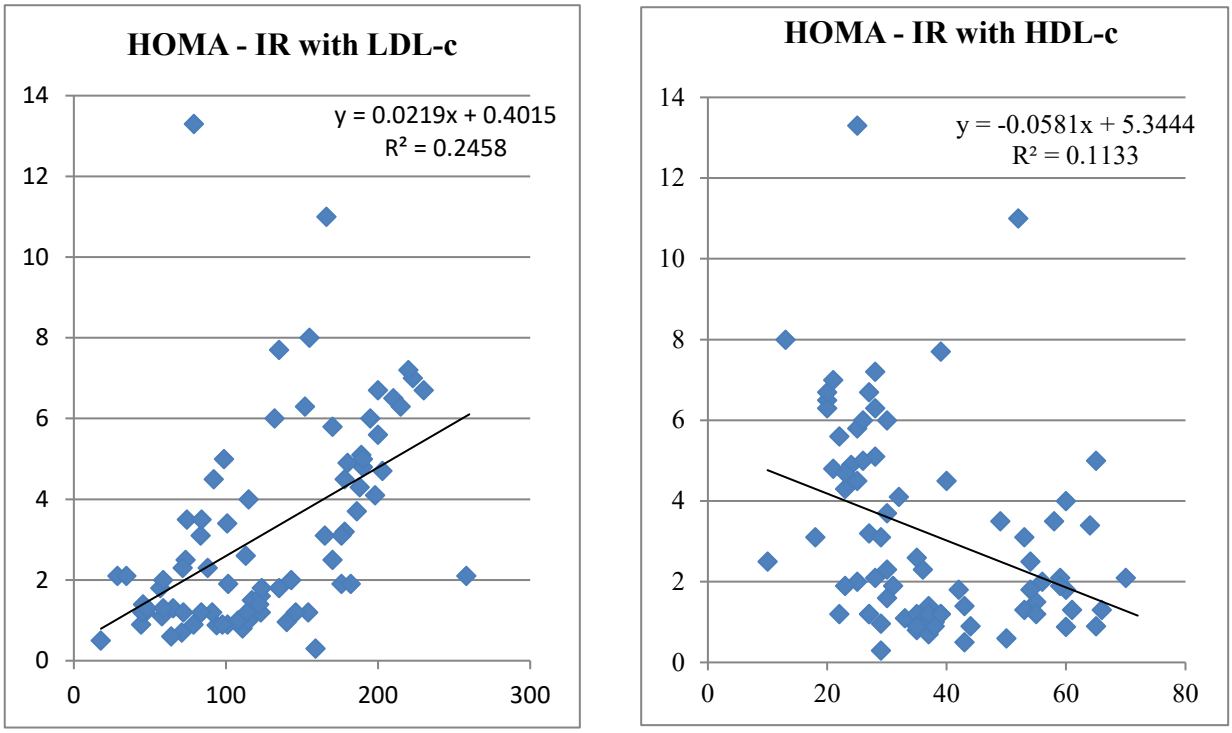
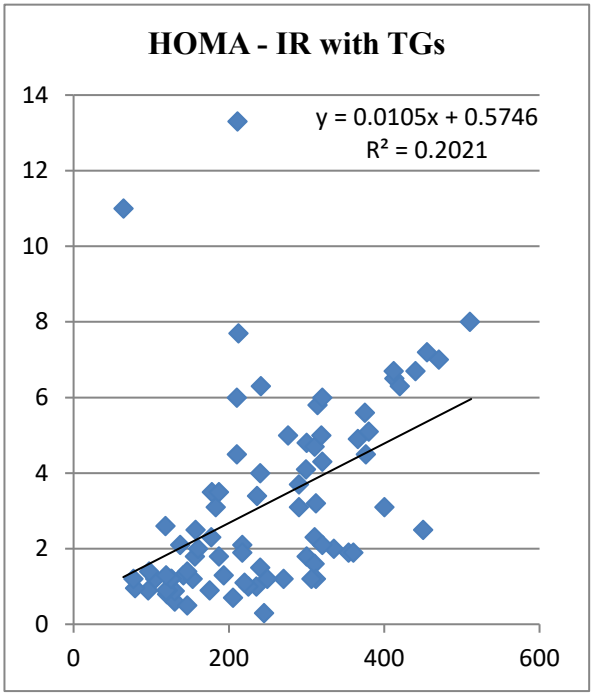


Figure 1. Scatter plot showing correlations between HOMA-IR and serum levels of LDL-c and HDL-c respectively in male participants. (HOMA-IR: Homeostatic model assessment for insulin resistance, LDL-c: Low-density lipoprotein cholesterol, HDL-c: High-density lipoprotein cholesterol) (**Prepared by Authors, 2025**).



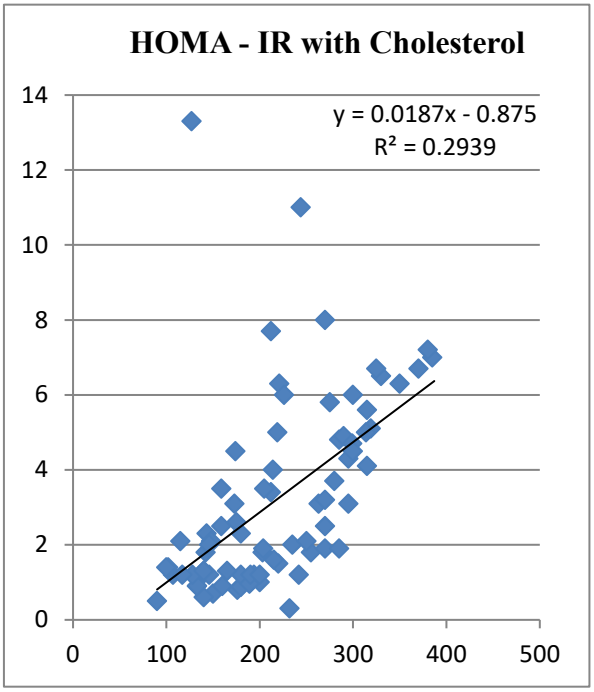
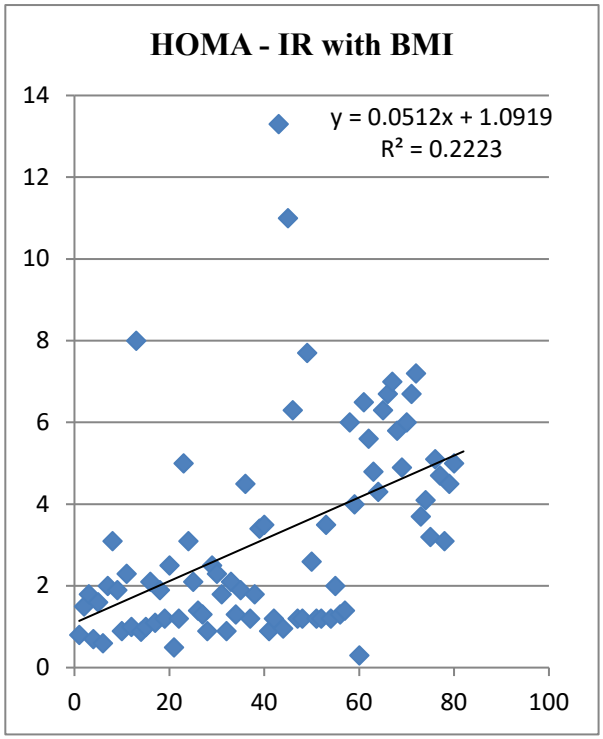


Figure 2. Scatter plot showing correlations between HOMA-IR and serum levels of TGs and total cholesterol respectively in male participants. (HOMA-IR: Homeostatic model assessment for insulin resistance, TGs: triglycerides) (**Prepared by Authors, 2025**).



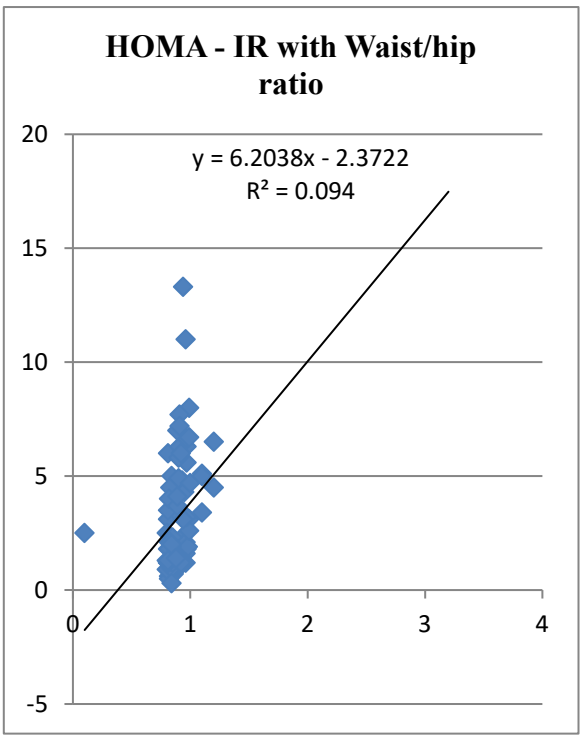


Figure 3. Scatter plot showing correlations between HOMA-IR and BMI, W/H ratio respectively in male participants. (HOMA-IR: Homeostatic model assessment for insulin resistance, BMI: body mass index) (**Prepared by Authors, 2025**).

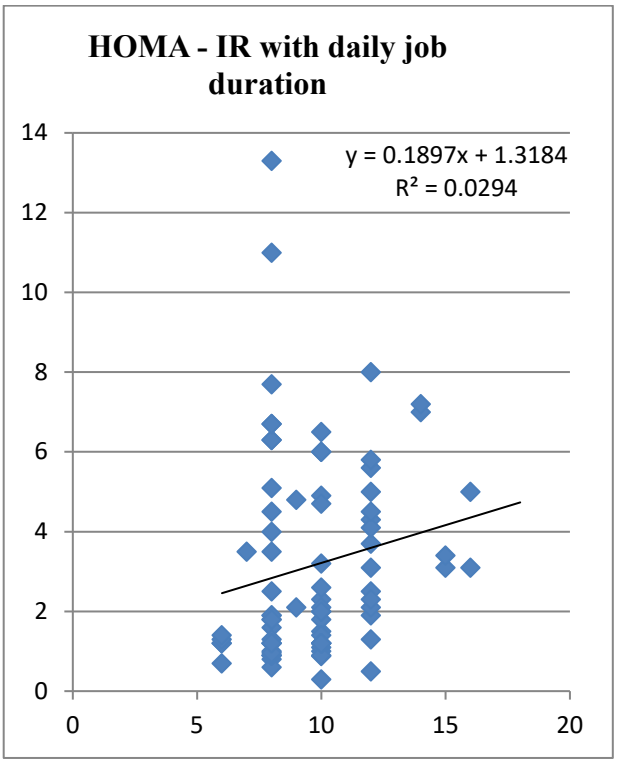


Figure 4. Scatter plot showing correlations between HOMA-IR and daily job duration in male participants. (HOMA-IR: Homeostatic model assessment for insulin resistance) (**Prepared by Authors, 2025**).

4. Discussion

The elevated HOMA-IR values observed in our study likely indicate subclinical insulin resistance rather than overt diabetes, as the increases are primarily driven by elevated insulin levels, given that participants with fasting glucose ≥126 mg/dL or a known diagnosis of diabetes were excluded.

Our results in Table 1 demonstrates a statistically significant positive correlation between triglyceride levels and age, suggesting that advancing age is associated with elevated triglyceride concentrations. This observation aligns with existing literature reporting higher plasma triglyceride (TG) levels in older adults compared to younger populations **(8)**. The increase in TG levels among the elderly has been partly attributed to a delay in postprandial triglyceride clearance. The clearance of total serum lipids following a fat-rich meal is reduced in older adults relative to younger subjects as this was observed by Spitler and Davies **(9)**. Similarly, due to slower hepatic clearance of remnant lipoprotein particles; Vinagre et al **(10)** proposed that this delayed TG clearance in elderly individuals may be at least partially.

The corresponding p-values for cholesterol, triglycerides, HDL-c, and LDL-c were 0.0001, 0.023, 0.0016, and 0.0001, respectively, indicating significant relationships as shown in Table 2 which outlines the associations between waist-to-hip ratio (WHR), lipid profile parameters, and insulin resistance. Obesity remains a global health concern which characterized by excessive accumulation and production of body fat. However, variations in fat distribution are noteworthy, with central or abdominal obesity characterized by fat deposition around the abdomen and upper trunk which consequently being linked to greater risks of metabolic conditions such as diabetes mellitus, atherosclerosis, and coronary artery disease (CAD), in comparison to peripheral or what is called (gynoid) obesity, that involves fat accumulation around the hips and thighs **(11)**. In a study conducted in rural Kerala, India, it was reported that 54% of the population was either overweight or obese and the prevalence rates of obesity and overweight differ across regions **(12)**, whereas, obesity rates of 34% in males and 40% in females were detected in research in Delhi **(13)**. Differences in dietary habits, lifestyle factors, and levels of health awareness, all of which influence body weight reflect theses discrepancies.

Non-communicable diseases such as diabetes mellitus, hypertension, and CAD frequently coexist with dyslipidemia is well established. Common lipid abnormalities in these patients include: elevated serum triglycerides and LDL-c, alongside decreased HDL-c levels.

For identifying individuals at increased risk for such conditions anthropometric measurements serve as practical and cost-effective screening tools **(14)**.

However, studies investigating the relationship between WHR and lipid parameters have yielded mixed findings. No significant correlations between WHR and total cholesterol or LDL-c was found in one study which involving 100 reported diabetic patients **(15)**. Another

investigation involving 251 participants found that triglycerides alone were associated with anthropometric indices (16). In contrast, a positive correlation between VLDL and WHR and an inverse relationship between HDL-c and WHR, suggesting that increased WHR which is more strongly associated with LDL-c and triglycerides, thereby highlighting its role in cardiovascular risk stratification which was observed by Slentz et al (17). A significant association between the duration of employment as a driver and insulin resistance was further confirmed in our study (Table 2 and Figures 1–4). The development of insulin resistance, particularly when combined with other risk factors such as physical inactivity, poor dietary habits, and psychological stress may be contributed by prolonged periods of driving.

Extended sedentary behavior reduces muscle activity and impairs glucose uptake, thereby negatively affecting insulin sensitivity. The nature of driving, which often entails prolonged sitting, limits physical movement and fosters a sedentary lifestyle known to promote insulin resistance by increasing pancreatic islet workload and decreasing their functional capacity through mechanisms including endoplasmic reticulum stress, mitochondrial dysfunction, oxidative stress, inflammation, and beta-cell apoptosis (18). Conversely, regular physical exercise preserves pancreatic islet function, enhances peripheral insulin sensitivity, and promotes beta-cell proliferation by elevating circulating growth factors such as growth hormone, insulin-like growth factor-1, and glucagon-like peptide-1 (19). The apoptosis of beta- cell is prevented by exercise so that the functional beta-cell mass will be increased accordingly. Slentz et al (17) found that people with a well-trained status have a good beta cell mass over physically inactive people which support our idea. According to other researches, prolonged inactivity, like going eight months without exercising, can raise fasting plasma glucose levels. Alternatively, these bad alterations could be reversed by restoring normal glucose metabolism and pancreatic islet function moderate to intense exercise (18). These findings show how important regular exercise is for preserving insulin sensitivity and avoiding beta-cell damage.

The Homeostatic Model Assessment for Insulin Resistance (HOMA-IR) is a trustworthy and precise technique for measuring insulin resistance, especially in individuals with type 2 diabetes mellitus. Many studies conducted by Khalili et al (20) and So et al (19) have demonstrated that how well HOMA-IR predicts the onset of diabetes and prediabetes Additionally, an increased sensitivity for early insulin resistance identification which was proved by Adiga et al (21); He proved that a high positive correlation was found between C-peptide, HOMA-IR, and insulin levels, suggesting that C-peptide-based HOMA calculations (21).

Potential biases might have been created by variations in the participants' food and exercise routines. This study does have certain drawbacks. Furthermore, the correlation between lipid metabolism and insulin resistance may be influenced by ethnic differences, which should be taken into account when interpreting the results.

5. Conclusion

A strong positive association as shown by HOMA-IR values with a number of lipid profile components. Elevated blood insulin levels and increased insulin resistance, were present in the taxi drivers in this investigation coupled with a range of lipid abnormalities and varying BMI measures. Maintaining an ideal waist-to-hip ratio (WHR) and body mass index (BMI) is crucial to lowering the risk of metabolic diseases. Within the limitations of this small cross-sectional study, HOMA-IR showed significant associations with some lipid parameters among male cab drivers. Larger studies are needed to confirm these findings and explore occupational and lifestyle influences.

6. Declarations

6.1 Acknowledgments

The authors thank all participating taxi drivers, the laboratory staff in Thi-Qar Governorate, and the College of Pharmacy, Jabir Ibn Hayyan University for Medical and Pharmaceutical Sciences, Iraq, for their support.

6.2 Ethical Considerations

Patient confidentiality was maintained through anonymization of identifiers during data extraction. The study protocol was examined and approved by the Institutional Ethics and Scientific. A thorough description of the study's goals and methods were given to all participants prior to registration. Each participant provided written informed consent, guaranteeing voluntary participation in compliance with ethical study guidelines.

6.3 Authors' Contributions

Mohammed N. Salman designed the study, supervised the research, and drafted the manuscript. Firas Fadhil Alyaseen contributed to study design and critically revised the manuscript. Hazim Ali Hussein performed data acquisition and analysis and contributed to manuscript preparation. All authors reviewed, edited, and approved the final version of the manuscript.

6.4 Conflict of Interest

The authors declare no conflict of interest.

6.5 Fund or Financial Support

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

6.6 Using Artificial Intelligence Tools (AI Tools)

The authors were not utilized AI Tools.

7. Publisher's Note

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All manuscripts in this issue were peer-reviewed and accepted for publication in *Journal of Advances in Medical and Biomedical Research (J Adv Med Biomed Res)*.

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