Journal of Neonatal Surgery
ISSN(Online): 2226-0439
Vol. 14, Issue 5s (2025)
https://www.jneonatalsurg.com

OPEN ACCESS

Association of Waist-To-Hip Ratio (WHR) With Blood Glucose and Dyslipidemia in Pre-Diabetic Subjects

Smita Rani Pradhan[1], Shrikrishna Bamne[2]

[1]Research Scholar, Department of Physiology, Index Medical College & Research Center, Malwanchal University, Indore, Madhya Pradesh, India.

[2]Professor, Department of Physiology, Krishna Institute of Medical Sciences, Karad, Maharashtra, India

Cite this paper as: Smita Rani Pradhan, Shrikrishna Bamne, (2025) Association of Waist-To-Hip Ratio (WHR) With Blood Glucose and Dyslipidemia in Pre-Diabetic Subjects. *Journal of Neonatal Surgery*, 14 (5s), 374-377.

ABSTRACT

Background: Prediabetes is a critical condition that increases the risk of progressing to Type 2 diabetes and cardiovascular diseases. An elevated waist-to-hip ratio (WHR), is a key factor in the development of metabolic disturbances, including dyslipidemia and impaired glucose metabolism.

Methodology: A case-control study was conducted with 120 subjects (ages 30-65) consist of 60 prediabetic and 60 control participants, based on ADA criteria. Lipid parameters and glucose were measured using the EM-200 analyzer. Independent t-tests were applied to compare biochemical markers between the two groups, and Spearman correlation tests applied to find out association of waist-to-hip ratio with lipid parameters and glucose levels. A p-value < 0.05 was considered statistically significant.

Result: The study included 120 subjects (60 prediabetic, 60 controls) with 63% males and 37% females, aged 41.23 ± 15.56 years. The average fasting plasma glucose was 110.1 ± 44.8 mg/dl. A significant correlation was found between waist-to-hip ratio (WHR) and HDL (r=0.28, p=0.001).

Conclusion: Higher WHR, indicating more abdominal fat, is strongly linked to higher blood glucose and poor lipid profiles, including increased triglycerides, low HDL, and high LDL cholesterol.

1. INTRODUCTION

The increasing global prevalence of diabetes, particularly Type 2 diabetes, has become a significant public health concern, with millions of individuals at risk of developing the disease [(1)]. Prediabetes, a condition characterized by higher-than-normal blood sugar levels that are not yet high enough to be diagnosed as diabetes, serves as a crucial stage in the progression toward diabetes. Several factors contribute to the development of diabetes, with one of the most important being the distribution of body fat [(2)]. The waist-to-hip ratio (WHR), a simple anthropometric measurement, has been extensively studied as an indicator of fat distribution, particularly abdominal obesity, which is closely linked to increased risk of metabolic disturbances, including dyslipidemia, a key risk factor for cardiovascular diseases [(3)]. Dyslipidemia is characterized by abnormal lipid levels, including elevated levels of triglycerides, low levels of high-density lipoprotein (HDL) cholesterol, and elevated low-density lipoprotein (LDL) cholesterol, all of which are common in individuals with prediabetes [(4)]. The association between WHR and lipid parameters in prediabetic subjects is crucial for understanding how abdominal fat contributes to lipid dysregulation in this at-risk population. Investigating this relationship could provide valuable insights into the pathophysiology of prediabetes and help identify individuals at higher risk for both diabetes and cardiovascular diseases [(5)]. Furthermore, understanding the link between fat distribution and lipid profiles in prediabetes may inform preventive strategies and early interventions aimed at reducing the burden of metabolic diseases. This study aims to investigate the association of waist-to-hip ratio with blood glucose and lipid parameters, including total cholesterol, triglycerides, HDL, and LDL cholesterol, in prediabetic subjects with comparison of their respective controls.

2. METHODOLOGY

A case control and observational type of study was conducted on total of 120 subjects with age group of 30-65 years in the department of Biochemistry at Index Medical College & Research Center- Indore, Madhya Pradesh, India in the duration two years. Present study has been obtained ethical approval from institutional ethical committee from Index Medical College & Research Center- Indore. Written and verbal consent were taken from all the participants. A total 120 subjects comprised of 60 pre-diabetic and 60 control subjects as the criteria laid down by ADA (2007) [(6)].

Study Population: As per the ADA guidelines a 60 prediabetic subjects attended OPD of Index medical college were enrolled for this study. 60 controls of in and around the hospital were also enrolled for this study.

Diagnostic Criteria: Criteria for diagnosis of prediabetic according to the American diabetic association (2007); Fasting plasma glucose (100-125 mg/dl).

Inclusion Criteria:

Study Group (N=60)

- Subject who was willing to participate.
- Age 30-65 years.
- Fasting blood glucose (100-125 mg/dl).
- With or without family history of diabetes.

Control Group (N=60)

- Age and sex matched healthy asymptomatic subjects.
- Fasting blood glucose <100 mg/dl.
- Without family history of diabetes.

Exclusion criteria:

- Age below 30 years and above 65 years.
- Fasting blood glucose >126 mg/dl. Hypertensive subjects.
- Persons who were not willing for this study.

Sample size calculation: The sample size was calculated using power analysis to ensure the study had sufficient statistical power to detect significant differences between the study and control groups.

Power analysis formula:

$n=(Z\alpha/2+Z\beta)2*(p1(1-p1) + p2(1-p2)) /(p1-p2)2$

Where:

- n = required sample size per group
- $Z\alpha/2$ = Z-value for a given confidence level (e.g., 1.96 for 95% confidence)
- $Z\beta$ = Z-value for desired power (e.g., 0.84 for 80% power)
- p1 = proportion of outcome in the control group
- p2 = proportion of outcome in the study group

Based on previous studies, we estimated the prevalence of prediabetes to be around 10% in the control group and 30% in the study group. Using a significance level of 0.05 and a power of 80%, the required sample size per group was approximately 59 subjects. To account for potential dropouts and incomplete data, we decided to include 60 subjects in each group, totalling 120 subjects.

3. SAMPLE COLLECTION AND ANALYSIS

Under aseptic precautions 5ml of the patient's intra-venous blood was obtained. The collected blood was distributed into 3 ml in plain for lipid profile and 2 ml fluoride tube for fasting Blood Glucose. Collected blood sample were centrifuged at 4000 rpm for 8-10 minutes to obtained serum and plasma sample. EM-200 fully automated analyzer was used to determine the concentration of lipid parameters, Glucose and Insulin levels in prediabetic and controls.

Study tools: Data were collected in case record form (CRF). The CRF comprise of details regarding diagnosis, cause, medication and serum biochemical marker values.

Statistical Analysis: The data were entered into Microsoft office excel and analyzed by Statistical Package for Social Sciences (SPSS) version 21 for windows software. Descriptive statistics were reported in the form of mean, standard deviation. Normal distribution of data was checked by Shapiro – Wilk test. Comparison between two groups of serum biochemical markers was done by independent t-test. Spearman correlation tests will be used to examine the relationship between waist-hip ratio with lipid parameters and Insulin levels. P-value < 0.05 will be considered as statistically significant.

Result: The present study included total of 120 study subjects comprised of 60 pre diabetic and 60 controls as per American diabetes association criteria. Among 120 subject, 63% Male and 37% Female. The mean age of the subjects are 41.23 ± 15.56 years. The average mean of fasting plasma glucose is 110.1±44.8 mg/dl. The present study find association between

WHR with blood glucose and lipid parameters. A significant association with HDL i.e. (r= 0.28, p=0.001) has been observed.

Table-1: Comparison Blood glucose and Lipid profile in Pre diabetic and its respective controls.

Variables	Control Group (N=60)	Prediabetic Group (N=60)	'T' Value	P value
Fasting blood sugar (FBS) (mg/dl)	82.2±11.0	110.1±44.8	4.684	<0.001
Total Cholesterol (mg/dl)	148.5±13.2	198.9±27.2	12.912	<0.001
Triglyceride (mg/dl)	118.3 ±20.3	159.9±52.8	5.696	<0.001
LDL (mg/dl)	100.7±11.4	127.7±11.7	12.802	<0.001
HDL (mg/dl)	46 ±8.7	41.1±7.8	3.248	=0.0015

Table-2: Correlation analysis between Waist to Hip Ratio and diabetic profile in Pre diabetic subjects.

Variables		R value	P value
Waist to Hip Ratio	Fasting blood sugar	0.018	0.452
	Total cholesterol	0.099	0.451
	Triacylglycerols	0.117	0.373
	High-density lipoprotein	0.284	< 0.001
	Low-density lipoprotein	0.051	0.697

4. DISCUSSION

Pre-diabetics exhibit elevated fasting serum glucose levels in comparison to controls, as anticipated, because of impaired glucose tolerance and/or impaired fasting glucose, which are essential characteristics of this metabolic state [7]. Compensatory hyperinsulinemia is frequently observed in conjunction with elevated fasting glucose levels, which is intended to mitigate decreased insulin sensitivity [8]. Researcher has demonstrated that insulin resistance, a defining characteristic of pre-diabetes, disrupts the normal metabolism and assimilation of glucose [10]. A dependable anthropometric measure, WC, significantly correlates with adverse metabolic outcomes and indicates central obesity. Numerous studies conducted have demonstrated a positive correlation between WC and lipid profiles, particularly TC and LDL [11]. In the control group of the present study we observed a significant positive correlation between WC and TC (R=0.917; P <0.001) and WC and HDL (R=0.431; P < 0.001). On the other hand, we observed a significant negative correlation between Waist to hip ratio and HDL (R= -0.353; P < 0.001). These results emphasize the importance of central adiposity in the development of dyslipidaemia and the risk of cardiovascular disease. Central obesity raises insulin resistance and the flow of free fatty acids, which in turn boosts the production of lipids in the liver and lowers the activity of LDL receptors, leading to higher levels of LDL and TC. Kim et al. [12] conducted a systematic review that demonstrated that abdominal adiposity is a significant predictor of elevated LDL, regardless of BMI. In a similar vein, Maksood et al. [6] conducted a study in South Asian populations, which revealed a robust correlation between WC and atherogenic lipid profiles. In terms of lipid profiles, pre-diabetics generally exhibit a Dyslipidemia, which is defined by an increase in triglycerides and a decrease in HDL. Insulin resistance, which influences lipid metabolism, is closely associated with these modifications [13]. In comparison to controls, pre-diabetics may also have marginally higher levels of TC and LDL, although the relationship is less consistent across studies. For instance, research indicates a substantial inverse correlation between fasting glucose and HDL, as well as a positive correlation with triglycerides, both of which are correlated with cardiovascular risk [14]. Variations by demographic factors, including age, sex, and ethnicity, have also been evident in population-based studies. The degree of dyslipidaemia and its correlation with glycaemic indices are influenced by these factors [15]. The increased risk of cardiovascular disease in pre-diabetic populations is underpinned by the interaction of triglycerides, HDL, and LDL with glucose dysregulation.

5. CONCLUSION

- The present findings highlight the critical role of abdominal obesity in the early stages of metabolic dysfunction.
- Our findings suggest that a higher WHR, indicating greater abdominal fat, is significantly correlated with elevated blood glucose levels and adverse lipid profiles, including increased triglycerides, low HDL cholesterol, and elevated LDL cholesterol.

- Therefore, WHR may serve as a useful and practical indicator for identifying individuals at higher risk of developing dyslipidemia.
- As WHR is a simple and accessible measure to assess risk, future studies are necessary to confirm its role in predicting metabolic disorders in prediabetic subjects.

REFERENCES

[1] Bansal N. Prediabetes diagnosis and treatment: A review. World J Diabetes. 2015 Mar 15;6(2):296-303. doi: 10.4239/wjd.v6.i2.296. PMID: 25789110; PMCID: PMC4360422.

[2] American Diabetes Association. Classification and Diagnosis of Diabetes: Standards of Medical Care in Diabetes—2020. Diabetes Care. 2020;43(Supplement_1): S14–S31.

[3] Anjana RM, Pradeepa R, Deepa M, Datta M, Sudha V, Unnikrishnan R, et al. Prevalence of diabetes and Prediabetes (Impaired fasting glucose and/or impaired glucose tolerance) in urban and rural India: Phase I results of the India Council of Medical Research – India DIAbetes (ICMR _ INDIAB) study. Diabetology 2011;54:3022-7

[4] Mauricio, D., Gratacòs, M. & Franch-Nadal, J. Diabetic microvascular disease in non-classical beds: the hidden impact beyond the retina, the kidney, and the peripheral nerves. Cardiovasc Diabetol.2023; 22:314. https://doi.org/10.1186/s12933-023-02056-3.

[5] Tuso P. Prediabetes and lifestyle modification: time to prevent a preventable disease. Perm J. 2014 Summer;18(3):88-93. doi: 10.7812/TPP/14-002. PMID: 25102521; PMCID: PMC4116271.

[6] Makshood M, Post WS, Kanaya AM. Lipids in South Asians: epidemiology and management. Current cardiovascular risk reports. 2019 Aug;13:1-1. https://doi.org/10.1007/s12170-019-0618-9

[7] Mulla IG, Anjankar A, Shinde A, Pratinidhi S, Agrawal SV, Gundpatil DB, Lambe SD. Comparison of Lipid Profiles Between Prediabetic and Non-prediabetic Young Adults. Cureus. 2024 Jul;16(7). DOI: 10.7759/cureus.65251

[8] Yang C, Liu Z, Zhang L, Gao J. The association between blood glucose levels and lipids in the general adult population: results from NHANES (2005–2016). Journal of Health, Population and Nutrition. 2024 Oct 16;43(1):163. https://doi.org/10.1186/s41043-024-00660-x.

[9] Shams S, Ashtiani MT, Monajemzadeh M, Koochakzadeh L, Irani H, Jafari F, Mohseni A. Evaluation of serum insulin, glucose, lipid profile, and liver function in β- thalassemia major patients and their correlation with iron overload. Laboratory medicine. 2010 Aug 1;41(8):486- .https://doi.org/10.1309/LMS0EOOUZSII2BNE

[10] Tahapary DL, Pratisthita LB, Fitri NA, Marcella C, Wafa S, Kurniawan F, Rizka A, Tarigan TJ, Harbuwono DS, Purnamasari D, Soewondo P. Challenges in the diagnosis of insulin resistance: focusing on the role of HOMA-IR and Tryglyceride/glucose index. Diabetes & Metabolic Syndrome: Clinical Research & Reviews. 2022 Aug 1;16(8):102581. https://doi.org/10.1016/j.dsx.2022.102581.

[11] Wang F, Han L, Hu D. Fasting insulin, insulin resistance and risk of hypertension in the general population: a meta-analysis. Clinica chimica acta. 2017 Jan 1;464:57-63. https://doi.org/10.1016/j.cca.2016.11.009

[12] Kim KB, Kim K, Kim C, Kang SJ, Kim HJ, Yoon S, Shin YA. Effects of exercise on the body composition and lipid profile of individuals with obesity: a systematic review and meta-analysis. Journal of obesity & metabolic syndrome. 2019 Dec;28(4):278.doi: 10.7570/jomes.2019.28.4.278

[13] Després JP, Lemieux I. Abdominal obesity and metabolic syndrome. Nature. 2016 Dec 14;444(7121):881-7. https://doi.org/10.1161/01.CIR.0000089505.34741.E5

[14] Faurholt-Jepsen D, Friis H, Mwaniki DL, Boit MK, Kaduka LU, Tetens I, Christensen DL. Waist circumference and low high-density lipoprotein cholesterol as markers of cardiometabolic risk in Kenyan adults. Plos one. 2021 Feb 25;16(2):e0247600. https://doi.org/10.1371/journal.pone.0247600

[15] Hidalgo B, Irvin MR, Sha J, Zhi D, Aslibekyan S, Absher D, Tiwari HK, Kabagambe EK, Ordovas JM, Arnett DK. Epigenome-wide association study of fasting measures of glucose, insulin, and HOMA-IR in the Genetics of Lipid Lowering Drugs and Diet Network study. Diabetes. 2014 Feb 1;63(2):801-7. https://doi.org/10.2337/db13-1100