Original Article

Correlation of High-Density Lipoproteins and Low-Density Lipoproteins in Polycystic Ovary Syndrome (PCOS) Patients

Ambreen Zeeshan,[1] Asia Atta,[2] Attiqa Muzzammil,[3] Saghir Ahmad Jafri,[4] Sameen Arshad,[5] Fatima Khalid[6]

Abstract

Objective: To investigate the correlation of high-density lipoproteins and low-density lipoprotein with poly cystic ovary syndrome patients (PCOS).

Materials and Methods: Data from 80 females were collected in a descriptive cross-sectional study. Participants were categorized into two groups normal healthy individuals and PCOS patients aged between of 18-45 years. Serum HDL and LDL levels were measured to assess liver function.

Results: The results revealed that most PCOS patients were between 26 and 35 years old. PCOS patients exhibited significantly reduced HDL levels (40.30 mg/dL). A correlation between HDL and LDL values in PCOS patients was observed. The Mean ± SD of High-Density lipoproteins (mg/dL) in healthy patients was found to be 50.52 ± 28.297 and in PCOS was 40.30 ± 8.549 The mean ± SD of Low-Density Lipoproteins (mg/dL) was found to be 106.50 ± 30.750 in healthy patients and 119.98 ± 27.776 in PCOS patients. In normal healthy individuals and PCOS patients the p- value of < 0.001 in HDL and < 0.235 in LDL was observed.

Conclusion: In conclusion, the current study highlighted a substantial link between HDL levels in healthy and PCOS patients. It also demonstrated that no significant change in LDL levels of PCOS and healthy patients. After comparing the high density and low-density lipoprotein these findings enhance our understanding of PCOS-related complications, enabling earlier and more accurate diagnoses.

Keywords: Polycystic Ovary Syndrome (PCOS), High-Density Lipoprotein (LDL), Low-Density Lipoprotein (LDL).

Introduction

Polycystic ovary syndrome (PCOS) is one of the most common endocrine and metabolic disease in females (Lovwers and Laven, 2020).[1] The criteria by

1. *Department of Biochemistry, FMH college of Medicine and Dentistry, Lahore.*
2. *Department of Biochemistry, NUR International University.*
3. *Gyane Department, Fatima Memorial, Hospital, Lahore*
4. *Basic Sciences, NUR International University.*
5. *Physiotherapy, King Edward Medical University.*
6. *Department of Anatomy, FMH College of Medicine and Dentistry, Lahore*

Correspondence:
Dr. Ambreen Zeeshan, *Demonstrator, Department of Biochemistry, FMH College of Medicine and Dentistry, Lahore.* ambreenzeeshan1@hotmail.com

the National Institute of Health (NIH) were used to see the PCOS prevalence, it was shown to range from 4% to 6.6% among unselected reproductive-age women residing in the South-east of the United States. PCOS prevalence estimates range from 2% and 26% (Deswal et al., 2020).[2] Numerous pathophysiological abnormalities, including insulin resistance, hyperinsulinemia, and dyslipidemia, are seen in hyperandrogenic PCOS patients. Ultrasound examination of women suffering from polycystic ovary syndrome shows, polycystic ovaries. Insulin resistance is a key component of polycystic ovary syndrome (Zehravi et al., 2021).[3]

PCOS was present in 19.58% of the individuals. Approximately 1 in 5 females with Type 2 diabetes have PCOS. This percentage is much greater than the anticipated 1.14% to 11.04% PCOS prevalence among all female

adolescents (Cioana et al., 2022).[4] Anovulation also found in dyslipidemic PCOS patients, alteration in lipid profile leads to infertility (liu et al., 2019).[5]

The link between the anthropometric characteristics of PCOS-afflicted women. They claimed that PCOS is the utmost prevalent endocrine disorder in female of fertility age, is related to reproductive and metabolic problems. According to recent studies, women with PCOS show early signs of developing an abnormal cardiovascular risk profile. Although these abnormalities differ depending on the culture, women with PCOS typically exhibited abnormal lipid profile patterns. Anthropometry was a straightforward and well-liked study method for identifying metabolic risk in PCOS-affected individuals. They looked at the anthropometry and lipid profiles of 86 married PCOS women between the ages of 18 and 35 applying Pearsons correlation of coefficient. The outcomes revealed that more than 80% PCOS-affected females had irregular anthropometric measurements, and more than 70% of these females also had dyslipidemia, like decrease HDL cholesterol and increased triglyceride and the low-density lipoproteins levels. Thus, it was determined that the most significant anthropometric factors associated with abnormal lipid profile in women of South Indian having PCOS were BMI & waist circumference. (Himabindu et al., 2017).[6]

According to research, specific nutrients such vitamins, minerals, and vitamin-like compounds should be included in the therapy of PCOS. Therefore, it was suggested that a vitamin or mineral shortage may be the root of PCOS. The nutritional supplements affect the oxidative stress caused by PCOS. Oxidative stress shapes the pathophysiology of PCOS. They concluded that antioxidant biomarkers and oxidative stress can effectively alter women's risk for cardiovascular events and PCOS severity. By reducing the impact of oxidative stress on PCOS, Simple dietary supplements could lessen these dangers. Supplemental nutrients like vitamins, minerals, probiotics, and other food additives can dramatically reduce PCOS symptoms. (Dubey et al., 2021).[7]

Treatment of PCOS may include lifestyle changes, weight loss by daily diet restriction and exercise must be included in daily life, recommended by health care providers. Medications, to regulate periods, clinician recommended hormonal therapy and in case of diabetes metformin and thiazolidinediones are widely used (Marinkovic et al; 2021)8. Statin drugs used to treat dyslipidemia and sodium-glucose co-transporter 2

(SGLT-2) inhibitors could be useful for PCOS patients due to beneficial cardiovascular and glycemic effects, which is an important issue in PCOS females (zhang et al; 2022).[9]

When compared to control subjects, women with PCOS had higher mean TGs and VLDL readings, but decreased HDL values. HDL is a diverse sub-particle class of lipoproteins known as High-density Lipoproteins includes a heterogeneous class of lipoproteins. Because lipid and protein ratios vary, these subclasses have different compositions and functions. The classification for these lipoproteins is founded on either density or composition (Wang et al., 2018).[10] Because high-density lipoprotein is the strongest antiatherogenic high-density lipoprotein subtype, research have pointed out a clear co-relation between lower levels of this lipoprotein and ischemic heart disease, even in individuals who were not obese (zhang et al; 2022)[9]. Independent of BMI, PCOS in early adulthood is linked to a higher long-term risk of diabetes and dyslipidemia. (Wang et al., 2018).[10]

There are five different types of lipoproteins are chylomicrons, high density lipoprotein, low density lipoprotein and very low-density lipoprotein. All these types of lipoproteins classify according to their composition and density. Lipoproteins are one of the complex particles in body, function of these lipoproteins are transport of lipids like cholesterol, triglycerides and phospholipids between the cells. As the name show high density lipoprotein have the height density of lipoprotein, composed of highest portion of proteins to lipids. Research shown a strong inverse association between HDL cholesterol and risk of atherosclerosis (bailey et al., 2022).[11] HDL is termed as good cholesterol, major role of HDL is reverse cholesterol transport, it removes excess cholesterol and carries cholesterol from peripheral tissues and back to liver through blood. The liver flushes it from the body. HDL reduces the adhesion molecules expression in endothelial cells and inhibits recruitment of monocytes into arterial wall so, it reduces the risk of heart disease and stroke. HDL also plays a protective role in case of injury. Evidence has shown that genetic, environment, lifestyle, obesity and dietary habits impair HDL function. (kosmas et l., 2018).[12]

LDL particles are composed of phospholipid, unesterified form of cholesterol, fatty acid ester of cholesterol, hydrophobic apo-B protein is also embedded in LDL membrane help in binding of LDL particle to specific receptors present on cell surface. Defects in function of LDL receptor can cause hypercholesterolemia an

autosomal dominant disorder known as familial hyper-cholesterolemia. LDL receptor consists of 839 amino acids and with single chain glycoprotein. LDL receptors found in liver and in other tissues (Hevonoja et al., 2023).[13] The objectives of this research were to estimate different lipoprotein mainly HDL and LDL in polycystic ovary syndrome patients to determine that PCOS patients have prevalence of decrease HDL levels. Decrease levels of HDL leads to multiple complications like heart attack, stroke, peripheral artery disease due to athero-sclerosis.

This research has a profound impact on medical practice, patient care, and public health. It addresses various aspects of the condition, leading to improved diagnosis, treatment, and overall well-being of women with PCOS. As research continues, it will undoubtedly bring further insights and advancements, leading to better healthcare practices and improved quality of life for those who suffer from PCOS.

Material and Methods

It was a descriptive cross-sectional study. The study location was the Department of Biochemistry, NUR International University and the outpatient Department of Obstetrics and Gynaecology, Fatima Memorial Hospital Lahore. A convenient Sampling Technique was used. In this type of sampling, selected only those samples that were easily available, easy to approach, and agreed to participate in the research. The Sample size consisted of 80 female individuals. Those females included healthy female participants and PCOS females. A total of 80 patients were divided into two groups that were Group A and Group B. Each group contained 40 female participants, aged 18 – 45 years. Group A was a control group with healthy females. Exclusion criteria of group A was Patients having PCOS, Diabetic patients, kidney and liver cirrhosis patients. Group B contained female participants suffering from PCOS. Exclusion criteria for Group B was patients having diabetes, kidney and Liver liver disease. A convenient Sampling Technique was used. A structured research Performa recorded all the lab investigations of the serum Lipid levels including HDL and LDL levels of both groups. Ethical Approval was obtained from the IRB department of NUR International University and Fatima Memorial Hospital. Informed consent was obtained from each participant after explaining to them the whole procedure and the reason for conducting the study. Only those subjects who submitted their consent were included in this study.

A structured research Performa recorded all the lab investigations of the serum Lipid levels including HDL and LDL. The measurements taken were then compared to the reference normal values of HDL > 50 mg/, and LDL < 130 mg/ dL (Rashidi, 2018).[14]

Properly trained and fully equipped technologists obtained a blood sample from each patient. The blood sample of each patient was collected by a standard aseptic method. Sample vials were marked properly with the patient's name and case number. Blood was withdrawn in 12 hours fasting and centrifuge it for 15 minutes at 3500x g to separate Serum and stored at -80C (butler et al., 2023).[15] lipid profile was measured by enzymatic colorimetric method with Arena BioScien kits according to the manufacturer's instructions by BioCor Microlab-300 (Germany) semi-automatic chemistry analyzer. All the collected data was entered and analysed statistically using IBM SPSS Statistics Software. The quantitative variable, age was presented as groups in percentages. Shapiro-Wilk test was used to evaluate normality. An independent sample t-test was performed on the groups to check significance where the p-value was taken as > 0.05 and results were presented as mean and SD.

Results

Study enrolled total 80 female participants aged 18-45 years. HDL and LDL levels were measured in participants, out of total 80 participants, 40 participants include in group A i.e. healthy females and 40 in group B having diagnosed PCOS patients. Out of 40 participants in Group A (control group), the ages of 4 were 18-25 years, 15 were 26-35 years, and 21 were 36-45 years. In Group B out of 40 PCOS patients, the ages of 6 were 18-25 years, 19 were 26-35 years, and 15 were 36-45 years.
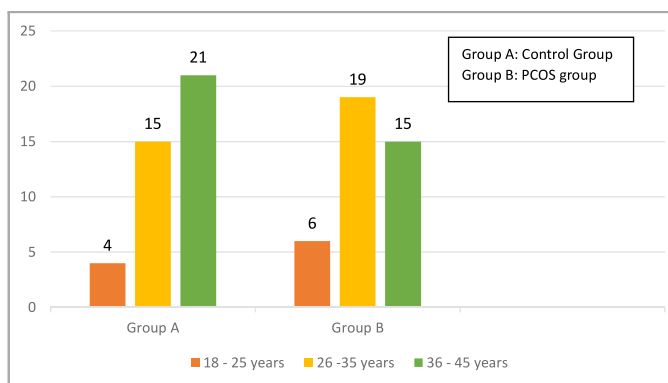

Fig-1: *Age of participants in Control (Group A) and in PCOS (Group B).*

All the selected samples of participants were inves-

tigated for lipid profile. Taking the reference values of HDL and LDL calculate Mean ± SD. Values explain in table 1.

Table 1: *High-Density Lipoprotein and Low-Density Lipoprotein of the Participants in Group A and B*

Groups	High-Density Lipoprotein mg/dL (Mean ± SD)	Low-Density Lipoprotein mg/dL (Mean ± SD)
Group A (Control Group)	50.52 ± 28.297	106.50 ± 30.750
Group B (PCOS Group)	40.30 ± 8.549	119.98 ± 27.776

After calculating Mean ± SD of HDL and LDL, correlate values between the groups in table 2.

Table 2: *Correlation of High-Density Lipoprotein and Low-Density Lipoprotein in Group A and Group B*

Group	High-density lipoprotein mg/dL	Mean ± Std. Deviation	Sig. (p-value)
A	>= 50	1.80 ± .410	< 0.001[a]
B	< 50	1.40 ± .494	
Group	Low-density lipoprotein mg/dL	Mean ± Std. Deviation	Sig. (p-value)
B	>= 130	1.40 ± .500	0.235[a]
A	< 130	1.55 ± .503	

Values are mean ± S.D. of carefully conducted independent sample t-test. values within a column show the level of significance (p < 0.05) observed at a 95% confidence interval (CI).

Discussion

Women of reproductive age are frequently affected by hormonal disorders, such as polycystic ovarian syndrome (PCOS). Their distinctive features include numerous small ovarian cysts, irregular menstrual periods, and hormonal irregularities (de Arajo et al., 2018)[16]. In the globe, one in 15 women suffer from this complicated endocrine condition (Bou Nemer et al., 2018)[17]. Most studies show that 35–50% of PCOS-afflicted women are overweight (BMI of 25 kg/m^{2}) or obese (BMI of 27 kg/m^{2}) (Hart et al., 2004).[18]

All laboratory assessments of the serum lipid level including HDL and LDL of groups were documented by structured research using Performa. Using IBM SPSS Statistics Software, all obtained data were in putted and statistically analysed, a separate t-test with a p-value of 0.05 or above was run, and the findings were shown as mean and standard deviation. Descriptive analysis was performed on the HDL and LDL, in the control group

and PCOS group.

Taking the Reference value of HDL is >40 mg/dL for Men and >50 mg/dL for Women (Information et al., 2017). Current study contains women patients, so an independent Sample t-test was performed to correlate HDL in the Group A that is control group and in patients with PCOS. There were significant differences as a p-value of <0.001 in scores for no PCOS in the control group and patients with PCOS. The magnitude of the mean ± SD (1.80±0.410, 95% CL) to Mean±SD (1.40 ± 0.494, 95% CL) was very small. Thus, it shows that HDL and PCOS are significantly correlated in PCOS patients.

Taking the Reference value of LDL is 130 mg/dL (Information et al., 2017) (Rashidi, 2018)[14]. An independent Sample t-test was performed to correlate LDL in control group without PCOS and patients having PCOS. There were no significant differences as a p-value of 0.235 in scores for Group A, that is healthy patients (group A) and the patients having PCOS. The magnitude of the mean ± SD (1.40 ± 0.500, 95% CL) to the Mean ± SD (1.55 ± 0.503, 95% CL) wasn't very small. Thus, it shows that LDL and PCOS are not significantly correlated in PCOS patients. According to a recent study, PCOS-afflicted women typically experience moderate hyper-cholesterolemia (Liu et al., 2019)[5]. It can be concluded that HDL levels decrease in dyslipidemia in patients with Polycystic Ovary Disease. When it comes to their lipid profiles, women with PCOS have lower HDL levels (Kim & Choi, 2013).[19]

Wild et al. recently published a meta-analysis of lipid levels in worldwide cross-sectional studies of women with PCOS (mostly conducted in women from Europe and America). Women with PCOS had TG levels 26 mg/dL (95% CL, 17 to 35) higher and HDL-C levels 6 mg/dL (95% CI, 4 to 9) lower than controls (Wild et al., 2011).[20] The scores for individuals with PCOS and those without PCOS in the Group A or control group differed significantly, with a p-value of 0.235. There was very little difference between the Mean±SD (1.40± 0.500, 95% CL) and the Mean ± SD (1.55 ± 0.503, 95% CL). As a result, it demonstrates that in PCOS patients, LDL and PCOS do not significantly correlate.

A prospective cross-sectional study was conducted between July 2014 and December 2016 to investigate the relationship between the hormone profile, lipid profile, clinical profile, and free testosterone index in PCOS subjects. 76 PCOS-afflicted women were included in the study, and they were split into two groups based on

whether they had hyperandrogenism or not. They claimed that not all patients exhibit hyperandrogenism, the main symptom of PCOS. Hormonal and metabolic problems both have an impact on the hyperandrogenic phenotype in PCOS patients. They concluded that FGS was not associated with hyperandrogenism in PCOS patients but that triglycerides, testosterone, and SHBG were (Hestiantoro et al., 2019).[21] Furthermore, increased levels of triglyceride-glucose, triglyceride/HDL, and total cholesterol/HDL ratios were found to be substantially linked with IR in Iranian women with PCOS (Kheirollahi et al., 2020).[22]

According to the metabolic syndrome criteria given in the WHO in 1999, the following conditions must also be present in these individuals glucose intolerance, insulin resistance and type 2 diabetes mellitus. Raised plasma triglycerides levels (>150 mg/dL) and low HDL cholesterol (35 mg/dL in men and 39 mg/dL in women), elevated arterial compression (>140/90 mmHg), If you have obesity (waist to hip ratio >0.9 for men and >0.8 for women) and a BMI >30 kg/m^2, or if you have micro-albuminuria (urinary albumin elimination rate 20 g/min or albumin-creatinine ratio 30 mg/g) and have central obesity (Ovalle, 2002).[23]

Connection to endocrine and metabolic parameters was the topic of a cross-sectional study that involved 52 females having PCOS and oligomenorrhea. They claimed that women with polycystic ovarian syndrome (PCOS) display an aberrant lipoprotein profile, defined by increased plasma triglyceride concentrations, mildly higher low-density lipoprotein (LDL) and lowered high-density lipoprotein (HDL).

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The utmost widespread endocrine disorder among female of fertile age is polycystic ovarian syndrome (PCOS) and it is also a contributes to persistent anovulation. Peripheral insulin resistance, hyperinsulinemia, and centripetal fat distribution are key components of metabolic disturbances (siddiq et al. 2005)[25]

Conclusion

We have concluded that there are abnormal serum lipid levels, in Polycystic ovary syndrome Patients. Our findings indicated that serum High-density lipoproteins were lower in the patients of polycystic ovary syndrome compared to healthy participants. Low HDL cholesterol is a major risk factor for cardiovascular disease. However, the levels of Low-density lipoproteins remained within the normal range. These findings after comparing the high den-sity and low-density lipoprotein these findings enhance our understanding of PCOS-related complications like cardiovascular disease and enabling earlier and more accurate diagnoses.

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Authors Contribution

A, AA: Conceptualization of Project
A, FK: Data Collection
AM: Literature Search
SAJ: Statistical Analysis
AA: Drafting, Revision
A, SA: Writing of Manuscript