

**A Comparative Study of Serum Magnesium & Glucose in Women with Polycystic Ovarian Syndrome and Healthy Controls****Pankaj Birla<sup>1</sup>, Meeta Sharma<sup>2</sup>, Chitra Upadhyay<sup>3</sup>, Sangeeta Meena<sup>4</sup>**<sup>1</sup>Resident, Department of Biochemistry, SMS Medical College, Jaipur<sup>2</sup>Assistant Professor, Department of Obstetrics and Gynaecology, Mahatma Gandhi Medical College Jaipur<sup>3</sup>Senior Professor, Department of Biochemistry, SMS Medical College, Jaipur<sup>4</sup>Associate Professor, Department of Biochemistry, SMS Medical College, Jaipur

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Conflict of interest: Nil

**Abstract:****Background:** Polycystic ovarian syndrome (PCOS) is a prevalent endocrine disorder affecting women of reproductive age, with a global prevalence of approximately 7-10%. The aim of this study is to conduct a comparative analysis of serum magnesium and glucose levels in women with PCOS and age matched healthy controls.**Methods:** A prospective study was conducted, collecting data on Blood glucose and magnesium levels in 70 cases of PCOS and healthy females. Student's t-test and chi-square test were used for analysis and comparison. The study was conducted from Jun 2021 to November 2022.**Results:** The mean serum magnesium levels in PCOS cases (1.88 0.21 mg/dl) is less as compared to controls (2.09 0.77) and this difference is statistically highly significant (p 0.001). Importantly, fasting blood sugar levels were significantly elevated in women who had PCOS compared with those who had healthy controls (p = 0.001). The negative linear correlation observed between mean Fasting blood glucose and serum magnesium level further strengthens the potential interplay between these two parameters.**Conclusion:** Serum magnesium and serum glucose levels are important biomarkers for early detection of metabolic changes and identification of individuals at increased risk of developing cardio-metabolic syndrome associated with the PCOS, which can facilitate the implementation of appropriate interventions to mitigate the long-term complications.**Keywords-** Magnesium, Glucose, PCOS, Risk Factor.This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.**Introduction**

Polycystic ovarian syndrome (PCOS) is a prevalent endocrine disorder affecting women of reproductive age, with a global prevalence of approximately 7-10% [1]. PCOS is characterized by a combination of hormonal imbalances, metabolic disturbances, and reproductive abnormalities. It poses serious health implications such as an increased risk of diabetes, cardiovascular disease, and infertility [1,2].

Insulin resistance is a key underlying feature of PCOS and plays a significant role in its pathogenesis. Insulin resistance leads to hyperinsulinemia, which in turn contributes to the development of hyperandrogenism, anovulation, and other clinical manifestations of PCOS [2,3]. Hyperinsulinemia not only affects ovarian function but also has systemic effects, including an increased risk of cardiovascular complications such as hypertension and thrombosis [2,4]. In recent

years, there has been growing interest in the potential role of magnesium in glucose metabolism and insulin resistance. Magnesium serves as a cofactor for numerous enzymes involved in energy metabolism, including those responsible for glucose transport and utilization [3,5]. Studies have shown that magnesium deficiency is associated with impaired glucose metabolism and insulin resistance in individuals with PCOS, diabetes mellitus, and metabolic syndrome [3,6].

Measuring serum magnesium and glucose levels provides a practical and accessible approach to assess metabolic abnormalities in women with PCOS. These parameters can serve as reliable and cost-effective biomarkers for identifying individuals at risk of developing cardio-metabolic syndrome associated with PCOS. By identifying women with PCOS who are at increased risk, appropriate interventions can be implemented to

prevent or manage complications and improve overall health outcomes.

The aim of this study is to conduct a comparative analysis of serum magnesium and glucose levels in women with PCOS and healthy controls. By examining the association between these parameters, we aim to explore their potential utility as biomarkers for early detection and risk stratification in women with PCOS.

### Method

After necessary permissions & counselling the study was conducted at SMS Medical Collage and attached hospitals.

**Study Type:** Hospital based case control observational study

**Study Period:** Study was conducted from Jun 2021 to November 2022.

**Sample size :** A sample of 70 cases in each group is require at 95 % confidence interval and 80% power to verify expected difference of 0.25 mg/dl in mean and SD 0.53 to compare serum magnesium level in control and case groups.

### Inclusion criteria:

**Cases:** Female patients diagnosed with PCOS based on Rotterdam Criteria, not on any treatment, in the age group of 18-40 years.

Diagnosis based on Rotterdam criteria (2003)

1. Oligomenorrhoea / Amenorrhoea
2. Clinical / Biochemical signs of hyperandrogenism (Hirsutism, Acne, Alopecia, Elevated androgen levels)
3. Presence of Polycystic ovaries on USG

### Exclusion criteria

1. Volunteers with DM, HTN, thyroid disorders, renal diseases, cardiovascular diseases, cushing syndrome
2. Pregnant or lactating women
3. Women on Oral contraceptive pills
4. Volunteers on drugs like hypoglycemic agents, lipid lowering drugs and hormonal medicines within 6 weeks

### Principle Assays

1. Glucose oxidase peroxidase (GOD - POD) method
2. Magnesium – Calmagite – EGTA - Colorimetric assay

### Result

The age group of subjects is between 18-40 years. As shown in Table-1 BMI, waist circumference, waist hip ratio, systolic & diastolic BP are more in cases as compared to controls and this difference is statistically highly significant ( $p < 0.001$ ). The mean Fasting blood sugar levels in PCOS cases ( $98.3 \pm 7.89$  mg/dl) is more as compared to controls ( $90.6 \pm 8.06$  mg/dl) and this difference is statistically highly significant ( $p < 0.001$ ). The mean serum magnesium levels in PCOS cases ( $1.88 \pm 0.21$  mg/dl) is less as compared to controls ( $2.09 \pm 0.27$  mg/dl) and this difference is statistically highly significant ( $p < 0.001$ ). When Pearson correlation applied to compare Fasting blood sugar and Serum Magnesium (Table-2, Figure-1), there is Negative linear correlation between mean Fasting blood sugar and Serum Magnesium and it is statistically highly significant ( $p = 0.001$ ).

**Table 1: Comparison of Various Parameters B/W Cases & Controls**

Para- Meters	Cases(n=70)	Controls(n= 70)	P- value
Mean Age(Years)	26.1 ± 3.99	27.21 ± 5.14	>0.05
BMI (Kg/M <sup>2</sup> )	27.75 ± 2.63	25.24 ± 2.29	<0.001*
Waist Circumference (cm)	86.03 ± 5.07	78.4 ± 4.30	<0.001*
Waist/Hipratio	0.79 ± 0.06	0.73 ± 0.05	<0.001*
Systolic BP(mm of Hg)	118.09 ± 8.81	111.37 ± 6.51	<0.001*
Diastolic BP(mm of Hg)	78.86 ± 5.35	74.65 ± 4.28	<0.001*
Fasting Blood Sugar(mg/dl)	98.3 ± 7.89	90.6 ± 8.06	<0.001*
Serum Magnesium(mg/dl)	1.88 ± 0.21	2.09 ± 0.27	<0.001*

**Table 2: Pearson Correlation B/W Sugar and Magnesium**

Parameter	P value	R Score	Significance
FBS v/s S.Magnesium	0.001	(-)0.379	S

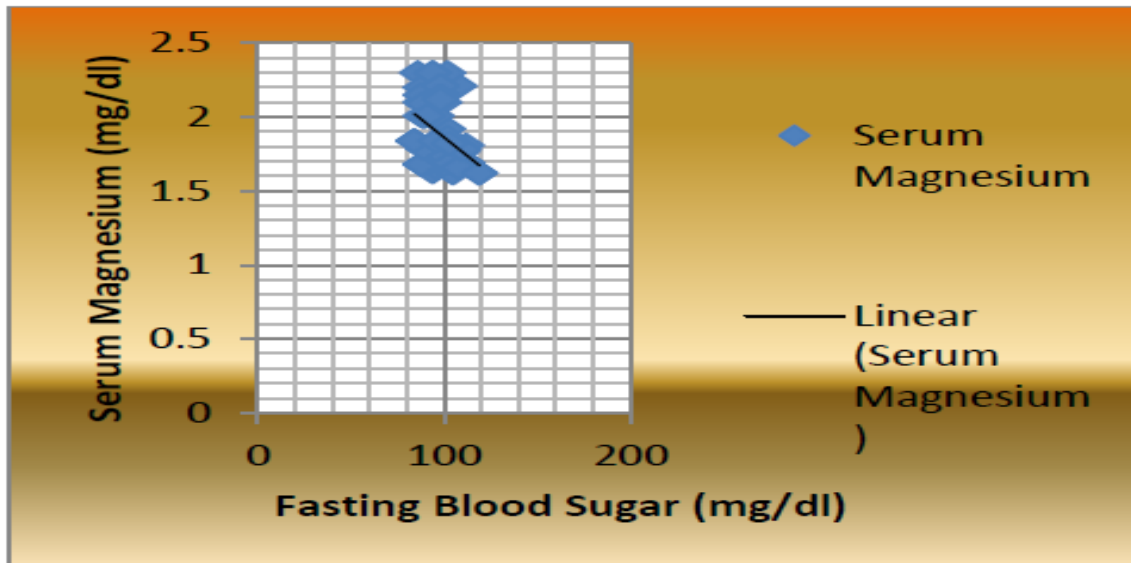


Figure 1: Pearson Correlation B/W Sugar and Magnesium

### Discussion

PCOS is no more a pure gynecological disorder but a multisystem endocrinopathy. Due to its varied presentation and associations like Hirsutism, Oligomenorrhoea, diabetes, heart disease, infertility, endometrial cancer etc, it is important to look for its early predictors and markers. This present study is an attempt forward on series of previous studies done to study the pattern of biochemical abnormalities in polycystic ovarian syndrome. In this comparative study, we compared blood glucose and magnesium in 70 cases of PCOS with age matched healthy controls.

The results of this study revealed significant differences in various parameters between women with polycystic ovarian syndrome (PCOS) and healthy controls. The age range of the subjects was between 18-40 years. The analysis showed that BMI, waist circumference, waist-hip ratio, systolic and diastolic blood pressure were significantly higher in PCOS cases compared to controls ( $p < 0.001$ ). These findings are consistent with previous studies highlighting the association between PCOS and metabolic abnormalities, including central obesity and hypertension [2,4].

Importantly, fasting blood sugar levels were significantly elevated in women with PCOS compared to controls ( $p < 0.001$ ). A study by Azevedo MF et al., reported higher fasting glucose levels in PCOS women which was statistically significant. Our result was consistent with the study of Azevedo MF et al. [7]

This finding suggests an increased risk of impaired glucose metabolism and insulin resistance in PCOS cases. Insulin resistance, often accompanied by hyperinsulinemia, is a characteristic feature of PCOS and is known to contribute to the

pathogenesis of the syndrome [3]. The findings of this study reinforce the importance of assessing glucose metabolism in women with PCOS to identify individuals at risk of developing diabetes and related complications.

Furthermore, the study found that serum magnesium levels were significantly lower in PCOS cases compared to controls ( $p < 0.001$ ). This observation supports previous research indicating a potential association between magnesium deficiency and insulin resistance in PCOS, diabetes mellitus, and metabolic syndrome [5,6]. Magnesium plays a crucial role in glucose metabolism as a cofactor for enzymes involved in energy metabolism and insulin signaling [8]. The reduced levels of serum magnesium in PCOS cases may contribute to the dysregulation of glucose metabolism and insulin resistance observed in these individuals.

Our study also showed significant negative correlation between fasting blood glucose and serum magnesium. The negative linear correlation observed between fasting blood sugar and serum magnesium levels further strengthens the potential interplay between these two parameters ( $p = 0.001$ ). The inverse relationship suggests that lower magnesium levels may be associated with higher fasting blood sugar levels in women with PCOS. In a cross sectional study by Shariffi et al involving 103 PCOS patients, the risk of PCOS was 19 times higher in subjects with Mg deficiency than those with normal serum Mg concentrations ( $P \leq 0.0001$ ). [9] This study show that an association is known to exist between the low serum ionized magnesium ( $Mg^{2+}$ ) and high ionized calcium to magnesium ( $Ca^{2+}/Mg^{2+}$ ) ratio with insulin resistance, cardiovascular problems, diabetes mellitus and hypertension. The finding of our study

also aligns with previous studies highlighting the influence of magnesium on glucose homeostasis [10].

The findings of this study emphasize the significance of assessing both serum magnesium and glucose levels in women with PCOS. These parameters serve as potential biomarkers for identifying individuals at risk of cardio-metabolic syndrome associated with PCOS. Early detection of metabolic changes and identification of high-risk individuals can facilitate the implementation of appropriate interventions to mitigate the long-term complications of PCOS.

Further research is warranted to elucidate the underlying mechanisms linking magnesium deficiency, insulin resistance, and glucose dysregulation in PCOS. Additionally, longitudinal studies are needed to evaluate the predictive value of serum magnesium and glucose levels in identifying women with PCOS at increased risk of developing cardio-metabolic syndrome.

### Conclusion

As per our study there is significant decrease in mean serum magnesium levels and it is inversely related to the glycemic levels. Thus low magnesium concentrations are associated with impaired glucose tolerance and increased risk for Type 2 diabetes mellitus. All the above derangements confirm that polycystic ovary syndrome contributes to place the patient at a higher risk of metabolic syndrome. Therefore, it is recommended that women with PCOS be routinely screened for these simple and cost-effective biochemical parameters which might prove to be biomarkers in early detection of these metabolic changes and so that treatment can be initiated at the earliest.

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