The Research of Medical Science Review
ISSN: 3007-1208 & 3007-1216 Volume 3, Issue 5, 2025

PREVALENCE OF POLYCYSTIC OVARY SYNDROME AND ITS ASSOCIATION WITH BODY MASS INDEX VARIATIONS: A SYSTEMATIC REVIEW

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DOI: https://doi.org/10.5281/zenodo.15583333

Keywords
BMI, Infertility, Insulin resistance, Obesity, PCOS

Article History
Received on 26 April 2025
Accepted on 26 May 2025
Published on 03 June 2025

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Abstract

Background: *Polycystic ovary syndrome (PCOS) is a serious clinical issue of the present age. It mostly affects women of reproductive age. Obesity is considered a potential risk factor associated with PCOS. This systematic review was conducted to evaluate the prevalence of polycystic ovary syndrome (PCOS) in relation to body mass index (BMI) variations across different populations.*

Methodology: *A comprehensive search was performed using Google Scholar, Springer, and PubMed to identify relevant articles. The search was limited to studies published within the last 20 years (2005 - 2025). Only Studies reporting mean BMI, mean age, and prevalence of PCOS in the study population were chosen, while others were excluded.*

Result: *Through database searching with pertinent keywords, such as Google Scholar (n = 80), PubMed (n = 10), and Springer (n = 10), a total of 100 entries were found. Fifty of the 85 records that were left after duplicates were eliminated were screened. After the screening procedure, 35 full-text papers were evaluated for eligibility; 20 studies were disqualified in accordance with the inclusion criteria. In the end, the comprehensive systematic review had 15 studies.*

Conclusion: *BMI plays a crucial role in PCOS development and severity, increasing risks of metabolic and hormonal complications, emphasizing the need for standardized diagnosis and personalized treatment*

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INTRODUCTION

Polycystic ovary syndrome (PCOS) is a hormonal disorder marked by imbalance of sex hormones that primarily affects women of reproductive age[1,2]. Signs and symptoms that are associated with PCOS include irregular menstrual cycle, polycystic ovaries, hirsutism, obesity, acne, hyperandrogenism, insulin resistance, impaired glucose tolerance (Type 2 Diabetes) and infertility[3]. The majority of women with PCOS (38-88%) are either overweight or obese[4,5]. The level of obesity can be determined by using body mass index (BMI). It is calculated by dividing the weight in kilograms by the square of the height in meters[6]. Adult

BMI is classified into three categories: underweight (<18.5 kg/m^2), normal weight (18.5 kg/m^2 to 24.9 kg/m^2), overweight (25 kg/m^2 to 29.9 kg/m^2), and obese (≥30 kg/m^2)[7]. The etiology of PCOS has yet to be discovered and there is no exact known cause at the moment. However, a genetic component as well as several additional risk factors, such as obesity and insulin resistance, has been identified.[8] In the current literature, there is a significant disparity in the BMI ranges associated with PCOS. Only a few researchers have looked into the relationship between BMI and PCOS. Due to variations with the diagnostic criteria for PCOS, these studies are frequently hampered by small sample sizes, selection bias, and are not comparable with the findings of other studies. The goal of this review is to evaluate the prevalence of PCOS based on ranges of BMI.

PCOS is a major clinical issue of the present age that has been reported to affect 8%-13% of reproductive aged women.[9] Obesity has been estimated to affect up to 80% of PCOS women in the United States.[10] According to a recent Spanish study, PCOS is five times more common in overweight or obese women of childbearing age (28.3 percent) as compared to general population (5.5 percent).[11] PCOS can appear at any time during a woman's reproductive life; however, it is most common during adolescence.[12] The incidence rate of infertility in reproductive-age women begins to climb at a BMI of 24 kg/m^2 and continues to increase as BMI rises.[13] According to a study published in June 2009, women with PCOS have reduced levels of follicle stimulating hormone (FSH) and increased levels of BMI as compared to normal women.

The most frequent finding in women with PCOS is obesity, and it is estimated that about 40% –80% of women suffering from this condition are either overweight or obese .[15] A recent systematic review of 35 studies found that overweight (BMI 25–30 kg/m^2) and obesity (BMI ≥30 kg/m^2) were about 2- and 2.8-fold more common in women with PCOS, respectively. Obesity is linked to changes in adipokine and inflammatory cytokine production, which may contribute to obesity-related insulin resistance and metabolic syndrome.[17] In culture, hyper-insulinemia has been demonstrated to promote ovarian androgen synthesis by acting as a co-gonadotropin.[18] Patients with PCOS who have a BMI of 23 kg/m^2 or more are more likely to develop metabolic disorders. With increasing weight, the prevalence of dyslipidemia rises.[20] A similar association persists in the metabolic syndrome. However, major multicenter research of women with PCOS reported no metabolic syndrome in those with PCOS and a BMI of 27kg/m^2[2,21]. It's unclear whether obesity causes PCOS or PCOS causes obesity. However, androgen exposure in postmenopausal women is the main cause of increasing visceral adiposity in obese as well as normal-weight women. Similarly, a recent study suggests that uncontrolled obesity before puberty combined with severe insulin resistance can lead to the development of PCOS later in life (figure 1.0).[23]

Obesity is also associated with elevated testosterone concentrations, suggesting increased androgen production.[24] Aromatase is a protein found in adipose tissue that promotes the synthesis of bio-active estrogens from androgens, which are then released into the bloodstream.[25] This can also cause elevated estrone levels, which have been observed in PCOS women.[26] According to a study published in 2011, elevated BMI levels are less specific than LAP (lipid accumulation product) in predicting IGT (impaired glucose tolerance)[27], confirming previous findings that LAP is better than BMI in predicting Type 2 Diabetes Mellitus.[28,29] This could be explained by the fact that an increase in BMI can be induced by an increase in lean mass or an enlargement of the protective SAT (subcutaneous adipose tissue) in the lower extremities.[30]

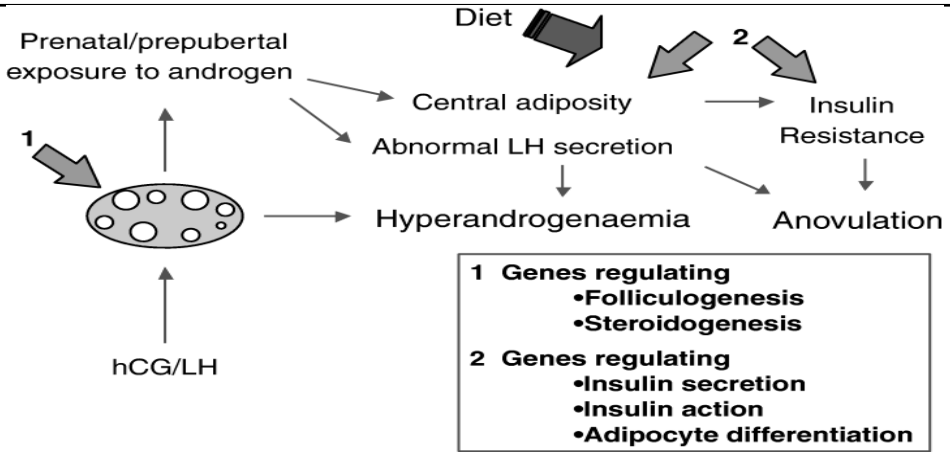

Figure 1.0 Schematic representation of development PCOS in women (Abbott et al., 2002).

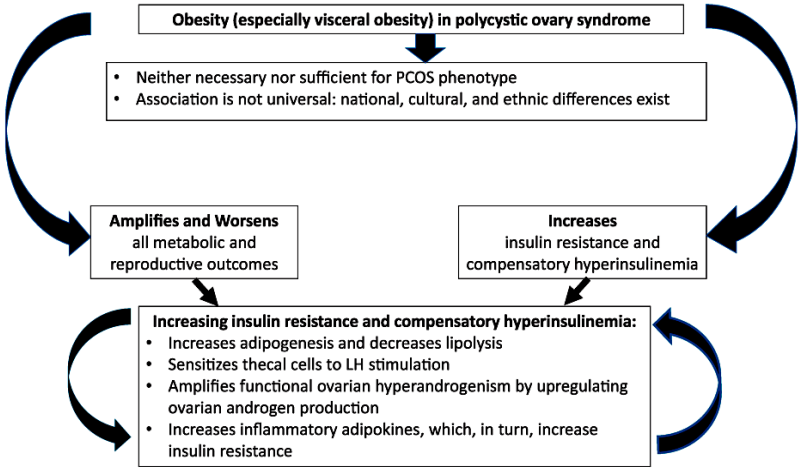

Figure 2.0 Showing Role of Obesity in PCOS [31]

MATERIAL AND METHODS

This systematic review follows the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analyses) guidelines but does not include a meta-analysis. A systematic review was conducted to evaluate variations in body mass index (BMI) among individuals diagnosed with PCOS across different populations. A comprehensive search was performed using Google Scholar, Springer, and PubMed to identify relevant articles. The search was limited to studies published within the last 20 years (articles published between 2005- 2025).Keywords used in the search included: BMI, Infertility, Insulin resistance, Obesity, PCOS.

Inclusion and Exclusion Criteria

This review included only peer-reviewed English articles reporting mean BMI, mean age, and PCOS prevalence. Studies were excluded if they lacked BMI or prevalence data, were non-research articles, had small sample sizes, or used unclear diagnostic criteria

Study Selection and Data Extraction

All identified articles were first screened for relevance based on title and abstract. Duplicates were removed before proceeding with the full-text review. The full-text articles were then assessed for eligibility based on predefined criteria. Data extraction focused on author details, publication year, study location, study design, diagnostic criteria for PCOS, sample size, mean age, average BMI, prevalence of PCOS & key findings.

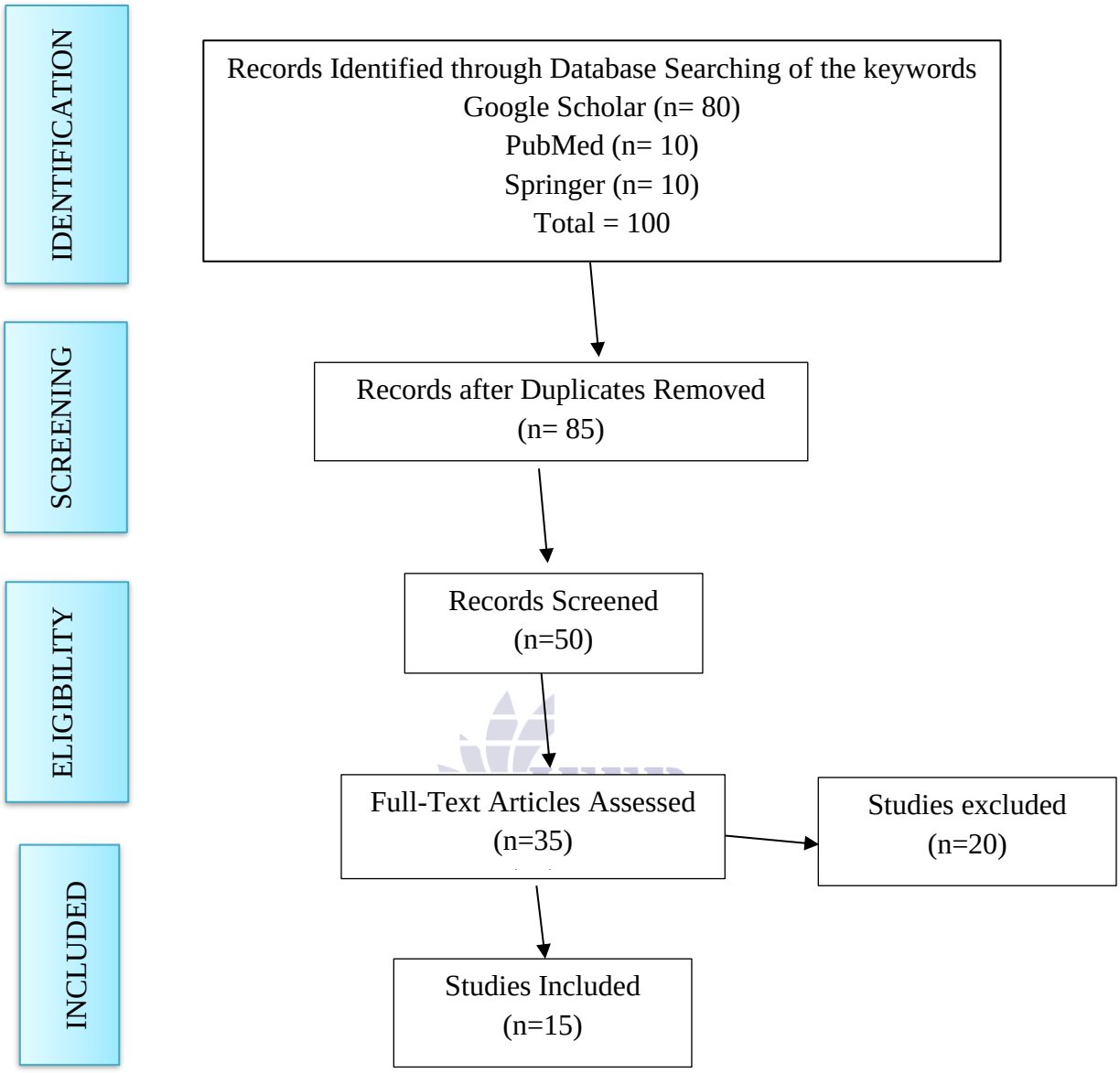

Figure 3.0: PRISMA flow diagram

RESULTS

The systematic review identified a total of 100 records through searches conducted in Google Scholar, Springer, and PubMed. After removing 15 duplicate studies, 85 records remained for screening. Based on title and abstract evaluation, 50 studies were selected for full-text assessment. Following the application of inclusion and exclusion criteria, 35 studies were reviewed in detail, and ultimately, 15 studies met the criteria for inclusion in this systematic review.

The findings indicate a significant association between body mass index (BMI) and the prevalence of polycystic ovary syndrome (PCOS). Women with higher BMI values showed a greater likelihood of developing PCOS, with a particularly strong link observed in obese individuals. According to Alvarez-Blasco et al. (2006), the prevalence of PCOS in obese individuals was markedly higher compared to those with normal BMI, accompanied by increased insulin resistance and metabolic complications. Similarly, March et al. (2010) found that obesity significantly influenced symptom severity in PCOS patients, with a higher prevalence noted among individuals diagnosed using different criteria. A global pattern of

BMI-related PCOS prevalence was evident in studies conducted in different regions, including the United States, Spain, China, Iran, Australia, and Pakistan. For instance, Joshi et al. (2014) reported that younger women with higher BMI had an increased risk of PCOS, with obesity exacerbating hormonal imbalances and insulin resistance. Additionally, a study by Haase et al. (2023) highlighted that weight loss interventions in overweight and obese women with PCOS improved reproductive outcomes and reduced metabolic complications.

The review also indicated inconsistencies in PCOS prevalence across different studies, largely due to variations in diagnostic criteria. The Rotterdam criteria, National Institutes of Health (NIH) guidelines, and the National Institute of Child Health and Human Development (NICHD) criteria led to differences in reported prevalence rates. For example, Tehrani et al. (2011) observed a strong correlation between obesity and PCOS when using the Rotterdam criteria, while studies using NIH criteria demonstrated lower prevalence rates. Overall, the results of this review confirm that PCOS is significantly influenced by BMI, with obesity being a key risk factor. The findings suggest that early interventions, particularly lifestyle modifications and weight management, could help in reducing the severity and prevalence of PCOS symptoms.

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Table 1.0. Summary of Key Studies on PCOS Prevalence and BMI

Author	Year	Country	Sample size of study	Mean age	Study Design	PCOS Diagnostic Criteria	Average BMI (kg/m^2)	Prevalence of PCOS (%)	Key Findings
Maria Trent et al[32]	2005	USA	283	16.9	Cross-sectional study	NIH	31.7	34.3	Overweight girls with PCOS had a lower quality of life, and BMI played a significant role in mediating PCOS symptoms
Alvarez-Blasco et al[33]	2006	Spain	113	26	Observational study	NICHD	34.8	6.5	PCOS prevalence was significantly higher in obese individuals, with increased insulin resistance and metabolic complications
X. Chen et al[34]	2008	South China	915	31.8	Cross-sectional study	RC	20.94	2.4	PCOS prevalence was low in the population, with BMI levels significantly influencing hormonal and metabolic parameters
Amini et al[35]	2008	Iran	157	34.8	Case-control study	NIH	32.8	8.3	PCOS was more frequent in overweight/obese women with diabetes, with higher androgen levels and menstrual irregularities.
March et al[36]	2010	South Australia	728	30.2	Population-based cohort study	NIH	25.7	17.8	PCOS prevalence varied depending on diagnostic criteria, with obesity playing a key role in symptom severity.
Tehrani et al[37]	2011	Iran	1126	34.4	Community-based cross-sectional study	RC	26.2	14.6	Obesity was associated with increased PCOS prevalence, along with insulin resistance and dyslipidemia.
Hana Fakhoury et al[38]	2012	Saudi Arabia	102	35.9	Cross-sectional study	RC	31.9	10	PCOS women showed significant hormonal imbalances, with BMI positively correlating with androgen levels
Teede et al[39]	2013	Australia	8612	30.5	Observational longitudinal study	Self-reported PCOS diagnosis	27.8	5.8	PCOS was linked to long-term weight gain, with metabolic syndrome risk increasing with BMI
Joshi et al[40]	2014	India	778	18.15	Cross-sectional study	RC	21.1	22.5	PCOS was prevalent in younger women, with obesity worsening symptoms and increasing insulin resistance
Raziye Keskin Kurt et al[41]	2014	Turkey	120	32.1	BMI-matched case-control study	RC	31.9	8.5	PCOS patients had higher inflammatory markers than BMI-matched controls, suggesting inflammation as a contributing factor
Sharif et al[42]	2016	Qatar	120	21	Cross-sectional study	NIH	22.95	11.7	PCOS prevalence was high among women with BMI >25kg/m^2, with increased risk of infertility.

E. Koivuaho et al[43]	2019	Finland	280	46	Longitudinal cohort study	Self-reported PCOS diagnosis	25.75	4.45	Women with PCOS had increased long-term metabolic risks, with BMI strongly influencing outcomes
Memon TF et al[44]	2020	Pakistan	185	22.6	University-based cross-sectional study	RC	21.6	15.4	PCOS was highly prevalent among university students with BMI >25kg/m^2, with significant hormonal imbalances.
Neubronner et al[45]	2021	Singapore	389	29.84	Prospective cross-sectional study	RC	25.14	34.4	PCOS phenotypes varied with BMI, with metabolic complications more common in obese individuals
Haase et al[46]	2023	UK	9955	27	Retrospective cohort study	EHR	31.2	10.5	Weight loss improved pregnancy chances in overweight PCOS women, with obesity linked to worse reproductive outcomes.

PCOS= Polycystic ovarian syndrome, BMI= Body mass index, NICHD= National Institute of Child Health and Human Development, RC= Rotterdam Criteria, NIH= National Institutes of Health, EHR= Electronic Health Record/clinically coded diagnosis

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DISCUSSION

The findings of this systematic review emphasize the critical role of BMI in the development and progression of PCOS. The evidence gathered from multiple studies confirms that women with higher BMI values are at a greater risk of developing PCOS, with metabolic disturbances and hormonal imbalances being more pronounced in overweight and obese individuals. Previous studies have also demonstrated that obesity contributes to hyperinsulinemia, which exacerbates androgen production and disrupts ovarian function, leading to PCOS symptoms (Tehrani et al., 2011; Fakhoury et al., 2012). A key aspect highlighted in this review is the bidirectional relationship between PCOS and obesity. While obesity is recognized as a risk factor for PCOS, the syndrome itself can contribute to weight gain through mechanisms such as insulin resistance and metabolic dysfunction. This cycle perpetuates the severity of PCOS symptoms and complicates management strategies (Haase et al., 2023). These findings underscore the need for targeted weight management strategies as a core component of PCOS treatment.

Another crucial factor discussed in this review is the variation in PCOS prevalence based on different diagnostic criteria. March et al. (2010) found that the application of the Rotterdam criteria resulted in higher prevalence rates compared to the NIH criteria, suggesting that broader diagnostic parameters may capture a wider spectrum of PCOS phenotypes. This inconsistency in diagnostic methods highlights the need for a standardized approach to improve comparability between studies. Furthermore, the review highlights the impact of PCOS on metabolic health, with several studies reporting a higher incidence of insulin resistance, dyslipidemia, and metabolic syndrome in women with higher BMI. Studies such as those by Alvarez-Blasco et al. (2006) and Neubronner et al. (2021) indicated that obesity exacerbates metabolic complications in PCOS, increasing the risk of long-term health issues such as type 2 diabetes and cardiovascular diseases.

Additionally, regional differences in PCOS prevalence suggest that genetic, environmental, and lifestyle factors may influence the condition's manifestation. Studies from South Asia, such as those by Memon et al. (2020), reported a high prevalence of PCOS among university students, likely due to dietary patterns, sedentary lifestyles, and genetic predispositions. Conversely, studies conducted in Europe and North America, such as Haase et al. (2023), focused on the role of weight loss interventions in improving reproductive health among PCOS patients.

CONCLUSION

The systematic review confirms that BMI is a critical factor influencing PCOS prevalence. Overweight and obese women are at a higher risk of developing PCOS and experiencing more severe symptoms, including insulin resistance, hyperandrogenism, and metabolic syndrome. Given the heterogeneity in diagnostic criteria and study populations, future research should focus on developing standardized diagnostic methods and exploring targeted interventions for PCOS management.

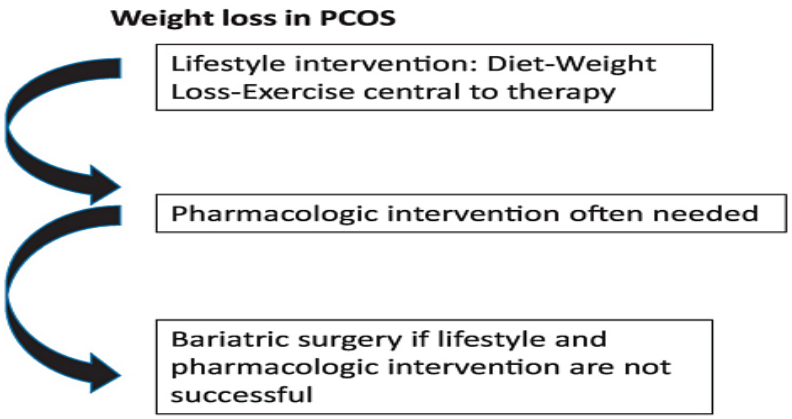

Figure 4.0 Showing treatment measures for PCOS [31]

Limitations and Recommendations

This review is limited by restricted study access, variability in diagnostic criteria, and reliance on cross-sectional studies, which may introduce biases. Future research should prioritize longitudinal studies, standardized diagnostic criteria, and exploration of genetic, dietary, and lifestyle factors, as well as intervention-based studies on weight management and pharmacological treatments.

AUTHOR CONTRIBUTION

Author	Contribution
Syed Zaigham Ali Shah	Manuscript writing, Conceptualization, and methodology
Muhammad Zubair	Supervision, review of methodology, and editing of the final draft.
Muhammad Bilal	Data extraction, risk of bias assessment, data synthesis, and critical revision of the anuscript.
Mansoor Khan	Quality assessment, formatting, reference management, and proofreading

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