The Impact of Polycystic Ovary Syndrome (PCOS) on Cardiovascular Health in Female Patients: Prevention and Management Strategies in Primary Care

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Abstract

Introduction

Polycystic Ovary Syndrome (PCOS) is a common endocrine disorder affecting 6–20% of women of reproductive age, with a high rate of underdiagnosis. It is associated with metabolic disturbances and is increasingly recognized as a cardiovascular risk-enhancing condition. While clinical management often prioritizes reproductive concerns, its long-term cardiovascular implications are increasingly recognized in literature but frequently overlooked in practice.

Purpose

This systematic review aims to evaluate the impact of PCOS on cardiovascular health and examine preventive and management strategies relevant to primary care, where early risk recognition and long-term follow up are essential. Inadequate disease education, limited resources, and delayed diagnosis can negatively affect quality of life in women with PCOS. Increased awareness in primary care is essential to support timely diagnosis, appropriate cardiovascular risk assessment, and the identification of effective treatment strategies to improve long-term health outcomes.

Methods

A systematic literature search was conducted in Medline, Embase, and the Cochrane Library for studies published between 1 January 2015 and 1 May 2025. Eligible studies included systematic reviews, meta-analyses, guidelines, and other reviews focusing on cardiovascular risk factors, outcomes, and interventions in women with PCOS.

Results

Women with PCOS exhibit a higher prevalence of cardiometabolic risk factors, including insulin resistance, type 2 diabetes mellitus, hypertension, dyslipidaemia, and metabolic syndrome. These risks are present across all BMI categories. Evidence suggests increased odds of composite cardiovascular disease and stroke, while findings for myocardial infarction and mortality remain inconsistent. Lifestyle interventions, including dietary modification and physical activity, improve weight, insulin sensitivity, and lipid profiles. Pharmacological treatments such as metformin, GLP-1 receptor agonists, statins, and SGLT2 inhibitors show beneficial effects on cardiometabolic parameters.

Conclusion

PCOS is associated with an adverse cardiometabolic profile and an increased cardiovascular risk, independent of BMI. Lifestyle interventions form the cornerstone of management, with additional benefits from pharmacological treatments such as metformin, GLP-1 receptor agonists, and SGLT2 inhibitors. Early recognition and systematic cardiovascular risk assessment in primary care are essential. However, current evidence on long-term outcomes remains limited, highlighting the need for further research.

Samenvatting

Inleiding
Het polycysteus ovariumsyndroom (PCOS) is een veelvoorkomende endocriene aandoening die 6–20% van de vrouwen in de vruchtbare leeftijd treft, met een hoge mate van onderdiagnostiek. Het gaat gepaard met metabole stoornissen en wordt in toenemende mate erkend als een aandoening die het cardiovasculaire risico verhoogt. Hoewel de klinische aanpak vaak prioriteit geeft aan reproductieve aspecten, worden de cardiovasculaire implicaties op lange termijn in de literatuur steeds meer erkend, maar in de praktijk vaak over het hoofd gezien.

Doel
Deze systematische review heeft als doel de impact van PCOS op de cardiovasculaire gezondheid te evalueren en preventieve en therapeutische strategieën te onderzoeken die relevant zijn voor de eerstelijnszorg, waar vroegtijdige risicodetectie en langdurige opvolging essentieel zijn. Onvoldoende voorlichting over de aandoening, beperkte middelen en vertraagde diagnose kunnen de levenskwaliteit van vrouwen met PCOS negatief beïnvloeden. Verhoogde bewustwording in de eerstelijnszorg is essentieel om tijdige diagnose, een adequate cardiovasculaire risicobeoordeling en de identificatie van effectieve behandelingsstrategieën te ondersteunen, met als doel de gezondheid op lange termijn te verbeteren.

Methoden
Er werd een systematisch literatuuronderzoek uitgevoerd in Medline, Embase en de Cochrane Library met studies die tussen 1 januari 2015 en 1 mei 2025 gepubliceerd zijn. Geïncludeerde studies omvatten systematische reviews, meta-analyses, richtlijnen en andere reviews gericht op cardiovasculaire risicofactoren, klinische uitkomsten en interventies bij vrouwen met PCOS.

Resultaten
Vrouwen met PCOS vertonen een hogere prevalentie van cardiometabole risicofactoren, waaronder insulineresistentie, type 2 diabetes mellitus, hypertensie, dyslipidemie en het metabool syndroom. Er is een verhoogde kans op samengestelde cardiovasculaire aandoeningen en beroerte, terwijl de bevindingen voor myocardinfarct en mortaliteit inconsistent blijven. Leefstijlinterventies, waaronder aanpassingen in het dieet en lichaamsbeweging, verbeteren het gewicht, de insulinegevoeligheid en het lipidenprofiel. Farmacologische behandelingen zoals metformine, GLP-1-receptoragonisten, statines en SGLT2-remmers vertonen gunstige effecten op cardiometabole parameters.

Conclusie
PCOS is geassocieerd met een ongunstig cardiometabool profiel en een verhoogd cardiovasculair risico, onafhankelijk van BMI. Leefstijlinterventies vormen de basis van de behandeling, met aanvullende voordelen van farmacologische therapieën zoals metformine, GLP-1-receptoragonisten en SGLT2-remmers. Vroege herkenning en systematische cardiovasculaire risicobeoordeling in de eerstelijnszorg zijn essentieel. De huidige literatuur omtrent de langetermijngevolgen is echter beperkt, wat de noodzaak van verder onderzoek aantoont.

Introduction

Polycystic Ovary Syndrome (PCOS) is an emerging and highly prevalent endocrine disorders among women during their reproductive age (1). Depending on the diagnostic criteria used, the incidence of this condition varies globally from 6% to 20%, with higher prevalence in overweight or obese women and in specific ethnic groups (2).

PCOS remains undiagnosed in about 70% of the cases according to the WHO (1). Variations in PCOS phenotype and reported symptoms often lead to symptomatic rather than comprehensive evidence-based treatment options and a delayed diagnosis (3).

Moreover, the pathophysiological mechanisms of PCOS are complicated and poorly understood (2).The etiology of this endocrine illness may involve developmental, genetic, environmental, epigenetic processes and intergenerational factors (2, 4).

There are various criteria for diagnosing PCOS, including the Rotterdam criteria, the Androgen Excess Society (AES) criteria, and the National Institutes of Health (NIH) criteria. The most commonly applied of these is the Rotterdam criteria. At least two of the three following Rotterdam criteria need to be met in order to diagnose PCOS (2, 3, 5, 6). These criteria include oligo- or anovulation, clinical or biochemical signs of hyperandrogenism, and the presence of polycystic ovaries. The number of follicles indicating polycystic ovaries depends on the ultrasound probe used, with probes having a frequency of ≥8 Hz requiring the presence of ≥20 follicles per ovary and an ovarian volume of 10 mL, while probes with a frequency of ≤8 Hz require the presence of ≥12 follicles and an ovarian volume of 10 mL. Additionally, it is essential to exclude other endocrine pathologies such as Cushing's syndrome, late-onset congenital adrenal hyperplasia, hyperprolactinemia, and androgen-producing tumours (5-7).

PCOS is often diagnosed during the reproductive stage of life, when women present with infertility associated with disrupted ovulation and possible anovulation, as well as clinical signs of hyperandrogenism, such as hirsutism, acne, and androgenic alopecia, including scalp hair thinning. Additional key manifestations include menstrual irregularities, ranging from amenorrhea to oligomenorrhea or light menstrual flow (3, 6, 8-13). Weight gain is prevalent among women with PCOS, with four out of ten affected individuals being overweight or obese. This weight gain often exacerbates other symptoms and increases the risk of long-term health issues (11, 14, 15). Depression is also a significant concern among women with PCOS, often arising from the emotional and physical challenges posed by the condition (11, 16). The degree of symptom manifestation can fluctuate and evolve over time.

Various patients may experience PCOS in different ways. We discuss four phenotypes, or manifestations (17). Phenotype A is characterised by the presence of clinical and/or biochemical hyperandrogenism (HA), accompanied by ovulatory dysfunction (OD) and polycystic ovarian morphology (PCOM). On the other hand, phenotype B includes clinical and/or biochemical hyperandrogenism (HA) along with ovulatory dysfunction (OD), but lacks polycystic ovarian morphology (PCOM). Phenotype C is identified by clinical and/or biochemical hyperandrogenism (HA) in conjunction with polycystic ovarian morphology (PCOM), without the presence of ovulatory dysfunction (OD). Lastly, phenotype D encompasses ovulatory dysfunction (OD) together with polycystic ovarian morphology (PCOM), yet does not include clinical and/or biochemical hyperandrogenism (HA) (18).

PCOS frequently raises the risk of chronic health issues such as type 2 diabetes, insulin resistance, metabolic syndrome, obstructive sleep apnea and endometrial hyperplasia and cancer (3, 6, 11). Multiple risk factors such as low-grade inflammation, higher coagulation factors and metabolic abnormalities such as poor glucose and lipid metabolism contribute to an increased risk of cardiovascular disease (CVD) (10, 19). In the academic literature, PCOS is often linked to numerous cardiovascular risk factors including diabetes, hypertension, hypercholesterolemia, hypertriglyceridemia and an elevated waist-hip ratio (3, 6, 20). Women with PCOS are also more likely to experience major adverse cardiovascular events (MACE), including myocardial infarction (MI), stroke, heart failure and cardiovascular mortality (21).

Differences in PCOS phenotypes contribute to different ranges of cardiometabolic risk. Studies showed that women with classic PCOS (phenotype A and B) are at a higher risk of developing type II DM and CVD in comparisons to non-classic PCOS (phenotype C and D) (22).

In general the quality of life and women's health are affected in women with PCOS. These individuals typically have higher rates of low self-esteem, depressive symptoms, anxiety disorders and a negative body image that impairs their quality of life (6, 23). On the polycystic ovary syndrome questionnaire (PCOSQ) hirsutism, menstrual irregularity and weight were the most significant issues followed by a lowered sense of emotional wellbeing (19).

Inadequate disease education, a lack of information resources and lengthy diagnosis processes can also be detrimental factors which can negatively influence quality of life (6). Awareness among clinical professionals in primary care concerning the impact of PCOS on long-term cardiovascular health is crucial, as well as timely diagnosis and comprehensive risk assessment in affected women. In this context, it becomes essential to identify which clinical and biochemical parameters should be considered during the diagnostic process, particularly those related to cardiovascular risk. Furthermore, a clearer understanding is needed of which treatment strategies may effectively reduce the cardiovascular impact of PCOS and improve long-term health outcomes.

The purpose of this systematic review is to investigate the effect of PCOS in developing cardiovascular diseases. In addition, we want to determine whether preventive measures as well as medication based treatment have an effect on cardiovascular health outcomes in patients with PCOS. Our goal is to contribute to an improvement in primary care practices, in order to enhance long-term cardiovascular health outcomes in patients with PCOS.

Thus, further evaluation of other effects of PCOS such as the psychological and reproductive components will not be discussed in this review.

Methods

This methods section describes the systematic approach used to identify, select, and evaluate relevant studies examining cardiovascular risk factors and outcomes in women with PCOS. The process followed established guidelines for systematic reviews, including predefined eligibility criteria, a search across multiple databases, and independent screening of studies. Key steps included an initial broad search of major biomedical databases, followed by the use of specific filters and eligibility criteria to narrow down the results.

In addition, steps were taken to ensure the quality and reliability of the process, including screening by two independent reviewers and assessment of study quality using established evaluation tools. Together, these steps aimed to provide a clear and balanced overview of the current evidence on cardiovascular risk in women with PCOS.

Search Strategy

Unfiltered Search

Several electronic databases including Medline, Embase and Cochrane Library were employed as our primary sources of information. These databases were systematically searched using a combination of medical subject headings (MeSH) terms and keywords related to PCOS and cardiovascular risk factors. The search terms and keywords were adjusted according to the specific requirements of each database.

Table 1: Search terms used per database

Database	MeSH terms and keywords used
Medline	("Polycystic Ovary Syndrome"[Mesh] OR "polycystic ovar* syndrome"[tiab] OR "polycystic ovary syndrome"[tiab:~2] OR "polycystic ovar* disease"[tiab] OR "PCOS"[tiab]) AND ((("Cardiovascular Diseases"[Mesh] OR "Cardiovascular Dis*"[tiab] OR "Cardiac Event*"[tiab] OR "Major Advance Cardiac Event*" [tiab] OR "cardiovascular complication*"[tiab] OR "major adverse cardiovascular event*"[tiab]) OR ("Heart Disease Risk Factors"[Mesh] OR "heart disease*"[tiab] OR "heart disease risk factor*"[tiab] OR "heart disease risk factor"[tiab:~2] OR "heart disease risk factors"[tiab:~2] OR "cardiac disease risk factors"[tiab:~2] OR "cardiac disease risk factor"[tiab:~2] OR "cardiovascular risk factor*"[tiab] OR "cardiovascular risk factor"[tiab:~2] OR "cardiovascular risk factors"[tiab:~2])) OR ("Cardiometabolic Risk Factors"[Mesh] OR "cardiometabolic risk factor*"[tiab] OR "cardiometabolic risk factor"[tiab:~2] OR "cardiometabolic risk factors"[tiab:~2]))
Embase	('ovary polycystic disease'/exp OR ‘polycystic ovar* syndrome’:ti,ab,kw OR ‘polycystic ovar* disease’:ti,ab,kw OR ‘PCOS’:ti,ab,kw) AND (('cardiovascular disease'/exp OR 'cardiovascular diseas*':ti,ab,kw OR ‘cardiovascular disorder*’:ti,ab,kw OR ‘cardiovascular complication*’:ti,ab,kw OR ‘cardiac event*’:ti,ab,kw OR ‘major adverse cardiovascular event*’:ti,ab,kw OR ‘Major Advance Cardiac Event*’:ti,ab,kw) OR ('heart disease risk factor'/exp OR (‘heart disease’ NEAR/3 ‘risk factor*’):ti,ab,kw OR (‘cardiac disease’ NEAR/3 ‘risk factor*’):ti,ab,kw OR 'cardiovascular risk factor'/exp OR (‘cardiovascular’ NEAR/3 ‘risk

	factor*'):ti,ab,kw) OR ('cardiometabolic risk factor'/exp OR ('cardiometabolic' NEAR/3 'risk factor*'):ti,ab,kw))
Cochrane Library	#1: [mh "Polycystic Ovary Syndrome"] #2: ((polycystic ovar* NEXT "syndrome") OR (polycystic ovar* NEXT "disease") OR "PCOS"):ti,ab,kw #3: #1 OR #2 #4 : [mh "Cardiovascular Diseases"] #5: (("cardiovascular" NEXT diseas*) OR ("cardiovascular" NEXT disorder*) OR ("cardiovascular" NEXT complication*) OR ("cardiac" NEXT event*) OR ("major adverse cardiovascular" NEXT event*) OR ("Major Advance Cardiac" NEXT Event*)):ti,ab,kw #6: #4 OR #5 #7: [mh "Heart Disease Risk Factors"] #8: (("heart disease" NEAR/3 risk factor*) OR ("cardiac disease" NEAR/3 risk factor*) OR ("cardiovascular" NEAR/3 risk factor*)):ti,ab,kw #9: #7 OR #8 #10: [mh "Cardiometabolic Risk Factors"] #11: (("cardiometabolic" NEAR/3 risk factor*)):ti,ab,kw #12: #10 OR #11 #13: #3 AND (#6 OR #9 OR #12)

The initial search results per consulted database are provided in Table 2 below.

Table 2: Initial search results

Database	Results without filtering
Medline (PubMed)	2,666
Embase	10,861
Cochrane Library	315
Total	**13,842**

The initial search results were further refined by applying additional filtering based on the eligibility criteria documented in the next section.

A comprehensive search of relevant literature was performed in these electronic databases from inception to 1 May 2025. Additionally, manual searches of reference lists of relevant articles were conducted to identify additional studies.

Filtered Results

The following filters were applied when possible: publication date (1 January 2015 until 1 May 2025), gender (female), study type (systematic reviews, reviews, and guidelines), language (English or Dutch), and availability of (free) full text. After applying filtering in each of the databases' search engine, our search results were narrowed down significantly before deduplication. Table 3 below shows the number of articles per consulted database after filtering.

Table 3: Total results before and after filtering

Database	Results without filtering	Filtered results
Medline (PubMed)	2,666	292
Embase	10,861	811
Cochrane Library	315	8
Total	**13,842**	**1,111**

Eligibility Criteria

Inclusion Criteria

Studies meeting the inclusion criteria outlined in Table 4 were considered eligible for inclusion.

Table 4: Inclusion Criteria

Domain	Inclusion Criteria
Language	Studies published in English or Dutch.
Topic	Studies investigating cardiovascular risks in women diagnosed with polycystic ovary syndrome (PCOS). Studies reporting outcomes such as cardiovascular events, cardiovascular risk factors (e.g., hypertension, dyslipidaemia) or surrogate markers of cardiovascular disease (e.g., carotid intima-media thickness).
Study Design	Guidelines, reviews, systematic reviews.
Population	Studies involving adult women (20 to 60 years old) diagnosed with PCOS were included.
Outcomes	Studies examining cardiovascular risk factors or outcomes, including but not limited to hypertension, dyslipidaemia, insulin resistance, type 2 diabetes mellitus, metabolic syndrome, endothelial dysfunction, atherosclerosis, and cardiovascular events such as myocardial infarction and stroke.
Intervention	Studies investigating preventive or pharmacological/medical treatment strategies for PCOS were included.

Exclusion Criteria

Studies meeting the exclusion criteria outlined in Table 5 were explicitly excluded.

Table 5: Exclusion Criteria

Domain	Exclusion Criteria
Topic	Studies not focusing on PCOS and its impact on cardiovascular risks.
Study Design	Studies without original data or with inappropriate study designs for the research question: animal studies, in vitro experiments, case reports, case series, qualitative studies, editorials, commentaries, letters, conference abstracts, and narrative reviews.
Methodological Quality	Studies with inadequate reporting of key methodological details, such as participant characteristics, study design, outcome measures, and statistical analysis methods.
Outcomes	Studies without relevant outcomes or endpoints. Studies lacking clear diagnostic criteria for PCOS or cardiovascular outcomes.
Other	Duplicate publications or studies with overlapping data. Studies with a high risk of bias. Full texts not accessible via available databases, interlibrary loan services, or other retrieval methods.

Study Selection

Two independent reviewers screened the titles and abstracts of all retrieved articles to assess their eligibility based on the predefined inclusion and exclusion criteria. This initial screening step was performed to exclude irrelevant studies and to identify potentially suitable articles for further evaluation. In cases where the relevance of a study was unclear based on the title and abstract alone, the article was retained for full-text review to avoid the risk of premature exclusion. Following this, full-text versions of all potentially eligible studies were obtained and independently assessed by the same reviewers to determine final inclusion. Any disagreements between the reviewers regarding study selection were resolved through discussion and consensus. If necessary, additional input was sought from the study supervisors to reach a final decision.

Study Risk of Bias Assessment

In line with PRISMA guidelines, the quality of the included studies was checked through a collaborative discussion process to ensure the findings were reliable. Two researchers (U.M. and Z.N.) independently reviewed each study, focusing on key areas such as how the participants were chosen and how the health outcomes were tracked. Any differences in their evaluations were resolved through thorough discussion and consensus. When necessary, two senior researchers (B.A. and F.D.K.) joined these discussions to help reach a final agreement. This approach ensured a careful and consistent assessment of the evidence.

Reporting

The reporting of this systematic review follows the PRISMA guidelines. Any deviations from the protocol or amendments made during the review process were documented and justified. The PRISMA flow diagram illustrating the study selection process is provided in Figure 1.

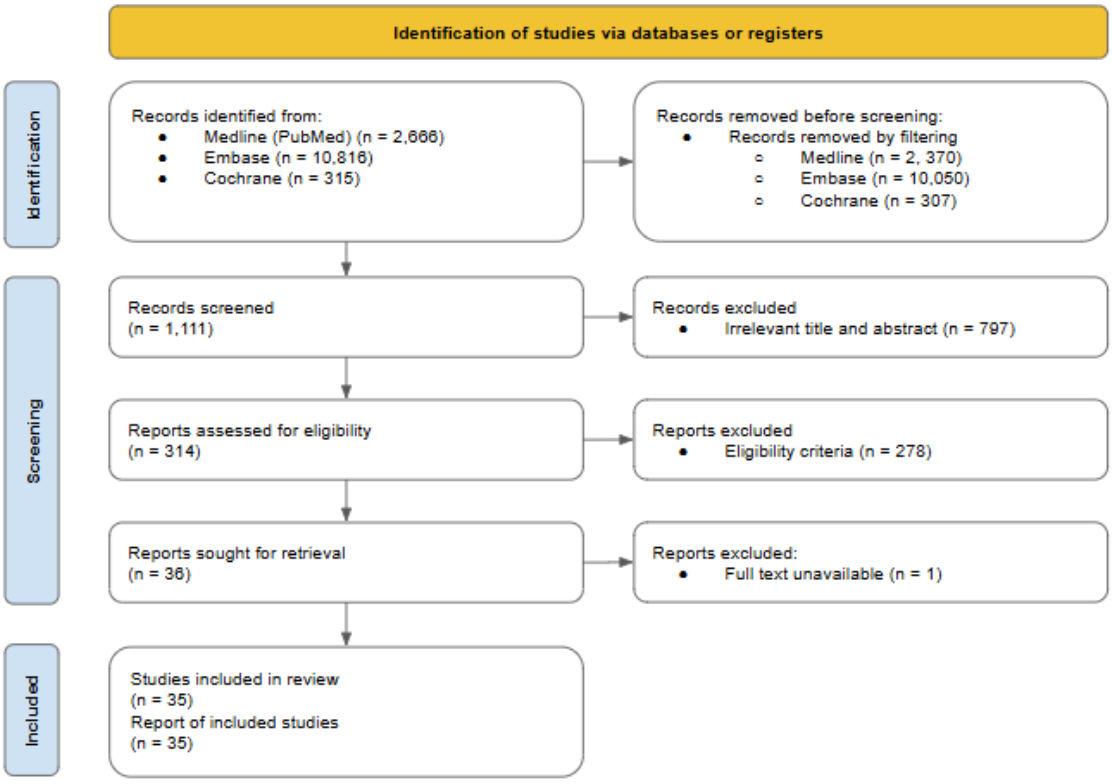


Figure 1: PRISMA Flow Diagram

Results

This section presents the findings of the literature reviewed on the impact of polycystic ovary syndrome (PCOS) on cardiovascular health and the effectiveness of preventive and management strategies relevant to primary care.

The results are organized into two parts to provide a comprehensive overview of the condition. The first part summarizes the evidence linking PCOS to cardiometabolic health issues, as well as cardiovascular events such as strokes. While many studies also evaluate hidden markers of heart disease, this section focuses on clinically manifest outcomes that are most relevant to routine primary care practice. The second part examines preventive and therapeutic strategies used to improve heart health in women with PCOS. This includes both non-pharmacological interventions and pharmacological options. Together, these results provide a clear picture of the cardiovascular burden associated with PCOS and the diverse range of interventions available to manage long-term health risks.

Effect of PCOS in developing cardiovascular diseases

1. Cardiometabolic disease and risk factors

1.a. Insulin resistance, impaired glucose metabolism, and type 2 diabetes

Narrative reviews and consensus statements indicate that insulin resistance is highly prevalent in women with PCOS, affecting approximately 60–80% overall and up to 95% of those with obesity. Notably, insulin resistance is also common in lean women with PCOS, with reported prevalence of around 75% (24-28).

Long-term cohort studies and meta-analyses further demonstrated a higher risk of impaired glucose tolerance and type 2 diabetes mellitus in women with PCOS. The meta-analysis by Wekker et al. (7) reported a relative risk (RR) of 3.00 for type 2 diabetes in women with PCOS compared to controls, with positive associations observed in both obese and non-obese populations. Increased odds of impaired glucose tolerance were similarly observed in BMI-matched analyses (odds ratio (OR) = 2.54) (22). Wild et al. (25) stated that up to 40% of women with classic PCOS developed type 2 diabetes by the fourth decade of life, with higher absolute risk among women with increased BMI.

1.b. Hypertension

Hypertension was reported more frequently among women with PCOS across multiple cohort studies and meta-analyses. Wekker et al. (7) reported a pooled relative risk (RR) of 1.75 for hypertension in women with PCOS, with positive associations observed in both obese and non-obese women. Cross-sectional data summarized by Osibogun et al. (22) reported hypertension prevalence of 65% among women with PCOS compared with 41% in controls. Narrative and review-based evidence consistently reported elevated blood pressure independent of BMI, with obesity further increasing prevalence (22, 27, 29). Some studies

noted that this association was more prominent during reproductive age and diminished after menopause, irrespective of BMI (29, 30).

1.c. Dyslipidaemia

Women with PCOS exhibited an adverse lipid profile across BMI strata. Several reviews described higher LDL-C and non-HDL-C levels in PCOS women compared with BMI-matched controls, suggesting BMI-independent dyslipidaemia (22, 27, 31). Wild et al. (25) stated that dyslipidaemia is highly prevalent in women with PCOS, affecting up to 70% of patients in the United States. The most common lipid pattern is the atherogenic lipoprotein phenotype, characterized by hypertriglyceridemia, low HDL-C, and increased small dense LDL particles. Wekker et al. (7) reported a mean difference in total cholesterol of 7.14 mg/dL and a lower HDL cholesterol level by -2.45 mg/dL in women with PCOS, while no significant differences were observed for LDL cholesterol or triglycerides. On the other hand, Osibogun et al. (22) reported higher LDL cholesterol by +9.2 mg/dL and higher non-HDL cholesterol by +16.3 mg/dL in women with PCOS compared with BMI-matched controls. A prospective study with a duration of 18 years found a twofold increase in incidence of dyslipidaemia in PCOS patients (31). Several studies noted that lipid abnormalities were more pronounced among obese women, although adverse lipid profiles were also observed in lean women with PCOS (25).

1.d. Metabolic syndrome

Metabolic syndrome is defined as elevated blood pressure (BP) (≥130/85 mm Hg), increased waist circumference (≥88 cm, non-Asian; ≥80 cm, East/South Asian women), elevated fasting glucose (≥100 mg/dl), reduced HDL-C (≤50 mg/dl in women), and elevated triglyceride (≥150 mg/dl) levels. It was consistently more prevalent among women with PCOS. The prevalence of metabolic syndrome in PCOS ranged from 33% to 46% across studies (27, 32). A meta-analysis cited within included reviews demonstrated higher odds of metabolic syndrome in PCOS (OR = 2.88), which persisted in BMI-matched populations (OR = 2.20) (22). Wild et al. (25) suggested that in women with classic PCOS, prevalence of metabolic symptoms is two or three times higher than in women without PCOS. Several studies emphasized that central or abdominal adiposity, rather than BMI alone, was strongly associated with metabolic syndrome, including among lean women with PCOS (25, 26, 32).

Table 6: Cardiometabolic disease and risk factors

Outcome	Key quantitative findings	BMI-related pattern
Insulin resistance	Prevalence 60–80% overall (24-28)	Present across BMI strata; higher prevalence with obesity; up to 95% in obese PCOS patients; ~75% in lean PCOS patients
Impaired glucose tolerance	OR 2.54 in BMI-matched analyses (22)	Persists after BMI matching
Type 2 diabetes mellitus	RR 3.00 (95% CI 2.56–3.51); up to 40% by fourth decade (7, 22)	Higher absolute risk with obesity, present in lean PCOS patients
Hypertension	RR 1.75; prevalence 65% vs 41% controls (7, 22, 27, 29)	Independent of BMI; obesity increases prevalence
Dyslipidaemia	TC +7.14 mg/dL; HDL −2.45 mg/dL; LDL +9.2 mg/dL (7, 22, 31)	Present in BMI-matched cohorts; possibly more pronounced with obesity
Metabolic syndrome	Prevalence 33–46%; OR 2.88 (BMI-matched OR 2.20) (22, 27, 32)	Central adiposity important even in lean PCOS patients

2. Clinical cardiovascular events

2.a. Composite cardiovascular disease

Several meta-analyses reported increased odds or incidence of composite cardiovascular disease (CVD) in women with PCOS, with effect estimates ranging from OR 1.30-1.68 (33-35). Tay et al. (35) further assessed the incidence rate for composite cardiovascular disease among PCOS women, reporting a rate of 1.40, indicating a 40% higher rate of new cardiovascular events over time in women with PCOS compared to their healthy counterpart.

Conversely, Wekker et al. (7) could not find any statistically significant difference in the composite outcome rate for non-fatal cardiovascular events in women with PCOS compared to their healthy counterpart. In a narrative review by Guan et al. (27) mixed results were found in studies assessing CVD in PCOS. Some studies found positive associations between PCOS and CVD, where other studies found no statistically significant difference in results with high heterogeneity among the included studies. Discrepancies were found in age-stratified analyses. Ramezani et al. (30) reported a higher prevalence of cardiovascular events among reproductive-aged women with PCOS, with an odds ratio of 1.43, while no significant difference was observed among menopausal or aging women.

2.b. Coronary artery disease and myocardial infarction

Several studies further examined the relationship between PCOS and coronary heart disease. Increased risk was reported for myocardial infarction and ischemic heart disease in different review studies including pooled analyses (34, 35), whereas other meta-analyses did not demonstrate a significant association after adjustment for BMI or metabolic comorbidities (7, 33). Zhang et al. (34) reported increased odds for myocardial infarction with an odds ratio of 2.57 and ischemic heart disease with an odds ratio of 2.77. Tay et al. (35) concluded, based on pooled results from a meta-analysis of prevalence studies, that women with PCOS have significantly increased odds of ischemic heart disease (OR = 1.48) and myocardial infarction (OR = 2.50).

In contrast, Wekker et al. (7) conducted meta-analysis including 9 prospective and 14 retrospective cohort studies, where they found no significant association with coronary events, even after BMI adjustment. Zhao et al. (33) reported a significant association between PCOS and coronary heart disease with an odds ratio of 1.44, while no association was observed for myocardial infarction (OR = 1.01).

2.c. Cerebrovascular events

Several meta-analyses reported an increased stroke risk in women with PCOS (7, 34-36). Wekker et al. (7) analysed 8 studies (2 prospective and 6 retrospective studies) for assessment of non-fatal cerebrovascular events. They found a positive association of PCOS and non-fatal cerebrovascular disease in the included retrospective studies. This study reported an increased risk of cerebrovascular events with an odds ratio of 1.41. Another meta-analysis of cohort studies from Zhang et al. (34) investigated the relation between PCOS and stroke events and found that the PCOS group had an increased risk of stroke (OR = 1.96). Zhou et al. (36) found a significantly increased risk of stroke in patients with PCOS (OR = 1.36). After further adjustment for BMI, the results still showed a 24% increased risk of stroke. Notably, this study showed that an increased risk of stroke persisted in women with PCOS younger than 50 years old (36).

2.d. Fatal cardiovascular events and mortality

Across all included cohort studies and meta-analyses, no statistically significant increase in cardiovascular mortality or all-cause mortality was observed among women with PCOS. Reported pooled estimates for cardiovascular mortality included odds ratios of 1.14, with consistent null findings across BMI categories and reproductive stages (7, 30, 34-36).

Table 7: Clinical cardiovascular events

Outcome	Effect estimates	BMI/age dependency
Composite CVD	OR 1.30–1.68; IRR up to 1.40 (33-35)	Some persistence after BMI adjustment; heterogeneity noted
Myocardial infarction	OR up to 2.57 in pooled analyses (7, 33-35)	Attenuated in some BMI-adjusted analyses
Coronary heart disease	OR 1.44–2.77 (33, 34)	Variable after BMI adjustment
Stroke	OR 1.36–1.96 (7, 34-36)	Residual risk +24% after BMI adjustment, stronger association in women <50 years old
Cardiovascular mortality	OR 1.14 (non-significant) (7, 30, 34-36)	No BMI effect observed
All-cause mortality	No significant association (7, 34, 36)	Consistent across BMI categories

Although not a primary focus of this review, several studies reported increased prevalence of subclinical cardiovascular abnormalities in women with PCOS. These included elevated inflammatory markers (e.g., C-reactive protein) and markers of subclinical atherosclerosis such as coronary artery calcification, carotid intima–media thickness, endothelial dysfunction, and arterial stiffness, with some findings persisting after BMI adjustment (22, 24-26, 28, 32, 37). These outcomes were not included in the primary synthesis due to the focus on clinically relevant endpoints in primary care.

Effect of preventive measures and medication based treatment on cardiovascular health outcomes in patients with PCOS

1. Non-Pharmacological Treatments

1.a. Diet

Within lifestyle interventions, dietary modification plays a central role. Nutritional analyses in women with PCOS have shown a pattern of high intake of saturated fats, cholesterol, and simple sugars, combined with a low intake of fiber and micronutrients. These findings support recommendations to reduce simple carbohydrates and saturated fats, while increasing fiber intake and ensuring a balanced macronutrient composition (38).

Several dietary approaches have been investigated, including DASH (Dietary Approaches to Stop Hypertension), low-glycemic-index (GI), and calorie-restricted diets. These interventions

were consistently associated with weight reduction, improved insulin sensitivity, better hormonal balance, enhanced menstrual regularity and ovulatory function, and improvements in cardiovascular and inflammatory parameters (38, 39). Although ketogenic diets have also been explored, current evidence does not demonstrate superiority over other calorie-restricted diets, and concerns regarding restrictiveness and mental well-being have been raised (38).

Importantly, even modest weight loss (approximately 5% of initial body weight) has been shown to improve lipid profiles, carbohydrate metabolism, insulin levels, and overall cardiometabolic health (38). Consequently, multiple guidelines and consensus statements identify dietary modification as a cornerstone in the management of PCOS and in reducing cardiovascular risk (25, 26, 28, 35).

More than 50% of women with PCOS are overweight or obese, largely due to decreased insulin sensitivity and impaired glucose tolerance, with a tendency toward central adiposity. Increased visceral fat is associated with reduced sex-hormone-binding globulin (SHBG) levels and elevated androgen production, contributing to greater disease severity. Compared to women without PCOS, obese women with PCOS have a higher risk of metabolic abnormalities and cardiovascular disease (7, 30, 32, 40). Treating obesity is therefore crucial, given its strong association with insulin resistance and cardiometabolic risk factors (22, 27, 40, 41).

1.b. Exercise

Regular physical activity, including aerobic exercise, resistance exercise and combined training, was associated with improvements in metabolic parameters in women with PCOS. Reported outcomes included reductions in BMI and waist circumference, improved insulin sensitivity, modulation of hormonal parameters, enhanced menstrual regularity, metabolic function and improvements in quality of life. Among the exercise modalities evaluated, aerobic exercise was more frequently associated with favourable outcomes in women with PCOS. Continuous aerobic training and intermittent aerobic training demonstrated comparable effectiveness in reducing anthropometric measures and hyperandrogenism (39, 42).

Evidence from dietary interventions indicated that energy-restricted diets leading to weight loss improved cardiometabolic outcomes in overweight and obese women with PCOS. The addition of regular aerobic or combined aerobic-resistance exercise did not further enhance hormonal, metabolic, or reproductive outcomes, but did contribute to more favourable changes in body composition (43). Other lifestyle factors such as sleep regulation, supplementation, and microbiota modulation were identified in the literature (42), but fall outside the scope of this review.

2. Pharmacological Treatments

Pharmacological interventions addressing cardiovascular and cardiometabolic risk in women with PCOS were evaluated in meta-analyses, randomized controlled trials (RCTs), narrative reviews, and international evidence-based guidelines (25, 35, 38, 40, 44-47). Medications assessed included insulin sensitizers (primarily metformin), lipid-lowering agents (statins), anti-obesity drugs (orlistat, GLP-1 receptor agonists), and emerging therapies such as sodium-glucose cotransporter-2 (SGLT2) inhibitors (48, 49). The importance of pharmacological intervention in this population is underscored by systematic reviews and meta-analyses demonstrating that PCOS is associated with an increased risk of coronary heart disease,

stroke and all-cause mortality, coronary artery calcification, and long-term cardiometabolic disease (7, 30, 32-34, 36, 37).

PCOS has been recognised as a female-specific risk-enhancing factor for cardiovascular disease (27, 41), and the role of chronic inflammation in mediating cardiovascular risk in this population has been highlighted (24). Several authors have emphasised the need for early cardiovascular risk assessment and targeted prevention strategies in women with PCOS (22, 25, 28, 29, 31).

2.a. Metformin

Women with PCOS have an increased risk of prediabetes, type 2 diabetes mellitus (Type 2 DM), and cardiovascular disease, partly independent of obesity (7, 30, 32). Metformin is widely used in women with PCOS, particularly in those with insulin resistance, impaired glucose tolerance, or other metabolic dysfunctions, although this remains an off-label indication (26, 40, 45, 46). Evidence supports the use of metformin in reducing the risk of progression to Type 2 DM, lowering serum androgen levels, and improving dyslipidaemia, particularly in obese women with PCOS (40, 45).

Metformin has demonstrated improvements in cardiometabolic risk markers relevant to cardiovascular health in women with PCOS. Meta-analytic evidence showed significant reductions in fasting insulin, fasting glucose, insulin resistance (HOMA-IR), body mass index (BMI), waist-to-hip ratio, and circulating androgen levels (28, 29, 31, 38, 44, 46).

In another narrative review, metformin has been shown to improve body mass index (BMI), metabolic parameters (e.g blood glucose concentrations, lipid profile), and menstrual regularity, especially in women with a BMI greater than 25 kg/m² (46).

A review of 44 randomized control trials (RCTs) reported significant unadjusted results favouring treatment with metformin, describing statistically significant random effect sizes (ES) for body mass index (BMI) (ES of 0.58), waist to hip ratio (ES of 0.02), low-density-lipoprotein cholesterol (LDL-C) (ES of 0.11), fasting insulin (ES of 2.82) and fasting glucose (ES of 0.10) (44).

2.b. GLP-1 Receptor Agonists

Treatment with GLP-1 receptor agonists in women with PCOS was associated with significant reductions in body weight, BMI and waist circumference (38, 40, 46). Improvements in glycaemic parameters, including fasting glucose, insulin levels and HOMA-IR, were reported in several studies, although results varied across interventions. Semaglutide demonstrated the largest mean weight reduction, with approximately 80% of obese women with PCOS achieving over 5% weight loss after three months of treatment, alongside improvements in insulin resistance, even in those unresponsive to lifestyle interventions (38).

2.c. Statins

Patients with PCOS frequently have metabolic abnormalities, such as dyslipidaemia, insulin resistance, and obesity. These anomalies may serve as significant risk factors, raising the likelihood of type 2 diabetes, heart disease, and stroke. Elevated levels of low-density lipoprotein (LDL) and triglycerides, low levels of high-density lipoprotein (HDL), and elevated concentrations of total cholesterol and lipoproteins are the hallmarks of dyslipidaemia, which

together contribute to a high CVD risk profile. Therefore, a successful PCOS treatment would include reducing cardiovascular morbidity and improving the lipid profile (40, 49).

Evidence on statin use in women with PCOS is derived primarily from randomized controlled trials and meta-analyses summarized in narrative reviews. Statin therapy has been associated with reductions in circulating androgen levels, including total and free testosterone, dehydroepiandrosterone sulfate (DHEAS), androstenedione, luteinizing hormone (LH), and the LH/FSH ratio, as well as improvements in lipid parameters and inflammatory markers (28, 40, 45, 49).

Kolnikaj et al. (49) reports on eight randomized controlled trials evaluating the effects of statin therapy on androgen levels in women with PCOS, with sample sizes ranging from 20 to 97 participants and follow-up periods between 6 weeks and 6 months. An included meta-analysis demonstrated that statin therapy, administered alone or in combination with metformin, was associated with significant reductions in total cholesterol, LDL cholesterol, triglycerides, fasting glucose, insulin sensitivity index, and high-sensitivity C-reactive protein. Another meta-analysis comparing simvastatin-metformin combination therapy with metformin monotherapy reported significant reductions in cholesterol and triglycerides in the combination group, although no significant differences were observed in HDL cholesterol, fasting glucose, or insulin sensitivity index (49).

Other placebo-controlled trials reported that atorvastatin reduced insulin resistance, inflammatory markers, and hyperandrogenaemia compared with placebo, and that atorvastatin pre-treatment enhanced subsequent improvements in HOMA-IR, free androgen index, total testosterone, and sex hormone-binding globulin following metformin therapy (40). However, other studies reported mixed metabolic effects, with simvastatin showing improvements in insulin resistance and endothelial function, while atorvastatin improved lipid and inflammatory markers, but was associated with worsening insulin sensitivity in some cohorts (45).

2.d. Sodium-Glucose Cotransporter-2 Inhibitors

Sodium-glucose cotransporter-2 (SGLT2) inhibitors were evaluated as a potential therapeutic option for addressing cardiometabolic risk factors associated with PCOS. These agents lower plasma glucose via insulin-independent inhibition of renal glucose reabsorption, reducing hypoglycaemia risk. In patients with Type 2 DM, they improve glycaemic control, reduce body weight (2-4 kg, predominantly fat mass), and confer cardiovascular and renal protection (40, 48).

Pruett et al. (48) reported on three clinical trials evaluating the effects of SGLT2 inhibitors in women with PCOS, with sample sizes ranging from 20 to 92 participants and treatment durations between 2 and 24 weeks. Empagliflozin administered for 12 weeks was associated with reductions in body weight, BMI, and fat mass. A 24-week trial of dapagliflozin demonstrated additive reductions in body weight and fat mass when combined with a GLP-1 receptor agonist (40, 48). In a short-term 2-week study, licogliflozin treatment was associated with reductions in insulin resistance and DHEAS levels (48).

Table 8 below summarizes the results obtained concerning pharmacological treatment options for patients with PCOS.

Table 8: Summary of pharmacological treatment options for PCOS

Pharmacological Class	Key Agents	Metabolic Outcomes	BMI-Related Pattern
Metformin	Metformin	↓ fasting glucose, ↓ fasting insulin, ↓ HOMA-IR, ↓ BMI, ↓ WHR, ↓ LDL-C; Improved lipid profile and reduced risk of progression to T2DM (26, 28, 29, 31, 38, 40, 44-46)	Effective in obese women and adolescents
GLP-1 receptor agonists	Semaglutide, liraglutide	↓ body weight, ↓ BMI, ↓ waist circumference; Improvements in insulin resistance and glycaemic parameters (22, 24, 27, 29, 31, 38, 40, 46)	Primarily used in obese women with PCOS; semaglutide showed greatest weight reduction, including in lifestyle-resistant cases
Statins	Atorvastatin, simvastatin	↓ LDL-C, ↓ triglycerides, ↓ inflammatory markers; Mixed effects on insulin sensitivity (24, 28, 40, 45, 49)	The effects of statins on BMI where not included in the scope of the reported studies
SGLT2 inhibitors	Empagliflozin, dapagliflozin, licogliflozin	↓ body weight, ↓ BMI, ↓ fat mass, ↓ insulin resistance (29, 31, 40, 48)	Significant weight loss was reported in overweight women with PCOS

Discussion

Main results

This systematic review demonstrates that polycystic ovary syndrome (PCOS) is consistently associated with an adverse cardiometabolic profile and an increased risk of cardiovascular disease (CVD), although the magnitude of these associations varies across studies. Collectively, evidence across multiple domains, including insulin resistance, dyslipidaemia, hypertension, metabolic syndrome, and clinical cardiovascular outcomes, indicates that PCOS represents a condition of increased cardiovascular risk that is only partially explained by traditional risk factors such as obesity (7, 22, 25, 27, 35).

Across the included studies, women with PCOS consistently exhibited a higher prevalence of cardiometabolic risk factors compared with women without PCOS, and these associations were frequently observed across BMI categories. Insulin resistance, impaired glucose tolerance, and Type 2 DM were among the most consistently reported metabolic abnormalities (7, 22, 25, 26, 28). The presence of insulin resistance in both obese and lean populations supports the concept that metabolic dysfunction is a central feature of PCOS rather than merely a consequence of excess body weight (25, 27, 28). Although obesity amplifies these abnormalities, the persistence of increased risk in BMI-matched and lean populations suggests that PCOS itself contributes independently to impaired glucose metabolism (7, 22). Nevertheless, variation in prevalence estimates across studies likely reflects differences in PCOS phenotypes, diagnostic criteria, and the absence of standardized measures for insulin resistance (7, 26).

A similar pattern is observed for dyslipidaemia, which is consistently characterized by an atherogenic lipid profile, including elevated triglycerides, reduced HDL cholesterol, and qualitative alterations in LDL particles (22, 25, 27). While these abnormalities are more pronounced in women with obesity, they are also evident in lean women with PCOS, further supporting a BMI-independent component (22, 32). Variability in lipid parameters across studies likely reflects heterogeneity in population characteristics, such as fat distribution and hyperandrogenic phenotypes, as well as methodological differences in lipid assessment and adjustment for metabolic confounders (22, 25, 32).

Hypertension is also more frequently reported among women with PCOS, with several studies demonstrating elevated blood pressure independent of BMI (22, 27, 29). However, the strength of this association varies across studies, suggesting the influence of modifying factors. In particular, age and reproductive status appear important, with stronger associations observed in premenopausal women and attenuation after menopause (27, 29). Additional heterogeneity may arise from differences in PCOS phenotype and diagnostic criteria.

Consistent with these findings, metabolic syndrome is more prevalent in women with PCOS, with evidence suggesting an approximately two- to threefold higher prevalence compared with controls (22, 25). Although this association persists across BMI categories, central or abdominal adiposity appears to be a more important determinant of risk than overall BMI (25, 26, 32). Geographic and ethnic differences, as well as variation in diagnostic definitions of

metabolic syndrome and PCOS, likely contribute to differences in reported prevalence across studies (22, 25).

These cardiometabolic abnormalities reflect underlying pathophysiological processes that may contribute to early, subclinical vascular alterations prior to clinically evident cardiovascular disease. Insulin resistance and compensatory hyperinsulinemia are associated with endothelial dysfunction and reduced nitric oxide availability, while chronic low-grade inflammation may promote early atherosclerotic changes (24, 28). In addition, hyperandrogenism and central adiposity may further exacerbate adverse vascular profiles (25, 28, 32). Evidence from studies assessing subclinical cardiovascular markers, including coronary artery calcification and vascular function, supports the presence of early vascular changes even in the absence of clinical events and across BMI categories. However, the extent to which these alterations translate into increased clinical cardiovascular risk remains uncertain.

In line with these mechanistic and subclinical findings, evidence regarding clinical cardiovascular outcomes generally supports an increased risk of CVD in women with PCOS, although results are heterogeneous. Most meta-analyses report higher odds and incidence of composite cardiovascular disease, but not all studies demonstrate statistically significant associations (33-35). Differences in study design contribute substantially to these discrepancies, with positive associations more frequently observed in prospective and case-control studies compared with retrospective analyses (33). Moreover, shorter follow-up durations and the inclusion of younger populations may limit the detection of cardiovascular events, which typically occur later in life (7, 35).

The association between PCOS and coronary heart disease and myocardial infarction is less consistent. While several studies report increased risks, others do not demonstrate significant associations after adjustment for BMI and metabolic comorbidities (7, 33-35). This suggests that traditional cardiovascular risk factors may partially mediate the relationship, although a degree of residual risk may persist independent of these factors. Variability in outcome definitions, statistical approaches, and population characteristics further contributes to heterogeneity across studies.

In contrast, the relationship between PCOS and cerebrovascular events, particularly stroke, appears more consistently positive, although effect sizes vary (7, 34-36). Some studies report persistent associations after adjustment for BMI, whereas others show attenuation, indicating that both PCOS-specific mechanisms and traditional risk factors likely contribute to cerebrovascular risk (36). Interpretation of long-term risk remains limited by the underrepresentation of older women and variability in diagnostic criteria (7, 36).

From a clinical perspective, both preventive and pharmacological interventions appear to improve cardiovascular health in women with PCOS. However, current evidence is insufficient to conclude that these strategies reduce hard cardiovascular outcomes such as morbidity and mortality. While both approaches consistently improve cardiometabolic risk factors, the available literature is largely limited to short-term studies assessing surrogate markers rather than long-term cardiovascular endpoints.

Lifestyle modification remains the first-line intervention in women with PCOS (25, 35, 38, 39, 42). Dietary approaches, including DASH, low-glycaemic-index, and calorie-restricted diets, have been shown to improve body weight, insulin sensitivity, lipid profiles, and inflammatory parameters, all of which are key determinants of cardiovascular risk (38, 39). Notably, even modest weight loss of approximately 5% is associated with significant improvements in metabolic health (38, 39). Regular physical activity further improves insulin resistance, body composition, and hormonal parameters, contributing to an overall reduction in cardiometabolic risk (39, 42). The combination of dietary modification and exercise appears to yield the most consistent benefits, and lifestyle interventions may be more effective than metformin alone in preventing progression to Type 2 DM (40). However, despite these favourable effects on surrogate markers, evidence on long-term cardiovascular outcomes remains limited, with most studies characterized by small sample sizes and short follow-up durations (39, 42, 43).

Pharmacological interventions target underlying metabolic dysfunction and may provide additional improvements in cardiovascular risk factors. Metformin, the most widely used insulin-sensitizing agent, has demonstrated consistent benefits in insulin resistance, fasting glucose, lipid profiles, and androgen levels (40, 44, 46), particularly in overweight and obese women. However, its effects on lipid parameters, especially total cholesterol, are inconsistent, and its metabolic benefits may diminish after discontinuation (40). Current guidelines recommend metformin primarily for women with impaired glucose tolerance or Type 2 DM rather than for universal cardiovascular prevention in PCOS (45, 46). No studies have demonstrated a reduction in long-term cardiovascular events with metformin in this population (44).

GLP-1 receptor agonists show promising effects, particularly in achieving significant weight loss and improving insulin resistance, with semaglutide demonstrating superior efficacy compared with other agents (38, 40). Given the central role of obesity in PCOS-related cardiovascular risk, these agents may confer indirect cardiovascular benefits. However, long-term safety and cardiovascular outcome data in women with PCOS remain limited (46).

Statins have been associated with improvements in lipid profiles, inflammatory markers, and androgen levels (40, 49), although their effects on insulin sensitivity and glucose metabolism are inconsistent (45). Evidence regarding combined statin-metformin therapy is conflicting, and current recommendations for statin use in PCOS outside standard cardiovascular indications remain unclear (45, 49).

Finally, SGLT2 inhibitors represent an emerging therapeutic option, demonstrating favourable effects on weight, glycaemic control, and insulin resistance in small, short-term studies (40, 48). However, evidence remains limited, and their role in PCOS management has yet to be established.

Across all outcomes, several sources of heterogeneity should be considered. Differences in study design, including retrospective versus prospective approaches and variation in follow-up duration, influence the detection of both metabolic and clinical outcomes (7, 33). In addition, heterogeneity in PCOS diagnostic criteria and phenotype classification limits comparability across studies (7, 27, 35). Differences in adjustment for confounding factors, particularly BMI and metabolic comorbidities, further affect the magnitude of observed associations (7, 22, 33). Population characteristics, including age distribution, menopausal status, and ethnicity, also

play an important role in modifying risk estimates (7, 25, 35). Finally, variability in outcome definitions and statistical methodologies contributes to inconsistent findings (34, 35).

Study limitations

The inclusion of studies with varying quality and reliability, including narrative reviews, may introduce variability in the quality of synthesized evidence. Due to substantial heterogeneity, quantitative synthesis was not feasible and findings were summarized narratively, which may limit the precision of effect estimates. Although BMI was a key focus, not all studies provided adequate BMI-adjusted or stratified analyses. Furthermore, the emphasis on clinically relevant outcomes for primary care, with limited inclusion of subclinical markers, may underestimate early cardiovascular changes associated with PCOS. Finally, potential publication and language bias cannot be excluded, as the review relied on published literature and may have missed relevant unpublished or non-indexed studies.

Implications for research and primary care practice

This review synthesizes current evidence on cardiovascular risk in PCOS, with a focus on clinically relevant outcomes and the role of BMI, highlighting that increased cardiometabolic risk is not confined to women with obesity.

These findings highlight a gap between existing evidence and clinical practice, particularly the underdiagnosis and delayed recognition of PCOS despite its cardiometabolic implications. A predominant focus on reproductive features may contribute to underrecognition in women presenting with metabolic abnormalities, especially in primary care settings. In primary care, these findings support a more proactive approach to PCOS recognition and cardiovascular risk assessment. Early identification of at-risk individuals may allow timely preventive interventions.

Future research should focus on improving early detection strategies in primary care, including standardized diagnostic approaches and risk-based screening models that reflect the heterogeneity of PCOS and its cardiometabolic manifestations.

Conclusion

This systematic review shows that PCOS is consistently associated with an adverse cardiometabolic profile and should be considered a cardiovascular risk-enhancing condition. Women with PCOS have a higher prevalence of insulin resistance, type 2 diabetes, hypertension, dyslipidaemia, and metabolic syndrome, independent of BMI. Evidence indicates a modestly increased risk of composite cardiovascular disease and stroke, while findings for coronary heart disease, myocardial infarction, and mortality remain inconsistent.
Both lifestyle and pharmacological interventions improve cardiometabolic parameters, with lifestyle modification as the cornerstone of management. Pharmacological options such as metformin, GLP-1 receptor agonists, and SGLT2 inhibitors provide additional benefits in insulin sensitivity, glycaemic control, and weight reduction, though their effects on lipid and inflammatory markers are more limited. However, the current evidence base is constrained by heterogeneity, small sample sizes, reliance on surrogate outcomes, and short follow-up durations, limiting conclusions about long-term cardiovascular outcomes.

In primary care, early recognition and systematic cardiovascular risk assessment are essential regardless of BMI. Management should be individualized and sustained over time, with pharmacological treatment targeted to higher-risk patients. Future research should focus on long-term studies assessing hard cardiovascular endpoints and on developing standardized screening and risk stratification strategies applicable in primary care.

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