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Prevalence of Acne Vulgaris Among Women with Polycystic Ovary Syndrome: A Systematic Review and Meta-Analysis

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Abstract

Background: Acne vulgaris is one of the most common dermatological conditions worldwide, particularly affecting women of reproductive age. It is often linked to underlying hormonal imbalances, including those seen in polycystic ovary syndrome (PCOS). PCOS is a prevalent endocrine disorder characterized by hyperandrogenism and insulin resistance, both of which contribute to acne vulgaris development.

This systematic review and meta-analysis aimed to estimate the global prevalence of acne vulgaris among women with PCOS and identify contributing factors, thereby highlighting the burden of this skin condition in the context of a common endocrine disorder.

Methods: In accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) and Meta-Analysis of Observational Studies in Epidemiology (MOOSE) guidelines, a systematic review of cross-sectional studies was conducted to assess the prevalence of acne vulgaris among women with PCOS. The literature search included studies published up to January 2025 and was performed in 5 major databases: PubMed, EMBASE, Scopus, Web of Science, and Google Scholar. Study selection was guided by the POLIS framework, focusing on women diagnosed with PCOS based on established criteria (Rotterdam, National Institute of Health [NIH], or Androgen Excess Society [AES]). Only cross-sectional studies reporting the prevalence of acne vulgaris in this population were included. A random-effects (REM) meta-analysis was performed using data from 95 eligible studies. Subgroup analyses were conducted based on geographical region, age, body mass index (BMI), PCOS diagnostic criteria, and acne vulgaris severity to explore sources of heterogeneity.

Results: As per the findings, acne vulgaris, the pooled prevalence of which was 49% (95% CI: 47%-52%), determined 95 studies, with high heterogeneity ($I^2 = 98.86\%$, $P = 0.04$) and evidence of publication bias ($P < 0.001$), remained the most frequent comorbidity in women with PCOS. However, after trim and fill adjustment, the prevalence fell to 37% (95% CI: 35%-39%). The subgroup analyses also revealed the prevalence of the highest in Oceania (76%, 95% CI: 69%-83%), whereas the prevalence of adolescents <18 years was 66%, 95% CI: 49%-81%, and less in Europe (32%, 95% CI: 28%-36%) and women >30 years (42%, 95% CI: 38%-46%), respectively. The rate was somewhat higher among women with a BMI ≤25 kg/m^2 (53%) in comparison with those with a BMI of >25 kg/m^2 (48%). Mild acne vulgaris scored the most (40%, 95% CI: 27%-53%) among the research participants.

Conclusion: The prevalence of acne vulgaris among women with PCOS varies widely across studies, with subgroup analyses revealing a range influenced by factors such as region, age group, and diagnostic criteria. These findings highlight the need for standardized diagnostic tools for PCOS and comprehensive management approaches that address hormonal, metabolic, and psychological aspects to improve outcomes for affected women.

Keywords: Polycystic Ovary Syndrome, Acne Vulgaris, Hyperandrogenism, Meta-Analysis, Evidence Synthesis

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↑What is "already known" in this topic:
Polycystic ovary syndrome (PCOS) is a prevalent endocrine disorder in women, often linked to acne vulgaris due to hyperandrogenism. Reported acne vulgaris prevalence in PCOS varies widely across studies.

→What this article adds:
This meta-analysis of 95 studies estimates that nearly half of women with PCOS experience acne vulgaris. It reveals variations by age, region, body mass index, and diagnostic criteria, highlighting the global burden. The findings call for standardized PCOS diagnosis and comprehensive care that addresses hormonal, metabolic, and dermatologic factors.

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Introduction

Acne vulgaris is a chronic inflammatory skin condition that affects the pilosebaceous unit and is especially common among adolescent and reproductive-age women. While acne vulgaris is often considered a cosmetic concern, it can lead to significant psychological distress and reduced quality of life. One of the critical underlying causes of acne vulgaris in women is hormonal imbalance, particularly the kind seen in polycystic ovary syndrome (PCOS). PCOS is a common endocrine disorder in women, marked by hyperandrogenism, ovulatory dysfunction, and polycystic ovarian morphology. It is frequently associated with infertility, irregular menstrual cycles, obesity, insulin resistance, and metabolic disturbances. These hormonal imbalances, especially elevated levels of luteinizing hormone (LH) and androgens, are key contributors to the development of acne vulgaris in affected women (1-3). PCOS not only affects physical health but also has a significant impact on mental well-being (4). Data from recent studies indicate a substantial increase in the number of women diagnosed with PCOS over the past decade, with a global prevalence estimated at 11% to 13%. In the United States, the prevalence rate is 5.2%, roughly 2 times the previous estimate and substantially higher than the rates documented in England (5-7). Studies by Pillay et al discovered that PCOS is notably more common among South Asian women, impacting 52% of this demographic, as opposed to 22% in predominantly White populations. Experts forecast that the incidence of PCOS will rise over the next 10 years (8, 9). Women with PCOS often experience a range of skin issues, including seborrhea, skin tags, androgenic alopecia, acanthosis nigricans, hirsutism, and acne (10). Acne vulgaris, also known as acne, is a chronic inflammatory condition that affects the hair follicles and sebaceous glands. Development is influenced by various hormonal factors, such as androgens, estrogens, corticosteroids, and insulin-like growth factor 1 (IGF-1) (11). Since the 1990s, there has been a steady rise in the number of adolescents and young adults experiencing acne, with higher rates seen in almost every country (12). Globally, the prevalence of acne is estimated at around 20.5%, with the highest rates (28.3%) occurring in individuals aged 16–24 (13). While acne can affect people at various stages of life, it is most commonly seen during adolescence (14). Several factors influence the severity and frequency of acne, including lifestyle choices like physical activity, demographic factors such as age and gender, dietary habits (eg, consumption of dairy and butter), family history, excessive sweating (hyperhidrosis), and stress (15, 16). Acne and hirsutism are both clinical signs of hyperandrogenism, which is a key characteristic of PCOS (17-19). In the general population, approximately 10% of women experience hirsutism, but this rate is even higher in those with acne or other signs of hyperandrogenism (20). Research by Alan et al found that women with acne are more likely to have increased levels of hyperandrogenism (21). However, it is essential to note that acne can also result from non-androgenic conditions (22).

Diagnosing PCOS in adolescents can be challenging because many of its symptoms overlap with the natural changes that occur during puberty. It requires careful evaluation of signs such as hyperandrogenism, hirsutism, severe acne, and menstrual irregularities after menarche. However, having polycystic ovaries alone, without other symptoms, should not be used as a diagnostic criterion. In postmenopausal women, there isn't a consistent set of symptoms to look for either (23-25). While many studies have been conducted on PCOS, the exact cause of the condition remains unclear (26-29). However, research suggests that insulin resistance (IR) and hyperandrogenism may play a significant role in its development (30). Androgens contribute to the enlargement of keratinocytes and sebaceous glands, increasing sebum production and abnormal keratinocyte growth, which leads to the formation of acne lesions (31). Acne vulgaris is one of the most common skin symptoms in women with PCOS, with a prevalence rate of 75.3% (10). This is not just a cosmetic issue; acne can lead to social withdrawal, depression, and low self-esteem (32-34). Interestingly, 2 studies found that 27.5% and 26.9% of women with acne were also diagnosed with PCOS (35, 36). In 2021, Ramezani Tehrani conducted a study on this topic, further exploring the connection between acne and PCOS (37).

Given the inconsistent findings in recent studies, an updated meta-analysis is warranted to clarify the prevalence of acne vulgaris among women with PCOS using the most up-to-date evidence. Understanding this association is essential for informing strategies aimed at improving the health and well-being of women affected by PCOS. This study aimed to estimate the prevalence of acne vulgaris in women with PCOS through a systematic review and meta-analysis. The findings are intended to support researchers, healthcare policymakers, clinicians, and specialists by enhancing awareness and guiding improved clinical care and resource planning for this population.

Methods

In this study, we adhered to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines in the search protocol (38), as well as the MOOSE (reporting guidelines of the Meta-Analysis of Observational Studies in Epidemiology) initiative (39). This study was registered in the PROSPERO database, and its protocol was accessible under the registration ID CRD42024584597.

Eligibility Criteria

This comprehensive review utilized the POLIS framework to inform the selection of studies evaluating the occurrence of acne in women with PCOS. The population included women diagnosed with PCOS according to established criteria like the Rotterdam, National Institute of Health (NIH), or Androgen Excess Society (AES) guidelines. The outcome of interest was the prevalence of acne vulgaris. The Location had no geographical restrictions and was accessible globally. The indicator (I) referred to

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standard diagnostic methods used in the included studies to confirm PCOS and acne. The study design was confined to analytical observational cross-sectional studies. Studies, case reports, and expert opinions without standardized diagnostic methods or precise prevalence estimates were excluded. No restrictions were placed on the publication dates of studies to enable the inclusion of all relevant research.

Information Sources

A systematic search was conducted up to January 2025 using international databases, including PubMed (Medline), EMBASE, Scopus, Web of Science, and Google Scholar. The search terms included "polycystic ovary syndrome," "acne," and "analytical observational studies." Grey literature, including conference abstracts, dissertations, and organization reports, was also searched.

Data Extraction

Data extraction focused on baseline characteristics necessary for prevalence estimation. Extracted information included author details, publication year, study location, sample size, diagnostic criteria for PCOS, participant age and BMI, acne prevalence and severity, and relevant methodological aspects. Longitudinal or follow-up data were not extracted, as the included studies were cross-sectional and the objective was to assess prevalence at baseline.

Risk of Bias and Quality Assessment

The methodological quality of the included studies was assessed using the Newcastle-Ottawa Scale (NOS) adapted for cross-sectional studies (40). Two researchers independently evaluated each study based on key domains, including selection of participants, comparability of study groups, and outcome assessment. Studies were classified into three categories based on their NOS scores: high quality (scores ≥7), moderate quality (scores 5-6), and low quality (scores ≤4). Discrepancies in scoring were resolved by discussion or consultation with a third reviewer. The NOS provides a standardized and validated tool for assessing the quality of observational studies included in meta-analyses.

Statistical Analysis

The pooled prevalence (percentage frequency) of acne vulgaris among women with PCOS was estimated using a random-effects meta-analysis, which accounts for both within-study and between-study variability. All statistical analyses were conducted using STATA version 18 (StataCorp), employing the Metaprop command, which is designed explicitly for meta-analysis of binomial data and provides variance stabilization via the Freeman-Tukey double arcsine transformation. This method allows accurate calculation of the 95% CIs around prevalence estimates. Statistical heterogeneity across studies was assessed using the I^2 statistic and Cochran's Q test. Heterogeneity was classified as low (I^2 = 0%-25%), moderate (26%-50%), high (51%-75%), or very high (>75%) (41, 42). $P < .10$ from the Q test was considered indicative of significant heterogeneity. Subgroup analyses were conducted to explore potential sources of heterogeneity. Stratifications were based on continent, age group (<18, 18-30, >30 years), BMI category (≤25 vs >25 kg/m²), diagnostic criteria for PCOS (Rotterdam, NIH, AES), year of publication (before and after 2015), and acne severity (mild, moderate/severe, severe with hirsutism). Publication bias was assessed using Egger's linear regression test, with statistical significance set at $P < 0.05$. When publication bias was detected, the Duval and Tweedie trim-and-fill method was applied to estimate the potential impact of unpublished studies on the pooled prevalence. All results are reported with corresponding 95% CIs, and findings are presented using forest plots for visual interpretation. Sensitivity analyses were also performed by excluding studies at high risk of bias to evaluate the robustness of the results.

Results

The database search initially identified 4599 records. After removing duplicates and clearly irrelevant records, 2368 studies remained for title and abstract screening. A total of 1482 studies were excluded based on title review, and 591 based on abstract review. The full texts of 295 articles were assessed for eligibility. Of these, 78 studies were excluded due to poor study design, defined as a lack of standardized diagnostic criteria for PCOS or acne, in-

Table 1. PECOT Framework, Eligibility Criteria, and Search Strategy

Category	Details
POLIS Framework	POLIS: Population – Women with PCOS (diagnosed by Rotterdam, NIH, or AES criteria) Outcome – Prevalence of acne vulgaris Location – Global Indicator – Standard diagnostic criteria for PCOS and acne Study design – Cross-sectional studies
Search Terms	"Polycystic ovary syndrome" AND " acne " AND "analytical observational studies"
Databases	PubMed (Medline), EMBASE, Scopus, Web of Science, and Google Scholar
Search Period	Up to January 2025
Inclusion Criteria	- Cross-sectional studies - Studies reporting the prevalence of Acne Vulgaris Among Women with Polycystic Ovary Syndrome - Full-text articles available in English - Studies reporting effect estimates (prevalence) with 95% Confidence Intervals
Exclusion Criteria	- Case reports, reviews, editorials, and conference abstracts - Studies not reporting effect estimates - Animal or in vitro studies

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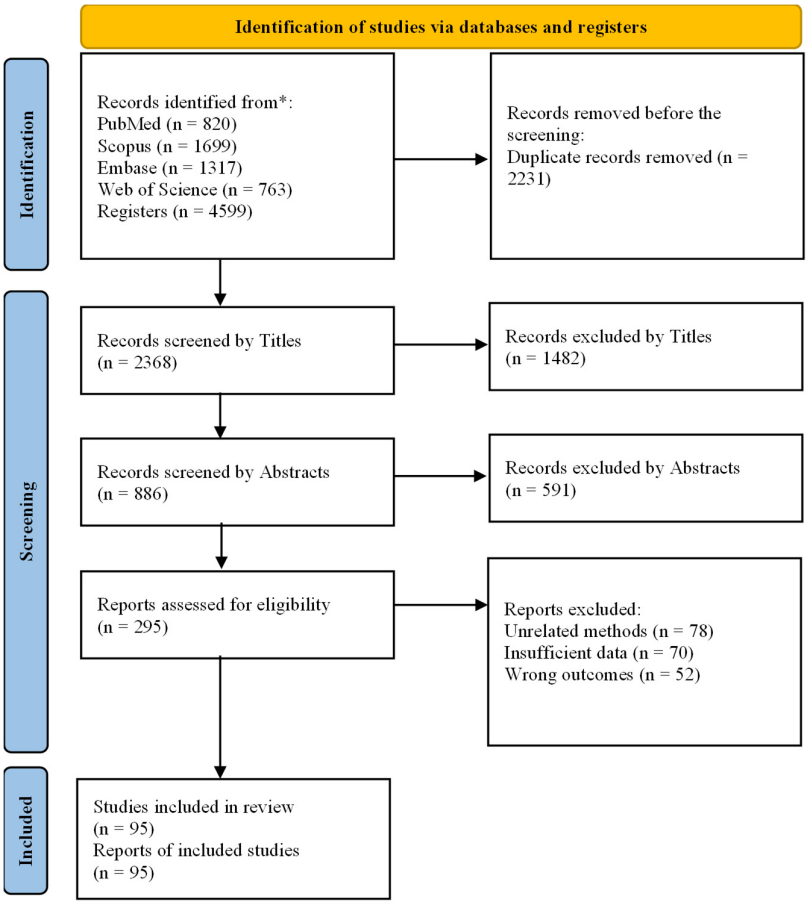

Figure 1. PRISMA 2020 flow diagram for new systematic reviews which included searches of databases and registers only

adequate population or sampling description, absence of prevalence data, or insufficient methodological detail. Additionally, 52 studies were excluded due to irrelevant outcomes, and 70 due to inadequate data for quantitative synthesis. A detailed breakdown of the excluded studies and reasons for exclusion is provided in Table 1. In total, 95 studies met the inclusion criteria and were included in the final systematic review and meta-analysis (Figure 1 and Appendix 1). The overall pooled prevalence of acne vulgaris among women with PCOS was 49% (95% CI: 47%-52%), based on 95 studies (Figure 2). A high degree of heterogeneity was observed across studies ($I^2 = 98.86\%$, $P = 0.04$), and publication bias was detected (B = 3.14, SE = 0.44, $P < 0.0001$). These results highlight the widespread occurrence of acne in this population and suggest the need for further research to identify sources of heterogeneity (Table 2). Further analysis using the trim-and-fill method adjusted the pooled prevalence estimate by imputing potentially missing studies. The observed pooled prevalence was 49% (95% CI: 47%-52%) based on 95 studies. After the trim-and-fill adjustment, the number of studies increased to 124, and the pooled prevalence was revised downward to 37% (95% CI: 35%-39%).

Risk of Bias Assessment

The quality of the included observational studies (95 studies) was evaluated using the NOS, which assesses 3 domains: selection of study groups (maximum 4 stars), comparability of groups (maximum 2 stars), and ascertainment of exposure or outcome (maximum 3 stars). Based on these criteria, the total NOS scores for the included studies ranged from 2 to 9, indicating a variation in methodological quality. Most studies scored between 7 and 9, suggesting moderate to high quality. Only a few studies received scores below 5, which indicates a higher risk of bias and lower methodological rigor. Studies with NOS scores of ≥7 were considered of acceptable quality for inclusion in meta-analyses and sensitivity analyses. NOS scores for each study are summarized in Appendix 1.

Subgroup Analyses

When analyzed by geographical region, significant variations in prevalence were noted. The prevalence of acne was highest in Oceania (76%, 95% CI: 69%-83%) with no significant heterogeneity ($I^2 = 0\%$, $P = 0.61$), while Europe reported the lowest prevalence (32%, 95% CI: 28%-36%) with high heterogeneity (I^2: 98.82%, $P < 0.0001$). Asia and America reported similar prevalence rates of

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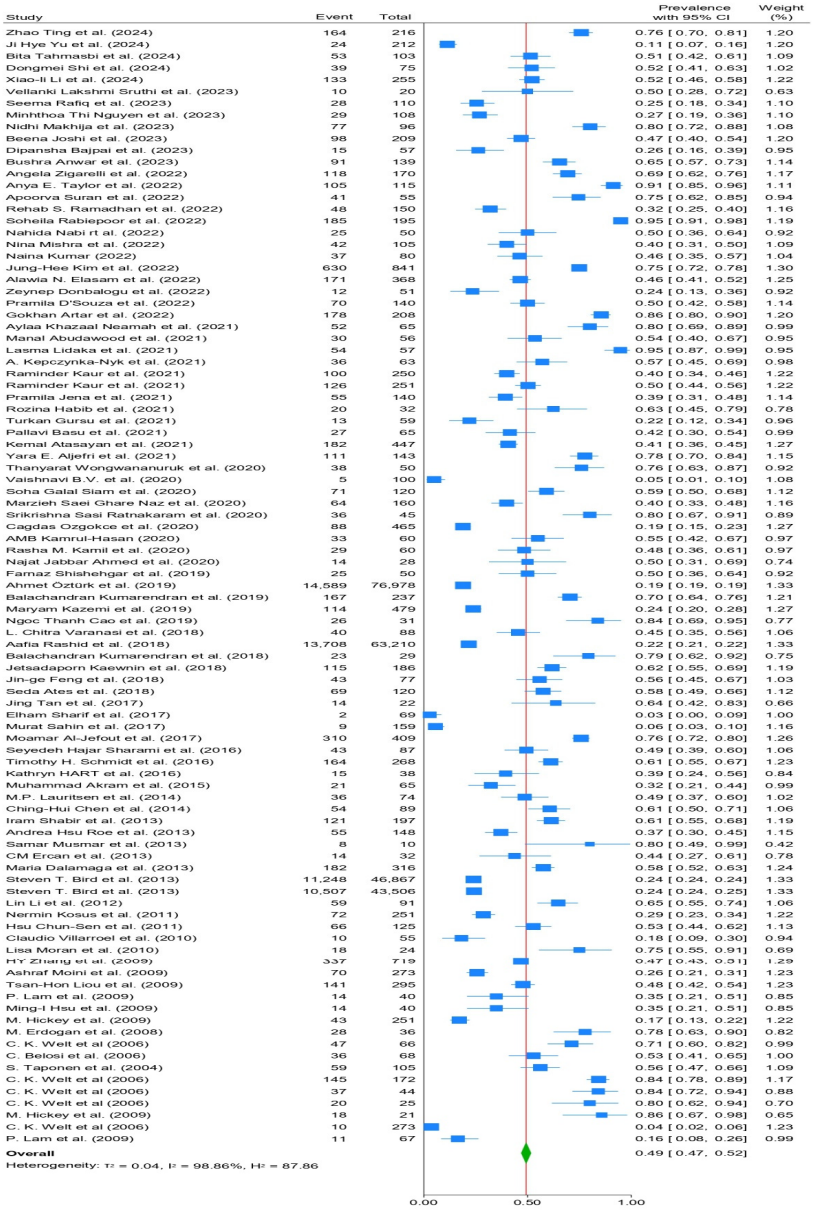

Figure 2. Forest plot of Overall Prevalence of Acne in Women with Polycystic Ovary Syndrome (PCOS)

50% (95% CI: 44%-56%) and 54% (95% CI: 49%-59%), respectively, whereas Africa reported 46% (95% CI**:** 41%-52%). These differences may reflect variations in genetics, environmental factors, diagnostic practices, or healthcare access across continents (Table 2).

BMI stratification revealed a slightly higher prevalence of acne among women with a BMI ≤25 kg/m^2 (47%, 95% CI: 43%-51%) compared to those with a BMI of >25 (49%, 95% CI: 47%-52%). Despite the observed differences, heterogeneity remained significant in both subgroups (I^2: 99.03% and I^2: 98.55%, respectively). This finding suggests that acne in PCOS may not be entirely dependent on body mass but could be influenced by other factors, such as hormonal profiles or metabolic conditions.

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Table 2. Overall Prevalence of Acne in Women with Polycystic Ovary Syndrome (PCOS) and Assessment of Heterogeneity and Publication Bias by Geographical Region, BMI, Age, and PCOS diagnostic criteria

Variable	Category	No. study	Pooled Prevalence (% 95 CI)	Heterogeneity assessment between studies		Publication bias assessments		
				I^2	P-value	B	SE	*P* value
Overall		95	49% (47% - 52%)	98.86	0.04	3.14	0.44	<0.001
Continent	Asia	66	50% (44% - 56%)	97.09	<0.0001			
	America	15	54% (49% - 59%)	98.99	<0.0001			
	Africa	1	46% (41% - 52%)	-	-			
	Europe	9	32% (28% - 36%)	98.82	<0.0001			
	Oceania	4	76% (69% - 83%)	0.00	0.61			
BMI	≤ 25	25	47% (43% - 51%)	99.03	<0.0001			
	> 25	70	49% (47% - 52%)	98.55	<0.0001			
Age	< 18	9	66% (49% - 81%)	95.45	<0.0001			
	18-30	62	50% (46% - 54%)	98.59	<0.0001			
	> 30	24	42% (38% - 46%)	99.03	<0.0001			
PCOS diagnostic criteria	Rotterdam	60	48% (45% - 51%)	98.84	<0.0001			
	Other	13	56% (41% - 71%)	97.65	<0.0001			
	AES	3	45% (20% - 72%)	97.21	<0.0001			
	NIH	10	32% (28% - 35%)	79.69	<0.0001			
Year	≤ 2015	31	45% (42% - 49%)	97.96	<0.0001			
	> 2015	64	51% (47% - 55%)	99.03	<0.0001			

Age also played a significant role in acne prevalence. Adolescents aged <18 years showed the highest prevalence (66%, 95% CI: 49%-81%), followed by women aged 18-30 years (50%, 95% CI: 46%-54%) and those aged >30 years (42%, 95% CI: 38%-46%). The gradual decline in prevalence with age could be due to hormonal stabilization and reduced androgen activity in older women. These results underscore the importance of age-specific management strategies for acne in women with PCOS.

PCOS diagnostic criteria influenced prevalence estimates. Studies using the Rotterdam criteria reported a prevalence of 48% (95% CI: 45%–51%), while those employing other criteria, including AES (45%, 95% CI: 20%–72%) and NIH (32%, 95% CI: 28%–35%), reported lower rates. These variations might reflect differences in the populations included and the broader scope of the Rotterdam criteria.

The prevalence of PCOS has varied in different years. The results showed that its prevalence before and after 2015 was 45% (95% CI: 42%-49%) and 51% (95% CI: 47%-55%), respectively. This difference could indicate changes and advances in diagnostic methods after 2015.

Risk factor analyses further highlighted variability in acne severity. Mild acne was reported in 40% (95% CI: 27%-53%) of cases, while severe acne was less common (8%, 95% CI: 5%-10%). Moderate/severe acne and acne associated with hirsutism showed pooled prevalences of 23% (95% CI: 11%-36%) and 39% (95% CI: 22%-57%), respectively. The significant heterogeneity in these subgroups underscores the complexity of acne pathophysiology in PCOS, influenced by hormonal, metabolic, and genetic factors (Table 3).

Discussion

This study aimed to determine the prevalence of acne vulgaris in patients with PCOS, using a systematic review and meta-analysis. The findings of this study demonstrated that the pooled prevalence of acne based on 95 studies is 49%. Acne is one of the complications of PCOS (43) The results of this study mean that out of every 100 women with PCOS, 49 people suffer from acne. This indicates that a remarkable number of women exhibit skin manifestations, which simplifies the diagnosis of PCOS (44). In addition, apparent heterogeneity was seen, which may be affected by various factors, including diagnostic criteria,

*Table 3.*The Prevalence of Acne in Women with Polycystic Ovary Syndrome (PCOS) and Assessment of Heterogeneity and Publication Bias by various risk factors

Variables	Category	No. study	Pooled Prevalence (% 95 CI)	Heterogeneity assessment between studies		Publication bias assessments		
				I^2	P-value	B	SE	*P* value
Risk factor	Mild acne	15	40% (27% - 53%)	95.68	<0.0001	3.14	0.44	<0.0001
	Moderate acne	12	25% (16% - 35%)	92.44	<0.0001			
	Moderate/severe acne	3	23% (11% - 36%)	50.98	0.042			
	Severe acne	10	8% (5% - 10%)	59.68	0.013			
	Hirsutism and/or acne	8	39% (22% - 57%)	97.98	<0.0001			
	Acne vulgaris	6	49% (36% - 62%)	95.12	<0.0001			

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study population, and methodologies. A study by Alexia S. Peña demonstrated that studies use Rotterdam diagnostic criteria and pelvic ultrasound to diagnose PCOS in adolescents, which is not suitable because the ovaries of most healthy adolescents in the first few years after menarche are similar to polycystic ovaries (45). The study population is very diverse in studies due to its definition and characteristics, entry and exit criteria, sampling, and the entire target population. For example, in a study involving 212 patients in North Africa from January 2023 to January 2024, the prevalence of acne in women with PCOS was 65.6% (46). In another study, there were 101 patients aged 18 to 40 years in Lahore from March 2019 to March 2020, and the prevalence of acne in the 24-28 years, 29-33 years, and 40-38 years age groups was 23.4%, 17.8%, and 9.9%, respectively (47). Some studies, such as Gencoglu's study, used the Acne Global Severity Scale to determine the severity of acne in 60 patients and classified the patients into 2 groups: moderate and severe acne (48). While most studies, such as Julia Estermann's study, did not separate severities of acne and reported the overall prevalence of acne in 1960 patients (49).

The results of this study are close to the previous report in this field in 2021, which was 43% (37). Remarkable geographic deviations in prevalence were observed, with the highest amount in Oceania, which could be due to various factors. The health of Australian women with PCOS, which is geographically close to Oceania, might be endangered by sleep disorders and also increase the severity of the disease (50). The development of acne, which is influenced by multiple factors including mental stress, genetic predisposition, aggressive facial products, hormones, medications, and diet, is known to be augmented by diet, which affects genes, bacterial proliferation, sebaceous gland function, and inflammatory responses (51). A study has reported that disparities in the quality of diagnostic tools and methods for PCOS (52) could explain the higher rates of acne in Oceania and lower rates in Europe. Diagnosis of PCOS in Europe includes the Rotterdam criteria, and in recent years, the examination of the steroid profile has received considerable attention (53). Based on this, it can contribute to the early diagnosis of PCOS, which can prevent acne, and can explain the lower rate in Europe. There is a direct association between acne vulgaris and high BMI, as the results of several studies have shown that acne and its severity are related to high BMI (54-57). Although acne can be found in all ages, research signifies that it is more common in teenagers and young adults (14, 58, 59).

Acne vulgaris is a common skin disorder, the mechanism of which includes disruption of the follicular keratinization process, Cutibacterium acne bacteria in the sebaceous glands, the rise of sebum secretion, growth and activation of inflammatory processes in pilosebaceous units, and cosmetics (60, 61). According to Al-Hattab's study, the severity of acne was identified to increase with factors such as more frequent sunlight exposure, sugar consumption, upper body fat, and stress levels (62, 63). Acne is constantly on the rise, which reflects the incapacity to meet the global demand for proper skin care and treatment (64). Therefore, the connection between acne and mental health problems can improve the attention and understanding of its psychological aspects in patients and healthcare professionals (65). In addition, stress, depression, and anxiety are recurrent in women with PCOS, and high BMI can cause depression in these women (66). Studies have suggested that women with PCOS, which is identified by irregular menstruation or anovulation due to hirsutism, acne, and infertility, affecting sexual health and family stability, should use alternative treatments and counseling. (67, 68).

In contrast to earlier studies, this research has comprehensively and accurately examined the prevalence of acne among women with PCOS by considering factors such as geographical area, age, and BMI. Based on the findings, it is suggested that health policymakers, healthcare providers, and specialists should adopt a global standardization of diagnostic criteria to reduce discrepancies in PCOS and acne diagnosis, as well as to facilitate early PCOS diagnosis. Additionally, since the syndrome covers various health aspects such as infertility, chronic and metabolic diseases, weight gain, androgen disorders such as acne and hirsutism, and mental and psychological disorders, comprehensive therapeutic interventions, psychological counseling, and diet management should be provided. It would be beneficial to conduct more studies with a stronger methodology and a more studied population. Notably, Brazil, Russia, Japan, Mexico, Argentina, South Africa, France, and Spain have not been studied in this field. It is important to note that the year-based subgroup analysis was conducted based on the available data collection times reported in the primary studies. This study has several limitations that should be considered when interpreting the results. First, the high heterogeneity observed across included studies limits the generalizability of the pooled prevalence estimates. Differences in study design, population characteristics, diagnostic criteria for PCOS and acne, and data collection methods likely contributed to this variability. Second, despite efforts to include only high-quality studies, the residual risk of bias cannot be excluded. Third, the presence of publication bias, as indicated by statistical tests, suggests that some relevant data may be missing. Finally, the cross-sectional nature of most included studies limits inferences about temporal or causal relationships between PCOS and acne. Future research using standardized diagnostic criteria and longitudinal designs is warranted to understand these associations better.

Conclusion

Our results demonstrate considerable variability in the prevalence of acne among women with PCOS across different populations. The prevalence ranged from 32% in Europe to 76% in Oceania, reflecting significant regional differences. Given the high heterogeneity observed among the included studies, these subgroup-specific prevalence estimates provide a more accurate reflection of the burden of acne in women with PCOS. Therefore, healthcare providers and specialists should emphasize early detection and holistic management of PCOS and acne, taking into

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account factors such as lifestyle, diet, physical activity, and age to optimize care for affected women.

Authors' Contributions

Y.M., B.P., and M.M. conceptualized the idea for this review, formulated the review question, and objectives. M.M. and Y.M. contributed equally to developing the search strategy and conducting the searches. N.S., M.A., and S.R. contributed equally to the data extraction, data analysis/interpretation, and writing the manuscript. All authors read and approved the final manuscript.

Ethical Considerations

Not applicable.

Acknowledgment

Not applicable.

Conflict of Interests

The authors declare that they have no competing interests.

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Appendix 1. Characteristics and Quality Assessment of the Included Studies

Author	Year	Continent	PCOS diagnostic criteria	Samples	Age case	BMI case	Risk factor	Total NOS
A. Kepczynka-Nyk et al.	2021	Europe	Rotterdam	63	26.56	27.58	Acne	7
Aafia Rashid et al.	2018	Asia	Rotterdam	88	22.67	24.21	Acne vulgaris	7
Ahmet Öztürk et al.	2019	Asia	Rotterdam	50	22.3	24.17	Acne	7
Alawia N. Elasam et al.	2022	Africa	Rotterdam	368	26	NA	Acne	7
AMB Kamrul-Hasan	2020	Asia	Rotterdam	465	22.52	26.63	Acne	7
Andrea Hsu Roe et al.	2013	North America	AES	148	16.9	28.5	Acne	9
Angela Zigarelli et al.	2022	North America	Rotterdam	170	NA	25.1	Acne	9
Anya E. Taylor et al.	2022	North America	NA	115	16	34.3	None acne Mild acne Moderate acne Severe acne	9
Apoorva Suran et al.	2022	Asia	Rotterdam	55	22.8	NA	Acne	7
Ashraf Moini et al.	2009	Asia	Rotterdam	273	27.94	27.91	Acne	8
Aylaa Khazaal Neamah et al.	2021	Asia	NA	65	NA	NA	Acne	7
Azadeh Akbari Sene et al.	2021	Asia	NA	116	31	26.66	None acne Mild acne Moderate acne Severe acne	7
Balachandran Kumarendran et al.	2019	Europe	Rotterdam	76978	30.2	28.6	Acne	8
Balachandran Kumarendran et al.	2018	Europe	Rotterdam	63210	30.6	NA	Acne	9
Beena Joshi et al.	2023	Asia	Rotterdam	209	26.27		Acne	8
Bita Tahmasbi et al.	2024	Asia	Ultrasound	103	31.23	26.56	Non acne Mild acne Moderate/severe acne	8
Bushra Anwar et al.	2023	Asia	Rotterdam	139	28.6	30.7	Acne	9
C. Belosi et al.	2006	Europe	Rotterdam/NIH	273	26.38	26.86	Acne	7
			Rotterdam	72	27.53	24.9		
		North America		305	28.7	32	Acne (IM/HA)	
				77	29.6	27	Acne (HA/PCOM)	
			NIH	105	30.2	31.5	Acne	
				172	28.8	30.7		
				44	28.4	36.3		
				25	26.3	32.3		
				21	25.5	26.3		
C. Belosi et al.	2007	North America	Rotterdam	36	30.2	24.7	Acne (IM/PCOM)	4
Cagdas Ozgokce et al.	2020	Asia	Androgen Excess Society	45	22.96	NA	Acne	5
Ching-Hui Chen et al.	2014	Asia	Rotterdam	89	26.5	22.5	Acne	7
Claudio Villarroel et al.	2010	South America	Rotterdam	55	29.73	29.17	Acne	7
CM Ercan et al.	2013	Asia	Rotterdam	32	27.4	25.5	Acne	4
Dipansha Bajpai et al.	2023	Asia	Rotterdam and NIH	57	NA		Acne	7
Dongmei Shi et al.	2024	Asia	Rotterdam	75	27.11	NA	Acne	7
Elham Sharif et al.	2017	Asia	NIH	22	21	23.93	Acne	2
Fahimeh Ramezani Tehrani et al.	2014	Asia	Rotterdam	11	25.6	25.4	Acne (AnOvu & HA & PCO)	2
				19	31.1	26.4	Acne (AnOvu & HA)	
				42	30.3	27.2	Acne (HA & PCO)	
				13	24.7	24.1	Acne (AnOvu & PCO)	
Farnaz Shishehgar et al.	2019	Asia	Rotterdam	28	29.7	31	Acne	6
Ghada Khafagy et al.	2020	Asia and Africa	Rotterdam	36	16.888	26.064	Acne grade 1 Acne grade 2 Acne grade 3 Acne grade 4	5
Gokhan Artar et al.	2022	Asia	Rotterdam	208	24.15	25.84	Acne	9
Hsu Chun-Sen et al.	2011	Asia	Rotterdam	125	26.6	24.9	Acne (HA & ANOV & PCOM)	7
				25	26.4	25.2	Acne (HA & ANOV)	
				37	27.1	25	Acne (HA & PCOM)	
				46	27.4	25.1	Acne (ANOV & PCOM)	

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Author	Year	Continent	PCOS diagnostic criteria	Samples	Age case	BMI case	Risk factor	Total NOS
HY Zhang et al.	2009	Asia	Rotterdam	193	26	36.5	Acne (hyperandrogenism & oligomenorrhoea & polycystic ovaries on ultrasound)	8
				55	25	35.8	Acne (hyperandrogenism & oligomenorrhoea)	
				96	27	30.9	Acne (hyperandrogenism & polycystic ovaries on ultrasound)	
				375	26	28.6	Acne (oligomenorrhoea & polycystic ovaries on ultrasound)	
				719			all	
Inan Anaforoglu et al.	2011	Asia	Rotterdam	54	22.5	28.1	Acne	8
				121	23.3	30.3	Acne	
Iram Shabir et al.	2013	Asia	Rotterdam	197	23	25.8	Acne	7
Jetsadaporn Kaewnin et al.	2018	Asia	Rotterdam	29	18.66	12.37	Non acne Mild acne Moderate acne Acne	4
Ji Hye Yu et al.	2024	Asia	Ultrasound	212	22.9	26.5	Acne	9
Jing Tan et al.	2017	Asia	Rotterdam	120	24.8	21.4	Acne	7
Jin-ge Feng et al.	2018	Asia	Rotterdam	186	NA	NA	Acne Mild acne Moderate acne Severe acne Very severe acne	8
Jung-Hee Kim et al.	2022	Asia	NA	841	30.37	21.14	Acne	7
Kathryn HART et al.	2016	Europe	NA	38	30.8	24.5	Acne	6
Kemal Atasayan et al.	2021	Asia	Rotterdam	65	24.5	25.1	Acne	7
L. Chitra Varanasi et al.	2018	Oceania	NIH	31	22	23.2	Acne Mild acne Moderate/severe acne	5
Lasma Lidaka et al.	2021	Europe	2018 European society of Human Reproduction and Embryology	57	15.9	25.7	None acne Mild acne Moderate acne Severe acne	9
Lateef A. Akinola et al.	2024	Africa	Rotterdam	60	26.9	26.39	Present acne Absent acne	9
Lin Li et al.	2012	Asia	Rotterdam	91	17.59	22	Acne Hirsutism and/or acne	9
Lisa Moran et al.	2010	Oceania	Rotterdam	24	22.41	29.17	Acne	3
M. Erdogan et al.	2008	Asia	Rotterdam	68	24.27	24.41	Acne	7
M. Hickey et al.	2009	Oceania	NIH	36	15.4	25.8	Acne Mild acne Moderate acne	4
			Rotterdam	66	15.3	24.3	Acne Mild acne Moderate acne	
M.P. Lauritsen et al.	2014	Europe	Rotterdam	74	31.5	24.2	Acne	7
Maha AH Sulaiman et al.	2018	Asia	Rotterdam	51 52	NA	NA	Acne	6
Manal Abudawood et al.	2021	Asia	NA	56	30.41	27.23	Acne	7
Maria Dalamaga et al.	2013	Europe	Rotterdam	56	24.9	28.7	Acne Severe and very severe acne	7
				260	24.8	24.9	Acne Severe and very severe acne	

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Author	Year	Continent	PCOS diagnostic criteria	Samples	Age case	BMI case	Risk factor	Total NOS
Maryam Kazemi et al.	2019	North America	AES	237	27.7	32.2	Mild acne vulgaris Moderate acne vulgaris Severe acne vulgaris	8
Marzieh Saei Ghare Naz et al.	2020	Asia	Rotterdam	120	16.58	25.13	Acne	9
Ming-I Hsu et al.	2009	Asia	Rotterdam	251	27.2	NA	Acne	8
Minhthoa Thi Nguyen et al.	2023	North America	Rotterdam	108	28.9	33.7	Acne	8
Moamar Al-Jefout et al.	2017	Asia	Rotterdam	159	24	28	Acne Hirsutism and/or acne	8
Muhammad Akram et al.	2015	Asia	Rotterdam	65	26.71	26.23	Acne	7
Murat Sahin et al.	2017	Asia	Rotterdam	69	24.82	21.86	Acne	7
Nahida Nabi rt al.	2022	Asia	Androgen excess society	50	28.5	NA	Acne	7
Naina Kumar	2022	Asia	Rotterdam	80 40	20.43 20.25	28.36 22.58	Present acne Absent acne Present acne Absent acne	7
Najat Jabbar Ahmed et al.	2020	Asia	Rotterdam	60	NA	NA	Acne	7
Nermin Kosus et al.	2011	Asia	AES	251	24.9	27.1	Acne	8
Ngoc Thanh Cao et al.	2019	Asia	Rotterdam	479	29	21	Acne	7
Nidhi Makhija et al.	2023	Asia	Rotterdam	96	25.4	26.3	Acne vulgaris	7
Nina Mishra et al.	2022	Asia	NA	105	NA	27	Acne Hirsutism and/or acne	8
P. Lam et al.	2009	Asia	Rotterdam	40	30.8	27.35	Acne Mild acne Moderate acne Severe acne Acne Mild acne Moderate acne Severe acne	5
Pallavi Basu et al.	2021	North America	Rotterdam	59	20.2	34	Mild acne Moderate acne Severe acne	7
Pramila D'Souza et al.	2022	Asia	NA	140	22	25.01	Mild acne Moderate acne Severe acne Very severe acne	8
Pramila Jena et al.	2021	Asia	Rotterdam	251	25.7	NA	Acne Hirsutism and/or acne	8
Raminder Kaur et al.	2021	Asia	Rotterdam	9 109 132	NA	Underweight Normal Overweight/obese	Present acne Absent acne Present acne Absent acne Present acne Absent acne	2
Rasha M. Kamil et al.	2020	Asia	Rotterdam	60	26.8	31.41	Acne	7
Rehab S. Ramadhan et al.	2022	Asia	Rotterdam	150	28.63	25.5	Acne Hirsutism and/or acne	8
Rozina Habib et al.	2021	Asia	Rotterdam	140	NA	NA	Acne	7
S. Taponen et al.	2004	Europe	Rotterdam	67	31	25.9	Acne	7
Samar Musmar et al.	2013	Asia	NIH	10	NA	23.37	Acne	3
Samy A. Abouzeid et al.	2022	Asia and Africa	Rotterdam	95	27.26	30.71	Acne grade 1 Acne grade 2 Acne grade 3	7
Seda Ates et al.	2018	Asia	NIH	77	17.68	24.87	Acne Non acne Mild acne Moderate/severe acne	7
Seema Rafiq et al.	2023	Asia	Rotterdam	110	32.2	NA	Acne	9
Seyedeh Hajar Sharami et al.	2016	Asia	Rotterdam	87 21 45 8	26.16 25 26 22.12	27.86 28.39 28.68 26.59	Acne (IM/PCO/HA) Acne (IM/PCO) Acne (IM/HA) Acne (PCO/HA)	7

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Author	Year	Continent	PCOS diagnostic criteria	Samples	Age case	BMI case	Risk factor	Total NOS
Soha Galal Siam et al.	2020	Asia and Africa	Rotterdam, NIH and AE-PCOS	100	NA	NA	Acne Hirsutism and/or acne	8
Soheila Rabiepoor et al.	2022	Asia	Rotterdam	195	26.93	NA	Mild acne Moderate acne	8
Srikrishna Sasi Ratnakaram et al.	2020	Asia	Clinical, laboratory and radiological investigations	160	26.19	24.42	Acne	9
Steven T. Bird et al.	2013	North America	ICD-9	46867	28.7	NA	Acne	9
Thanyarat Wongwananuruk et al.	2020	Asia	Rotterdam	143	25.2	24.3	Acne	9
Timothy H. Schmidt et al.	2016	North America	Rotterdam	268	28.1	30.3	Acne	8
Tsan-Hon Liou et al.	2009	Asia	Rotterdam	295	26.7	NA	Acne Hirsutism and/or acne	8
Turkan Gursu et al.	2021	Asia	Rotterdam	32	25.55	20.18	Acne vulgaris	4
Vaishnavi B.V. et al.	2020	Asia	Ultrasonographic	50	24.26	NA	Acne vulgaris	7
Vellanki Lakshmi Sruthi et al.	2023	Asia	Ultrasound	20	20.1	24	Acne	2
Xiao-li Li et al.	2024	Asia	Rotterdam	255	24.59		Acne Hirsutism and/or acne	8
Yara E. Aljefri et al.	2021	Asia	NA	447	29	28.76	Acne vulgaris	8
Yue Zhao et al.	2016	Asia	Rotterdam	409	27.61	25.73	Acne (met with the above all three criteria)	8
				58	27.47	25.77	Acne(met with criteria 1 and 2)	
				101	27.46	25.72	Acne (met with criteria 2 and 3)	
				79	23.24	23.24	Acne (met with criteria 1 and 3)	
Zeynep Donbalogu et al.	2022	Asia	NA	51	15.72	24.3	Acne	7
Zhao Ting et al.	2024	Asia	Rotterdam	216	25.7	24.63	Acne	9

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