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Global Research Trends on Preconception Care on the Infertility Prevention: A Bibliometric Study

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ABSTRACT

Background: Infertility affects approximately one in six individuals globally and remains a growing reproductive health concern, often linked to modifiable risk factors present before conception. Preconception care (PCC) has gained recognition as a preventive strategy, however the implementation of PCC at scale remains challenged and yet its research landscape in relation to infertility remains under-mapped.This study aimed to analyze global research trends on preconception care in the context of infertility prevention using bibliometric methods.
Subjects and Method: A bibliometric analysis was conducted using the Scopus database, with data retrieved on May 12, 2024. The search strategy included terms related to PCC and infertility, yielding 486 eligible publications after screening. Included documents were English-language publications in final form, relevant to preconception care and infertility, and classified as articles, reviews, conference papers, or book materials. Analysis was performed using Scopus tools, Biblioshiny (R), and VOSviewer to examine publication trends, key contributors, and thematic evolution.
Results: A total of 486 publications from 1991 to 2025 were identified, with an annual growth rate of 6.43%. Most documents were original articles (67.7%) and reviews (28.4%), authored by 2,529 contributors across 307 publication sources. Several national strategies have formalized PCC into broader public health policy to reduce disparities in pregnancy outcomes and unmet fertility needs, but there remains a critical gap in the global PCC research agenda, such as the heterogeneity in intervention protocols.
Conclusion: Research on preconception care in the context of infertility prevention has expanded steadily. However, Future research should prioritize longitudinal and interventional studies, foster global collaboration, and align with broader reproductive justice goals to strengthen the evidence base. Ultimately, enhancing the visibility and implementation of PCC in both clinical and public health domains will be pivotal in addressing modifiable infertility risks and promoting equitable reproductive outcomes worldwide.

Keywords: infertility, bibliometric analysis, scientific mapping, reproductive health

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BACKGROUND

Infertility remains a pressing global reproductive health concern, affecting approximately one in six individuals of reproductive age worldwide, with increasing prevalence noted across both high- and low-income countries (Harris, 2023). The burden of infertility is not only clinical but also deeply psychosocial, often associated with distress, stigma, and deteriorating quality of life, particularly among women who face greater social and diagnostic scrutiny (Bueno-Sánchez et al., 2024; de Vries et al., 2024). Epidemiological analyses from the Global Burden of Disease Study (GBD 2019) report significant increases in disability-adjusted life years (DALYs) attributed to infertility from 1990 to 2021, with South Asia, North Africa, and parts of Latin America experiencing disproportionately high burden (Feng et al., 2025; Huang et al., 2023; Shen et al., 2024). Crucially, many infertility cases are linked to modifiable risk factors such as obesity, diabetes, smoking, infections, and nutritional deficiencies, factors which are often present and identifiable prior to conception attempts (Jurewicz et al., 2014; Lim et al., 2024; Xu et al., 2022).

Preconception care (PCC) refers to a set of biomedical, behavioral, and social health interventions provided to individuals of reproductive age before conception, with the goal of improving health outcomes for both parents and future offspring (Berglund and Lindmark, 2016; Johnson et al., 2006; Posner et al., 2006). This proactive approach extends beyond clinical fertility management to encompass health education, chronic disease management, and lifestyle modification, recognizing the importance of maternal and paternal health in determining fertility potential and pregnancy success (Berglund and Lindmark, 2016; Hill et al., 2020). According to the WHO, PCC is an essential component of a continuum of maternal and child healthcare and includes interventions for nutrition, infection control, substance use reduction, and management of comorbidities including systemic lupus erythematosus, polycystic ovary syndrome, and diabetes mellitus (Berglund and Lindmark, 2016; Hill et al., 2020; Nekuei et al., 2015). The U.S. Centers for Disease Control and Prevention (CDC) has similarly underscored the importance of early intervention, launching the Preconception Health and Health Care Initiative to address health risks before pregnancy occurs (Posner et al., 2006; Waggoner, 2013).

PCC has been shown to contribute positively to fertility-related outcomes through multiple mechanisms, including improving ovulatory function, reducing miscarriage risk, and addressing male fertility factors (Beyuo et al., 2022). Despite growing recognition of its value, utilization of PCC services remains limited in many settings due to low awareness, cultural beliefs, and health system barriers (Beyuo et al., 2022; Mazza et al., 2013; Ndou et al., 2023). Nevertheless, studies across diverse populations, including women with chronic conditions and those in low-resource settings, have reported perceived benefits from PCC and emphasized the need for public health systems to prioritize its implementation as a preventive fertility strategy (Beyuo et al., 2022; Ndou et al., 2023; Temel et al., 2015).

Despite increasing attention to PCC within reproductive health research, its role in the context of infertility prevention remains underexplored from a bibliometric perspective. Few studies have systematically mapped the development, distribution, and thematic focus of research linking PCC to fertility outcomes. A bibliometric approach is well-suited to evaluate publication trends, identify leading contributors, and highlight collaboration patterns in various research topic domains (Cilmiaty and Ilyas, 2024; Ghozali

et al., 2024; Ilyas, Lado, et al., 2024; Romaniyanto et al., 2025; Wijayanto et al., 2023). Therefore, this study aimed to map the global research landscape and thematic evolution of PCC as a preventive strategy for infertility through bibliometric and scientific mapping analysis.

SUBJECTS AND METHOD

1. Study Design

This study is a bibliometric analysis aimed at mapping the scientific landscape of research on preconception care in the context of infertility prevention. The methodological approach was adapted from several previous bibliometric studies to ensure consistency and rigor in the analysis process (Dirgahayu, Ilyas, et al., 2024; Dirgahayu, Wijayanto, et al., 2024; Ilyas, Lukas, et al., 2024; Mirawati et al., 2024; Sumarwoto et al., 2023).

2. Data Source

The primary data source for this analysis was the Scopus database. Scopus was selected because of its comprehensive coverage of peer-reviewed literature and its compatibility with bibliometric tools such as Biblioshiny and VOSviewer. Prior to its selection, Scopus was compared with PubMed and ScienceDirect in terms of the relevance of content and completeness of bibliographic metadata, and was found to be the most suitable for this study's objectives.

3. Search Strategy

The literature search was conducted on Monday, May 12, 2024, in order to minimize variability due to daily indexing updates. The search strategy involved the use of a comprehensive string combining terms related to preconception care and infertility: ("preconception care" OR "preconception counseling" OR "preconception consultation" OR "preconception health" OR "preconception interventions" OR "pre-pregnancy care" OR "pre-pregnancy counseling" OR "reproductive planning") AND ("infertility" OR "subfertility" OR "reduced fertility" OR "fertility disorders"). This search yielded a total of 514 initial records.

4. Inclusion Criteria

Documents were included if they met the following criteria: written in English, fully indexed and in the final publication stage, and categorized as original research articles, review articles, conference papers, books, or book chapters. Additionally, the titles and abstracts of the documents had to be relevant to the topic of preconception care in the context of infertility prevention.

5. Exclusion Criteria

Studies were excluded if they were not written in English, were not in their final publication form (e.g., in-press or with incomplete metadata), or if their titles and abstracts were deemed irrelevant to the focus on preconception care and infertility.

6. Data Extraction

After applying the inclusion and exclusion criteria, a total of 486 publications were retained for analysis. From these, relevant bibliographic data were extracted from Scopus, including information on author names, institutional affiliations, countries of origin, keywords, citation counts, funding sources, and year of publication.

7. Research Ethics

The extracted data were analyzed using both descriptive and network-based bibliometric methods. Scopus analytical tools were used to identify the most prolific authors, institutions, countries, funding sponsors, and highly cited documents. The Biblioshiny application, based on the Bibliometrix package in R, was employed to examine annual publication trends, citation impacts, and thematic developments over time. Trend topic analysis was also performed to visualize up to four dominant research themes for each year. Furthermore, keyword co-occurrence analysis was conducted using VOSviewer (version 1.6.18), applying a minimum keyword occurr-

ence threshold of three and a total link strength threshold of two. To ensure consistency in the visualization and interpretation of results, synonymous or semantically similar keywords were standardized.

RESULTS

1. Characteristics of the Included Publications

A total of 486 publications on preconception care and infertility were included, spanning the period from 1991 to 2025, with an annual growth rate of 6.43%. These publications appeared in 307 different sources, including journals, books, and conference proceedings, and together cited 22,474 references. The average age of the documents was 8.35 years, with a mean of 25.85 citations per document. Most publications were journal articles (n=329) and reviews (n= 138), with smaller numbers of book chapters (n=12), conference papers (n=6), and books (n=1). A total of 2,529 authors contributed to the dataset, including 42 single-authored documents. The average number of co-authors per document was 6.29, and 19.34% of the publications involved international collaboration. The dataset also contained 1,068 author keywords and 4,230 Keywords Plus, reflecting the diversity of terminology used across studies.

2. Trends in Annual Scientific Output and Citation Impact

Figure 1 illustrates the annual number of publications and the mean total citations per year related to preconception care and infertility from 1991 to 2025. The volume of publications remained relatively low and sporadic until the mid-2000s, followed by a gradual increase, with notable growth from 2016 onward, peaking in 2024 with 46 articles. Citation impact, as measured by mean total citations per year, showed modest values in the early decades but began to rise significantly from 2008, with peaks in 2010, 2017, and 2020—years associated with both higher publication output and increased academic attention. Recent years, such as 2024 and 2025, show a decline in mean citation rates, likely due to citation lag for newly published works. This trend suggests increasing research interest and dissemination in this field, although newer publications have yet to accumulate citations.

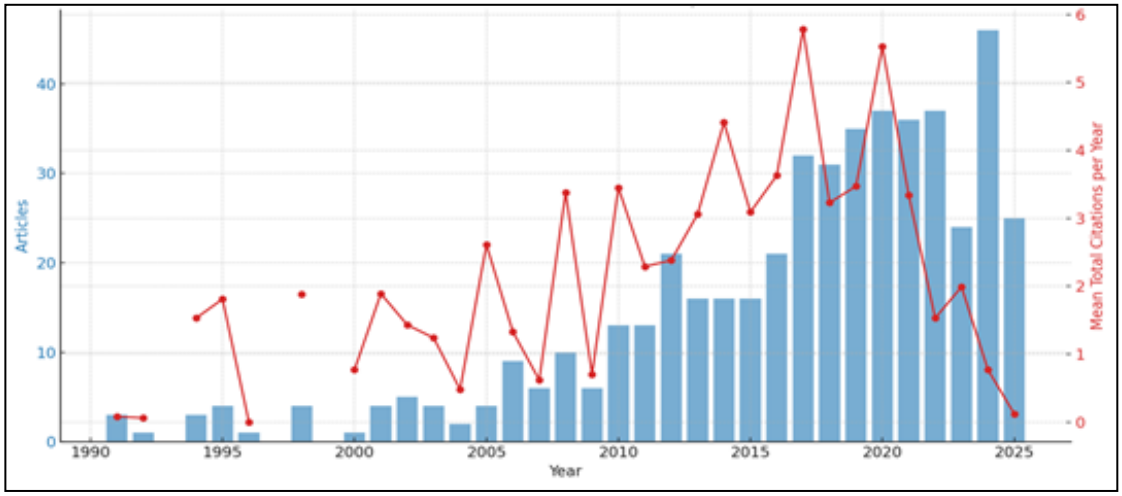

Figure 1. Annual publications and mean total citations per year (1991–2025)

3. Leading Authors, Institutions, Countries, and Funding Agencies

Figure 2 presents the leading contributors to research on preconception care and infertility prevention. Laven, J.S.E. is the most

prolific author with 10 publications, followed by Mumford, S.L. and Schisterman, E.F. Several other researchers, including Steegers-Theunissen, Tincani, and Moran, also show consistent output. Erasmus MC and Monash University lead among institutions, each producing more than 15 documents, while Harvard Medical School, the University of Toronto, and NICHD also appear prominently. The United States is by far the most active country in this field, contributing 174 publications, much higher than the United Kingdom, Australia, and other countries. Funding support is largely concentrated in U.S. agencies, with the National Institutes of Health and the Department of Health and Human Services funding the most studies, followed by NICHD and other international bodies such as NHMRC (Australia) and the European Commission.

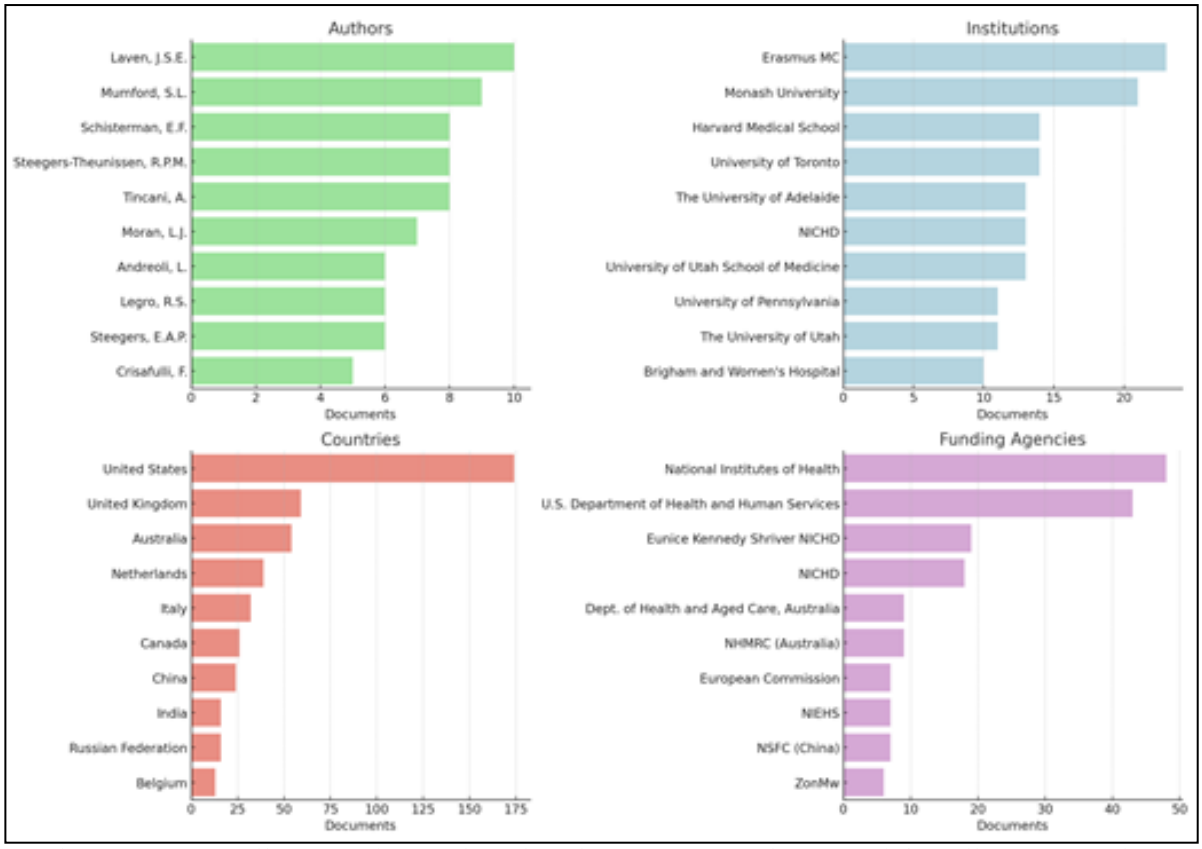

Figure 2. Leading authors, institutions, countries, and funding agencies

4. Core Research Themes and Emerging or Underexplored Topics

Figures 3 and 4 show the co-occurrence and temporal trends of keywords in research related to preconception care and infertility prevention. The most frequently used keywords include pregnancy (101), infertility (78), fertility (51), and preconception care (50), indicating their central position in the literature. Commonly associated terms cover clinical topics like obesity (25), polycystic ovary syndrome (12), diabetes mellitus (5), systemic lupus erythematosus (8), antiphospholipid syndrome (4), cystic fibrosis (5), congenital heart disease (4), epilepsy (3), and multiple sclerosis (3). Interventions and reproductive technologies also appear frequently, including assisted reproductive technology (17), in vitro fertilization (13), cryopreservation (5), and preimplantation genetic diagnosis (3). Preventive and behavioral aspects are reflected in terms like nutrition

(7), lifestyle (8), folic acid (9), and vitamin D (4). Figure 4 illustrates how some topics, like pregnancy and reproductive health, dominated earlier years, while more specific or emerging topics such as genetic screening, myo-inositol, and next-generation sequencing have gained interest more recently. The keyword map shows how the field has developed across clinical, technological, and preventive dimensions over time.

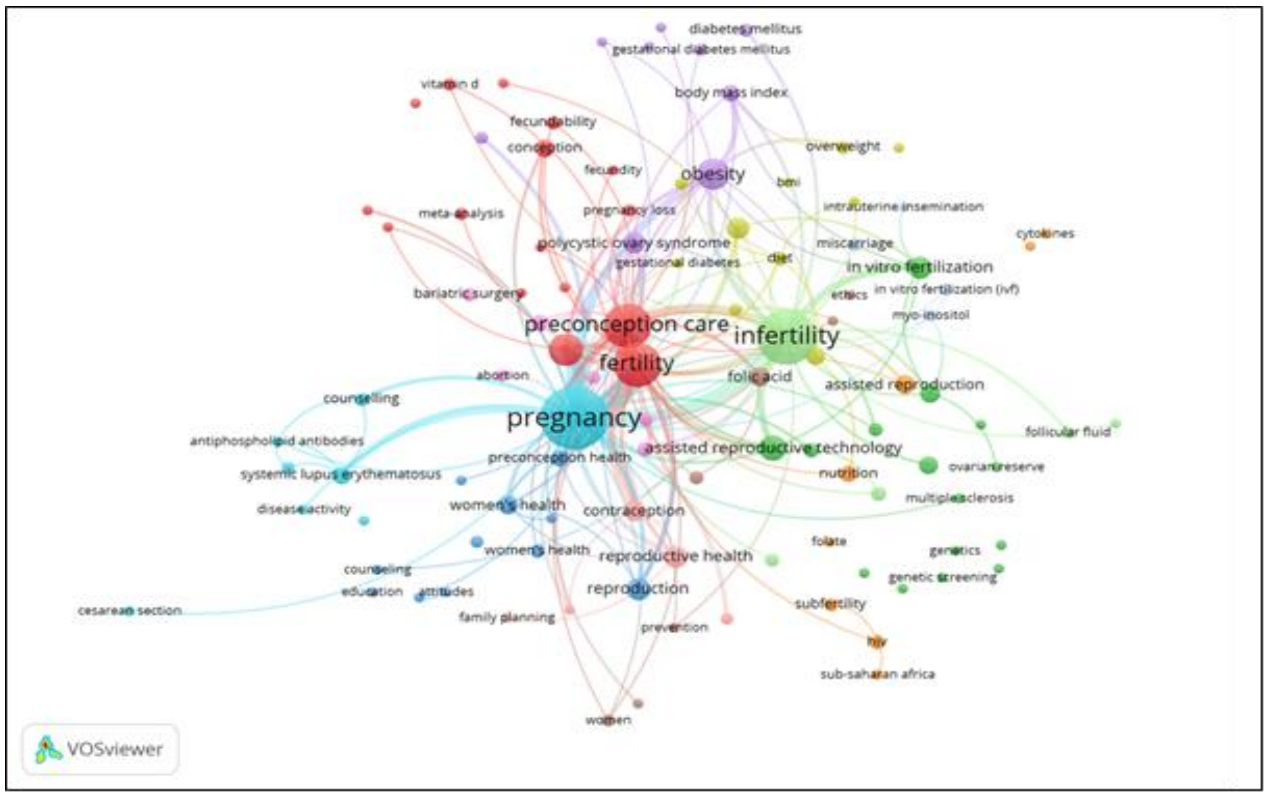

Figure 3. Keyword Co-occurrence Network in Publications

The following is a complete list of author keywords and their frequencies as identified in the Figure 3: Pregnancy (101), infertility (78), fertility (51), preconception care (50), preconception (26), obesity (25), assisted reproductive technology (17), reproduction (13), reproductive health (13), in vitro fertilization (13), contraception (12), polycystic ovary syndrome (12), preconception counseling (12), assisted reproduction (10), women's health (10), IVF (10), folic acid (9), lifestyle (8), systemic lupus erythematosus (8), preconception counselling (8), conception (8), male infertility (7), preconception health (7), nutrition (7), body mass index (7), subfertility (5), counselling (5), cryopreservation (5), pcos (5), pregnancy planning (5), miscarriage (5), sperm (5), cystic fibrosis (5), bariatric surgery (5), diabetes mellitus (5), women's health (5), attitudes (3), abortion (4), gestational diabetes mellitus (4), pregnancy complications (6), pregnancy outcome (6), public health (4), myo-inositol (4), overweight (5), health knowledge (3), meta-analysis (4), in vitro fertilization (IVF) (4), management (4), vitamin D (4), antiphospholipid syndrome (4), pregnancy loss (4), congenital heart disease (4), follicular fluid (4), birth weight (3), birth cohort study (3), cesarean section (3), ethics (3), oxidative stress (3), prenatal diagnosis (3), genetic screening (3), gestational diabetes (3), miscarriage (5), ovarian reserve (3), oocyte donation (3), oocyte quality (3), recurrent miscarriage (3), fecundity (3), fecundability (5), family planning (3), folate (3), health promotion (3), education (3), epilepsy (3), gestational age (3), intrauterine insemination (3), live birth (3), advanced maternal age (3), disease activity (3), next-generation

sequencing (3), multiple sclerosis (3), risk factors (3), spontaneous pregnancy (3), sub-Saharan Africa (3), and preimplantation genetic diagnosis (3).

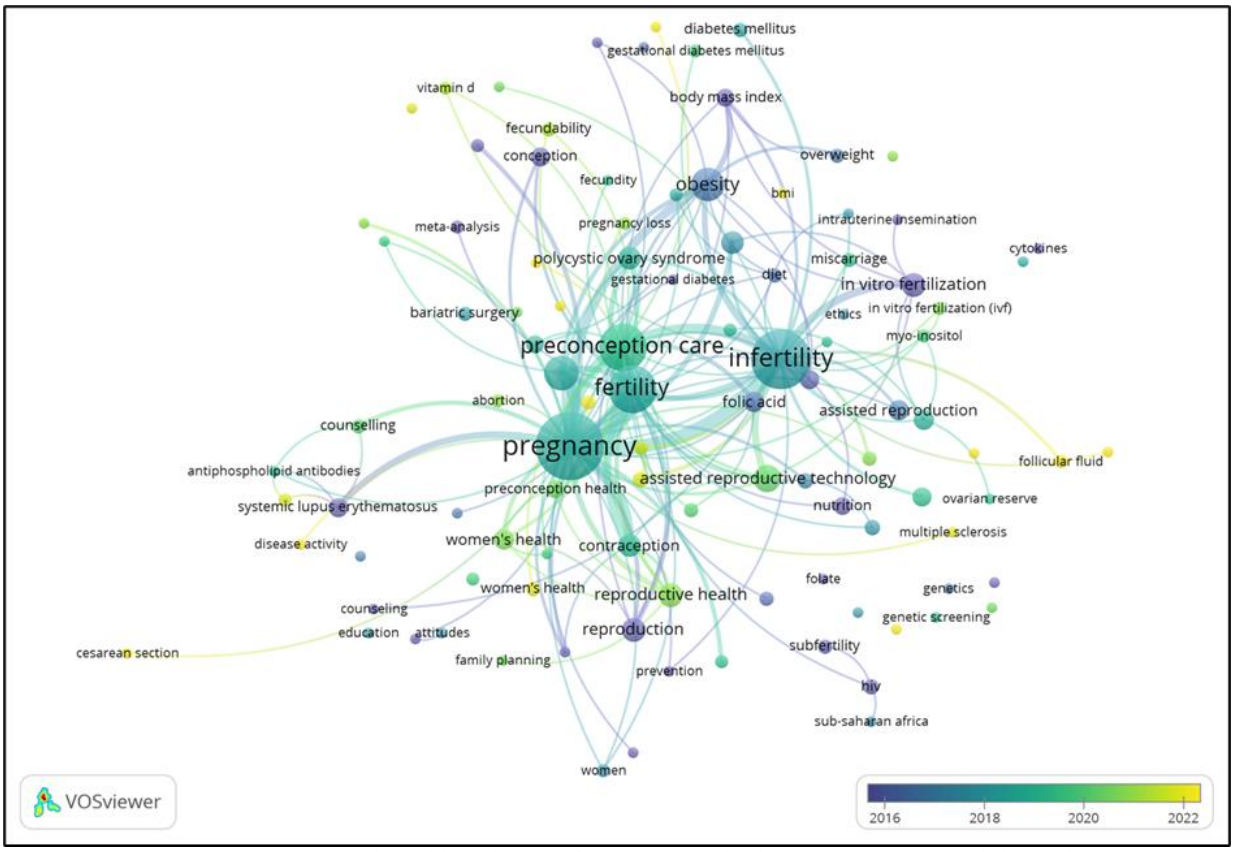

Figure 4. Temporal Distribution of Keywords by Average Publication Year

DISCUSSION

The integration of preconception care (PCC) into national reproductive health strategies has gained momentum as a policy response to persistent maternal and neonatal health challenges. PCC is increasingly acknowledged not as a standalone intervention but as an essential component of the Reproductive, Maternal, Newborn, Child, and Adolescent Health (RMNCAH) continuum, reinforcing the lifecycle approach to healthcare (World Health Organization, 2012, 2013). Within this framework, PCC enhances the capacity of health systems to address modifiable risks prior to conception and bridge service gaps between adolescent, maternal, and child health programs. Several national strategies—such as Indonesia's MoH regulations on pre-pregnancy health services and Nigeria's SRHR integration efforts—have formalized PCC into broader public health policy to reduce disparities in pregnancy outcomes and unmet fertility needs (Bawa-Muhammad, 2024; Linda et al., 2022). Moreover, the WHO's global consensus emphasizes that PCC is not only critical in high-burden, low-resource settings but also relevant in high-income countries where epidemiological transitions demand pro-active reproductive health measures (WHO, 2012).

Central to PCC's integration is the recognition of pregnancy planning as a determinant of reproductive success and maternal wellbeing. Tools such as the One Key Question® and Reproductive Life Planning (RLP) have been widely advocated to assess pregnancy intention during routine

care and guide patients toward evidence-based interventions tailored to their reproductive goals (ACOG, 2024; Hammarberg et al., 2022). Such screening approaches facilitate timely initiation of preconception interventions—ranging from folic acid supplementation and chronic disease control to genetic counseling—especially for individuals with high-risk conditions such as diabetes, epilepsy, or systemic autoimmune disorders (ACOG, 2024; World Health Organization, 2012). Furthermore, planned pregnancies that follow recommended interpregnancy intervals (>18 months) have been shown to halve the risks of adverse outcomes such as low birth weight and preterm birth, underscoring the importance of PCC in optimizing conception timing (Ministry of Health and Family Welfare Government of India, 2021).

Despite its proven value, the implementation of PCC at scale remains challenged by systemic limitations, including fragmented care delivery, insufficient provider training, and sociocultural perceptions that equate women's health solely with reproductive capacity (Lancet Global Health, 2022; MedlinePlus, 2022). The UK's Preconception Partnership and Healthy People 2030 in the U.S. exemplify efforts to institutionalize PCC through multilevel frameworks encompassing policy, community engagement, school-based education, and workplace health promotion (AAFP, 2019; Southampton University, 2023). However, successful integration must extend beyond clinical scope to recognize women's autonomy and reproductive rights, ensuring that health promotion is framed not just in terms of maternal outcomes but also individual wellbeing across the life course (WHO, 2024; NHS, 2023). As evidence continues to mount, PCC's role as a preventive and equity-driven strategy in reproductive health is becoming indispensable.

1. Core Components of Preconception Care in Infertility Prevention

Preconception counseling is central to effective infertility prevention strategies, offering a personalized platform for identifying reproductive risks and tailoring interventions. Early identification of modifiable risk factors—such as chronic disease, medication exposure, and reproductive history—can influence both fecundity and gestational outcomes (Atrash et al., 2006; ACOG, 2019). Tools such as the "FINDS" (Family violence, Infections, Nutrition, Depression, Stress) and "BBEEFF" (Breastfeeding, Back-to-sleep, Exercise, Environmental exposures, Family planning, Folate) frameworks offer structured guidance for comprehensive risk assessment (Moos et al., 2008). Preconception care is particularly consequential for women with pre-existing conditions including kidney transplant recipients, diabetes, and cancer survivors, where early counseling is associated with improved fertility preservation and reduced adverse pregnancy outcomes (Collins et al., 2020; Oncofertility Review, 2021). Despite its demonstrated value, inconsistent provider engagement and variability in national guidelines continue to hinder optimal delivery (Elsinga et al., 2008; Temel et al., 2014).

Nutrition constitutes a foundational pillar of PCC, with strong evidence supporting its influence on fertility via mechanisms such as hormonal regulation, oocyte maturation, and endometrial receptivity. A meta-analysis showed that overweight (BMI 25–29.9) and obese (BMI ≥30) women experience longer time-to-pregnancy and higher odds of infertility (OR 1.60; 95% CI: 1.31–1.94), while underweight status also correlates with reduced fecundability (Zhang et al., 2024). Beyond BMI, micronutrient-rich dietary patterns—including folate, iron, and antioxidants—have been associated with improved ovulation and fertilization rates

(Gaskins and Chavarro, 2018; WHO, 2013). Interventions delivered during the preconception period that combine nutrition education with psychosocial support and hygiene improvements, such as those in the WINGS trial, demonstrate measurable benefits on birth weight and developmental outcomes (Pintó et al., 2022). These findings emphasize the need for integrated nutritional assessments as a standard PCC element for fertility optimization.

Lifestyle behaviors—including tobacco and alcohol use, sedentary habits, and psychological stress—exert profound effects on reproductive capacity and are primary targets of PCC interventions. Reproductive life plan counseling (RLPC) has been shown to enhance women's knowledge of how smoking, alcohol, and stress impact fertility, and increase motivation for behavioral change (Stern et al., 2019). Physical activity, while often underemphasized, contributes to hormonal homeostasis and improved insulin sensitivity, both of which are essential for ovulatory regularity (Legro et al., 2022). Furthermore, micronutrient supplementation—particularly folic acid—has robust evidence for reducing neural tube defects and possibly enhancing fecundity when taken preconceptionally (De-Regil et al., 2010; Temel et al., 2014). Emerging studies also highlight the role of vitamin D in follicular development and iron in reducing anovulation risk, especially in women with heavy menstrual bleeding or dietary insufficiencies (Mistry et al., 2023; EARTH Study, 2024). Taken together, these components reinforce PCC as a critical period for modifiable intervention in infertility prevention.

2. Assisted Reproductive Technology and Infertility Treatment Trends

The rising global reliance on assisted reproductive technology (ART) reflects a paradigm shift in reproductive health policy, driven by demographic changes and medical innovation. As the average maternal age continues to increase due to sociocultural shifts, professional aspirations, and late union formations, ART has become a crucial compensatory intervention in addressing age-related infertility (ESHRE, 2020; ICMART, 2023). Notably, ART-conceived births account for a substantial proportion of national fertility in some European countries, with reported rates approaching 10%, highlighting its significant contribution to population dynamics (Sobotka et al., 2023). Yet, regional disparities remain stark, especially across Latin America, sub-Saharan Africa, and low-resource Asian countries, where ART coverage remains under 1% of births and is often limited to private, out-of-pocket services (Gurtin, 2024; Inhorn, 2023). These inequities underscore the importance of integrating ART within public health systems and insurance frameworks, especially in settings where infertility prevalence intersects with delayed reproductive timing.

Contemporary utilization patterns of ART reveal a marked dominance of in vitro fertilization (IVF) and its derivative techniques, with intracytoplasmic sperm injection (ICSI) now representing over 70% of global ART cycles (ESHRE, 2021). Initially developed for severe male infertility, ICSI is now routinely used in cases of unexplained infertility, borderline semen parameters, and repeated fertilization failure, despite ongoing debates about its overuse (Dyer et al., 2023). Importantly, improvements in protocol standardization and embryo culture systems have contributed to enhanced implantation and live birth rates, while recent evidence confirms no independent association between ART and adverse obstetric outcomes such as breech presentation or major cardiovascular events in offspring (Kärkkäinen et al., 2024; Qin et al., 2024). Moreover, individualized factors such as maternal sleep quality, life-

style, and biological biomarkers like extracellular vesicle content in follicular fluid have emerged as predictive markers for ART success, signaling a future of precision reproductive medicine (Liu et al., 2023; Zhao et al., 2024).

One of the most transformative advancements in modern ART is the widespread adoption of cryopreservation technologies, especially frozen embryo transfer (FET), which now surpasses fresh transfer cycles in many fertility centers globally (ICMART, 2023). FET offers several advantages, including improved endometrial receptivity, reduced ovarian hyperstimulation syndrome risk, and enhanced scheduling flexibility. Studies comparing neonatal outcomes between fresh and frozen embryo cycles have explored implications on birth weight and perinatal complications, contributing to ongoing refinement in FET protocols (Zhou et al., 2018). Beyond immediate ART applications, cryopreservation has redefined fertility preservation—allowing cancer patients, individuals with autoimmune diseases, and those choosing elective egg or sperm banking to safeguard reproductive potential (Lemoine and Assou, 2024). As cryopreservation increasingly intersects with social egg freezing and gender-affirming care, its role in supporting reproductive autonomy and long-term planning is likely to grow, warranting continued ethical, clinical, and policy dialogue.

3. Comorbid Conditions Affecting Fertility: Emerging Focus in Preconception Care

As preconception care evolves toward a more personalized and risk-stratified model, the integration of comorbidity assessment has emerged as a central focus in fertility optimization. The pathophysiological burden of chronic conditions—particularly obesity and polycystic ovary syndrome (PCOS)—has garnered increasing attention due to their shared mechanisms of endocrine disruption and ovulatory dysfunction. Obesity alters the hypothalamic–pituitary–gonadal axis via hyperinsulinemia and peripheral aromatization of androgens, which dysregulates gonadotropin release and impairs follicular development. Meanwhile, PCOS, characterrized by hyperandrogenism and insulin resistance, disrupts folliculogenesis through sustained luteinizing hormone elevation, aberrant GnRH pulsatility, and premature arrest of follicle maturation. The convergence of these metabolic abnormalities not only reduces fecundability but also increases the risk of poor ART outcomes, necessitating early intervention via lifestyle modification and insulin sensitizers prior to conception (Shukla et al., 2025).

Beyond metabolic disorders, autoimmune diseases such as systemic lupus erythematosus (SLE) and antiphospholipid syndrome (APS) represent critical, often underdiagnosed, contributors to subfertility and early pregnancy loss. SLE may reduce ovarian reserve through chronic inflammation and cytotoxic therapy exposure, while menstrual irregularities and anti-Müllerian hormone (AMH) depletion have been reported even in stable disease (Lee et al., 2021; Stamm et al., 2022). APS, frequently coexisting with SLE, is directly implicated in implantation failure, recurrent miscarriage, and placental insufficiency through prothrombotic and inflammatory mechanisms at the maternal–fetal interface. Contemporary management strategies involve stratified anticoagulation using low-dose aspirin and low molecular weight heparin, with preconception planning guided by antiphospholipid antibody profiles and previous obstetric history (Lee et al., 2021). These findings underscore the importance of incorporating autoimmune screening into routine PCC, particularly for patients with known auto-

immune backgrounds or recurrent pregnancy loss.

A growing body of evidence also supports the inclusion of genetic, metabolic, and neurological conditions in preconception evaluations due to their nuanced impacts on fertility. In men with cystic fibrosis, near-universal infertility caused by congenital bilateral absence of the vas deferens (CBAVD) is now addressable through sperm retrieval and IVF/ICSI, while women with CF may face subfertility from cervical mucus abnormalities and nutritional deficits. Likewise, adults with congenital heart disease—especially those with simple to moderate defects—can achieve comparable fertility rates to the general population, though multidisciplinary preconception counseling remains crucial to manage hemodynamic stress during pregnancy. Diabetes mellitus introduces additional complexity through endocrine and microvascular damage, affecting both male and female reproductive physiology and necessitating stringent glycemic control preconceptionally (Condorelli et al., 2018). Finally, neurological disorders such as epilepsy and multiple sclerosis (MS) influence fertility via hormonal axis dysregulation, sexual dysfunction, and medication-related gonadotoxicity. Women with epilepsy experience elevated rates of anovulation and menstrual disturbances, while MS patients—particularly those on cytotoxic therapies—may experience diminished ovarian reserve and increased barriers to natural conception. A tailored, interdisciplinary model of care that anticipates these disease-specific reproductive challenges is critical for ensuring equitable fertility outcomes in patients with chronic illnesses.

4. Evidence Synthesis, Gaps, and Research Imperatives

Meta-analyses have played a central role in consolidating fragmented evidence on the efficacy of preconception care (PCC) interventions, particularly in relation to fertility and assisted reproductive technology (ART) outcomes. Synthesized data have confirmed the benefits of specific interventions such as lifestyle modification, which has demonstrated significant effects on weight loss and spontaneous pregnancy rates among subfertile populations (OR 1.87; 95% CI: 1.24–2.81) (Lan et al., 2017). Additionally, PCC in women with pregestational diabetes markedly reduces congenital malformations (RR= 0.29; 95% CI= 0.21 to 0.40) and perinatal mortality (RR= 0.46; 95% CI= 0.23 to 0.94) (Wahabi et al., 2020). Vitamin D sufficiency has been associated with improved ART outcomes (live birth OR= 1.33; 95% CI= 1.08 to 1.65) (Chu et al., 2018), and thyroid function assessment before conception has shown predictive value for miscarriage risk (OR= 1.91; 95% CI= 1.09 to 3.35 for TSH 3.5–5 mIU/L) (Zhao et al., 2018). These findings underscore the potential of meta-analysis to inform clinical guidelines by aggregating heterogeneous trial data into actionable insights.

Despite this progress, significant gaps remain in the current literature. Most studies have limited external validity due to homogeneous populations, with an overrepresentation of overweight subfertile women in high-resource settings and minimal inclusion of men, adolescents, or underrepresented ethnic groups (Bayrami et al., 2016; Lan et al., 2017; Wise et al., 2025). Intervention heterogeneity also limits interpretation, as protocols vary in duration, intensity, and components, precluding identification of standardized, high-yield PCC packages (Lan et al., 2017). Social determinants, mental health, and structural racism remain underexplored despite emerging data showing racial disparities in fecundability (FR 0.60 for non-Hispanic Black vs. White participants) (Wise et al., 2025). To address these limitations, future research must include

longitudinal, interventional designs with diverse cohorts and harmonized intervention protocols. Integrating PCC into routine services such as family planning and adolescent health may improve reach, while long-term follow-up is necessary to evaluate sustained reproductive and offspring outcomes (Mekonnen and Tsega, 2024). A coordinated global research agenda is essential to generate equitable, evidence-based PCC strategies.

This study is limited by its reliance on a single database, Scopus, which, while comprehensive, may exclude relevant publications indexed elsewhere. The analysis was also restricted to English-language documents, potentially omitting important research in other languages. Additionally, keyword-based bibliometric methods may be influenced by variations in terminology and indexing practices across journals. As a result, some relevant studies might have been overlooked despite efforts to standardize terms. Lastly, while bibliometric analysis provides valuable insights into publication trends and research patterns, it does not assess the

5. Quality or clinical impact of individual studies

This bibliometric analysis provides a comprehensive overview of the global research landscape on preconception care (PCC) in the context of infertility prevention. The findings indicate a steadily increasing volume of publications since the early 2000s, with notable surges in scholarly output and citation impact in the past decade. The literature is shaped by contributions from a relatively concentrated group of countries, authors, and institutions—most notably the United States and affiliated funding bodies—highlighting geographic and institutional disparities in research productivity. Thematic mapping reveals that research has evolved from general reproductive health concerns toward more specialized topics, including metabolic, autoimmune, and genetic comorbidities as well as advanced assisted reproductive technologies. Clinical concepts such as PCOS, ART, and cryopreservation, along with behavioral interventions like nutrition and folic acid supplementation, have emerged as central themes, underscoring the multidisciplinary nature of PCC in infertility prevention.

Despite increasing academic attention, there remains a critical gap in the global PCC research agenda, such as the heterogeneity in intervention protocols. This may hinder the formulation of standardized Preconception care packages. Moreover, limited integration of social determinants, mental health, and structural inequities into PCC frameworks reflects an urgent need for more inclusive, intersectional approaches. Future research should prioritize longitudinal and interventional studies, foster global collaboration, and align with broader reproductive justice goals to strengthen the evidence base. Ultimately, enhancing the visibility and implementation of PCC in both clinical and public health domains will be pivotal in addressing modifiable infertility risks and promoting equitable reproductive outcomes worldwide.

AUTHOR CONTRIBUTION

Revi and Siti were responsible for the study design, and drafting of the manuscript. Muhana, Rufidah and Nurul, provided substantial contributions to the study design and critical revision of the manuscript. Atriany and Luluk, contributed to the im provement of the manuscript by providing critical insights and expertise on the topic.

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CONFLICT OF INTEREST

There is no conflict of interest in this study.

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