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Determinants and Causes of Stillbirth in South Africa: Systematic Literature Reviewand Bibliometric Analysis

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ABSTRACT
Stillbirth remains a significant public health challenge in South Africa, with complex determinants and causes contributing to its prevalence. This systematic literature review aims to identify and analyze the key determinants and causes of stillbirth in South Africa, utilizing VOSviewer for data visualization and bibliometric analysis. A comprehensive search was conducted across multiple academic databases, focusing on studies published between1994 and 2024. Studies were screened, evaluated, and selected based on predefined inclusion and exclusion criteria, focusing on maternal health, healthcare access, socio-economic conditions, and clinical care practices.
The analysis revealed several critical determinants of stillbirth in South Africa, including poor antenatal care quality, maternal infections, hypertension, diabetes, preterm birth, and insufficient healthcare infrastructure, particularly in rural and under-resourced areas. Socio-economic factors, such as poverty, limited access to healthcare services, and cultural practices, also emerged as significant contributors. VOSviewer was employed to visualize co-occurrence networks, revealing relationships between these determinants and key research themes in the literature.
The findings highlight the multifactorial nature of stillbirth in South Africa, emphasizing the need for comprehensiveevidence-based interventions targeting both clinical and socio-economic factors. Using VOSviewer allowed for a deeper understanding of the research landscape, identifying gaps in the existing literature and areas for future investigation. This review contributes to the ongoing efforts to reduce stillbirth rates in South Africa by providing evidence-based insights to inform public health policies and maternal healthcare practices specifically in low-income rural districts.

Keywords: Stillbirth, South Africa, determinants, causes, VOSviewer, systematic review, maternal health, antenatal care, socio-economic factors.

1. INTRODUCTION

Globally, an estimated 2.6 million stillbirths occur annually, with 98% occurring in low- and middle-income countries (LMICs) (Blencowe et al., 2018; Aminu & van den Broek, 2019). The global stillbirth rate is approximately 13.9 per 1,000 births, with significant regional disparities (Souza & Bahl, 2022). Rates in LMICs can exceed 20 per 1,000 births, particularly in sub-Saharan Africa and South Asia (Saleem et al., 2018). Major causes include asphyxia, placental disorders, maternal hypertension, and infections (Aminu et al., 2019). Risk factors include advanced maternal age, low education, lack of antenatal care, and previous stillbirth history (Kasa et al., 2023).Stillbirth remains a significant issue in South Africa, with rates ranging from 10.1 to 38.4 per 1000 births(Hlongwane et al., 2022; Ntuli & Malangu, 2012).Stillbirth, defined as the death of a fetus after 20 weeks of gestation but before delivery, remains a significant public health issue worldwide(Murphy et al., 2022).WHO recommends standardizing the international stillbirth definition for epidemiology studies, utilizing a birthweight of ≥1000 g and ≥28 weeks gestation(Kelly et al., 2021). Despite some progress, many countries are not on track to meet the Every Newborn Action Plan target of 12 stillbirths per 1,000 births by 2030 (Goldenberg et al., 2023; McClure et al., 2020). According to McClure et al. (2020), improved obstetric care, and addressing preventable conditions could significantly reduce stillbirth rates (Blencowe et al., 2018).The complex interplay of clinical, socioeconomic, and healthcare system-related factors contributes to stillbirth occurrence(Mostert, 2021). According to Adeleye et al. (2024), key determinants include maternal age, education, antenatal care, skilled birth attendance, gender inequality, and maternal health conditions such as anemia and hypertension.

In South Africa, stillbirth continues to pose a major challenge within the public health system(Marincowitz & Marincowitz, 2024). The national stillbirth rate is approximately 18 per 1,000 births, higher than the global average, underscoring the need for more robust interventions(Marincowitz & Marincowitz, 2024). According to Hlongwane et al. (2022), in South Africa (SA), approximately 16,000 stillbirths occur annually, and most are classified as unexplained and occur in district hospitals.The burden is hefty in rural areas and economically disadvantaged regions such as the Lejweleputswa District Municipality in the Free State province. Contributing factors include inadequate access to quality maternal healthcare, delays in seeking care, and underlying conditions such as maternal infections and hypertension(Malinga et al., 2020). According to Mostert (2021), socio-economic inequalities and the varying quality of antenatal care services exacerbate the problem, especially in public health facilities.

Social norms and cultural practices significantly influence stillbirth experiences and outcomes in developing countries(Noge et al., 2020). Healthcare providers face challenges in addressing stillbirths, including inadequate training and emotional burdens(Christou et al., 2021). While interventions like the National Health Promotion Policy have shown some impact in reducing stillbirths and maternal mortality, addressing stillbirths requires multifaceted approaches(Mostert, 2021). These include improving healthcare access, promoting culturally sensitive care, and strengthening maternal health services(Christou et al., 2021). Implementation of stillbirth interventions varies between national and subnational levels, influenced by global norms, local contexts, and health system factors(Rumbold et al., 2020). According to Rumbold et al. (2020), persistent disparities in stillbirth risk and care highlight the need for targeted interventions for vulnerable populations, such as Indigenous women and those from migrant backgrounds. Addressing stillbirths effectively requires consideration of social determinants, cultural beliefs, and health system constraints.

The determinants and causes of stillbirth are multifaceted in South Africa, encompassing both preventable and non-preventable factors(Madhi, Briner, et al., 2019; Marincowitz & Marincowitz, 2024). According to Marincowitz and Marincowitz (2024), clinical conditions such as maternal infections, hypertensive disorders, diabetes, preterm birth, and fetal growth restrictions are widely recognized contributors. However, social determinants of health, including poverty, limited access to quality healthcare, cultural practices, and health system inefficiencies, also play a crucial role in influencing stillbirth rates(Adeleye et al., 2024). Understanding these determinants is essential for developing targeted interventions to reduce stillbirths and improve maternal and neonatal health outcomes(Souza et al., 2024).In South Africa, the disparity in stillbirth rates between urban and rural areas, as well as between public and private healthcare sectors, highlights the need for a comprehensive analysis of the underlying causes(Hlongwane et al., 2022). Previous studies have explored various determinants of stillbirth. Still, there is a need for a more systematic approach to synthesizing this knowledge, identifying research gaps, and visualizing the relationships between these factors.

This study aims to conduct a systematic literature review of the determinants and causes of stillbirth in South Africa, utilizing VOSviewer for bibliometric analysis and data visualization. VOSviewer is a widely used tool for creating network maps of scientific publications, enabling the identification of key themes, research trends, and co-occurrence relationships between factors related to stillbirth(Van Eck & Waltman, 2007). By applying this approach, the study seeks to provide a comprehensive overview of the factors contributing to stillbirth in South Africa, highlighting the most critical areas for public health intervention.

The review will focus on the following research objectives:

a) To identify and analyze the clinical, socio-economic, and healthcare system determinants of stillbirth in South Africa.
b) To map the research landscape on stillbirth using VOSviewer, highlighting key themes and relationships between determinants.
c) To identify gaps in the literature that require further investigation to inform policy and improve maternal healthcare services.

To understand the objectives of this study, it is essential to examine how various factors contribute to stillbirthFigure 1 outlines a framework that represents the various settings and conditions contributing to stillbirth mortality. This framework serves as a structured approach to identifying and categorizing the different factors involved in stillbirth. The clinical determinants include maternal health conditions such as hypertension, infections, and pre-existing health conditions, which directly affect pregnancy outcomes.

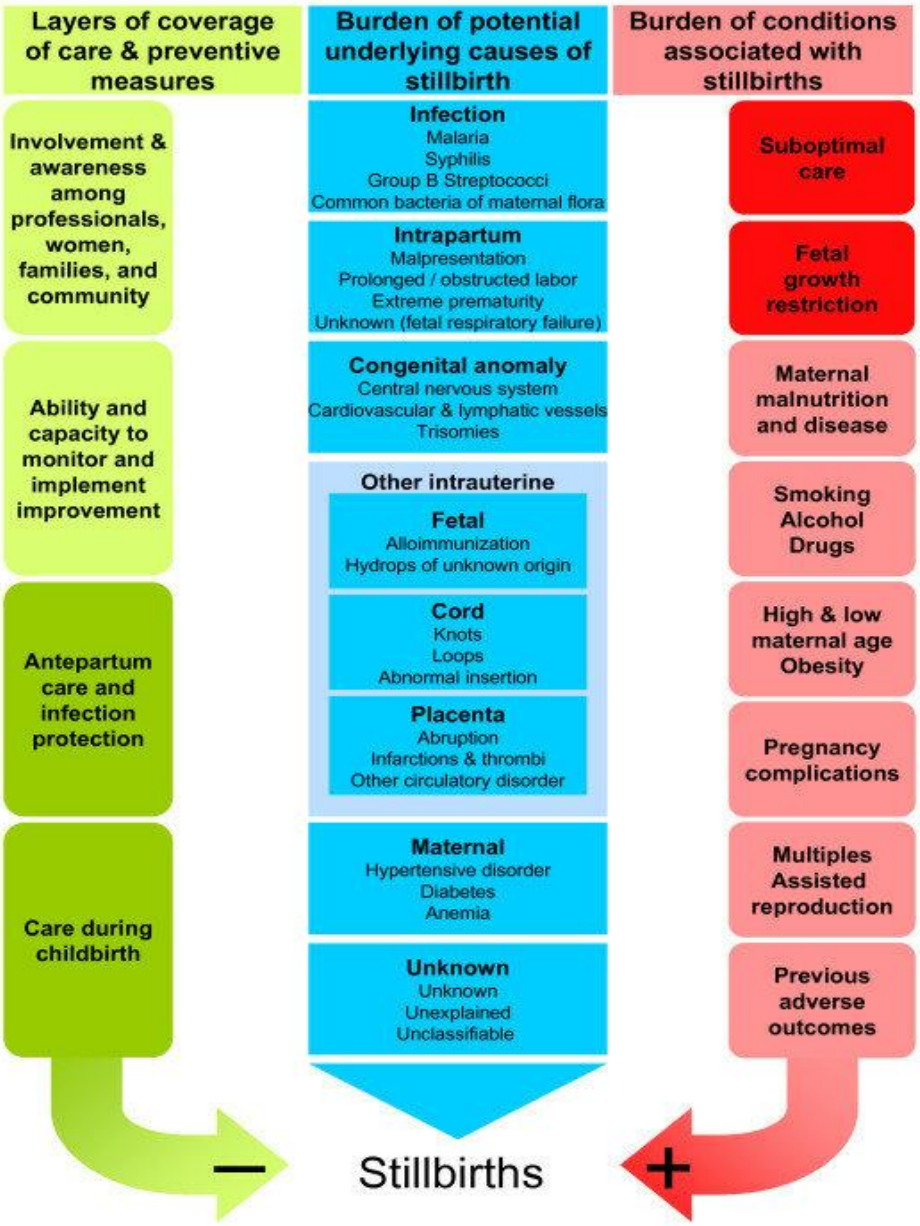

Figure 1: Stillbirth determinants. A framework of the setting and conditions that constitute the data sources needed for the understanding of stillbirth mortality
Source: Adapted from Frøen et al. (2009)

2. METHODOLOGY

Instead of relying on a narrative literature review, our methodology leverages a combination of two evolving approaches: the systematic literature review (SLR) and bibliometric analysis(Sunge & Mudzingiri, 2023). Although SLR originated over two centuries ago in health science research, its application in social sciences and business has only gained traction in recent years(Lame, 2019; Sunge & Mudzingiri, 2023).Systematic Literature Reviews (SLRs) are structured methodologies for comprehensively analyzing research in a specific field (Danese et al., 2018). They follow rigorous procedures to minimize bias and ensure reproducibility (Azarian et al., 2023). Artificial Intelligence is increasingly being applied to semi-automated SLR tasks, particularly in screening and data extraction(Bolanos et al., 2024). However, challenges remain in defining best practices and methodological consistency (Azarian et al., 2023). As the field evolves, researchers must carefully consider review objectives, search strategies, and quality assessment to ensure robust and transparent results(Priharsari, 2022).

In addition, the systematic nature of an SLR enhances transparency, as it allows others to track and evaluate how the sources were selected and analyzed, thus increasing the credibility of the review(Varsha et al., 2024). According to (Varsha et al., 2024), by eliminating subjectivity and ensuring consistency in the selection of literature, the SLR provides a comprehensive and explicit summary of the existing evidence on a particular topic. This makes it easier for researchers to identify existing knowledge gaps and areas that require further investigation(Dhir et al., 2020). Ultimately, an SLR helps in building a solid foundation for future research, offering an exhaustive overview of the current state of knowledge on a given subject(Hinderks et al., 2020). This makes it a particularly valuable tool for researchers seeking to contribute meaningful advancements to their fields.

We conducted the systematic literature review (SLR) following the updated guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 Statement. This updated version, which builds upon the 2009 Statement, includes 27 essential items for reporting, with a more detailed checklist offering specific recommendations, an abstract checklist, and an enhanced flow diagram Figure 1. To complement the findings from the SLR, we incorporated bibliometric analysis (BA)(Page et al., 2021). According to Page et al. (2021), SLR provides a framework for selecting and excluding research themes, it does not quantitatively assess them and this is where BA becomes essential. BA employs a range of quantitative techniques, such as citation analysis and co-occurrence patterns, applied to bibliometric units like authors, journals, and research themes (Donthu et al., 2021; Sunge & Mudzingiri, 2023).

BA is divided into two main categories which are performance analysis and science mapping(Farooq, 2024). Performance analysis focuses on metrics related to publications, citations, document counts, and citation-based metrics. Science mapping, on the other hand, includes techniques like citation analysis, co-citation, bibliographic coupling, and co-authorship analysis(Moral-Muñoz et al., 2020). The choice of indicators should align with the specific research objectives. Since our study aimed toaims to conduct a systematic literature review of the determinants and causes of stillbirth in South Africa, we employed co-word analysis. Unlike other science mapping methods, which use cited or citing documents, co-word analysis examines the actual content of the publications (Deng et al., 2021). For this, we utilized the latest version of VOSViewer 1.6.20 by Van Eck and Waltman (2020) to perform the bibliometric co-word analysis, enabling us to create the Network, Overlay, and Density Visualization presentations.

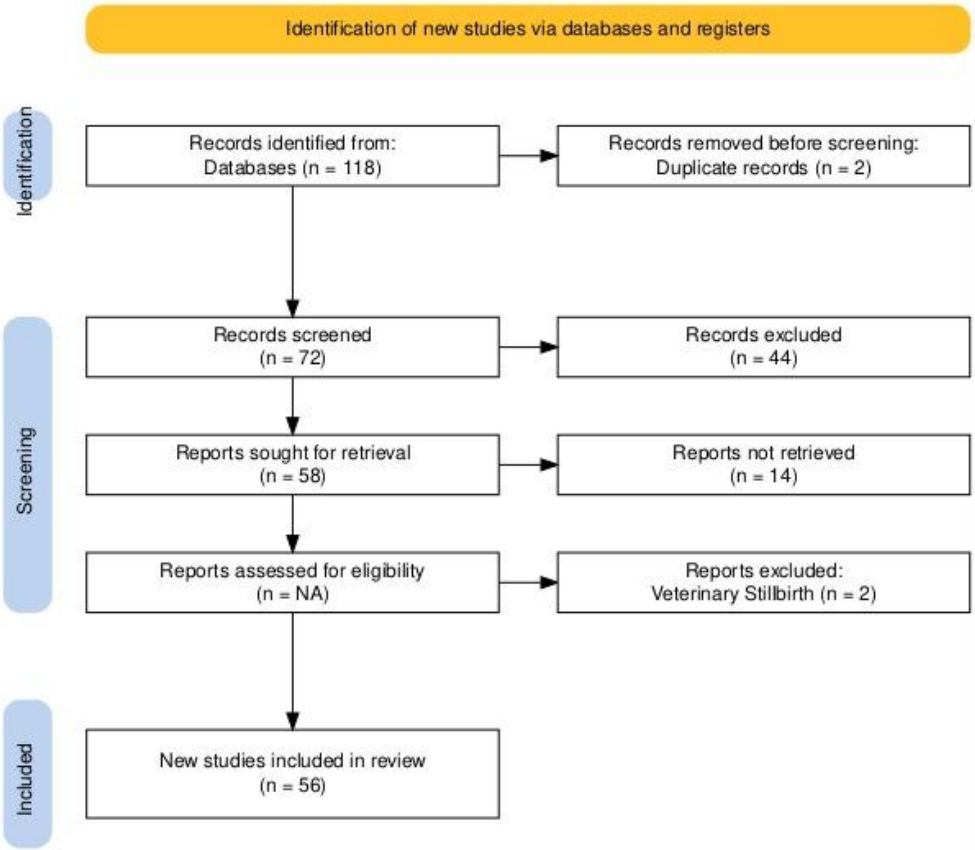

Figure 2: Updated PRISMA Flow Chart Statement 2020
Source: Adapted from Haddaway et al. (2022)

2.1 Data Source

The data source for this study comprises publications obtained from Scopus, a widely recognized and comprehensive academic database. Scopus was selected as the primary data source because it is one of the largest and most robust repositories for peer-reviewed literature, offering extensive research coverage across multiple disciplines, including health, social sciences, and business. Its extensive scope makes it an ideal choice for conducting bibliometric analysis, as it provides access to a vast array of academic journals, conference proceedings, books, and research articles(Sunge & Mudzingiri, 2023).

Moreover, Scopus offers powerful tools for citation tracking and bibliographic analysis, allowing researchers to analyze publication trends, citation impact, and collaboration networks in a systematic and detailed manner(Simons, 2018). Its indexing covers a wide range of high-quality sources, making it particularly suitable for identifying key studies, authors, and institutions contributing to the field of stillbirth research in South Africa(Baas et al., 2020). By using Scopus, this study benefits from a comprehensive and reliable dataset, ensuring that the literature review and bibliometric analysis are built on a solid and extensive foundation of scholarly publications(Giannakos et al., 2020).

2.2 Search Strategy

The search strategy employed in this study involved the use of the Scopus advanced search function, utilizing the following search syntaxTITLE-ABS-KEY (Stillbirth AND Causes OR Determinants OR Risk Factors AND South Africa). This syntax was designed to focus on the search for publications specifically related to stillbirth by targeting keywords within the title, abstract, and keywords of each paper. The inclusion of TITLE-ABS-KEY ensures that only papers with these terms in these key sections are retrieved, filtering out irrelevant studies and honing in on the most pertinent literature.

In this search, the terms "Stillbirth" were combined with related factors such as "Causes," "Determinants," and "Risk Factors" using the Boolean operator AND, ensuring that all retrieved papers addressed these specific aspects of stillbirth. The use of "OR" between "Causes," "Determinants," and "Risk Factors" allowed for a more flexible search, capturing a broader range of studies that may have used different terminology to describe the factors influencing stillbirth. The additional inclusion of "South Africa" as a geographic limiter further refined the search to focus on literature specific to the South African context, ensuring that the results were directly relevant to the country under study.

This targeted approach ensured a comprehensive yet focused retrieval of studies, allowing for an in-depth analysis of the determinants and causes of stillbirth specific to South Africa, while also accounting for variations in how these factors may have been described across different studies. By leveraging Scopus' advanced search capabilities, this strategy maximized the relevance and quality of the literature included in the systematic review and bibliometric analysis.

3. RESULTS AND DISCUSSION

Our results are organized into two main sections. The first section focuses on presenting findings related to the most influential journals and prominent authors leading the stillbirth research. This analysis sheds light on the key contributors to the field, identifying where the most impactful research is being published and which researchers and countries are at the forefront of stillbirth studies. In the second section, we provide the results of the bibliometric keyword co-occurrence analysis, which maps out the relationships between frequently occurring keywords in the literature. This analysis helps to reveal dominant themes and topics in stillbirth research, as well as emerging areas of interest.

At each stage of analysis, we not only present the findings but also offer a discussion of the key trends and insights uncovered. We focus on identifying significant research gaps, particularly to the causes and determinants of stillbirth in rural districts, which are often underrepresented in the existing literature. By highlighting these gaps, we aim to inform future studies and encourage more targeted research that addresses the unique challenges faced by rural communities. This dual approach of analyzing leading contributions and thematic trends provides a comprehensive understanding of the current state of stillbirth research, paving the way for further exploration and intervention in areas that are critical for improving maternal and fetal health outcomes.

3.1 Scopus journal

The primary database utilized in this research was Scopus, from which 118 journal articles were selected for analysis. Scopus was selected due to its extensive coverage of peer-reviewed literature in various academic fields, including medicine, social sciences, and public health. Its wide range of high-quality research articles ensures a strong and reliable dataset, making it suitable for systematic reviews and bibliometric analysis.By exclusively using Scopus, this study ensured access to a diverse range of reputable journals and research outputs that have undergone rigorous peer review. However, focusing on a single database means that certain relevant studies from other sources, such as PubMed, Web of Science, or regional databases, may have been missed.

Nonetheless, the 118 journal articles retrieved from Scopus form a substantial body of literature, forming a strong foundation for understanding the determinants and causes of stillbirth.
The 118 articles serve as the basis for both qualitative and quantitative analyses. Through a systematic screening process, these studies were meticulously chosen for their relevance to stillbirth, particularly focusing on clinical, socio-economic, and healthcare system determinants within the South African context. The selected articles then underwent bibliometric analysis to identify trends, key themes, and gaps in existing research, providing valuable insights into future research directions to address critical issues, particularly in underserved rural districts.

3.2 Main Authors

Figure 3 shows documents by author listing the top ten authors with Pattison, R.C on 16 articles followed by Madhi, S.A with 13 articles and Bassat, Q and Blau, D.M both on 9 articles. Akelo, V, Mahtab, S, Onyango, D, Velaphi, S and Wadula, J all have 7 articles each with Adam, Y having 6 articles.

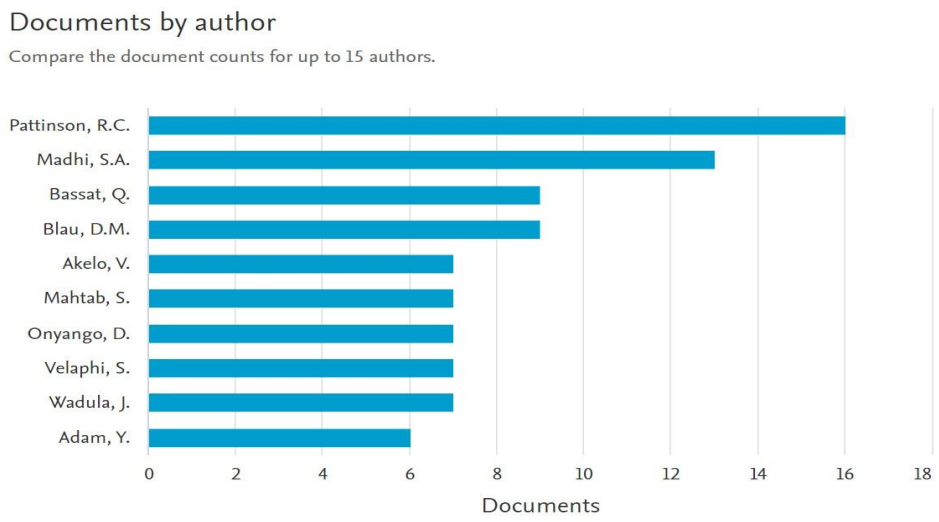

Figure 3: Documents by Author
Source: Adapted from Scopus search results analysis

Researcher Pattinson is the most prolific contributor to the research examined in this study with 16 articlesand after the screening, he had 8 articles (Allanson et al., 2015; Bergh et al., 2019; Hlongwane et al., 2023; Lavin et al., 2018; Lavin & Pattinson, 2018; Lavin et al., 2020; Nkosi et al., 2019; Pattinson & Theron, 1989). His work primarily focuses on crucial aspects of perinatal mortality and efforts to enhance the classification and understanding of stillbirths in low- and middle-income countries (LMICs), particularly in South Africa. One of his major research areas involves exploring the feasibility of using the International Classification of Diseases-perinatal Mortality (ICD-PM) coding for the classification of perinatal deaths in existing datasets. This work is vital for standardizing how perinatal deaths, including stillbirths, are classified and helps in identifying the causes and patterns of mortality more accurately.One of the significant challenges in Pattinson's research is the detection of stillbirth risk during pregnancy, particularly in low-risk populations. He emphasizes the promising approach of using continuous-wave Doppler ultrasound (CWDU) to screen for placental insufficiency, a major cause of stillbirths. CWDU aids in identifying cases where the placenta is not providing sufficient oxygen and nutrients to the fetus, potentially leading to stillbirth if not properly managed. By focusing on placental health, CWDU provides a valuable tool for early detection, especially in settings with limited access to advanced antenatal care.
Pattinson's work also involves comparing stillbirth risk across pregnancy between small-for-gestational-age (SGA) and appropriate-for-gestational-age (AGA) pregnancies in the Western Cape Province of South Africa. His research aims to determine whether babies smaller than expected for their gestational age are at a higher risk of stillbirth compared to those of appropriate size. This investigation offers crucial insights into risk stratification and early intervention strategies.Additionally, Pattinson explores stillbirth risk across different stages of pregnancy and variations between provinces in South Africa, each with different antenatal care schedules. His research emphasizes the importance of early and frequent antenatal visits to detect potential complications that could lead to stillbirth. This underscores the differences in healthcare delivery across provinces and how variations in antenatal care schedules may impact perinatal outcomes.

Pattinson has extensively analyzed population-based perinatal mortality data from Mpumalanga, a province in South Africa with an LMIC setting, to determine the causes of perinatal death and examine the rate of maternal complications in cases where perinatal deaths occur. By analyzing these patterns, his work provides valuable data on the factors contributing to perinatal mortality in under-resourced settings, which is essential for shaping effective interventions to reduce stillbirths and improve maternal health outcomes.
He has significantly contributed to the understanding of perinatal mortality and stillbirth risk in South Africa, offering valuable insights into both the clinical and systemic factors influencing maternal and fetal health in LMICs.

3.3 Documents over time

The findings presented in Figure 4 highlight a fluctuating trend in the growth rate of research on the causes, determinants, and risk factors of stillbirth in South Africa over recent years. Notably, there was a sharp increase in the volume of research between 2016 and 2019, a period characterized by heightened attention to maternal and perinatal health issues globally. This surge in research may be attributed to the increasing recognition of stillbirth as a major public health concern, as well as the implementation of initiatives aimed at improving maternal healthcare, such as the 2016 WHO Antenatal Care Guidelines, which emphasized reducing preventable stillbirths.
However, following this period of growth, the data shows a sharp decline in the number of publications starting in 2020, likely a result of the disruptions caused by the COVID-19 pandemic. The pandemic strained healthcare systems worldwide, including in South Africa, diverting attention and resources away from non-COVID health issues. Research priorities shifted towards pandemic-related topics, while lockdowns and restrictions also impacted fieldwork and data collection for many ongoing studies. This resulted in a noticeable reduction in the number of stillbirth-related research publications during this time.
Interestingly, from 2022 onward, the data indicates a resurgence in the number of articles published on stillbirth in South Africa. This rebound can be attributed to the recovery of research activities following the easing of pandemic-related restrictions. As healthcare systems began to stabilize, researchers were able to refocus on critical issues such as stillbirth. Moreover, the post-pandemic period likely saw a renewed commitment to addressing gaps in maternal healthcare that may have worsened during the pandemic, further driving interest in stillbirth research.
This fluctuating growth pattern highlights both the challenges and resilience within the academic and healthcare research community. It reflects how external factors, such as global health crises, can disrupt research momentum, while also underscoring the enduring importance of stillbirth as a public health issue in South Africa that continues to demand attention and investigation.

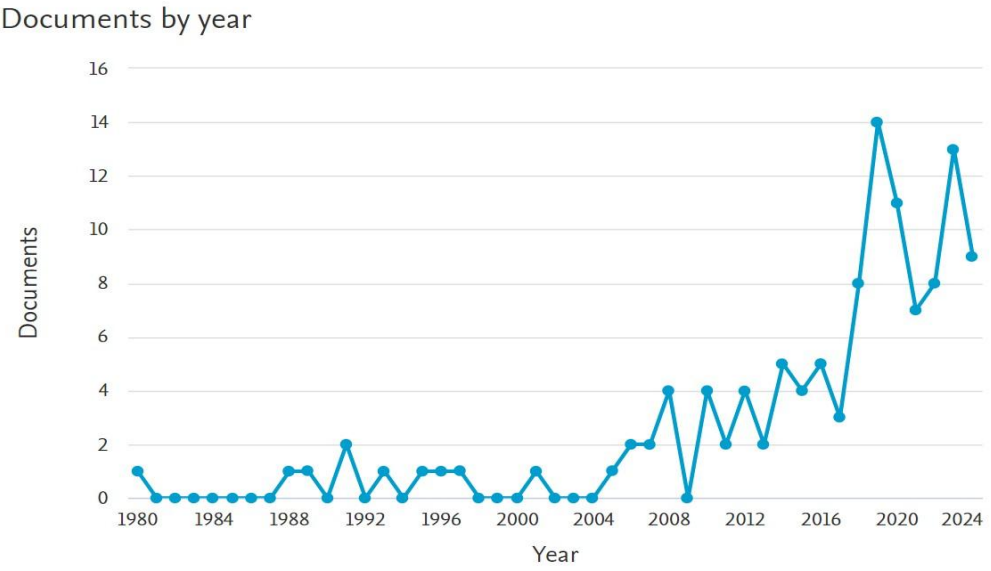

Figure 4: Documents by year
Source: Adapted from Scopus search results analysis

3.4 Key Words

We carried out a detailed examination of the primary focus areas by conducting a bibliometric analysis of the keywords extracted from the documents obtained from Scopus. The results are depicted in Figures 5–7. Figure 5 showcases a Network Visualization, which exhibits clusters, keyword co-occurrences, the number of connections between them, and the strength of these connections. Within this visualization, there are seven distinct clusters, each denoted by different colors. For instance, cluster 1 is visualized in red and encompasses 25 items. The network was created using VOSViewer software version 1.6.20 (Akdeniz & İnam, 2024; Van Eck & Waltman, 2020).

This Network Visualization also incorporates a heatmap of the keywords that appeared at least five times across all the studies examined in the literature. The heatmap emphasizes areas of high keyword concentration, aiding in the identification of the most frequently discussed themes in stillbirth research. The co-occurrence patterns and clusters offer insights into the interconnectedness of different keywords, reflecting the primary research themes and gaps in the field.

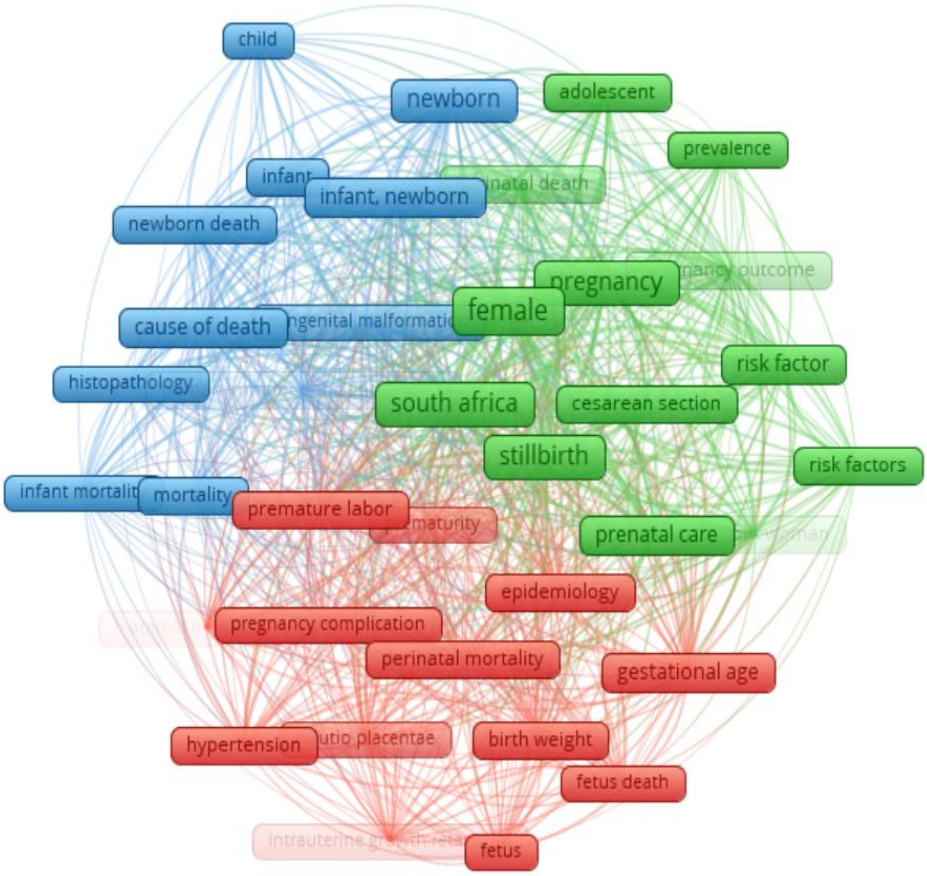

Figure 6. Keyword co-occurrences Network Visualization
Source: Generated from VOSViewer

The bibliometric keyword co-occurrence results are explained by five visualization elements: the item, link, strength, network, and cluster(Sunge & Mudzingiri, 2023). An item is the unit of analysis, in our case keywords. A link is a path connecting two terms (keywords) with the connection measured by some positive value showing its strength (Van Eck & Waltman, 2020). The link and strength in Figure 5, capture the number of documents or publications in which two keywords co-exist. According to Sunge and Mudzingiri (2023), a network is formed by a collection of items and links. Additionally, a cluster or community represents a group of closely related items. The keywords are represented by nodes, where the size of the node and its label reflect the keyword's significance or weight(Akdeniz & İnam, 2024). The distance between nodes illustrates how closely related the keywords are to one another, with shorter distances indicating stronger relationships(Sunge & Mudzingiri, 2023; Van Eck & Waltman, 2020).

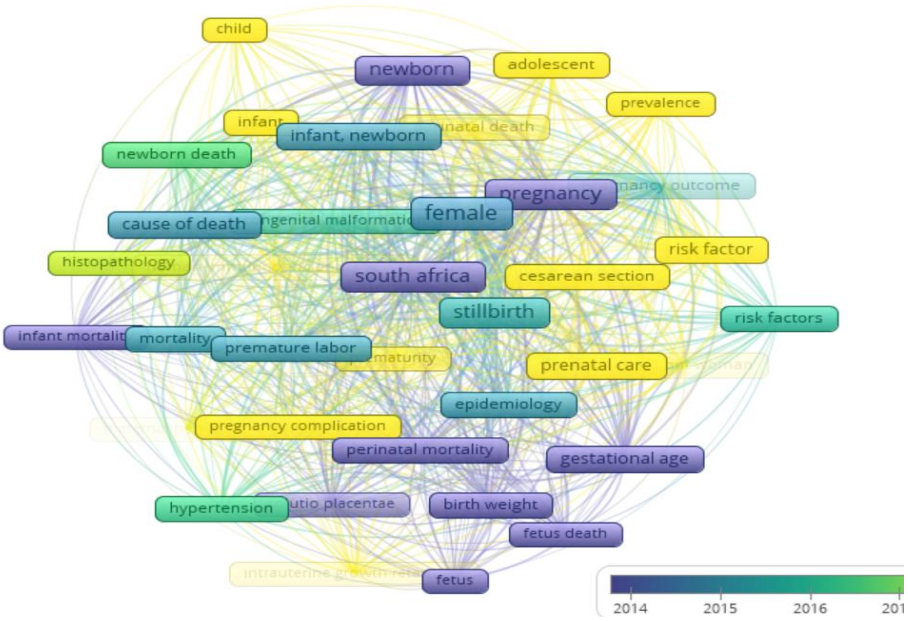

Figure 6: Stillbirth Visualization
Source: Generated from VOSViewer

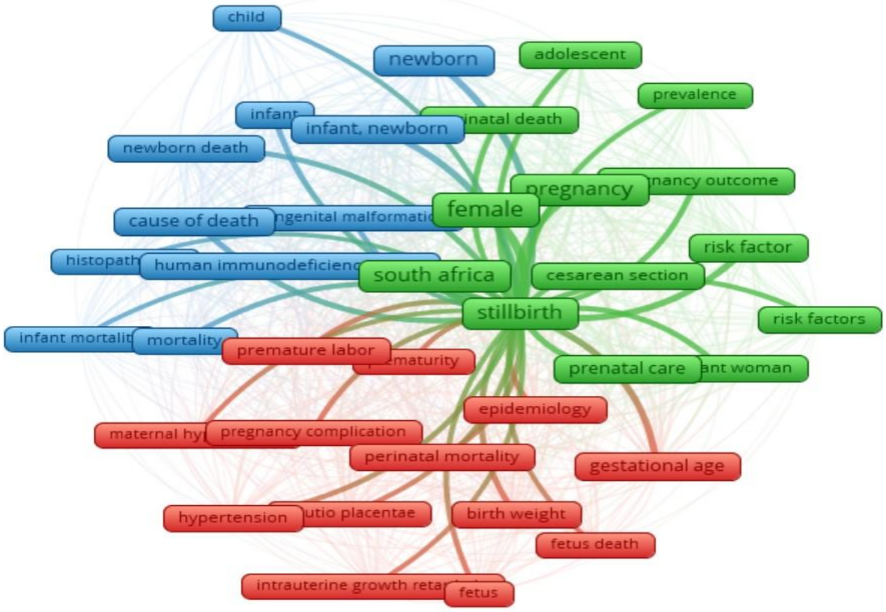

Figure 7: Causes and Determinants of Stillbirth in South Africa
Source: Generated from VOSViewer

Accordingly, it can be observed from Figures 6 and 7 that the word female has the biggest node, having been mentioned at least eight times in 57 publications. (These values are obtained by zooming the data in VOSViewer 1.6.20). The files are attached in Supplementary Materials. One must install VOSViewer (freely downloadable at www.vosviewer.com, accessed on 12September 2024). The word female has 36 links with a strength of 552 (see Table 1). Near the female node are South Africa, stillbirth, pregnancy, newborn, and risk factors. The analysis suggests that most studies focus on women's health, particularly stillbirth and its associated risk factors during pregnancy and the postpartum period. These results highlight the central role of maternal and neonatal health in the existing research, with a particular focus on the South African context, where stillbirth rates remain a significant public health concern.

Table 1. Keyword (top 10) co-occurrence bibliometric analysis results

Key Words	Co-Occurrences	Links	Links Strength	Cluster
Female	57	36	552	2
Stillbirth	54	36	515	2
Pregnancy	52	36	470	2
Risk factors	47	35	269	2
Newborn	29	36	325	3
Gestational age	21	35	255	1
Cause of death	21	35	248	3
Prenatal care	20	36	222	2
Pregnancy outcome	18	36	171	2
Prenatal mortality	15	34	191	1

Source: Authors' compilation from bibliometric analysis results.

Research on maternal and fetal health is primarily focused on the interconnections between females, stillbirth, risk factors, pregnancy outcome, and prenatal care, as highlighted by a bibliometric analysis from VOSviewer. Understanding how maternal factors and access to healthcare contribute to stillbirth, as well as how improvements in prenatal care can lead to better pregnancy outcomes, is the main emphasis in this field(Madhi, Pathirana, et al., 2019). The interconnected network of terms in research underscores the comprehensive approach taken by researchers to address the multifaceted nature of stillbirth prevention. Maternal hypertensive disorders, placental separation and hemorrhage, and chorioamnionitis are identified as the leading underlying causes of stillbirth.Determining the death burden for prioritizing public health interventions necessitates detailed data on the causal pathways to death. Postmortem minimally invasive tissue sampling (MITS), incorporating histology, and molecular and microbial culture diagnostics, enhances cause-of-death attribution, particularly for infectious deaths. These studies show that MITS proves a valid alternative to full diagnostic autopsies(du Toit et al., 2024; Gupta et al., 2024; Madewell et al., 2022). Studies have shown screening a low-risk pregnant population using continuous-wave Doppler ultrasound may substantially reduce the prevalence of unexplained stillbirths in SA(Hlongwane et al., 2023; Nkosi et al., 2019)

The results we presented in Table 1 are of great importance to scholars, funders, and research institutions. If causes and determinants of stillbirth are to propel the pregnancy outcome, especially for women in rural districts, then more effort should be put into the hotspots to maximize the return and minimize the costs of maternal adverse outcomes. Nonetheless, looking at Table 1, we make an important observation.Pregnancy outcome is also a critical concept connected to both stillbirth and prenatal care, with 18 co-occurrences and 36 links. The outcome of a pregnancy, including whether it results in a healthy birth or a stillbirth, is heavily influenced by the quality of prenatal care. Prenatal care (20 co-occurrences, 222 link strength) involves a range of services, including regular monitoring of maternal and fetal health, which can help identify potential risks early on. Adequate and timely prenatal care is one of the most important interventions in reducing the risk of stillbirth and ensuring positive pregnancy outcomes. The connection between prenatal care and pregnancy outcomes demonstrates the importance of healthcare services in improving maternal and fetal health.

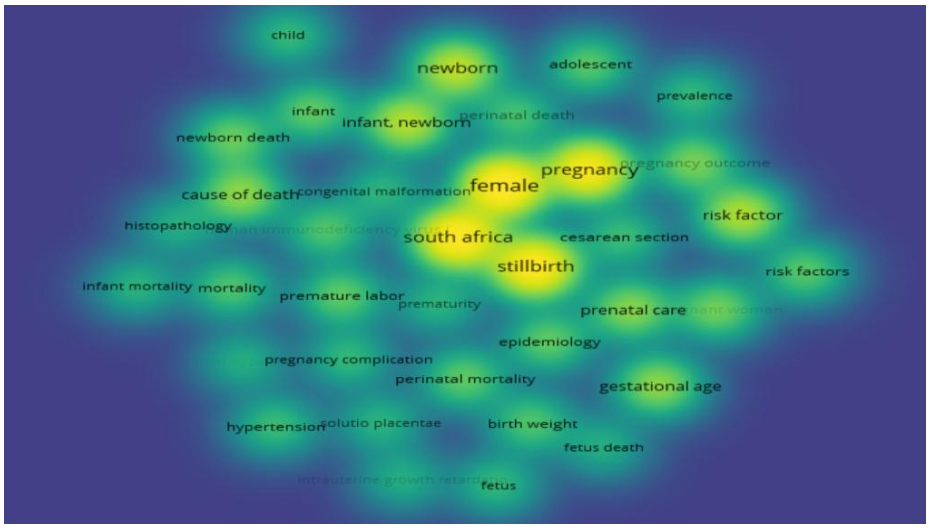

Figure 8. Density visualization
Source: Generated from VOSViewer

In Figure 8, every point in the visualization has a color that shows the density of keywords at that point. The colors range from blue (lowest weight) to red (highest weight). It is seen that the keywords with the highest co-occurrence, links, and link strength in Table 1 are in the red zones. This identifies them as hotspots of the research.

4. Conclusions and Areas of Further Research

The systematic review of existing literature and the bibliometric analysis of stillbirth causes and determinants in South Africa offer crucial insights. Researchers mainly focus on maternal health factors such as female demographics, prenatal care, and risk factors, directly linked to pregnancy outcomes. It is evident that socioeconomic conditions, healthcare quality, and medical risk factors like gestational age and placental insufficiency significantly contribute to stillbirth prevalence, especially in rural and underserved areas of South Africa. The analysis also reveals fluctuations in research activity, with steady growth from 2016 to 2019, followed by declines during the COVID-19 pandemic, and a recent increase in studies from 2022, indicating renewed interest in addressing this issue.

Some instances of stillbirths cannot be explained, even after extensive medical investigations and post-mortem examinations, emphasizing the intricate nature of stillbirth, where certain underlying causes may escape detection due to limitations in medical technology or understanding. Nevertheless, research consistently indicates that a significant number of stillbirths can be prevented, especially those associated with identified risk factors like maternal health conditions, infections, and complications during pregnancy. This highlights the essential role of proper prenatal care in reducing preventable stillbirths.

Prenatal care is crucial in monitoring the health of both the mother and the fetus, identifying risk factors early, and managing complications before they pose a threat to life. Regular prenatal visits enable healthcare providers to identify and address conditions such as hypertension, diabetes, infections, and fetal growth restrictions, all of which are linked to higher risks of stillbirth. Additionally, prenatal care offers an opportunity to educate mothers about proper nutrition, hygiene, and lifestyle adjustments that promote healthy pregnancies. It also allows for timely interventions, such as administering treatments for infections or deciding on early delivery when the fetus is at risk. Ensuring that comprehensive prenatal care is accessible to every pregnant woman, particularly in settings with limited resources where stillbirth rates are disproportionately high, many avoidable deaths can be prevented. Health systems should prioritize improving the quality and availability of prenatal services, ensuring that even those in rural or marginalized communities can benefit from regular check-ups, appropriate screening, and early treatment interventions.

Some stillbirths may remain unexplainable, enhancing the coverage and quality of prenatal care is a proven approach to reducing preventable stillbirths. Policymakers and healthcare providers need to prioritize universal access to prenatal care to ensure that all pregnant women receive the attention and care necessary to reduce the risk of stillbirth and improve maternal and fetal health outcomes. While considerable progress has been made in understanding stillbirth determinants, there is a need to address research gaps, particularly in rural settings and among vulnerable populations. Future research should prioritize policy-relevant studies to enhance healthcare interventions, reduce the stillbirth burden, and improve maternal and child health outcomes in South Africa.Despite significant progress in understanding stillbirth causes and risk factors, there are remaining gaps in the literature. Future research should prioritize exploring rural disparities in healthcare services and implementing interventions to improve maternal health outcomes, particularly in areas with limited resources. Additionally, further studies are necessary to thoroughly assess the impact of socio-economic factors such as poverty, education, and healthcare access, especially among vulnerable populations.

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