

A Systematic Literature Review on Maternal Healthcare Services in Rural Districts in South Africa: Infrastructure, Staffing, and Quality Service Delivery, Utilizing VOSviewer for Bibliometric Analysis

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ABSTRACT

It is evident that maternal healthcare services are in high demand in the rural districts of South Africa. This can be attributed to factors such as the lack of adequate infrastructures, a shortage in workforce capacity, and poor delivery of the services. In this context, it is necessary to conduct a systematic review of existing literature on maternal healthcare services in such regions so as to establish how such challenges affect the delivery of care. As part of the research objectives, it seeks to explore available statistics on healthcare facilities, the status of trained staff, and the level of maternal care services by using bibliometric analysis through VOSviewer in order to identify key patterns and missing links.

Scopus stated that it was the only publication that offered primary maternal health services that forms the backbone for the systematic literature review that was performed on the maternal health services. Bibliometric investigation using VOSviewer was integrally linked to the conceptual structure through the elements of infrastructure, health workers, and the quality of care offered in rural areas. In addition, the network and density visualizations directed the research into more productive areas while clarifying the less developed areas of research.

It emerged from the results that there are quite large deficiencies in some critical aspects such as healthcare infrastructure and human resource which provide the nursing care, this further, affects the level of maternal care that is provided. In conclusion, the research attempts to indicate that there has been some level of success, but additional effort towards conducting studies to determine how best the gaps in provision of these studies are focused at in resource deficient rural areas. This review provides a basis for future policy improvements and the prioritization of maternal healthcare services in rural South Africa.

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INTRODUCTION

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Antenatal care which is mostly provided at the primary healthcare level is regarded as the cornerstone for the success of the maternal and child healthcare programme (Sibiya, Ngxongo and Bhengu 2018). The need to highlight issues of access and utilization of antenatal care services was significant because poor access to and underutilization of health care services could potentially influence the success of this programme and pregnancy outcomes (Mulondo 2020). According to (Mulondo 2020), maternal and child healthcare services are provided free of charge in South Africa. Despite this, utilization of antenatal care services remains a major public health challenge (Mulondo 2020; Hlongwane *et al.* 2021).

Maternal healthcare service usage is low, which contributes to the high number of maternal deaths that happen during labor, delivery, and the first few days following childbirth, especially in low- and middle-income countries (Health 2003; Desta, Mengistu and Arero 2024). According to Desta, Mengistu and Arero (2024), the health of the mother and the unborn child depends on receiving the right care during pregnancy and delivery facility.

Maternal healthcare services play a pivotal role in ensuring the health and well-being of both mothers and newborns, particularly in rural districts, where infrastructure, staffing, and quality of care often fall short of national standards (Gamberini, Angeli and Ambrosino 2022; Syed *et al.* 2022). Overall, in South Africa, maternal health, particularly in rural populations, is still a significant issue in light of approximately half of all mothers and children dying due to a combination of out-of-control health systems and limited healthcare resources. This systematic literature review seeks to examine the seamless provision of maternal healthcare services in rural South African districts. emphases are placed on the maternal healthcare infrastructure and the human resourcing and or quality of service delivery as well (Mahada, Tshitangano and Mudau 2023). We also apply VOSviewer in conducting the bibliometric analysis which will allow to distinguish research patterns, cooperation's networks and differentiation of this subject in science. The purpose of this review is to identify the deficiencies in the provision of healthcare services, which factors are the determinants, and suggest possible strategies aiming at these services to be advanced towards better maternal and neonatal health outcomes.

BACKGROUND

The alarming statistics regarding the mother mortality, especially in rural regions of South Africa, concern about the overall problems within healthcare systems (Mahada, Tshitangano and Mudau 2023). These regions are often deprived of both the requisite physical facilities such as well-equipped hospitals and clinics, and trained personnel on maternal health (Okemiri 2024a). Other relational determinants which contribute to the unfavourable antenatal care situations include long distances to healthcare facilities, absence of trained maternal care personnel and poor quality of care – which results in poor antenatal care – that leads to a higher risk of maternal morbidity, mortality, and stillbirth during pregnancy (Penman et al. 2023). The rural districts have very little advanced facilities and very few healthcare workers, with 12% physicians and 19% nurses for 46% of the population (Solomon et al. 2020). It has been established that the provision of maternal healthcare in rural districts is worse than in vacuum areas due to the factors. (Belay et al. 2024; Mpolokeng and Musekiwa 2024). Addressing maternal health in the rural context is essential in attaining this goal SDG 3 that seeks to lower the global maternal mortality rate and provide sexual and reproductive health services to all (Nelson et al. 2022).

A major obstacle to provision of maternal healthcare in rural districts in South Africa is the distance to healthcare services (Dahab and Sakellariou 2020; Myburgh et al. 2024). A large number of women residing in rural areas are situated at large distances from the clinics and hospitals, which prevents them from making regular antenatal visits or seeking emergency care during pregnancy and childbirth (Myburgh et al. 2024). This problem is compounded by the absence of efficient transport and poor road networks in most rural locales (Mweemba et al. 2021). Pregnant women guaranteedly experience delays in the reception of health services which raises the risk of increasing complications including mortality, morbidity and still births (Okemiri 2024b). Likewise, unavailability of trained manpower for maternal healthcare in rural districts is another significant problem (Ngene, Khaliq and Moodley 2023). Ngene, Khaliq and Moodley (2023) explain that all urban healthcare workers prefer deploying to urban centers with better resources, better opportunities to grow in their careers and live comfortably. This has also led to clinics and hospitals in rural areas having permanently low staffing levels and no staff trained to care for complicated pregnancies and obstetric emergencies (Mumbauer et al., 2021). Due to such high demand and low supply of expertly trained personnel, in these regions there is a high risk poor services will be rendered and to maternal care overall, low standards will prevail (Samuel, Zewotir and North 2021).

Ewing, Reid and Morris-Paxton (2020) suggest that this challenge is also complicated by scarcity of the necessary medical supplies and equipment, which restricts the ways in which healthcare providers can adequately assist. Ultrasound machines, surgical instruments and sanitation are severely lacking in many rural health care facilities and these resources are crucial in dealing with pregnancy and delivery complications (Gumede, Taylor and Kvalsvig 2021). It is this inadequacy in the service provision that is responsible for the high incidence of maternal mortality and the still births (Gumede, Taylor and Kvalsvig 2021; West et al. 2021). Closer examination of the available research indicates the inverse relationship between the degree of urbanization of women's place of residence and maternal mortality. Most studies attribute the poor health outcomes to the fact that even in the lowest rungs of rural districts maternal healthcare is rather poor. This inequity calls for timely access and high quality maternal healthcare for rural communities, which makes up a considerable portion of South African population (West et al. 2021). Undoubtedly women in these areas tend to suffer avoidable complications due to pregnancy, thus it is imperative to narrow the gaps in health service delivery (Souza et al. 2024).

Addressing challenges relating to maternal health care in rural areas of the country is a vital component in the attainment of Sustainable Development Goal 3, which hopes to lower the maternal mortality ratio to below 70 per 100,000 live births by 2030, as well as universal coverage for sexual and reproductive health services (UN Women 2022; Raina et al 2023). As Raina and his colleagues pointed out, the realization of this goal is accompanied by the enhancement of the physical and human resources and the formulation of appropriate strategies that target rural women and their access to antenatal, obstetric, and post-natal care. The provision of appropriate equipment and the right caliber of personnel will alleviate the danger of complications from pregnancy and childbearing and will aid in the realization of the worldwide aspiration to decrease maternal mortality (Vallely et al. 2023)Figure 2.1 is a conceptual diagram/table explaining Maternal Healthcare Service in RDs in South Africa. It addresses the primary dimensions of Physical facilities, human resources, and quality of service delivery influence maternal health outcomes including still birth and maternal death.

Figure 1: Maternal Healthcare Services in Rural South Africa

Component	Key Elements	Challenges in Rural Districts	Impact on Maternal Healthcare
Infrastructure	➤ Availability of medical equipment ➤ Facility maintenance ➤ Transportation & emergency services	➤ Limited access to modern medical equipment ➤ Poor maintenance of facilities ➤ Inadequate transportation for emergencies	➤ Reduced ability to manage complicated pregnancies ➤ Higher maternal mortality and stillbirth rates
Staffing	➤ Availability of healthcare professionals	➤ Shortage of skilled healthcare	➤ Lower quality of care

	➤ Training and skill level ➤ Workload & burnout	- workers (e.g., midwives, obstetricians) ➤ High patient-to-staff ratio ➤ Staff burnout and turnover	➤ Inability to manage emergencies ➤ Increased risk of complications
Quality Service Delivery	➤ Antenatal care (ANC) services ➤ Emergency obstetric care ➤ Postnatal follow-up	➤ Inconsistent ANC coverage ➤ Lack of standardized care protocols ➤ Gaps in emergency services and follow-up care	➤ Higher rates of preventable complications ➤ Poor maternal and neonatal outcomes, including stillbirths

Source: Generated by researcher

Nxiweni et al (2022) are of the view that issues related to low healthcare seeking habits of women in rural areas and poor maternal health outcomes can be dealt with by improving provision for transport, education and lifting people out of poverty. Such conditions have a bearing impact on women's seeking treatment, attending antenatal care sessions, and receiving even emergency treatment services (Nxiweni et al. 2022). Also, health education towards the need to always attend maternal check-ups and deliver with skilled attendance can help empower rural women to participate actively in their maternal health promoting even further the culture of lowering maternal mortality and stillbirths (Adongo et al. 2024). Tackling the structural impediments impeding maternal healthcare in the rural regions of South Africa's provinces is essential for the achievement of better maternal health outcomes and in the quest for SDG 3. By stressing the need to improve quality of service, combat staff deficits and strengthen physical amenities, better and progressive policies can be implemented to avert the appalling statistics of maternal deaths in rural settings.

METHODOLOGY

Instead of relying upon a narrative literature review, our methodology utilizes a fusion of two emerging techniques which are systematic literature review (SLR) and bibliometric analysis (Sunge and Mudzingiri 2023). SLR is one of the methodologies that resurged about two centuries back during creation of health science research but its relevance has only been felt in the field of social sciences and business within the last few years (Lame 2019; Sunge and Mudzingiri 2023). SLRs, or systematic literature reviews, are specialized processes designed to evaluate the body of work within a single discipline or topic (Danese, Manfè and Romano 2018). They use strict and standard procedures to reduce bias and maximize reproducibility (Azarian et al. 2023). AI technologies are steadily being used for semi-automated SLR assignments, particularly for the screening and data extraction phases (Bolanos et al. 2024). Moreover, the issues remain relating to the optimal practices and methodological coherence (Azarian et al. 2023). In light of these developments, however, researchers are expected to be more prudent when determining the aims of reviews for any relevant research sub-area, the search strategies, and methods of quality assessment (Priharsari 2022).

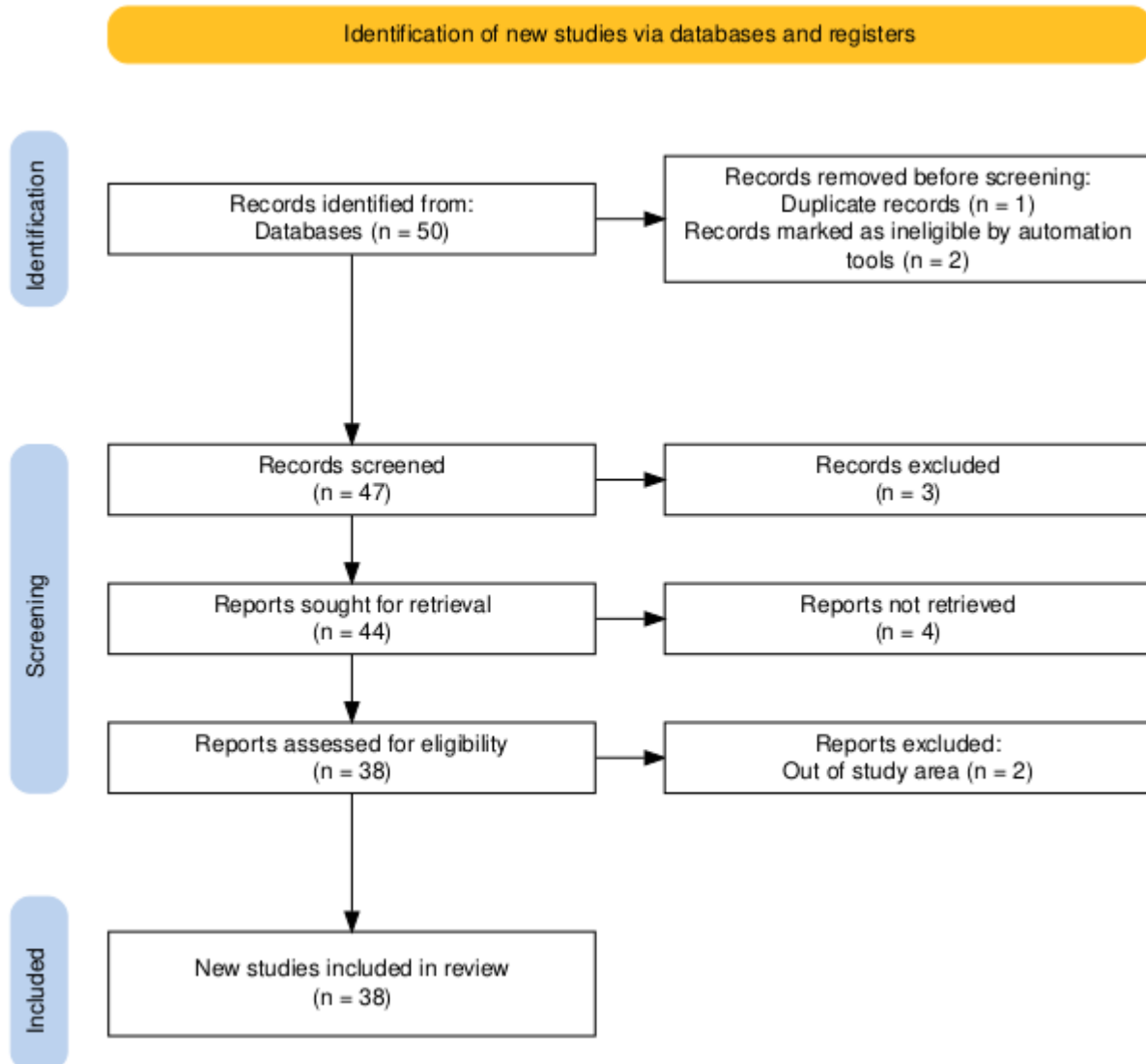
The transparent nature of a SLR is increased due to the tracking and appraisal of the processes of source selection and analysis as stated by (Varsha, Chakraborty and Kar 2024). In their work, (Varsha, Chakraborty and Kar 2024) point out that because the SLR eliminates subjectivity in literature selection and entails a systematic approach, it offers a summarization of the already available evidence on a particular subject in great detail. As a result, it becomes possible for researchers looking to fill existing gaps in knowledge and problems that call for original research to locate such areas easily (Dhir et al 2020). A clear picture of all the lines of evidence available for a specific area further builds a strong base for subsequent studies thus SLR complements the level of knowledge that is already possessed by a particular body of researchers (Hinderks et al 2020). It thus becomes particularly useful for researchers who would want to offer sound contributions to the discipline.

The process of the systematic literature review (SLR) was done according to the reporting guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 Statement as discussed above. This is a new version that reiterates and builds on the 2009 Statement of PRISMA as it presents an abstract with a better flow chart and additional 27 reporting items, along with recommendations on how to proceed with specific detailed checklists (see Figure 1). As a further elaboration of the issues raised by the SLR, we used bibliometric analysis (BA) (Page et al. 2021). Page et al. (2021) state that SLR acts as a collating star system when it comes to including or excluding research sub-areas, it does not quantitatively appraise them, and it is at this point BA is key. Evaluating BA deals with assessment parameters such as citation and co-occurrence patterns among several other quantitative techniques which are focused on bibliometric units like authors, journals, and research themes (Donthu et al 2021).

As BA practitioners focus on two goals: performance analysis and science mapping (Farooq 2024). Performance analysis targets metrics of publication, metrics of citation such as the number of documents and citation metrics. On the other hand, science mapping incorporates citation analysis, co-citation, bibliographic coupling and co-authorship (Moral-Muñoz et al. 2020). The selection of indicators should meet the prevailing research questions and goals. Since our study aimed to aims to conduct a systematic literature review of the determinants and causes of stillbirth in South Africa, we employed co-word analysis. Other

science mapping methods include the cited and citing documents, whereas co-word analysis focuses on the 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 Scopus database has a wide range of scientific articles, journals and conferences available and is the primary source of data used in this study. Scopus Contains literature that is peer-reviewed covering numerous topics such as health, social sciences and business hence it is regarded as one of the largest and most powerful databases (Afriany and Japar 2024). Because of its comprehensive approach, this database is well-suited for bibliometric studies. It includes a sizable number of academic journals, books, conference proceedings, and research articles (Sunge and Mudzingiri 2023; Afriany and Japar 2024).

Simons (2018) helps in the systemization of publication trends, citation influence or impact, or even collaboration through different countries or organizations, through citation analysis and/or bibliographic analysis tools. Its wide indexing includes high volume of qualitative studies hence it is useful in tracing prominent studies, authors and institutions involved in the area of stillbirth studies in focus country of South Africa (Baas et al. 2020) This study is not only gaining an accurate data set but also comprehensive information in the literature review and bibliometric analysis as literature output is vast and solid (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 syntax TITLE-ABS-KEY (TITLE-ABS-KEY ("Maternal health*") AND TITLE-ABS-KEY (rural*) AND TITLE-ABS-KEY (infrastructure*) OR TITLE-ABS-KEY (midwife*) OR TITLE-ABS-KEY (staff*) OR TITLE-ABS-KEY ("Quality service delivery*") OR TITLE-ABS-KEY ("Access to maternal*") OR TITLE-ABS-KEY ("antenatal*") AND TITLE-ABS-KEY ("South Africa") AND (LIMIT-TO (LANGUAGE, "English")).

This structure was created with the aim of streamlining the search for the works in which subjects of maternal health, rural South Africa, and enumerated other words are discussed and which can be found in the title, abstract and in the key words of the relevant papers. The inclusion of TITLE-ABS-KEY guarantees retrieval of only those papers that contain those terms within those key sections, thus sifting irrelevant studies and zeroing in on the relevant literature.

In this scrutiny, the words Maternal health were adjoined to Rural, South Africa and Infrastructure through the operator AND, so that papers retrieved did not ignore these factors of the problem of stillbirth. The adoption of OR between infrastructure, staff, and Quality of Maternal delivery was posed so that a broad selection of factors influencing stillbirth would not be lost. The further imposition of South Africa as a geographical limiter restricted the search to literature pertaining to South African culture making the findings relevant to the country under investigation.

This particular strategy enabled a holistic but selective collection of studies and undertook an analytical examination of the ways in which personnel and material deliverables as well as the standard of maternal delivery services impact maternal healthcare practice in South Africa, making provision for the differences in the definitions that such studies may employ. The aim of this strategy was to optimize the inclusion of Scopus literature in the systematic review and bibliometric analysis as well as its quality.

2.3 Inclusion and Exclusion Criteria

Inclusion criteria

Studies focusing on maternal healthcare in rural South Africa, articles assessing infrastructure, staffing, and quality service delivery. Research published in peer-reviewed journals. Studies that applied quantitative, qualitative, or mixed methods approaches.

Exclusion criteria

Studies focusing on urban or semi-urban areas and research not available in English or without full-text access.

RESULTS AND DISCUSSION

Our results are structured into two primary sections. The first section highlights findings regarding the most influential academic journals and leading authors in stillbirth research. This part provides insights into the major contributors in the field, showcasing where significant research is being published and identifying the prominent researchers and countries spearheading studies on stillbirth. In the second section, we present the results from the bibliometric analysis of keyword co-occurrence, mapping the connections between frequently appearing terms in literature. This analysis uncovers key themes and topics in maternal healthcare and quality of maternal care, as well as highlights emerging trends in the field.

At each stage of analysis, we present the findings and offer a discussion of the key trends and insights uncovered. We focus on identifying significant research gaps, particularly in how the shortage of staff, infrastructure, and quality of maternal delivery impacts maternal healthcare in South Africa's rural districts, which are often underrepresented in existing literature. By highlighting these gaps, we aim to inform future studies and encourage more targeted research addressing the unique challenges rural communities face. Combining such an analysis of the leading contributions made and vested interests together with trends and thematic areas of focus allows for quite an in-depth appreciation of the current status of maternal healthcare and the maternal outcome research with regards to quality and allows for future research and intervention in very important areas that can help improve maternal and fetal health outcomes.

3.1 Scopus journal

The database that was mostly utilized in the present study was Scopus and from this database, forty five journal articles were picked for examination. The selection of Scopus was based on the fact it covers a vast area of the peer-reviewed literature on different academic subjects specifically medicine, social and public health. Its diversity of the high quality research articles helps in ensuring the dataset that is strong and of credible source thus making it ideal for systematic reviews and bibliometric analysis. By exclusively employing Scopus for this research, the authors were also assured that the research was based on the moderation of significant peer reviewed sources while also being able to encompass a variety of prestigious journals and research outputs. The downside of being in one database is that it results in the omission of a number of pertinent studies if they are sought elsewhere for instance PubMed, Web of Science, or some regional databases. Nonetheless, the 50 journal articles retrieved from Scopus form a substantial body of literature, forming a strong foundation for understanding the influence of infrastructure, midwives, and quality of maternal delivery on the current state of maternal healthcare in the rural districts of South Africa.

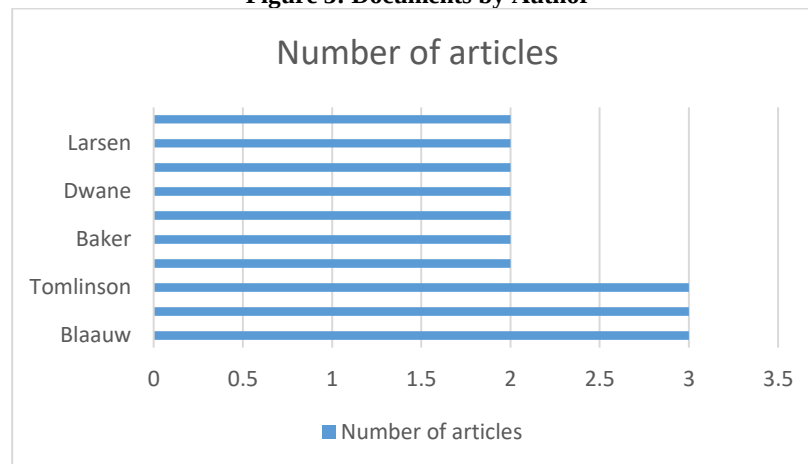
The 50 articles serve as the basis for both qualitative and quantitative analyses. Through a systematic screening process, these studies were meticulously chosen for their relevance to maternal healthcare, particularly focusing on clinical, socio-economic, and healthcare system determinants within the 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 Blaauw. D, Jackson. D, Tomlinson. M, Wilkinson. D, all have the highest number of articles with 3 followed by Baker. V, Chersich, M, Dwane. M, Goudge. J, Larsen. J. V, and Le Roux. K. W. with all 2. Blaauw's research focused on the disparities in maternal healthcare in South Africa, particularly the small inequalities in service utilization across different population groups, with the poorest sometimes having better access. However,

there were significant differences in maternal health outcomes, likely due to varying quality of care, HIV prevalence, and social determinants of health. Poor practices among healthcare workers, especially midwives in district hospitals, were highlighted as a contributor to high maternal mortality. His ethnographic study examined how public sector reforms, particularly financial management, influenced midwives' daily practices during the reform period. Blaauw is one of the highest contributors with 3 articles which are (Penn-Kekana, Blaauw and Schneider 2004; Wabiri *et al.* 2013; Wabiri *et al.* 2016).

Figure 3: Documents by Author



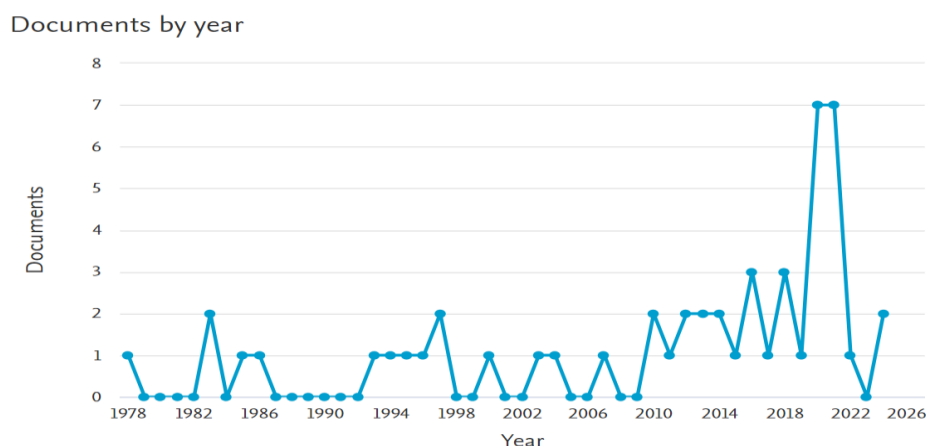
Source: Adapted from Scopus search results analysis

Tomlinson's research investigates the persistent barriers to healthcare access, particularly in rural areas, despite efforts like community health worker (CHW) interventions. His work focuses on how women respond to these barriers and navigate the healthcare system. He explores the effectiveness of CHW home visits in improving maternal and child health outcomes, highlighting that while such programs show success in peri-urban settings, their efficacy often diminishes when scaled to rural areas. His study in South Africa's rural OR Tambo District evaluates the impact of CHW home visits on maternal and child health, compared to standard antenatal care. Wilkinson's research focuses on the role of the perinatal mortality rate (PNMR) as a critical health indicator and how it is significantly impacted by healthcare quality. His work examines the challenges in establishing causal links between interventions and PNMR changes due to the lack of control groups, but he suggests that measuring avoidable perinatal deaths offers a solution for more accurate evaluations. Additionally, his studies highlight the effects of inadequate treatment for maternal syphilis in South African antenatal clinics, and his efforts to assess maternal and child health indicators to inform a comprehensive health information system in rural districts. With contribution on (Wilkinson 1997; Rotchford *et al.* 2000; Wabiri *et al.* 2013).

3.3 Documents over time

Before 1994, research on certain key topics was sparse, with only one article published in 1978, two in 1982, and one each in 1985 and 1986. The political transition in South Africa in 1994, marked by the end of apartheid and the establishment of a black-majority government, likely spurred increased academic interest and research activity. This shift in governance, along with broader societal changes, contributed to a surge in research, particularly related to public health, social issues, and governance. From 2018 to 2022, there was another notable rise in research output, possibly driven by global health concerns and local policy changes, before a sharp decrease thereafter. The increase in studies during this period likely reflected a renewed focus on addressing socio-economic challenges and the evolving health landscape in the country. Figure 4 illustrates trends in documents over time.

Figure 4: Documents overtime



Source: Adapted from Scopus search results analysis

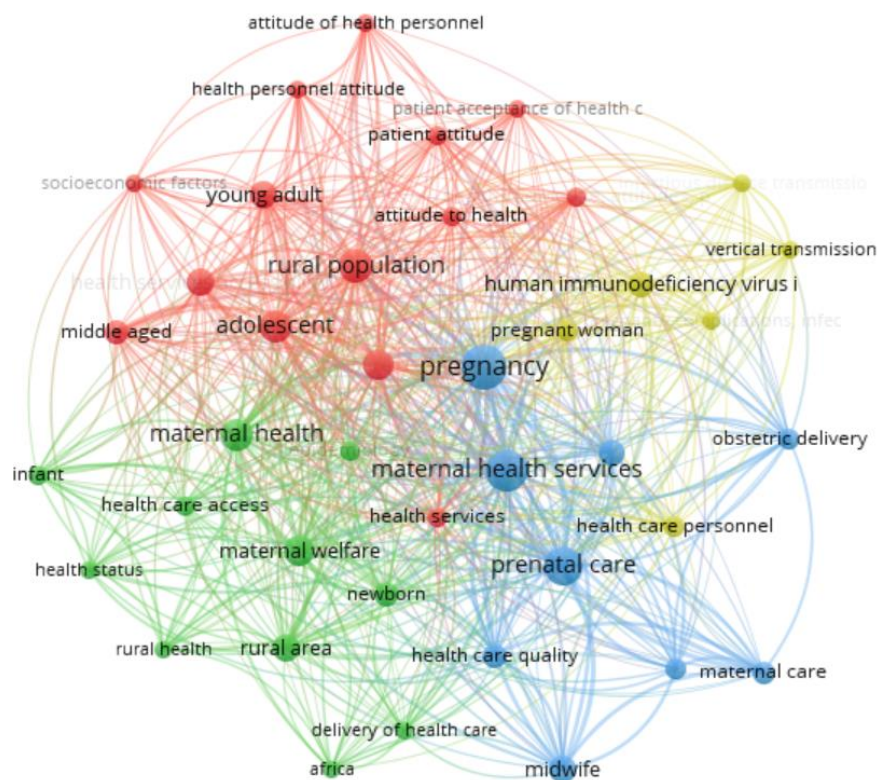
3.4 Network visualization

The network visualization from the VOSviewer analysis of maternal healthcare services in rural districts provides a visual representation of the key concepts and their interrelations. The visualization is based on a co-occurrence analysis of keywords within the literature, grouping them into distinct clusters based on their thematic connections. The red cluster focuses on the rural population, adolescent health, and socioeconomic factors, highlighting the challenges that rural communities and young adults face in accessing quality healthcare services. Concepts like the attitude of health personnel and patient attitude indicate the critical role that social dynamics play in shaping healthcare experiences in these areas. The green cluster 2 emphasizes maternal health, maternal welfare, and healthcare access, showcasing key concerns regarding how healthcare services are delivered to pregnant women and their access to necessary services. Concepts like infant health, rural health, and maternal welfare reflect a focus on improving outcomes for both mothers and their newborns in rural settings.

Cluster 3 Blue is central to this cluster are terms like prenatal care, maternal health services**, and midwives, underlining the importance of healthcare quality during pregnancy. Healthcare quality, obstetric delivery, and maternal care are tightly interconnected, revealing the essential role of skilled birth attendants in improving maternal outcomes and reducing stillbirths. Cluster 4 which is in yellow, is a smaller cluster highlighting human immunodeficiency virus (HIV), vertical transmission, and related terms, pointing to the ongoing concern regarding HIV and its impact on maternal health in South Africa, especially in rural districts. The inclusion of infection transmission underscores the need for continued interventions to manage HIV during pregnancy.

The network map illustrates the complexity and interrelation of various factors ranging from healthcare infrastructure and staffing to societal attitudes and disease prevalence impacting maternal health in rural South African districts. It visually emphasizes the multi-dimensional nature of maternal healthcare delivery, which requires an integrated approach for improvement.

Figure 5: Network visualization

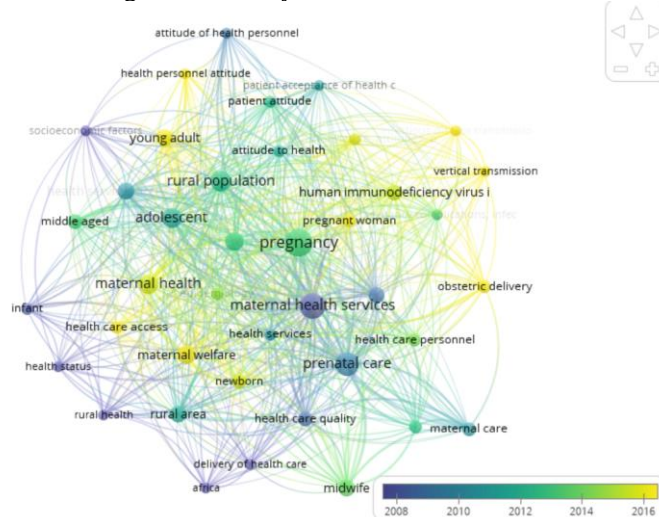


Source: Generated from VOSViewer

3.5 Overlay Visualization

The overlay visualization from the VOSviewer bibliometric analysis provides a time-based representation of research trends and connections in the field of maternal healthcare, specifically related to rural districts in South Africa. The color of each node corresponds to the average publication year of the research papers. The spectrum at the bottom indicates that purple shades represent earlier research (from around 2008), while the yellow shades indicate more recent research (closer to 2016 and beyond). This suggests a chronological progression of research, where topics in the yellow spectrum, such as vertical transmission and obstetric delivery, have been more recent focuses, while earlier research concentrated on topics like maternal welfare and health care access. The size of each node indicates the frequency or importance of a term in the literature. Key terms like "maternal health services, prenatal care, and pregnancy dominate the visualization, highlighting their central role in maternal healthcare research. Smaller nodes like vertical transmission and obstetric delivery may indicate emerging areas of focus in more recent studies.

Figure 6: Overlay visualization



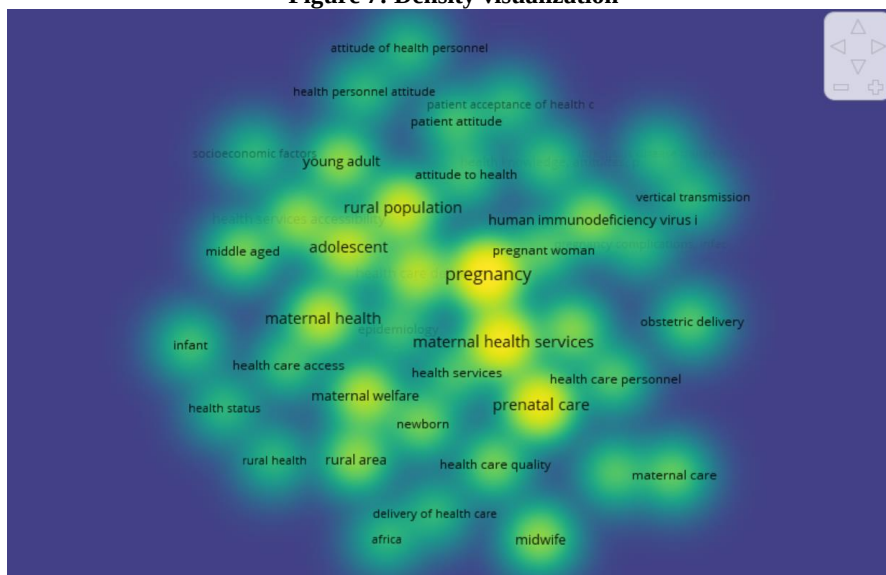
Source: Generated from VOSViewer

The lines between nodes show co-occurrences of keywords, meaning these topics are often studied together. For example, there are strong connections between maternal health services, prenatal care, and healthcare quality, suggesting that these topics are closely linked in the context of maternal healthcare delivery in rural settings. The visualization reveals the evolving focus of research in maternal healthcare, with early studies concentrating more on maternal welfare and healthcare access, while more recent studies delve into issues related to HIV (e.g., human immunodeficiency virus) and the specifics of healthcare delivery (e.g., "obstetric delivery and healthcare personnel"). This trend indicates a shift towards more specialized and clinical aspects of maternal healthcare. The overlay visualization offers insights into the development of maternal healthcare research, revealing that while access to care and general maternal welfare were initial concerns, the field has moved toward more specific challenges in healthcare quality, clinical outcomes, and disease prevention.

3.6 Density visualization

The density visualization provided highlights key areas of focus and research intensity in the context of maternal healthcare services in rural districts in South Africa. The brighter or more intense areas of the map indicate where research topics and keywords frequently co-occur in the analyzed literature, suggesting these areas are of significant interest to scholars. The most intense region is centered around terms like pregnancy, maternal health services, prenatal care, maternal health, and rural population. This suggests that research on maternal healthcare services, particularly related to pregnancy and prenatal care in rural populations, has been a dominant theme in this body of work. These keywords reflect central aspects of maternal healthcare delivery, indicating a focus on how healthcare services are provided during pregnancy and the prenatal period. Slightly less intense but still prominent areas include terms like maternal care, midwife, human immunodeficiency virus, and obstetric delivery. This suggests a broader exploration of maternal healthcare services beyond pregnancy and prenatal care, extending into issues like HIV, midwifery, and delivery practices in rural settings.

Figure 7: Density visualization



Source: Generated from VOSViewer

The terms adolescent, young adult, and middle-aged show that there is attention to different age groups in maternal health research. This suggests that researchers are considering how maternal healthcare needs vary by age, perhaps addressing the unique challenges faced by adolescents, young adults, and middle-aged women in rural districts. Keywords like the attitude of health personnel, health personnel attitude, and patient attitude suggest that there is research examining the role of healthcare providers' attitudes and practices, as well as patient perceptions, in shaping maternal health outcomes. This indicates an interest in understanding how interpersonal dynamics within healthcare settings impact service delivery. The appearance of terms like human immunodeficiency virus and vertical transmission points to research on the intersection between infectious diseases (especially HIV) and maternal health, with a particular focus on how these diseases are transmitted during pregnancy and childbirth.

The terms health care access, health care quality, and delivery of health care suggest ongoing exploration into how accessible and high-quality maternal healthcare services are in rural settings. This highlights the importance of both the availability of services and the standard of care provided to pregnant women and new mothers. The density visualization effectively maps the dominant research areas and themes in maternal healthcare services in rural South Africa. The intense focus on pregnancy, prenatal care, and maternal health services indicates these are central concerns in the literature. At the same time, attention to issues like healthcare personnel attitudes, infectious diseases, and service accessibility reflects a broader engagement with the social, economic, and health system factors that shape maternal health outcomes in these communities. This visualization provides a comprehensive view of the research landscape, highlighting both well-established areas of inquiry and emerging topics in maternal health research.

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

Keywords	Co-Occurrences	Links	Links Strength	Cluster
Female	42	59	683	4
pregnancy	30	59	526	1
Maternal health services	25	59	422	4
Prenatal care	23	59	385	2
Rural Population	17	56	317	3
Adolescent	15	54	294	3
Healthcare delivery	14	56	279	1
Maternal health	15	56	265	1
Maternal welfare	14	55	244	3
Health service accessibility	11	53	232	1

Source: Authors' compilation from bibliometric analysis results.

Table 1 shows the top 10 key analyses. The keyword analysis presents a clear picture of the key areas of focus and interconnectedness in the literature on maternal healthcare services in rural districts. The term Female has the highest co-occurrence (42), links (59), and link strength (683), indicating that much of the research revolves around women's health issues, with a strong emphasis on maternal healthcare and outcomes. Pregnancy (co-occurrence: 30) also stands out, showing its central role in maternal healthcare discussions, as expected, given its relevance in reproductive health. The high link strength (526) reflects a broad connection with other health topics like prenatal care and maternal services. Maternal health services (co-occurrence: 25), are vital to understanding how healthcare structures and delivery systems function in rural settings. Its connection to 59 other keywords and significant link strength (422) highlights the importance of service availability and quality in improving maternal outcomes. Prenatal care (co-occurrence: 23) is closely related, showing that early maternal interventions are a focal point of healthcare research, particularly in addressing issues like maternal mortality and stillbirth.

The terms Rural population (co-occurrence: 17) and Adolescent (co-occurrence: 15) show attention to demographic factors, with rural and young populations being central to maternal health challenges. The cluster these terms belong to shows a focus on marginalized groups, often more vulnerable to healthcare disparities. Similarly, Healthcare delivery and Maternal welfare reflect the need for improving how services are distributed and received, ensuring equitable access to maternal care in underserved areas. Health service accessibility (co-occurrence: 11) rounds off this analysis, showing that despite an emphasis on service provision, accessibility remains a critical barrier in rural districts. The interconnectedness of these terms illustrates a multi-dimensional approach to improving maternal healthcare, addressing clinical care, population-specific challenges, and the logistics of service delivery.

CONCLUSIONS AND AREAS OF FURTHER RESEARCH

The review of maternal healthcare services in rural districts of South Africa highlights several critical areas infrastructure, staffing, and quality of service delivery. These elements are crucial to ensuring effective maternal healthcare, particularly in underserved regions. The bibliometric analysis utilizing VOSviewer revealed that maternal health services, prenatal care, and healthcare accessibility are among the most recurring themes in the literature, indicating their importance in both research and practice. Infrastructure remains one of the major constraints in delivering quality maternal healthcare in rural areas. Limited facilities, poor transport networks, and inadequate equipment were frequently cited as barriers that prevent women from accessing timely and

adequate care. Similarly, staffing shortages, particularly the lack of qualified health professionals like midwives and obstetricians, are pervasive challenges. This has led to a reliance on task-shifting approaches, where community health workers (CHWs) take on roles typically filled by more qualified personnel, though the effectiveness of this approach in rural settings is still under review. The quality of service delivery was also a recurring issue, with many studies pointing to disparities in the level of care received by women in rural districts compared to their urban counterparts. Antenatal and postnatal care remain underutilized due to factors like cultural beliefs, socio-economic challenges, and inadequate healthcare infrastructure, all of which are interrelated and contribute to maternal morbidity and mortality.

Long-term studies on the effectiveness of community health workers (CHWs) are needed to better understand their impact on maternal outcomes in rural districts where professional healthcare staff is limited. Given the task-shifting strategies in these areas, it is crucial to assess the sustained effects of CHWs on improving maternal health, especially in remote regions. Moreover, ongoing efforts to enhance **healthcare infrastructure** in rural areas, such as new clinics, telemedicine, and mobile health units, also require thorough evaluation. Future research should measure how these projects influence maternal health outcomes to ensure that infrastructure improvements are translating into better care. In addition, socio-cultural factors that shape healthcare-seeking behavior among pregnant women need to be explored. More qualitative research is necessary to examine how cultural beliefs and practices impact the use of maternal healthcare services in rural areas, including identifying barriers to accessing care during pregnancy and after childbirth.

More investigations are needed to determine the effectiveness of specific interventions in low-resource settings. Research should focus on prenatal care programs, mobile health technologies, and other strategies to understand which approaches have the most positive impact on maternal health in rural, resource-constrained environments. Addressing these research gaps will help guide better policymaking and the implementation of targeted interventions, ultimately improving maternal health outcomes and reducing mortality rates in South Africa's rural regions.

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