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REVIEW ARTICLES

A bibliometric analysis of garlic to improve wound healing

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Abstract
The use of complementary therapies in wound healing continues to grow. One natural ingredient that has many benefits is garlic—however, limited studies have investigated this area of interest. The purpose of the study was to explore the trend of the number of publications, citations, and the journal with the highest number of publications, which field has the most consent to publish, network visualization, overlay visualization, and density visualization on the effect of garlic in wound healing through bibliometric analysis—Bibliometrics analysis used in this study. Records are identified through database searches. Paper restricted in publications years 2018-2023, focus in the field of Health sciences, nursing, public health, clinical sciences and publication type is the article. Data were analyzed using a VOS viewer, and then the analysis was reviewed by co-occurrence and co-authors. Publication searches related to garlic and wound healing yielded 47.351 articles. After screenings through the specified criteria, the number of articles obtained was 12.472. The peak of publications about garlic and wound healing was in 2018. On the other hand, the lowest number was in 2023. Research on the effect of garlic in wound healing is carried out by the fields of medicine, public health or nurses and other fields such as agricultural, vetenary, and food sciences, medical and biomolecular chemistry, pharmacology and pharmaceutical sciences, and medical biotechnology. The peak of publications about precision health and precision medicine was in 2021; the lowest number was in 2023. Research related to the use of garlic has been carried out on acute and diabetic wounds. However, safe concentrations are a concern for more in-depth research on their use in wound care.

Keywords: Wound care; wound healing; garlic; bibliometric analysis; nursing research

Introduction

Wounds are a challenging clinical problem that can lead to complications and cause morbidity and mortality (Sen, 2021). The condition, due to several factors such as open wounds, is susceptible to infections, which can lead to severe complications such as sepsis, a life-threatening systemic response to infection (Ashoobi et al., 2023). Chronic wounds, such as diabetic ulcers or pressure ulcers, can impede mobility, resulting in further health issues and a diminished quality of life (Dias, Ferreira, Vilaça, & Pereira, 2022). The prevalence of wounds is increasing every year, causing global death and posing a threat to health in every country in the world (Nieto-García et al., 2023). Based on this data, it is necessary to make efforts to develop new therapies and technologies in wound management and care (Ding et al., 2022). One of the main aspects of providing nursing care is maintaining skin integrity by treating wounds/skin (Carlin et al., 2022). Planned and consistent wound care interventions are important to ensure high-quality care in wound healing. Wound healing standards require a strong evidence base, which must be effective and efficient (Welsh, 2018). Traditional medicines as wound healing agents are gaining popularity. However, the safety of using these products must be proven before they are recommended to patients (Pereira & Bártolo,2016). The use of traditional products as medicinal remedies is widespread, particularly in the large populations of India and China. These traditional products are also exported to various countries around the world. Similarly, in Indonesia, the use of medicinal plants to treat health problems, both for prevention and treatment of diseases, has a long history, dating back to our ancestors. The use of medicinal plants as natural remedies is more widely accepted for the treatment of various ailments compared to synthetic medications (Cedillo-Cortezano et al., 2024). This is because medicinal plants are believed to be safer and have fewer side effects (Parham et al., 2020).

Garlic (Allium sativum Linn) is a medicinal plant with numerous benefits (Marefati et al., 2021). Historically, it has been used as medicine for thousands of years, recognized by ancient civilizations such as the Egyptians, Babylonians, Greeks, Chinese, Indians, and Romans. Garlic has served not only as an important flavoring agent but also as a traditional medicine and a functional food, contributing to both physical and mental health improvements (Saoudi et al., 2021). There is a pressing need for future studies to explore trends and innovations related to the effects of garlic on wound healing. Bibliometric analyses can provide valuable guidance for these studies by evaluating the quality and primary research areas of existing publications in this field. This type of analysis allows researchers to gather information from the growing body of literature efficiently. Currently, there is no bibliometric analysis specifically addressing the effects of garlic on wound healing to identify trends and innovations. This study aims to fill that gap by answering the following questions as follows, what does the network visualization of the topic of garlic's effects on wound healing reveal? How can overlay visualization be applied to this topic? What insights does density visualization provide regarding the topic of garlic's effects on wound healing?

According to Fu et al. (2023), bibliometric analysis is a method that is based on statistics and is used to generate a visual representation of the contribution of academic institutions as well as changes in research hotspots. It is a scientific and quantitative strategy for evaluating published works in order to identify development patterns and research hotspots in particular domains, which ultimately results in the provision of future research directions (Soytas, 2021). According to Lam et al. (2022), bibliometric analysis is a method that assists researchers in identifying new areas and future directions in study domains through the utilization of visualization tools. The evaluation of information theory inside worldwide databases has been carried out by a number of writers through the utilization of bibliometric analysis (Lam et al., 2022). In addition to providing network visualization, overlay visualization, and density visualization on the subject of the effects of garlic on wound healing, the objective of this study was to investigate patterns in the number of publications and citations that have been made on the subject.

Method

There are five types of study metrics for data analysis: Scientometrics, Bibliometrics, Cybermetrics, Informetrics, and Altmetrics (Chellappandi & Vijayakumar, 2018). Bibliometric analysis is particularly suitable for quantitatively analyzing the distribution of research papers, terms, and keywords to determine research trends (Murugesu et al., 2022). Additionally, bibliometric analysis is a research method used in library and information science to evaluate research performance (Syros et al., 2022). It is essential in assessing research impact, with studies being ranked based on the citations they receive (Pahwa et al., 2022). The data sources used in this study were based on online searches via [Dimensions](https://app.dimensions.ai/). Data was collected on June 21, 2023. The literature search followed the stages outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flowchart (Page et al., 2021). Papers restricted to publication years 2018-2023, focused on Health Sciences, Nursing, Public Health, Clinical Sciences, and publication type as articles were included as inclusion criteria for this study.

The stages in PRISMA include identification, screening, and inclusion **(Figure 1)**. Stage 1 (Identification) detected 47.531 records from Dimensions.ai, considering each of the main search terms (garlic and wound healing, “article and proceeding document type,” and “all published data in the date range from 2018 to 2023”). In Stage 2 (Screening), the option “article title, abstract” was selected in the field of each search term, resulting in 43,902 articles being excluded. In Stage 3 (Inclusion), the final sample yielded 3,450 articles. Data were analyzed using VOS Viewer, a computer program for creating and viewing bibliometric maps (van Eck & Waltman, 2010). The type of analysis selected was to create a map based on text data. In this study, the analysis was reviewed by co-occurrence and co-authors. The procedure for co-occurrence analysis included the following stages: the data source was selected, data was read from reference manager files, fields from which terms will be extracted were chosen (title and abstract fields), the counting method was set to full counting, the minimum number of occurrences of a term was set to 10, and the final selection of terms resulted in 133 terms. The procedure for co-author analysis involves several stages. First, the type of data is chosen, specifically creating a map based on bibliographic data to develop a co-authorship map. Next, the data source is selected, where data is read from reference manager files, with the supported file type being .ris. Finally, the type of analysis and counting method is determined, selecting co-authorship as the analysis type and full counting as the counting method.

Results

The VOS-viewer software requires at least two terms to be used for the analysis. The results of the analysis produced 5 clusters (red, blue, yellow, purple, and green), each of which illustrates the relationship between the different topics. VOS-viewer can display bibliometric mappings using three different visualizations: network visualization **(Figure 2)**,

overlay visualization **(Figure 3)**, and density visualization **(Figure 4)**. These visualizations provide valuable insights into the research landscape and the relationships between the various topics related to the effects of garlic on wound healing.

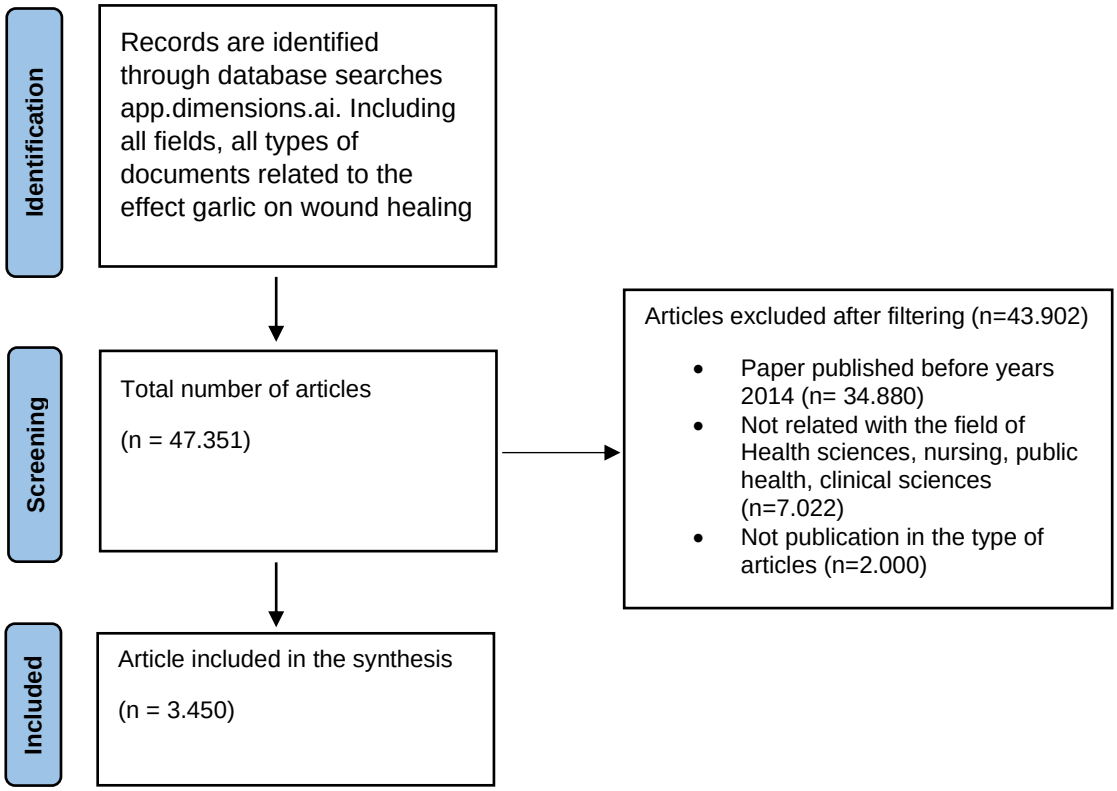

Figure 1. Article selection process.

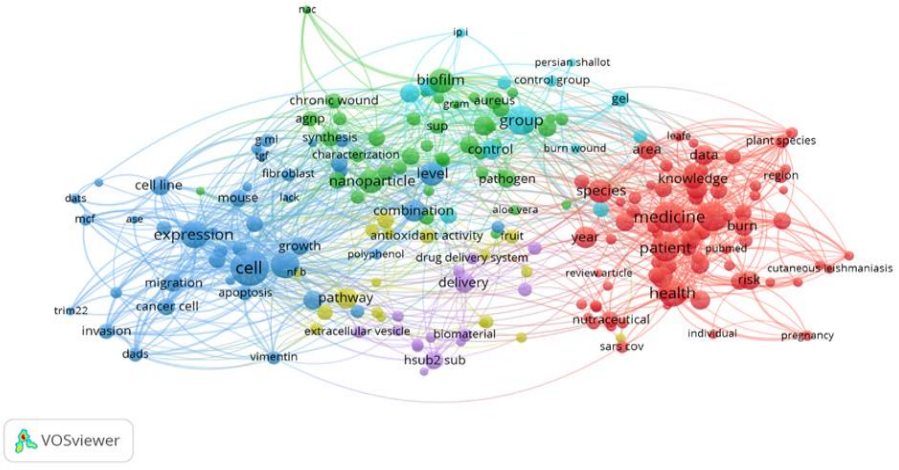

Figure 2. Network visualization.

Discussion

Nurses play a critical role in maintaining skin integrity as part of their nursing care responsibilities. When patients present with wounds, nurses are tasked with providing appropriate wound care interventions. In recent times, the use of herbal plants has emerged as a complementary therapy in wound management. One such herbal plant with

significant antioxidant properties for wound care is garlic (Allium sativum) (Zugaro et al., 2023). Fresh garlic is particularly valuable due to the presence of the compound allicin, which provides a multitude of health benefits (White, 2021). These benefits include cardiovascular disease prevention and treatment, antioxidant effects, antimicrobial properties, and reduced cancer risk (Ansary et al., 2020). A network visualization analysis (Figure 1) of the research on the use of garlic in wound healing identified 213 items across six distinct clusters. The literature highlights the efficacy of garlic, often in combination with honey, in promoting faster wound epithelialization and contraction, as well as improved histological recovery of the treated tissue and inhibition of cancer cell growth (Parham et al., 2020; Gam et al., 2022). However, it is important to note that a systematic review has also reported the potential for garlic to cause skin burns when applied topically (Hitl et al., 2021). These findings underscore the need for nurses to remain vigilant and well-informed when incorporating herbal remedies, such as garlic, into their wound care practices. A comprehensive understanding of the benefits and risks associated with these natural therapies is crucial to providing safe, evidence-based, and holistic nursing care.

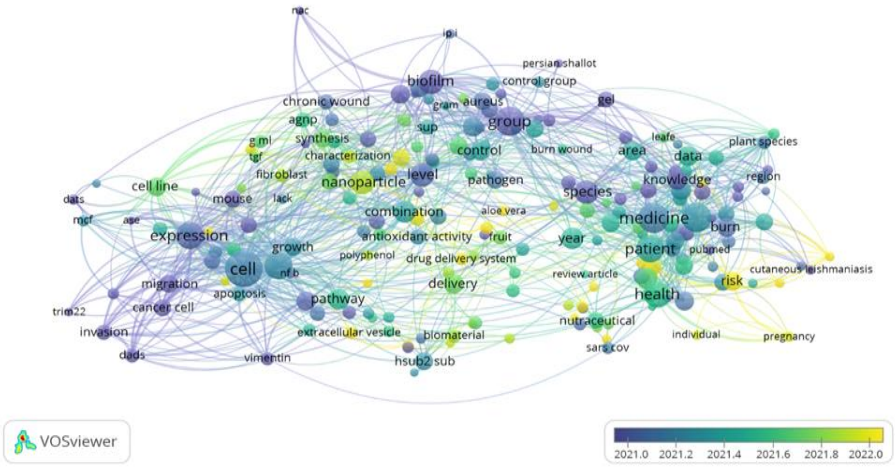

Figure 3. Overlay visualization.

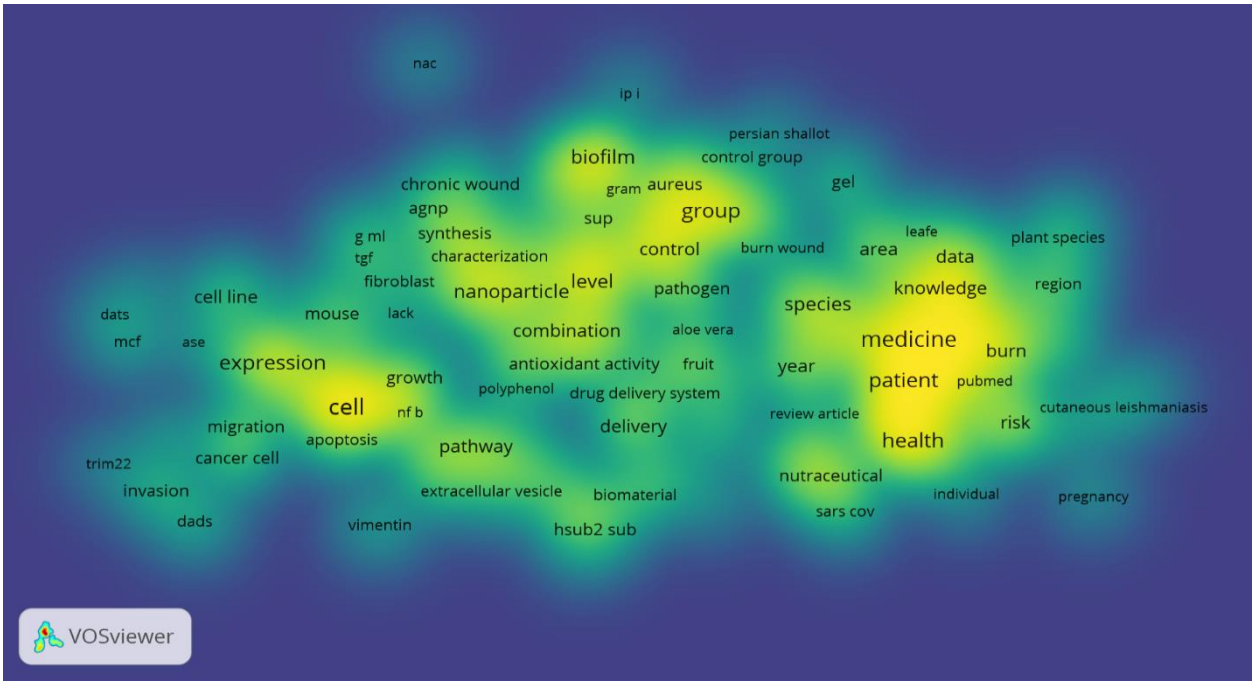

Figure 4. Density visualization

The temporal trends depicted in Figure 2 reveal a surge of research activity on the use of garlic for wound healing, particularly in the years 2021 and 2022. This escalating scientific interest underscores the growing recognition of garlic's remarkable medicinal properties. Garlic, scientifically known as Allium sativum, has long been revered across the globe for its diverse therapeutic applications. Its health benefits are attributed to a plethora of bioactive compounds, which appear to work synergistically to elicit a range of beneficial effects. Garlic and its extracts, notably aged garlic extracts (AGEs), are rich in potent anti-inflammatory, antioxidant, antimicrobial, and neuroprotective agents (Amirsalari et al., 2021; Siddique et al., 2020). These multifaceted attributes have prompted researchers to explore the potential of garlic in the context of Alzheimer's disease (AD), a pressing public health concern in aging populations (Tedeschi et al., 2022). The overlay visualization in Figure 3 provides a striking representation of the depth and breadth of research in this domain. The darker the color, the greater the concentration of studies, underscoring the significant research efforts dedicated to understanding the potential of garlic as a wound-healing agent. These investigations have revealed garlic's efficacy in the management of various wound types, including acute, chronic, burn, and diabetic wounds (Santiago et al., 2020).

Of particular note, the alliin content in garlic (Allium sativum L) has been found to possess remarkable healing properties for shallow second-degree burns owing to its anti-platelet, fibrinolytic, and antimicrobial activities (Mousa et al., 2022). Furthermore, the synergistic effects of garlic, turmeric, and fibroin extracts have demonstrated exceptional promise in accelerating the healing of diabetic wounds in animal models, with significant improvements in collagen deposition, inflammation, and cytokine/enzyme profiles (Jini et al., 2022). Additionally, the incorporation of garlic and ginger essential oils into nano-emulsions has shown impressive antibacterial activity and enhanced wound healing compared to traditional drug formulations, suggesting the potential for essential oil-based interventions (Ibrar et al., 2022). These compelling findings highlight the transformative potential of garlic and its derivatives in the realm of wound care. As the scientific community continues to unravel the multifaceted mechanisms underlying garlic's therapeutic effects, the prospects for developing innovative, evidence-based, and naturalistic wound management strategies grow ever brighter. In essence, the growing scientific interest and research activity surrounding the use of garlic for wound healing reflect a recognition of its multifaceted bioactive properties, versatility in wound management, and potential for driving innovative advancements in natural, evidence-based wound care therapies (Alhashim & Lombardo, 2020). As the scientific understanding of garlic's mechanisms of action continues to evolve, the prospects for translating these findings into improved patient outcomes are expected to grow increasingly promising (Lee Hall, Portera, & Patel, 2021).

Nurses occupy a vital role in the effective utilization of garlic-based interventions for wound care. As frontline healthcare providers, nurses are uniquely positioned to integrate these natural remedies into comprehensive wound management strategies (Dutton, Chiarella, & Curtis, 2014). Through meticulous assessment and close monitoring, nurses are responsible for closely observing patients' wound characteristics, progression, and responses to garlic-based products. They must remain vigilant for any potential side effects or adverse reactions, such as skin irritation or allergic responses, and meticulously document their observations (Lee & Chang, 2023). This diligent monitoring and thorough documentation are essential for evaluating the efficacy and safety of garlic-based wound care. Nurses also play a crucial part in educating patients and their families about the potential benefits and risks of using garlic for wound healing. By guiding the proper application, dosage, and storage of garlic-based products, nurses can empower patients to use these natural remedies safely and effectively. Furthermore, nurses can address any concerns or misconceptions patients may have regarding the use of herbal therapies, fostering an environment of trust and transparency (Zeighami & Soltani-Nejad, 2020). The nurses' role extends beyond direct patient care, as they serve as vital liaisons within the interdisciplinary healthcare team. By facilitating the integration of garlic-based wound care into the overall treatment plan, nurses ensure seamless coordination among physicians, pharmacists, wound care specialists, and other providers.

Conclusion

Nurses occupy a seminal position in safeguarding the continuity of care for patients employing garlic-based wound therapies. Through their vigilant monitoring of patient progress and seamless adjustment of the care plan, these healthcare guardians orchestrate the seamless transition of treatment from the hospital setting to the community, ensuring the consistent and appropriate application of garlic-based remedies. Moreover, nurses serve as steadfast advocates, championing the inclusion of these evidence-based natural interventions within institutional wound care protocols, thereby promoting the integration of holistic, transformative approaches into the mainstream of healthcare practices. As the scientific community continues to unravel the multifaceted potential of garlic in wound management, the role of nurses will undoubtedly remain pivotal, guiding patients toward optimal healing and paving the way for

the continued evolution of this naturalistic yet profoundly impactful domain of wound care. Future studies are needed to explore the role of garlic in other types of wounds.

Author's declaration
The authors made substantial contributions to the conception and design of the study and are responsible for data analysis, interpretation, and discussion of results. For manuscript preparation, all authors read and approved the final version of this article.

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Availability of data and materials
All data are available from the authors.

Competing interests
The authors declare no competing interest.

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