CHAPTER 14

Social Network Analysis in Midwifery: Its Implications on Social Interaction and Healthcare Services

Sena Dilek AKSOY
Kocaeli University, Türkiye

To Cite This Chapter:
Aksoy, S.D. (2023). Social Network Analysis in Midwifery: Its Implications on Social Interaction and Healthcare Services. In H. Arikan, Y. Uzun & I. Cetin (Eds.), *Current Studies in Basic Sciences, Engineering and Technology 2023* (pp. 131–144). ISRES Publishing.

Introduction

The rapid advancement of technology has made communication and information sharing accessible in today's world. Consequently, the midwifery profession has become significant when examined in the context of social networks, particularly in terms of public health, access to information, and health literacy. This is especially evident as technology continues to progress. The profession is crucial in addressing societal health, facilitating access to information, and promoting health literacy when viewed through social networks (Damar, 2022; Hinton et al., 2023; Vivilaki et al., 2023). Social network-based applications have experienced exponential growth in recent years, creating an efficient research area in various scientific disciplines, particularly when coupled with advanced computational techniques for extracting valuable information from the Web. This trend has provided a fertile ground for productive research across different fields (Camacho et al., 2020).

Midwifery is a crucial and critical profession that provides health services to women and their families throughout their lives, from birth to death (Jefford et al., 2019; Stevens & Alonso, 2020). In recent years, social networks have become an important tool supporting midwifery and enhancing information sharing in this field. They are a valuable tool for academic articles (Hinton et al., 2023; S. J. Nolan et al., 2021). Experiences, best practices, and up-to-date information about midwifery are shared through social media, leading to continuous improvements in the professional context (S. Nolan et al., 2018; S. J. Nolan et al., 2021). Social networks also play a critical role in information sharing and support for pregnant women and mothers who have given birth. Groups created for discussing pregnancy-related concerns and similar experiences enable women to exchange information, contributing to developing health literacy regarding pregnancy, breastfeeding, and infant care. This situation can assist them in receiving support both emotionally and sociologically and may help them find quicker solutions to their issues (Gleeson et al., 2019; Hinton et al., 2023; McDaniel et al., 2012; S. J. Nolan et al., 2021).

Empowering midwifery as a profession through social networks can enhance access to midwifery services and raise awareness. Simultaneously, it can contribute to professional solidarity and collaboration and strengthen social connections, thereby elevating the standards of midwifery practice. This, in turn, can improve public health (Damar, 2022; Hinton et al., 2023; Prosen, 2022). While the ease of using social networks brings convenience, it also introduces certain issues. These include patient

privacy, information security, and ethical responsibilities. Midwives need to prioritize an approach that emphasizes ethical standards when adapting to this new communication method and leveraging social networks to meet the requirements of the modern age (Garcia-Mendez et al., 2022; Simbar et al., 2023).

Midwifery and social networks collaborate strongly to improve public health and facilitate information sharing. When used correctly and adhering to ethical codes, social networks can enrich midwifery practices, positively contributing to the community in areas such as pregnancy, childbirth, the postpartum period, newborn health, and breastfeeding experiences.

Definition and Fundamental Concepts of Social Network Analysis

With globalization and digitization, social networks have become integral to our lives today. Social network analysis has increasingly gained significance in recent years as a discipline to understand interpersonal communication and interaction and to decipher valuable information for solving societal dynamics. Social network analysis is a discipline that examines the connections between individuals, groups, or communities. This method studies interpersonal relationships, information flows, or resource sharing among individuals. The structures, strength, frequency, and effects of connections are evaluated, leading to the discovery of various information and syntheses (Serrat, 2017; Sosa, 2022; Tabassum et al., 2018). The scientific literature defines social network analysis as (1) examining services, applications, or specific domains (such as friendship, professional connections, common interests, etc.) that allow individuals to define a public (or semi-public) profile, (2) managing the list of other users with whom an individual (or organization) will share connections, and (3) viewing and navigating these lists, analyzing connections, and examining connections established by others within the social site. Although its roots extend to the Social Sciences, it has begun to enter the field of health and natural sciences in recent years. The concept of social network analysis was first introduced by British anthropologists Alfred Radcliffe-Brown and John Barnes (Barnes, 1954; Camacho et al., 2020; Radcliffe-Brown, 1930, 1940).

Table 1

Some Examples of Social Networks (Tabassum et al., 2018)

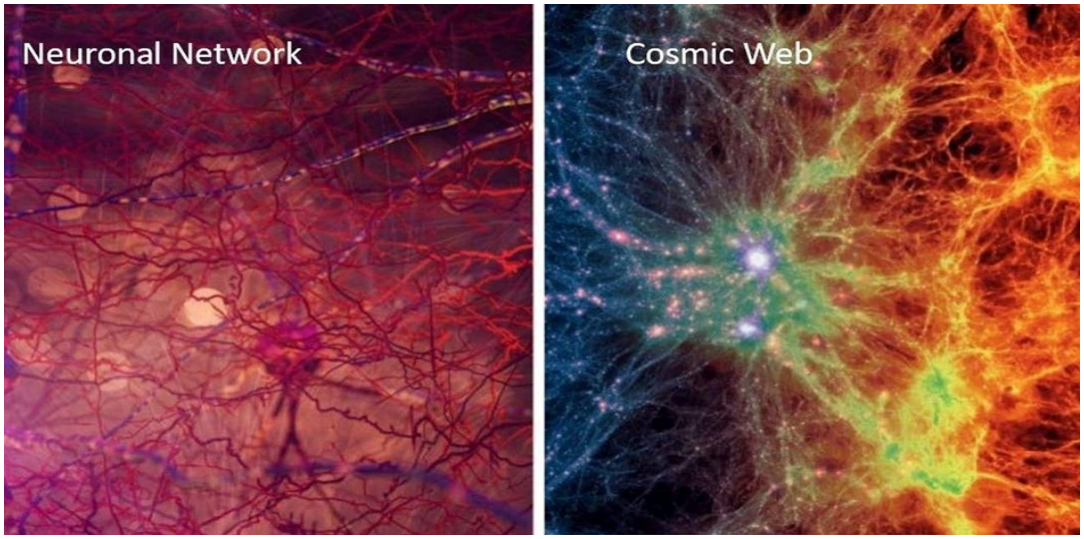
Examples	Applications
Friendship networks	University/school students, organizations, or web (Facebook, MySpace, etc.)
Follower networks	Twitter, LinkedIn, Pinterest etc.
Preference similarity networks	Pinterest, Instagram, Twitter etc.
Interaction networks	Phone calls, Messages, Emails, WhatsApp, Snapchat, etc.
Collaborative authorship networks	DBLP, ScienceDirect, WikiBooks, other scientific databases, etc.
User-user citation networks	DBLP, ScienceDirect, WikiBooks, other scientific databases, etc.
Distributed networks	Epidemics, Information, Rumors, etc.
Supporting actor networks	IMDb, etc.

According to social network analysis, a network consists of living or non-living nodes (individuals, institutions, companies) and their connections. In an individual's environment, there are numerous natural and artificial networks, whether visible or invisible. It is possible to talk about many networks, ranging from the structure of an atom to human cells and systems created by celestial bodies (Tabassum et al., 2018). Social networks are networks in which individuals are connected directly or indirectly. The nodes in any social network represent individuals, institutions, companies, etc.,

within the network, and the edges or links represent the relationships between these groups. For example, friendship connections among individuals, business relationships among institutions or companies, or interpersonal communication patterns can be considered. With social network analysis, features such as the distribution of resources, information flow, or the overall connectivity of the network can be revealed by analyzing the network structure and the characteristics of individuals within the network (Smith, 2013). Social network analysis aims to identify the most effective, significant, or central actors using statistical measurements, define central figures and authorities through connection analysis algorithms, discover communities, employ community detection techniques, and understand how information spreads in the network through algorithms. These analyses are highly effective in extracting information from networks and problem-solving processes. Due to the high potential opened up by such analyses, social network analysis is utilized as a current and popular approach in numerous fields, ranging from biology to business (Tabassum et al., 2018). Social network analysis is typically visualized as a network graph. This graph depicts individuals (nodes) and the connections between them (edges). This graph shows social organization, information transfer, interaction patterns, and power dynamics.

Consequently, scientific data can be obtained (Tabassum et al., 2018). Social Network Analysis is employed in a diverse range of fields. Initially perceived as impactful in the business realm, spanning from customer relationship management to collaborative projects, in recent years, it has also found application in the healthcare sector to comprehend relationships and interactions between patients and healthcare personnel or among the patients themselves. Furthermore, it serves as a potent tool for understanding educational sciences, political science, international relations, and societal interactions (Germani & Biller-Andorno, 2021; Olanrewaju et al., 2020). One significant feature of social network analysis is its capability to analyze real-time data, facilitated by access to big data through social media platforms and online environments, enabling swift and effective results (Serrat, 2017; Sosa, 2022; Toivonen et al., 2019).

Figure 1.
Quantitative Comparison Between Neural Network and Cosmic Network (Brown, 2021)



Social network analysis involves several fundamental concepts;
Centrality: Centrality is a fundamental concept that measures the importance of a node within a network. In a social network, various centrality metrics exist, each emphasizing different aspects of a node's position within the network. These various centrality metrics include degree centrality (the number of direct connections a node has), betweenness centrality (how many times a node acts as a bridge on the shortest path between two other nodes), and eigenvector centrality (the sum of centrality scores for all nodes connected

to a particular node) (Borgatti & Brass, 2019).
Density refers to the measure of the likely occurrence of connections within a network. The higher the density in a social network, the more it can be interpreted that participants in the network are interconnected to a significant degree (Faust, 2006).
Clusters or Communities: Compared to the rest of the network, these groups, which are more densely interconnected and form distinct nodes, are referred to (Gamsu & Donnelly, 2021; Wu et al., 2013).
Structural Holes and Brokerage: Structural Holes are a concept initially developed by Ronald Stuart Burt and utilized in social network research (Burt, 2004) They are the voids in a network where nodes can serve as bridges between two disconnected components of the network (Brass, 2022).

Software Tools Used in Social Network Analysis

There are various tools available for conducting Social Network Analysis (SNA). These range from open-source software to commercial offerings, each with strengths and weaknesses. Here are a few examples:
***Gephi - The Open Graph Viz Platform*:** Gephi is an open-source, interactive visualization, and exploration platform for all types of networks and complex systems. User-friendly enables users to interactively manage network visualization, conduct network analysis, and export results in various formats.
***UCINet – Analytic Technologies*:** UCINet is a comprehensive package designed for the analysis of not only social network data but also other 1-mode and 2-mode data. Widely utilized in social science research, it provides extensive capabilities for analyzing various types of data
***NetDraw Software for Network Visualization*:** NetDraw, commonly used with UCINet, is a free tool for visualizing networks. It supports the visualization of large networks and offers various customization options.
***Pajek*:** Pajek is a program designed to analyze and visualize large networks. It is a comprehensive tool offering various complex network metrics and is available for non-commercial use free of charge.
***NodeXL: network analysis & insights as easy as pie charts*:** NodeXL is a free, open-source template for Microsoft Excel that allows users to visualize and analyze network graphs. Its integration with Excel makes it user-friendly, particularly for those familiar with Excel.
***Cytoscape - Network Data Integration, Analysis, and Visualization in a Box*:** originally designed for biological research, Cytoscape has evolved into a popular open-source software platform for visualizing complex networks and integrating them with various types of qualitative data.
***SocioViz - SocioViz is a free Social Network Analysis tool for Twitter*:** SocioViz is a social media analysis platform focusing on network analysis and visualization of Twitter data. It is a powerful tool for researchers interested in online social networks.
***NetworkX — NetworkX documentation*:** NetworkX is a Python package designed for the creation, manipulation, and exploration of the structures, dynamics, and functions of complex networks. It integrates well with other scientific Python tools such as SciPy and Matplotlib.
***igraph – Network analysis software*:** igraph is a library that can be utilized in R, Python, and C for creating, modifying, and analyzing networks. It is highly efficient and capable of handling large networks.
***RSiena*:** RSiena is an R package dedicated to the statistical analysis of network data, specifically focusing on longitudinal social networks.

Methods of Social Network Analysis

Social network analysis is a research and analysis method employed to study individuals, groups, organizations, or societies, aiming to understand/unravel their connections and develop models. This analytical approach utilizes various techniques to visualize

complex relationships in social networks and examine diverse network relationships and features (Knoke & Yang, 2020).

Network Visualization: Network visualization is a fundamental method used in social network analysis. Network visualization involves the graphical representation of individuals (nodes) and the connections between them (edges). The network graphs used in the visualization process serve as crucial tools for understanding and depicting the network structure. These graphs identify strong connections between nodes, subgroups, and interaction patterns within the network (Can & Alatas, 2019; Freeman, 2004; Knoke & Yang, 2020).

Centrality Measures: Centrality metrics are expressed as metrics that measure the centrality, or importance, of a node in a network. These metrics are utilized to evaluate the connections and interactions of a node with other nodes. Moreover, various centrality measures emphasize different aspects of a node's position in the network. Among these, degree centrality assesses the number of connections a node has, betweenness centrality measures how frequently a node appears on the shortest path between other nodes, closeness centrality evaluates how quickly a node can reach all other nodes in the network, and eigenvector centrality expresses the influence of a node in a network (Stroele et al., 2017).

Network Structure Analysis / Community Detection: This aims to identify clusters of nodes in a social network that are more closely connected than the rest of the network, also known as clustering. This process can assist in uncovering subgroups or communities within the network. Additionally, measurements such as "Connection Density," "Modularity," and "Transitivity" can be used to analyze communities, groups, and the overall structure of the network (Fumanal-Idocin et al., 2020; Nikolaev et al., 2015).

Social Network Mining: Social network mining involves the analysis of large datasets to uncover patterns, trends, and information within social networks. This process enables prediction, identification of trends, and understanding of societal dynamics using data obtained from social networks (Nasution, 2019).

Dynamic Network Analysis: Dynamic network analysis is a method used to understand the changes in a network over time. Examining a network's evolution is employed to comprehend how relationships develop, undergo alterations, and terminate. Thus, this method can assist in gaining insights into the dynamics occurring within the network over time (Lerner et al., 2021).

Structural Equivalence and Block Modeling: The measure of how two nodes in a network are similarly connected to the rest of the network is expressed as structural equivalence. Nodes demonstrating structural equivalence generally assume similar roles within the network. Through the block modeling technique, structurally equivalent nodes are grouped, simplifying the network (Butts, 2008).

Network Correlation and Regression: Correlation and regression are statistical techniques. In social network analysis, these techniques are employed to identify and test patterns within the network. For example, the statistical analysis of the connectivity patterns among nodes with certain characteristics within a network can be conducted using these techniques (Zhang et al., 2008).

Some notable examples of Social Network Analysis include:

Public Health – COVID-19 Pandemic: In China, Fang et al. (2023) utilized social network analysis to model the spread of the COVID-19 virus during the pandemic. Communication and interactions among individuals were mapped in a network format, identifying those contributing to faster virus transmission (super-spreaders). This information proved valuable for public health interventions related to COVID-19 (Fang et al., 2023).

Business – Google's "PageRank" Algorithm: Google's PageRank algorithm is a form of social network analysis. Web pages can be considered as nodes, and links as connections, determining the importance of each page based on the quantity and quality of links directed to it (Chen et al., 2007).

Sociology – Stanley Milgram's "Small World" Experiment: The renowned sociologist Stanley Milgram's most significant experiment and theory in the United States. This approach posits that in a given country, everyone can be connected through, at most, two intermediaries and, in many cases, this communication may occur through only one person in between (Milgram, 1967).

Online Social Networks – Facebook's "People You May Know" Feature: Facebook employs social network analysis to suggest new friends and help users discover potential connections. Essentially, the platform analyzes an individual's existing network, often revealing the likelihood of mutual acquaintance by displaying friends of friends or individuals who share common connections (Guy et al., 2009).

Criminal Network Analysis – Capture of Osama bin Laden: Social network analysis is a method also employed in criminal network analysis. It has been reported that social network analysis was utilized in the operation leading to the capture of Osama bin Laden following the Twin Towers incident in the United States. Intelligence agencies could pinpoint the location of the Al-Qaeda leader by mapping the social connections of known associates (Javed et al., 2022; Krebs, 2002).

Academic Research – Collaboration Networks: Social network analysis is employed in bibliometrics to analyze collaboration networks among researchers. Studies on co-authorship networks in scientific articles can reveal collaboration patterns among scientists working in different disciplines and unveil knowledge flows (Isfandyari-Moghaddam et al., 2023; Toral et al., 2011).

The Use of Social Network Analysis in Midwifery Applications and Research

The application of social network analysis in healthcare initially emerged in the field of public health, aiming to understand and examine the spread of infectious diseases, how networks reinforce social norms, and the organization of public health interventions (Pow et al., 2012). Furthermore, the significance of social network analysis has been highlighted in understanding the adoption or non-acceptance of contraception use and innovations in healthcare by society, emphasizing the impact of social norms in these dynamics (Gayen & Raeside, 2007, 2010b). Social network analysis has been employed in numerous studies, such as evaluating adolescents' utilization of sexual and reproductive health services, identifying support groups for coping with various disease groups, and characterizing dynamic groups or family members in the caregiving processes of mothers with their children (Gayen & Raeside, 2007, 2010b, 2010a; Hinton et al., 2023; Hirdes & Scott, 1998; Kawachi et al., 1996).

Applying social network analysis to midwifery provides a straightforward method to understand human interactions and how they may influence various health outcomes. Specifically, it can assist in identifying influential individuals as agents of change, forming social norms, examining their impact on communication, and determining the extent to which a group accepts new interventions and thought patterns. Therefore, collaborating with key individuals within a network is crucial for the success and sustainability of implemented health interventions. Additionally, social network analysis can aid in evaluating the effectiveness of such interventions in the midwifery profession from the perspectives of healthcare providers and recipients (Gleeson et al., 2019; Hinton et al., 2023; Pow et al., 2012; Prosen, 2022; Stevens & Alonso, 2020; Vivilaki et al., 2023).

Social network analysis can offer various advantages in numerous applications and research within midwifery. It can contribute to strengthening support networks among women, fostering collaboration and solidarity among colleagues, and enhancing the quality of midwifery services, among many other valuable topics. Additionally, it can provide advantages in utilizing midwifery practices, emphasizing the importance of employing certain methods in this context.

Analysis of Patient Support Groups: Social network analysis can be employed to examine support groups among expectant mothers during pregnancy. It can be used to understand interactions within these groups and identify connections between groups. Consequently, it can help identify robust support networks where experiences among

women are shared during pregnancy, childbirth, and postpartum periods, strengthening these networks (Groves et al., 2021; Wentzer & Bygholm, 2013).

Communication Analysis Among Midwifery Professionals: Social network analysis can assess communication and collaboration among midwifery professionals. This facilitates the sharing of best practices, the exchange of professional knowledge, and the global dissemination of accurate practices. Both professional solidarity and seamless exchange of information are crucial for the advancement of the midwifery profession, and in this context, social network analysis can contribute significantly (Gemperle et al., 2022; Ramesh et al., 2023).

Examination of Women's Information Exchange: Social media platforms and online forums serve as spaces where women exchange information and share information. By scrutinizing women's posts on various social media platforms and forum pages, social network analysis can reveal prominent topics, the prevalence of certain information, and the formation of support networks. This enables researchers to draw numerous insights from the data acquired by analyzing women's interactions in these online spaces (Xie et al., 2021; Zeavin, 2022).

Analysis of the Spread of Educational Materials: Social network analysis can also be employed to examine the dissemination of valuable information and educational materials. Particularly in midwifery, it can explore how educational materials spread across different communities, which networks predominantly use these materials, and through which networks the dissemination occurs. Additionally, insights can be gained into the characteristics of individuals accessing these materials. The findings derived from such analyses can contribute to the profession's advancement, providing midwifery professionals and students with more effective access to current data (Trivedi, 2021).

Determining Strong Connections for Public Health: In many applications related to public health, individuals can influence each other. Social network analysis can be employed to enhance the effectiveness of midwifery care and services for public health. Strong connections within the community, in particular, can assist in accessing and participating in health services. This approach can be utilized and researched in various public health applications, such as identifying risk factors within the community and developing early intervention strategies. Additionally, it can be valuable in applications related to maternal and newborn care (Muhidin et al., 2019).

- Identifying risk factors for pregnancy complications through social media analysis can facilitate early intervention and support for individuals at risk.
- Social network analysis in midwifery can be utilized to enhance public health awareness. Disseminating accurate information about pregnancy, childbirth, and postpartum baby care through social media can contribute to a more informed community on health matters.
- It can assist in identifying genetic risk factors and understanding how these factors spread among families. This information can contribute to the prediction and prevention of diseases by providing genetic counseling and recommendations.
- It is crucial for determining lifestyle and environmental factors within the community. Identifying these factors can improve public health by promoting healthy habits and reducing adverse environmental impacts.
- It can help us understand individuals' genetic predispositions and personal health histories. This information can be used to determine individuals' susceptibility to specific diseases and take preventive measures through early diagnosis.

In conclusion, social network analysis in midwifery can positively affect public health. It can increase information sharing, identify and develop prevention strategies for risk factors, and raise health awareness within the community. However, adhering to ethical standards and privacy regulations is essential when conducting such analyses (Assegaai & Schneider, 2019; McCullough et al., 2016; Simpson et al., 2021).

Future Research and Application Recommendations in Social Network Analysis within Midwifery

Social network analysis in midwifery holds significant potential for future research and application. Attention should be directed towards specific areas to advance the field and effectively leverage research in this domain. Further exploration and careful consideration are essential for progressing in the studies conducted in this field and extracting optimal benefits from such research endeavors.

Participation and User Experience: Future research in midwifery within social network analysis should concentrate on how users engage and experience the platform. Within this framework, strategies that enhance participation and strengthen user experience can be identified and integrated into applications (Sheridan et al., 2018).

Data Security and Privacy: One of the most crucial aspects is data security and privacy, a critical concern in social network analysis within midwifery applications. Future research should particularly focus on developing more effective and user-friendly security measures to eliminate users' concerns about data sharing (McCarthy et al., 2017).

Ethnic and Cultural Diversity: Future social network analysis applications in midwifery should focus on how they reflect ethnic and cultural diversity and reach different communities. This approach can contribute to effectively disseminating midwifery applications to a broader audience (Beake et al., 2013; Burton & Ariss, 2014).

Data Analysis and Artificial Intelligence: Future research endeavors may concentrate on more advanced data analysis methods and artificial intelligence applications in social network analysis. This approach can provide deeper insights and more effective predictions to strengthen midwifery applications (O'Connor et al., 2023).

Professional Collaboration and Education: Further research in social network analysis can be conducted to support collaboration and education among healthcare professionals. Specifically, social network analysis in midwifery applications can enhance the coordination of healthcare teams and facilitate the exchange of up-to-date and effective information (Ramesh et al., 2023).

Patient Education and Awareness: Data obtained from social network analysis research in midwifery should contribute to developing strategies to educate and raise awareness among women and the community regarding health issues better, with implications for behavioral change (Trivedi, 2021).

Developments in Mobile Applications: The increasing significance of mobile applications in recent years can also be leveraged in midwifery applications. Attention should be given to user-friendly interfaces, data security, accessibility, and user experience in mobile applications (Tripp et al., 2014).

Community Engagement and Feedback: Social network analysis in midwifery applications should focus on more community-centered initiatives to enhance community participation in health-related matters and make improvements based on feedback. Encouraging active user participation, soliciting feedback, and conducting assessments within this framework are essential (Simpson et al., 2021).

These recommendations can contribute to more effective and user-centric midwifery research in social network analysis. Thus, social network analysis has the potential to become a more powerful tool for strengthening midwifery applications and enhancing women's health experiences.

Conclusion

Social network analysis in the midwifery profession represents a significant realm of research and application for strengthening health services for both mothers and newborns and their families during pregnancy, childbirth, and postpartum periods. Through these analyses, interactions, information exchange, and emotional support systems between women and healthcare professionals can be comprehensively understood, fostering a holistic perspective. However, ethical standards and data privacy must be prioritized to achieve meaningful and extensive progress in this field, with solutions developed within this framework. The integration of future planned studies into the midwifery profession

and the increasing importance of its effective use on a broad scale are anticipated. Additionally, focusing on enhancing user security and improving public health will enable a thorough evaluation of the full potential of this field. Social network analysis in midwifery should increasingly garner importance in future research and applications, serving as a critical tool to optimize healthcare services and support women's health experiences in this evolving landscape.

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About The Authors

Sena Dilek AKSOY, Ph.D., Kocaeli University, Faculty of Health Sciences, Department of Midwifery is where they currently serve as an Assistant Professor. They hold a doctoral degree in Obstetric and Gynecologic Nursing from Marmara University. Their primary areas of interest include midwifery, childbirth, women's health, research methods in midwifery, and both quantitative and qualitative statistical analysis methods in midwifery. **E-mail:** senadilekaksoy@gmail.com, **ORCID:** 0000-0003-4366-5056.

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