

Bibliometric Analysis of Individualized Developmental Care Studies: A Web of Science Sample

Bireyselleştirilmiş Gelişimsel Bakım Çalışmalarının Bibliyometrik Analizi: Web of Science Örneği

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Abstract

This study was conducted using the bibliometric analysis method to investigate general trends in studies on individualized developmental care practices in neonatal intensive care units, to reveal the current state of global research, and to identify unexplored areas and various variables. The research includes publications from 1990 to 2024 that investigate the concepts of "premature" and "individualized developmental care." The data were collected on December 22, 2024, using the Web of Science (WoS) database. The search keywords were "premature", "developmental care", "individualized care", "neonatal nursing" and "nursing care". Data analysis was performed using the "biblioshiny" interface, a web application of the Bibliometrix R package, along with RStudio software. The keyword search identified 715 studies by 3,157 authors. More than half of the articles (n = 375) were published after 2017. It was found that Als et al. conducted the largest number of studies and The Journals Advances in Neonatal Care and Early Human Development (n = 35) published the most articles on the topic. Since 2022, the use of the concept of "neurodevelopmental outcomes" in publications has increased. The most frequently used keywords were "premature infants" and "developmental care" and the majority of studies on the subject were conducted in the United States.

Keywords: Bibliometric analysis, developmental care, individualized developmental care, newborn, nursing

Özet

Bu çalışma, bibliyometrik analiz yöntemi kullanılarak yenidoğan yoğun bakım ünitelerinde bireyselleştirilmiş gelişimsel bakım uygulamalarına yönelik yapılmış çalışmalarla ilgili genel eğilimleri incelemek, küresel çapta araştırmaların durumunu ortaya koymak, henüz çalışılmamış alanları ve farklı değişkenleri belirlemek amacıyla gerçekleştirilmiştir. Araştırma "prematüre" ve "bireyselleştirilmiş gelişimsel bakım" kavramlarını inceleyen, 1990-2024 yılları arasında yapılan yayınları içermektedir. Araştırmanın verileri, 22.12.2024 tarihinde Web of Science (WoS) veritabanı kullanılarak toplanmıştır. Araştırma veri tabanına "prematüre", "gelişimsel bakım", "bireyselleştirilmiş bakım", "yenidoğan hemşireliği", "hemşirelik bakımı" anahtar kelimeleri kullanılarak ulaşılmıştır. Verilerin analizi, RStudio yazılımı ile birlikte bibliyometrik analiz için geliştirilmiş bir Bibliometrix R uygulaması arayüzü olan "biblioshiny" aracı kullanılarak yapılmıştır. Kullanılan anahtar kelimelerle yapılan taramada 715 çalışmanın yer aldığı, yayınlara 3157 yazarın katkıda bulunduğu, incelenen makalelerin yarısından fazlasının (n=375) 2017 yılından sonra yayınlandığı, Als ve arkadaşları tarafından yapılan çalışma sayılarının daha fazla olduğu, "Advances In Neonatal Care" ve "Early Human Development" dergilerinin (n=35) konuyla ilgili en fazla yayın yapan dergiler olduğu, yayınlarda 2022 yılından itibaren "nörogelişimsel sonuçlar" kavramının kullanımının arttığı, en sık kullanılan anahtar kelimelerin ise "prematüre bebekler" ve "gelişimsel bakım" olduğu, konuyla ilgili en fazla çalışmanın ABD' de yapıldığı sonucuna ulaşılmıştır.

Anahtar Kelimeler: Bibliyometrik analiz, gelişimsel bakım, bireyselleştirilmiş gelişimsel bakım, hemşirelik, yenidoğan

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1. Introduction

It is estimated that approximately 13.4 million premature babies are born each year worldwide (Ohuma et al., 2023). Due to their birth before completing maturation, premature infants may require admission to neonatal intensive care. Thanks to advancing technology, survival rates of infants in intensive care have increased. However, it should not be overlooked that these infants are at risk of morbidity (Chandebois et al., 2021). The fact that premature infants are born before their body structures and systemic developments are complete, and that they enter an unsuitable external environment for their development, causes them to experience significant stress (Wong et al., 2022). During their stay in intensive care, factors such as light, sound, tactile stimuli, and repeated painful procedures are significant contributors to the stress experienced by these infants (Nist et al., 2022). The stress experienced by the infant negatively affects the formation of brain connections and cerebral maturation (Cheong et al., 2020). Individualized developmental care is implemented to reduce the stress factors encountered by infants in neonatal intensive care (Weber & Harrison, 2019). The individualized developmental care theory offers a perspective for understanding premature and ill infants, asserting that each infant has unique behaviors and responses according to their developmental stage (Griffiths et al., 2019). Developmental care allows staff to monitor the infant's behaviors and to individualize care according to the infant's needs, thereby improving the sensory and clinical environment (Als et al., 2003). According to the European Foundation for the Care of Newborn Infants (EFCNI), individualized developmental care is one of the main components of infant care (EFCNI, 2019). Practices of individualized developmental care in neonatal intensive care units include environmental improvements, protection of sleep, establishment of sleep-wake cycles, collective care practices, and family-centered care approaches. The literature provides evidence of the effectiveness of this type of care in improving parental involvement and supporting the infant's motor, cognitive, and socio-emotional development (Soleimani, 2020). Clinical studies have shown that premature infants receiving individualized developmental care have shorter hospital stays, reduced need for mechanical ventilation, and increased daily weight gain (Aita et al., 2021; Sanchez-Sanchez et al., 2022). Therefore, it is believed that individualized developmental care is an important part of newborn care. The scope of the studies conducted and the examination of gaps will shed scientific light on guiding future research. Despite the important role of individualized developmental care in neonatal care, to the best of our knowledge, there is no bibliometric analysis on this subject. The aim of this study is to examine the general trends in studies on the implementation of individualized developmental care in neonatal intensive care units using bibliometric analysis, to reveal the global research landscape, and to identify unexplored areas and different variables.

2. Method

This research is a descriptive bibliometric study that examines studies on neonatal individualized developmental care published in the Web of Science database.

2.1. Aim of Study

The research was conducted in order to investigate the general trends related to the studies conducted on individualized developmental care practices in neonatal intensive care units, to reveal the status of global research, and to determine areas that have not yet been studied and different variables.

2.2. Questions of Study

How is the annual scientific production of studies on "individualized developmental care"?

What are the most frequently used keywords in studies on "individualized developmental care"?

Which are the journals that publish the most on the topic of "individualized developmental care"?

How is the thematic map structured according to the keywords selected by the authors?

What are the trending topics in "individualized developmental care" studies?

How is the collaboration network structured in studies on "individualized developmental care"?

2.3. Sample of Study

A search was conducted in the Web of Science database using the keywords "premature" or "preterm", "developmental care" or "individualized care", and "neonatal nursing" or "nursing care". As a result of the search, 715 articles were found.

2.4. Data Collection and Tools

Research data were collected using the Web of Science database. Compared to Google Scholar or Scopus, the WoS database is considered more reliable and useful due to its coverage of journals and citation archives from previous years, the inclusion of high-impact factor journals, and ease of access (Zavadskas, Skibniewski, and Antucheviciene, 2014). Therefore, the study data were obtained on December 22, 2024, by using the keywords 'Premature' or 'preterm birth,' 'developmental care' or 'individualized care,' and 'neonatal nursing' or 'nursing care' in English within the Web of Science database. All research articles published until 2024 were included in the study, while book chapters, case reports, and articles published in languages other than English were excluded.

2.5. Ethical Aspects of the Study

There are no phases of the study conducted with any human or animal subjects. The studies were reviewed using the WoS database, and the research was carried out using the data from the existing studies. Therefore, ethical committee approval was not obtained.

2.6. Limitations and Strengths of Study

The primary limitation of this study is that it only includes research indexed in the Web of Science (WoS) database. The citation counts presented in the study reflect the numbers as of the date the database search was conducted. Citation numbers and rankings may vary in searches conducted at different times

2.7. Data Analysis and Evaluation

The data were analyzed using the "biblioshiny" interface, a web-based application of the Bibliometrix R package developed for bibliometric analysis, in conjunction with RStudio software. RStudio is an integrated development environment for R, a programming language used for statistical analysis and graphical representation. Biblioshiny allows researchers to upload datasets on specific topics of interest and analyze them across various dimensions. It provides visualization of different metrics such as citation statistics, author, country, and journal performance. Moreover, it facilitates the effective presentation of findings such as hot topics and core sources through generated graphs (Aria & Cuccurullo, 2017). The analysis of the retrieved articles was carried out across various modules of the application, including Main Information, Annual Scientific Production, Wordcloud, Most Relevant Sources, Most Global Cited Documents, Thematic Evolution, Trend Topics, Co-Citation Network, and Collaboration Network.

3. Results

3.1. Main Information

The analysis was conducted on a dataset comprising 715 articles that met the inclusion criteria of the study. These articles were published in 258 sources between 1990 and 2024, with an annual growth rate of 12.8%. A total of 3157 authors contributed to this field, and the number of author-defined keywords was found to be 1597. The number of single-authored articles was 54. The average number of co-authors per article was 5.6, and 16.22% of the articles involved international co-authorship. The average number of citations per article was 22.06 (Figure 1).

Timespan	Sources	Documents	Annual Growth Rate
1990-2024	258	715	12.8%
Authors	Authors of single-authored docs	International Co- Authorship	Co-Authors per Doc
3157	54	16.22%	5.6
Author's Keywords (DE)	Refereances	Document Average Age	Average citations per doc
1597	19183	9.94	22.06

Figure 1. Main Information

3.2. Annual Scientific Production

When the articles investigated in the scientific production analysis were categorized by publication year, it was observed that the highest number of publications occurred in 2024 ($n=60$), while the lowest number of publications ($n=1$) were recorded in the years 1990, 1991, 1992, and 1999. A total of 35 studies were published between 1990 and 1999, 130 between 2000 and 2009, 293 between 2010 and 2019, and 257 in the last five years (2020–2024). More than half of the investigated articles ($n=375$) were published after 2017. The distribution of the studies conducted between 1990 and 2024 is presented in Figure 2

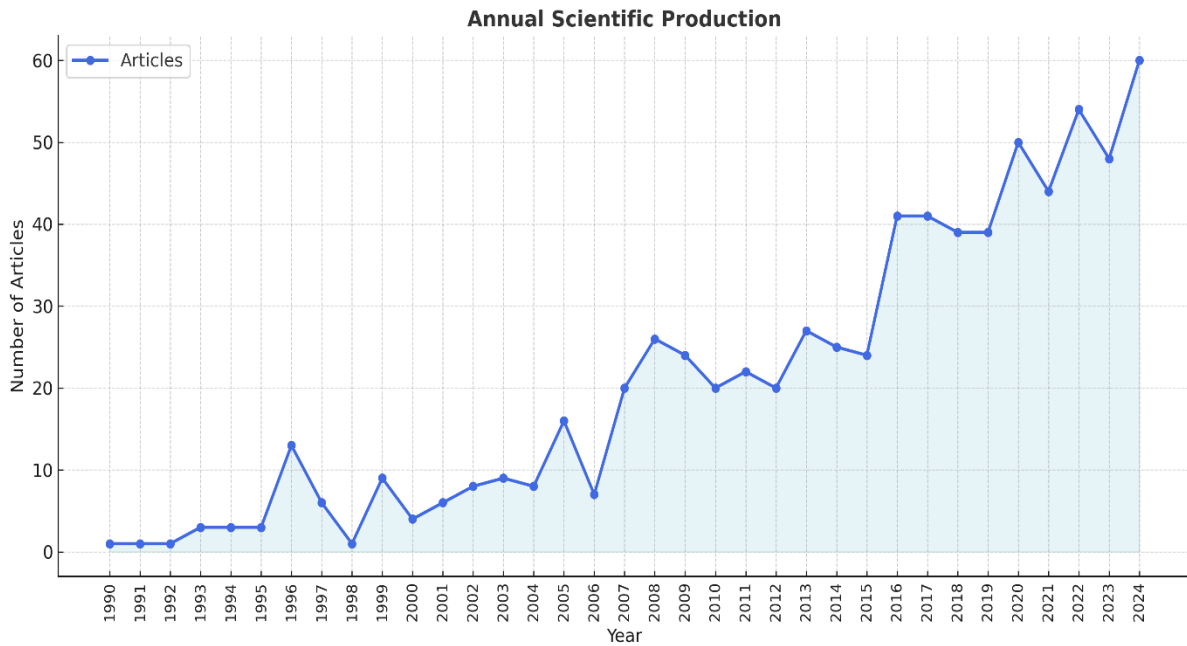


Figure 2. Annual Scientific Production

3.3. Most Relevant Words

The most frequently used keywords by the authors in the analyzed articles were investigated. The most relevant words identified in our analysis are presented in Figure 3. While "preterm infants" was the most frequently used keyword, other commonly used terms included "developmental care," "individualized developmental care," "outcomes," "infants" and "premature infants".

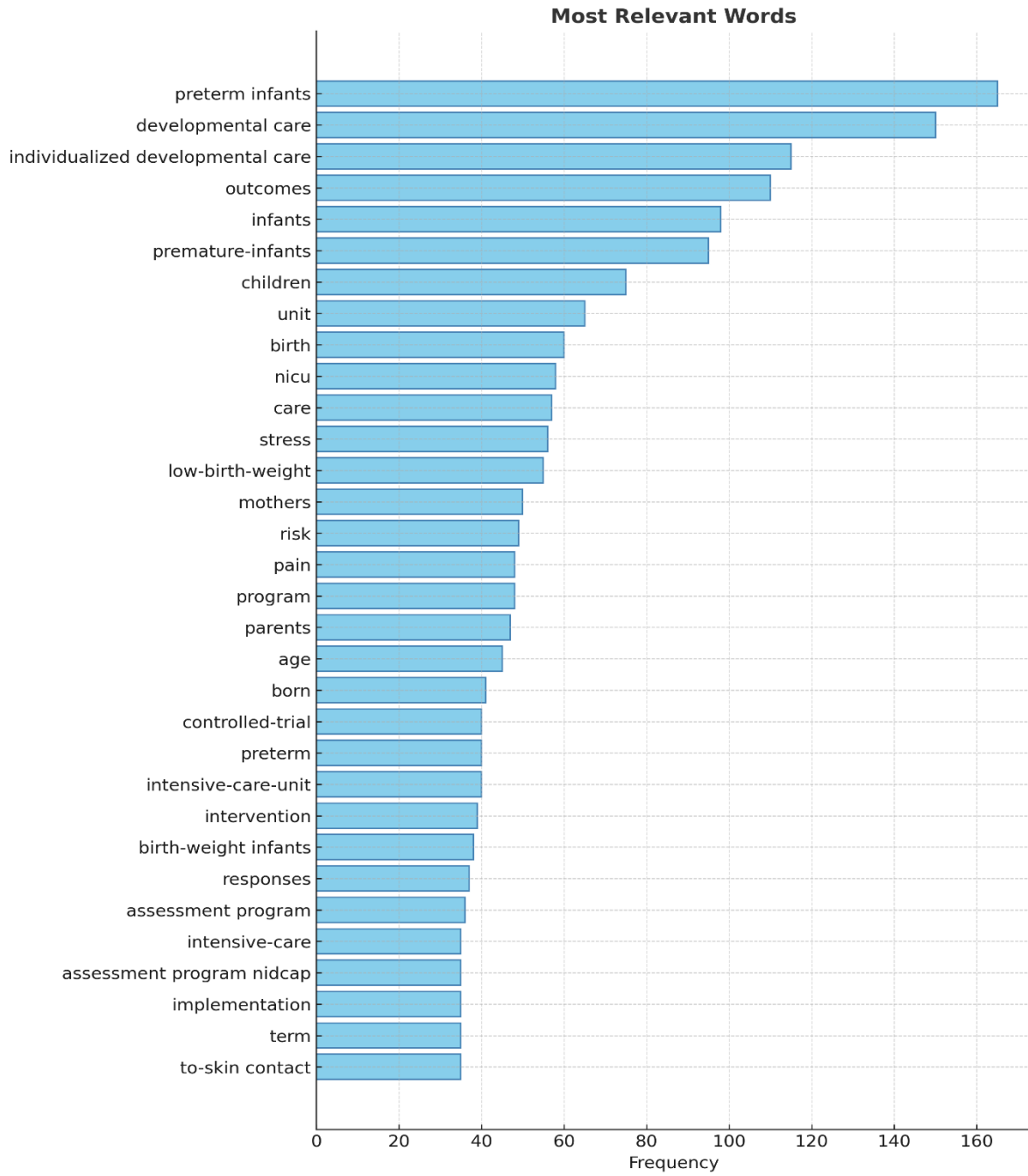


Figure 3. Most Relevant Words

3.4. Most Relevant Sources

The journals that published articles using the specified keywords related to individualized developmental care in neonates are listed in Figure 4. "Advances in Neonatal Care" and "Early Human Development" (n=35) ranked first in terms of the number of publications, followed by the "Journal of Perinatal & Neonatal Nursing" in second place, and "Acta Paediatrica" in third.

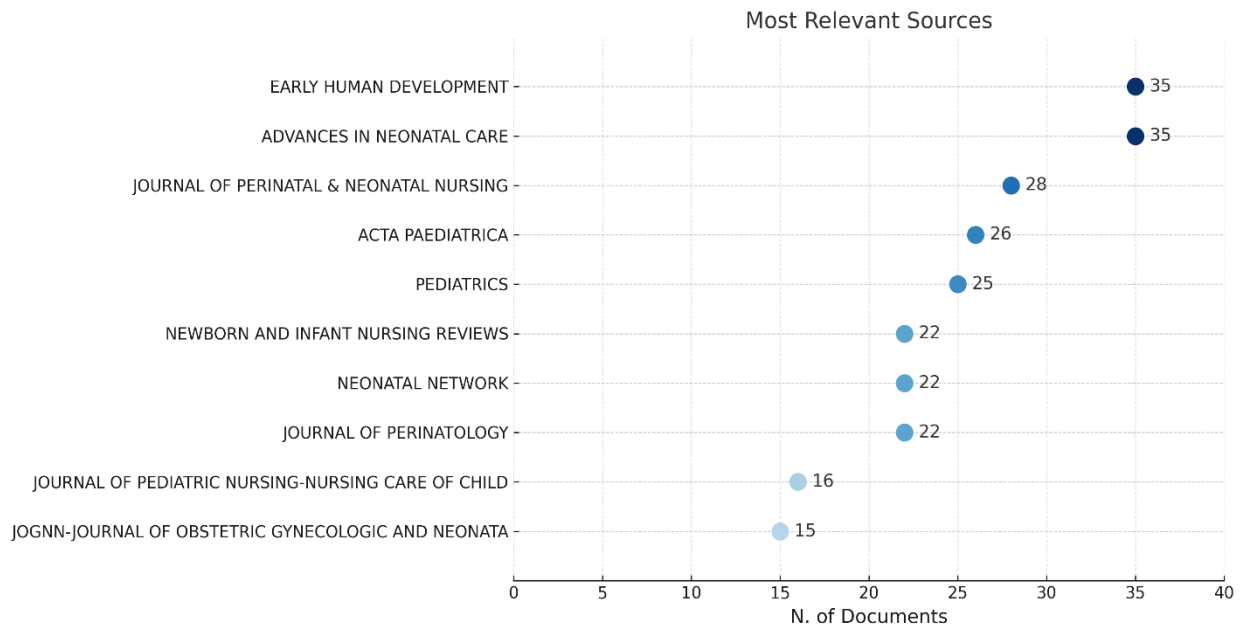


Figure 4. Most Relevant Sources

3.5. Most Global Cited Documents

The globally most cited publications are presented in Figure 5. Ranked first is the article published in Pediatrics by Als et al. (2004), which received 532 citations. In second place is the article published in the Journal of the American Medical Association (JAMA) by Als et al. (1994), which discusses the medical and neurofunctional effects of individualized developmental care for premature infants. Third is a multicenter cohort study published in Pediatrics by Delobel-Ayoub et al. (2009).

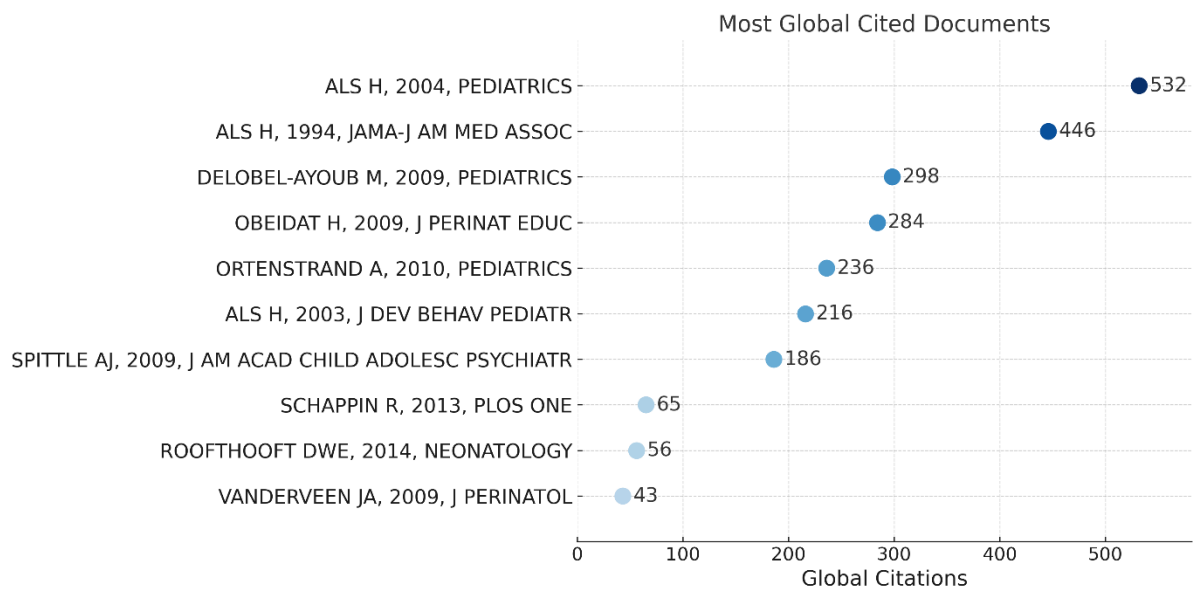


Figure 5. Most Global Cited Documents

3.6. Thematic Map

The thematic map was analyzed based on proximity to the central axis, categorizing themes as emerging or declining, core, or niche. When evaluated according to the keywords preferred by the authors, the themes located near the central (relevant) axis revealed a prominence of concepts such as care, pain, and responses. In the upper right quadrant, which represents motor themes, concepts like developmental care, infants, and neonatal intensive care were emphasized. The lower left quadrant included emerging or declining themes, where concepts such as the United States and environment appeared. Core themes that retain their significance were located in the lower right quadrant, notably including premature infants, individualized developmental care, and outcomes. In the upper left quadrant, niche themes such as sucking, transition, and coordination stood out. In the resulting thematic map, the frequency with which a topic is addressed is directly proportional to the size of the circles on the map (Figure 6).

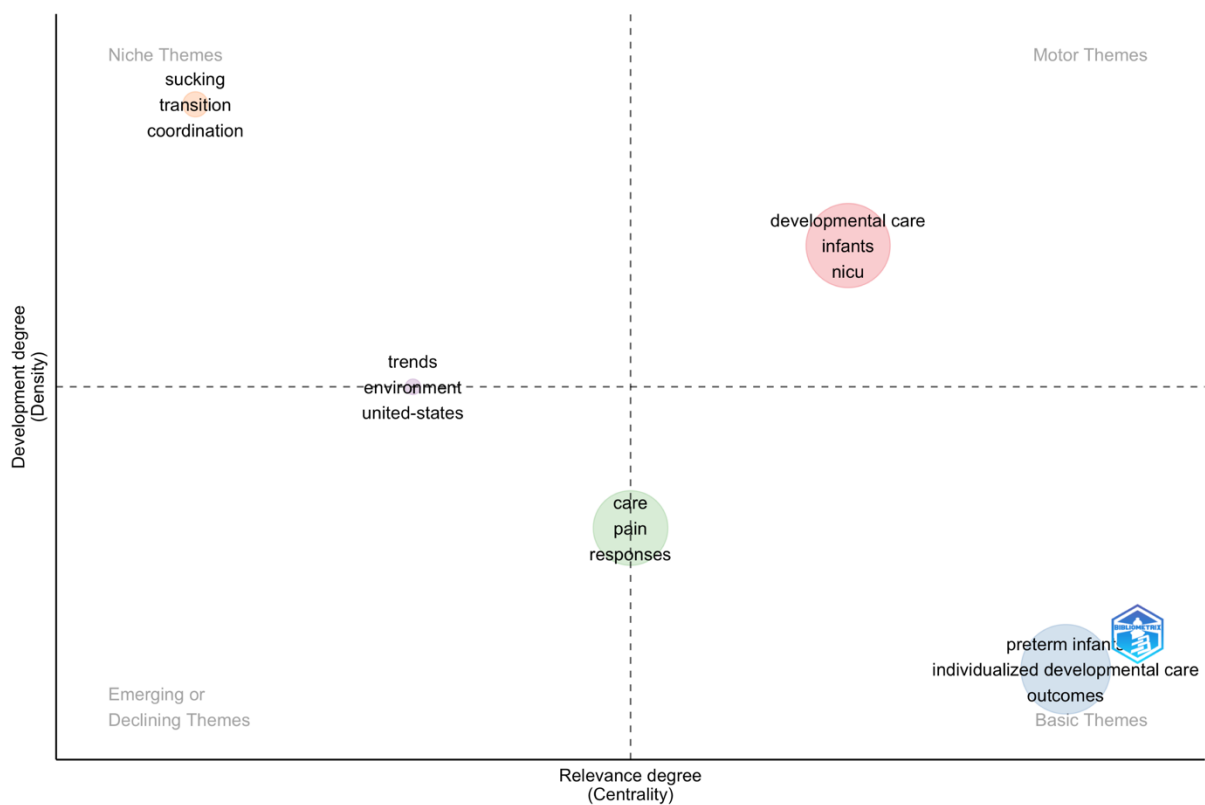


Figure 6. Thematic Map

3.7. Trend Topics

In this section, trending keywords that stand out in the literature based on authors' keyword preferences are examined (Figure 7). It was identified that the terms “premature infants,” “developmental care,” and “neonatal intensive care” were frequently used. Additionally, the use of the term “neurodevelopmental outcomes” has increased since 2022. It was observed that the trend status of the keywords varied over

the years examined. The size of the circular shapes above the linear lines in the graph is directly proportional to the frequency of keyword usage.

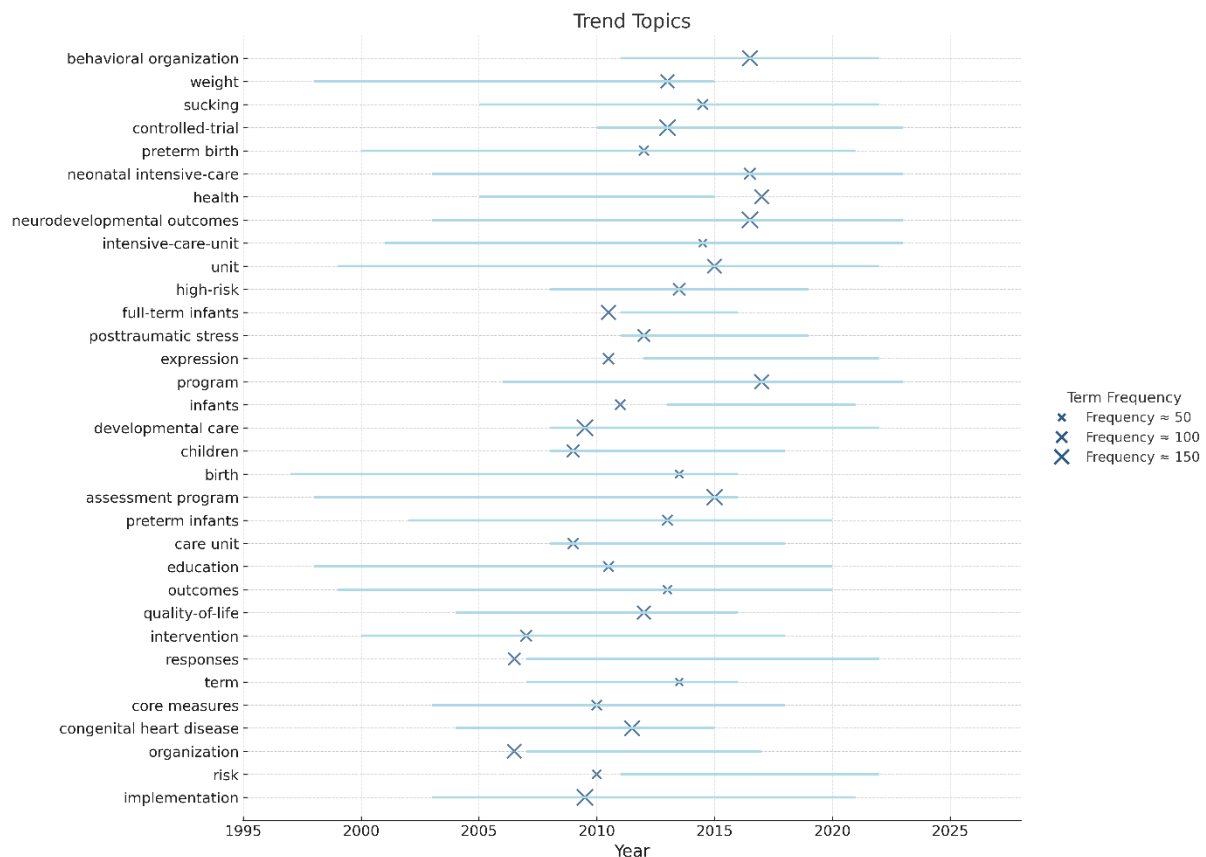


Figure 7. Trend Topic

3.8. Collaboration Network

The collaboration network (Figure 8) illustrates the countries with the highest scientific output and the extent of their collaborative efforts. According to the analysis, the United States ranks first, followed by the United Kingdom in second place, and Switzerland in third. The strongest collaborations were observed between the United States and Canada (n=9), Sweden and the United Kingdom (n=8), Italy and the United Kingdom (n=7), and Italy and the United States (n=7). In the Web of Science database, filtered by the selected keywords, no international collaboration involving Turkey was identified.

4. Discussion

In this study, we performed a bibliometric analysis of research on individualized developmental care in neonates. The results demonstrate a steady increase in publications since 1990, with a notable surge after 2017. Remarkably, 52.5% of the total 715 articles were published from 2017 onward, and 2024 marked the year with the highest publication count. This rising trend likely reflects the growing recognition of individualized developmental care as an effective approach to improving outcomes for premature infants, enriching the content and quality of neonatal care, and enhancing nurses' job satisfaction (Bozlar, 2022). Given these observations, it is reasonable to anticipate continued growth in research on individualized developmental care in the coming years.

In this bibliometric analysis, “preterm infants” and “developmental care” emerged as dominant keywords, reflecting the clinical importance and priority of this vulnerable patient population. The need for individualized developmental care in preterm infants arises from their incomplete intrauterine maturation, which predisposes them to risks such as impaired growth and adverse neurological outcomes. These factors underscore the necessity of implementing targeted and developmentally appropriate interventions to support optimal outcomes (Burstein, Aryeh, and Geva, 2024). In addition to their frequency in the literature, it is noteworthy that these keywords frequently appear in studies with high levels of evidence, such as systematic reviews and randomized controlled trials (Lyu et al., 2024; Soleimani et al., 2020). Incorporating such keywords in literature searches on individualized developmental care may enhance researchers’ ability to identify and access high-quality, evidence-based studies that inform clinical practice and future research.

Beyond identifying the dominant keywords and trends, it is also important to examine where this research is being published. An examination of journals contributing to this field identified *Advances in Neonatal Care* (SCI-E/Q3) and *Early Human Development* (SCI-E/Q2) as leading outlets, each publishing 35 articles. The *Journal of Perinatal and Neonatal Nursing* (SCI-E/Q2) ranked second with 28 articles, followed by *Acta Paediatrica* (SCI-E/Q2). Among these top four journals, two focus on nursing, while the other two are clinical medical journals.

In addition to identifying publication venues, evaluating the scholarly impact of these studies through citation analysis provides deeper insight into the field. Citation analysis is widely recognized as a robust method for assessing research influence (Hack et al., 2010). This analysis revealed that Als et al. (1994, 2004) held the top two positions in citation rankings, with Delobel Ayoub et al. (2009) following closely behind. Several factors are known to influence citation frequency, including the impact factor of the journal, its quartile ranking, and the breadth of references cited within the article (Tonta and Akbulut, 2021). A closer examination of these highly cited studies shows that they often featured multicenter designs and high levels of evidence, particularly randomized controlled trials. These studies also approached developmental care from a multidimensional perspective, which contributed to their significant scholarly impact.

In the thematic map, the concepts of “care,” “pain,” and “responses” emerged as core topics within the field. These terms reflect their critical role in optimizing clinical outcomes through individualized developmental care approaches for neonates. These findings highlight the importance of addressing such themes in both research and clinical practice to ensure comprehensive and infant-centered care strategies. The motor themes such as “developmental care,” “infants,” and “neonatal intensive care” represent high-interest areas that have received considerable attention in recent years. This trend may be attributed to the global shift toward creating optimal healthcare environments for preterm infants and the increasing recognition of the long-term effects of developmental interventions (Chen et al., 2025).

Although global research efforts continue to expand, examining emerging or declining themes helps provide additional context. For instance, the keywords “USA” and “environment” may indicate a transition in focus from geographically specific research to more globally distributed or collaborative studies. The early prominence of the USA may reflect the country’s leadership in developmental care

research during the initial phases of adoption. However, the recent decline could signal a broader distribution of research efforts across multiple regions. Similarly, environmental considerations in neonatal care, including noise reduction, light modulation, and the creation of parent-infant bonding spaces, are now more commonly integrated into neonatal intensive care unit designs. This trend may suggest that environmental themes have reached a level of maturity in the literature (Andy et al., 2025).

The core themes in the lower right quadrant of the thematic map, such as “preterm,” “infants,” “individualized developmental care,” and “outcomes,” align with a growing body of evidence that emphasizes the importance of tailored interventions to support neurodevelopment in preterm infants. These findings are supported by randomized controlled trials and systematic reviews that demonstrate the benefits of adapting care to meet the individual needs of each infant (Franck and O'Brien, 2019).

Niche themes such as “sucking,” “transition,” and “coordination” represent specialized but underexplored areas in the current literature. Although these topics occupy a smaller portion of the research landscape, they reveal important gaps, particularly regarding feeding readiness, neurobehavioral development, and the coordination of motor patterns in premature infants. The size of the circles in the thematic map reflects the frequency of these topics in the literature and highlights both established areas and those that offer opportunities for future investigation.

Trend analysis further revealed that “preterm infants,” “developmental care,” and “neonatal intensive care” continue to dominate the literature. However, the concept of “neurodevelopmental care” has gained particular prominence since 2022. The growing emphasis on neurodevelopmental care reflects its critical role in reducing long-term morbidity among infants born at extremely low gestational ages and with low birth weights. Improvements in neonatal medicine have significantly increased survival in these populations, likely explaining the growing interest in neurodevelopment-focused approaches (Chowdhury et al., 2024).

Despite global momentum, countries vary in their levels of participation and collaboration. Many nations contribute actively to the research on individualized developmental care, particularly through international partnerships. Collaborative activity appears to be especially concentrated in the United States and European countries. In contrast, Turkey has not yet established visible international collaborations in this area. Limited research infrastructure and restricted funding in health sciences may pose challenges for engaging in multinational projects, particularly in specialized fields such as individualized developmental care. Additionally, a shortage of professionals with advanced expertise may hinder the development of sustainable international partnerships (Onat, 2013). Language barriers, especially limited English proficiency, may further reduce researchers' ability to publish in high-impact journals and participate in global scientific communities. Institutional differences related to healthcare delivery, ethical approval procedures, clinical protocols, and technological capacity may also impede collaboration across borders (Çalikoğlu et al., 2022). Moreover, the limited involvement of nurses in research, despite their critical role as primary caregivers, may reduce the scope and interdisciplinarity of contributions.

Despite these region-specific limitations, global interest in individualized developmental care continues to grow. This field remains a critical aspect of neonatal practice, especially for infants born preterm who

are exposed to extrauterine stressors before completing essential stages of neurodevelopment. Since behavioral cues are their primary means of communication, responsive and well-tailored care is essential. These findings support the growing consensus that individualized developmental interventions must be adapted based on each infant's unique behavioral and physiological profile. In light of the challenges discussed, Turkey may currently face significant barriers in contributing to the advancement of this field, but the global trajectory of individualized developmental care continues to emphasize its importance for improving neonatal outcomes.

5. Conclusion

Within the scope of this study, it was found that the Web of Science database includes studies categorized under “developmental care” and “individual care,” with a total of 3,157 authors contributing to research on individualized developmental care. The most frequently cited works were those conducted by Als et al. (1994–2004). The journals with the highest number of publications on this topic were *Advances in Neonatal Care* and *Early Human Development*. The majority of the studies were conducted in the United States, the United Kingdom, and Sweden, respectively. More than half of the 715 articles analyzed were published after 2017. The most frequently used keyword was “preterm infants,” followed by “developmental care.” As of 2022, the concept of “neurodevelopmental care” has begun to gain prominence. Among the four journals with the highest number of publications in the field, two are nursing journals (*Advances in Neonatal Care* and *Journal of Perinatal & Neonatal Nursing*), while the other two are clinical medical science journals. It is recommended that individualized developmental care practices be standardized in neonatal care, with interventions planned based on the behavioral responses of infants according to their gestational age using validated assessment tools. Furthermore, it is suggested that individualized developmental care be categorized into subtypes (e.g., neurodevelopmental care, environmental care, sensory care) and that further high-evidence-level studies be conducted in these areas.

Authors Contributions

Topic selection: SKB, EE; Design: SKB, EE; Planning: SKB, EE; Data collection and analysis: SKB, EE; Article writing: SKB, EE; Critical review: SKB, EE.

Conflict of Interest

No conflict of interest has been declared by the authors.

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