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BIBLIOMETRIC STUDY: INDICATORS OF CHILD DEVELOPMENT FROM THE PERSPECTIVE OF CHILD PSYCHOLOGY

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ABSTRACT

During early childhood, measuring and monitoring developmental indicators is essential for identifying difficulties across various domains and risk factors that require intervention to reach expected milestones. This study aimed to explore scientific research trends addressing child development indicators within Child Psychology in the context of Child Development Centers (CDCs) during the 2015–2025 period. A bibliometric design with a descriptive scope was employed; the search was conducted in Scopus and Web of Science (WoS) using search equations. Selection followed a four-stage process: identification, screening, eligibility, and inclusion, represented in a PRISMA flow diagram based on inclusion criteria. Data treatment was performed in Microsoft Excel, and analytical processing was conducted in Bibliometrix (RStudio). Findings show an annual growth rate in production with high international collaboration and a strong concentration of publications across specific affiliations, countries, and multidisciplinary journals. The mapping identified themes centered on developmental monitoring, milestone achievement, and early detection of delays, supported by robust institutional and international networks, alongside emerging themes based on socio-emotional and linguistic indicators.

KEYWORDS: Developmental Indicators, Child Development, Milestones, Child Psychology, Bibliometrics.

1. INTRODUCTION

Child development is a dynamic and multidimensional process integrating cognitive, socio-emotional, linguistic, and motor aspects, which lay the foundation for future well-being and learning. During early childhood, the interaction between biological and environmental factors determines developmental trajectories that can enhance or limit a child's growth (McCormick et al., 2020). Consequently, measuring and monitoring indicators during this critical window is essential for identifying domain-specific difficulties and risk factors that demand intervention to achieve expected milestones.

Despite this, the heterogeneity of indicators used to evaluate development hinders systematic and comparative monitoring across different contexts. Studies have shown that the relationship between physical growth and cognitive development is complex in low- and middle-income settings, raising questions about the relevance of certain traditional indicators (Tran et al., 2019). Furthermore, the widespread adoption of measurement tools is obstructed by cultural adaptation and a lack of standardization (Venancio et al., 2020). In this context, it is crucial to understand how the use of child development indicators has evolved from a psychological perspective.

Within the field of child psychology, developmental indicators serve as key tools for early risk detection. In this regard, literature indicates that scientific interest in measuring this process through standardized indicators has grown in recent years (Herrera et al., 2019; Pérez et al., 2017) to guide public policies and intervention programs. Among these, the technical process for the Early Childhood Development Index 2030, promoted by the United Nations Children's Fund (UNICEF, 2023), is noteworthy. Recent studies on tools and indicators also show variability in the selection of domains (health, nutrition, learning, protection, and responsive caregiving) and in the quality of measurements available for population surveillance (Jeong et al., 2022). These efforts seek to provide a comprehensive view of the current state of child development across various areas and reduce inequalities through appropriate and personalized interventions.

In particular, Child Development Centers (CDCs), institutional spaces and public programs providing free early childhood education (Alvarado & Acosta, 2022), operate as critical nodes for the collection, monitoring, and evaluation of developmental indicators. These centers focus on reducing child malnutrition rates and strengthening caregiver capacities by promoting affectionate and stimulating environments for children

aged 0 to 3 (Hidrovo et al., 2025). In other words, these centers offer the opportunity to conduct assessments, observe interactions, and generate comparative data at both internal and inter-institutional levels. However, many of these centers lack a system for measurement or employ instruments without proper psychoeducational validation, limiting the ability to generate robust evidence from a child psychology perspective. Therefore, the extent to which CDCs participate in research implementing indicator systems aligned with child psychology remains unknown.

This landscape highlights a knowledge gap, as there is currently no bibliometric analysis systematically describing research trends on child development indicators from a child psychology perspective. The performance of scientific production (most relevant authors, citations, institutions, countries, sources, and institutional affiliations) is not documented, nor is there mapping that integrates co-author collaboration networks and keyword co-occurrence. Furthermore, there is a lack of thematic evolution monitoring to identify motor themes, specialized niches, and basic or emerging areas in this field. This scarcity of bibliometric evidence limits the ability to identify strengths and gaps in current research and, consequently, restricts the capacity of development centers to implement standards, policies, and methodologies that promote more comprehensive and internationally comparable assessments.

The importance of this study lies in providing a generalized and updated overview of the scientific literature on child development indicators from a psychological perspective a field essential for understanding holistic well-being in early childhood. Consequently, this study will contribute to strengthening the empirical foundation of the discipline and optimizing the quality of evaluation within CDCs. The objective focuses on exploring scientific research trends addressing child development indicators from the perspective of Child Psychology in the context of Child Development Centers during the 2015–2025 period.

To achieve this purpose, the following specific objectives were established to facilitate the findings:

1. To identify the status of scientific performance regarding child development indicators within child psychology in the context of CDCs.
2. To determine the distribution of mapping networks related to the records of child development indicators within child psychology in the context of CDCs.
3. To describe the thematic evolution of child development within Child Psychology in the

context of CDCs.

2. METHODOLOGY

The present study employed a bibliometric design with a descriptive scope aimed at analyzing scientific production related to child development indicators from the perspective of child psychology within the context of Child Development Centers (CDCs) during the 2015–2025 period. Through the quantitative analysis of published literature, this methodological approach allowed for the identification of research trends, collaboration networks, influential contributors, and existing knowledge gaps within this specific scientific

domain.

The selection of databases focused on Scopus and Web of Science (WoS), as they are the most comprehensive, updated, and reliable repositories of high-impact scientific information covering multidisciplinary areas of interest. Accordingly, the search and selection process followed four sequential stages: identification, screening, eligibility, and inclusion, as illustrated in Figure 1.

During the identification phase, conducted on October 18, 2025, search equations were applied using thematic descriptors and Boolean operators (Table 1), yielding 602 initial records. After applying a chronological filter (2015–2025), 235 documents were excluded, leaving 367 for further evaluation.

Table 1: Search Strategy.

Database	Strategies and Equations
Scopus	(TITLE-ABS-KEY (child development indicators* OR early childhood development OR child development milestones) AND TITLE-ABS-KEY (child psychology*) AND TITLE-ABS-KEY (child development center* OR child care center*))
Web of Science	(TS= (child development indicators* OR early childhood development OR child development milestones) AND TS= (child psychology*) AND TS=(child development center* OR child care center*))

In the second phase (screening), a title-based review led to the exclusion of 248 non-relevant documents, leaving 119 studies for the next stage. During the third phase (eligibility), these 119 records were assessed for accessibility, resulting in 92 full-text open-access studies. Following a rigorous abstract review of this group, the sample was narrowed to 43 articles.

In the final phase (inclusion), a full-text

examination was carried out to ensure thematic alignment based on the following criteria: (1) child development indicators from (2) the perspective of Child Psychology and (3) within Child Development Center (CDC) contexts with comparable age populations (1 to 3 years). Ultimately, 29 articles were confirmed for the final bibliometric analysis (Figure 1)

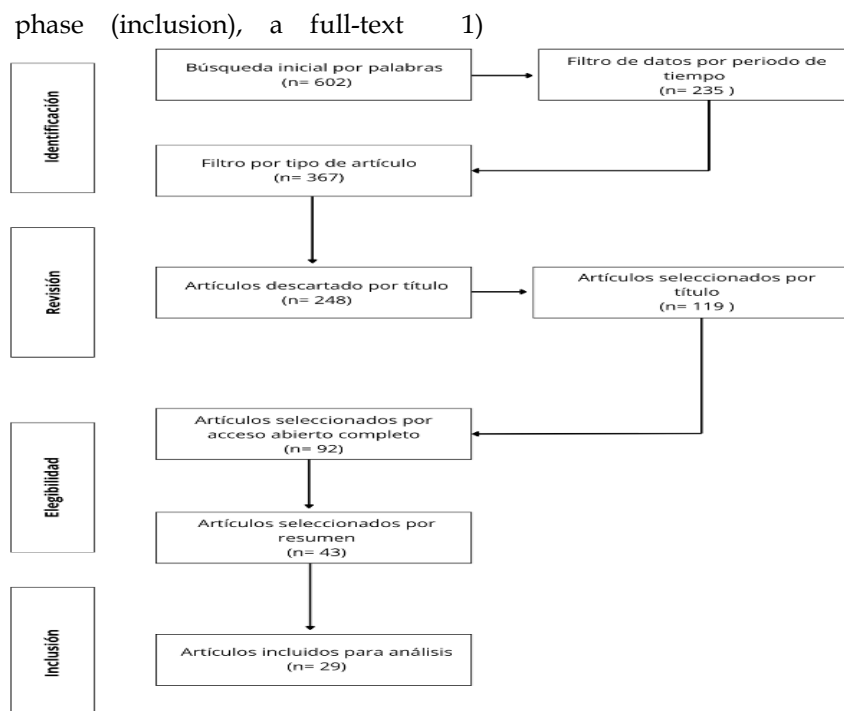


Figure 1: Prisma Flow Diagram.

The analysis of the records was performed using bibliometric metrics provided by the selected

databases, exported in CSV and BibTeX formats. These formats allowed for the preservation of structured information such as authors, publication year, titles, keywords, citations, affiliations, and journal sources. Additionally, for initial data management, Microsoft Excel was used to clean, organize, and filter the retrieved records. Subsequently, the Bibliometrix package within the RStudio environment was employed to generate tables and graphical representations of the scientific production. This approach ensured a systematic, transparent, and reproducible treatment of the information, in line with current methodological standards for bibliometric research in psychology and child development.

3. RESULTS

3.1. Scientific Performance

The bibliometric analysis of child development indicators from the perspective of child psychology within the context of CDCs was conducted over the

2015–2025 period. However, since no documents met the eligibility criteria during the first year of the search, the effective chronological distribution of the findings spans from 2016 to 2025. Within this timeframe, a total of 29 documents published across 26 different sources were identified. The annual growth rate of scientific production reached 12.98%, with documents having an average age of 2.76 years and a mean of 13.9 citations per article. A total of 261 references were analyzed, featuring 322 Keywords Plus and 95 Author Keywords, which highlight the thematic diversity of the field. A total of 190 authors participated in the study, of whom only one produced a single-authored document. Collaboration indicators revealed an average of 7.03 co-authors per publication and an international co-authorship rate of 34.48%, reflecting robust global research interaction. All analyzed documents were scientific articles, emphasizing the dominance of dissemination through specialized journals in this research area (Figure 2)



Figure 2: Main Information Regarding Scientific Production.

The analysis identified five prominent authors, Pinchas Akiva, Guy Amit, Ravit Baruch, Yair Sadaka, and Deena Rachel Zimmerman, each with three publications and a fractional contribution of 0.35. Sally M. Grantham-McGregor and Marta Rubio-Codina followed with two articles each and higher fractional values of 0.7. Tamar Sudry and Meytal

Avgil Tsadok also contributed two works with a fractional rate of 0.225. Ali M. Abdallah participated in one study with a fractional value of 0.05 (Table 2). These findings reflect collaborative research dynamic where a small group of authors demonstrates significant influence in the field.

Table 2: Most Relevant Authors.

Authors	Articles	Articles Fractionalized
Akiva, Pinchas	3	0,35
Amit, Guy	3	0,35
Baruch, Ravit	3	0,35
Sadaka, Yair	3	0,35
Zimmerman, Deena Rachel	3	0,35
Grantham-Mcgregor, Sally M.	2	0,7
Rubio-Codina, Marta	2	0,7
Sudry, Tamar	2	0,225
Tsadok, Meytal Avgil	2	0,225
Abdallah, Ali M.	1	0,05

The analysis of the most relevant sources revealed that BMC Pediatrics, Early Human Development, and PLOS ONE were the leading journals, each publishing two articles related to child development

indicators from a child psychology perspective. Other sources, such as BMC Psychology, BMJ Open, BMJ Paediatrics Open, Child: Care, Health and Development, Developmental Psychology, Frontiers

in Pediatrics, and Frontiers in Psychology, contributed one article each (Table 3). This distribution indicates a diverse yet concentrated

dissemination of research across multidisciplinary journals in the fields of pediatrics, psychology, and child development.

Table 3: Most Relevant Sources.

Sources	Articles
Bmc Pediatrics	2
Early Human Development	2
Plos One	2
Bmc Psychology	1
Bmj Open	1
Bmj Paediatrics Open	1
Child: Care, Health and Development	1
Developmental Psychology	1
Frontiers In Pediatrics	1
Frontiers In Psychology	1

The analysis of institutional affiliations revealed that the KI Research Institute, the National Research Centre, and ShanghaiTech University were the most productive institutions, each with ten publications related to child development indicators within the field of child psychology. The Johns Hopkins University School of Medicine followed with seven articles, while Shanghai Normal University

contributed six. Additionally, the Ministry of Health, The University of Queensland, Universidad Politécnica de Madrid, and the University of Oslo each produced five publications, and Ben-Gurion University of the Negev contributed four (Table 4). These results indicate a strong international presence in the research area, with notable participation from institutions across Asia, Europe, and North America.

Table 4: Most Relevant Affiliations.

Affiliation	Articles
Ki Research Institute	10
National Research Centre	10
Shanghaitech University	10
Johns Hopkins University School Of Medicine	7
Shanghai Normal University	6
Ministry Of Health	5
The University of Queensland	5
Universidad Politécnica De Madrid	5
Universitetet I Oslo	5
Ben-Gurion University of the Negev	4

The analysis showed that production is led by China, which stands out as the primary hub for knowledge generation in this area. Israel and the United States follow closely, reflecting solid and sustained research activity. Egypt and Norway also show significant academic participation, highlighting the growing relevance of the topic across various cultural contexts. Countries such as Australia, the United Kingdom, Japan, Spain, and

Finland contribute through consistent research efforts that enrich the global perspective of the field. Furthermore, emerging contributions from nations in Asia, Europe, and the Americas, such as Cambodia, Thailand, Germany, Brazil, and Canada, illustrate the international expansion of this research line (Figure 3). Overall, the map reveals a strong concentration of scientific production in Asia and North America.

Country Scientific Production

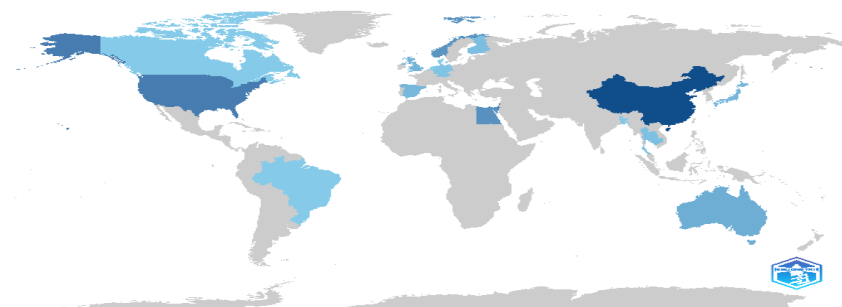


Figure 3: Countries With Most Relevant Contributions.

3.2. Mapping Networks

The keyword co-occurrence network (Figure 4)

revealed a highly interconnected structure centered on core concepts such as human, female, humans, child, male, and child development, which exhibit the highest levels of centrality and connectivity within the network. These terms form the primary thematic cluster, emphasizing a strong focus on developmental processes and their relationship with human and gender variables during early childhood. Closely related concepts such as child, preschool, preschool child, and infant further reinforce the dominance of early developmental stages in the research field. The network also highlights specialized terms such as developmental disorder,

motor performance, language, and developmental disabilities, which bridge the clinical and developmental dimensions of the study. Additionally, a secondary cluster integrates methodological terms such as motor development, questionnaire, cohort analysis, and longitudinal study. This points toward the empirical and quantitative orientation of the research. Overall, the network demonstrates a cohesive and multidisciplinary approach, where biological, psychological, and methodological perspectives converge to understand early child development.

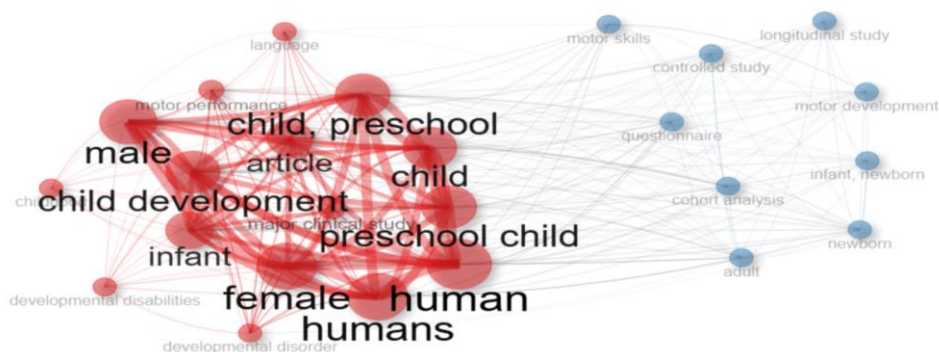


Figure 4: Keyword Co-Occurrence Network.

The author collaboration network (Figure 5) revealed a highly cohesive structure led by a core group composed of Pinchas Akiva, Guy Amit, Ravit Baruch, Yair Sadaka, and Deena Rachel Zimmerman, who present the highest indicators of connectivity and centrality. This group demonstrates strong internal collaboration and constitutes the primary nucleus of scientific production on child development indicators within child psychology. Closely associated with them are Tamar Sudry and Meytal Avgil Tsadok, who maintain moderate links with the lead authors, contributing to the consolidation of this primary research group.

Beyond this dominant cluster, the network branches into secondary collaborative groups

reflecting international diversity. A notable group includes Sally M. Grantham-McGregor and Marta Rubio-Codina, connected with researchers such as María Caridad Araujo and Orazio Pedro Attanasio, indicating a focus on global development studies and applied psychology. Other groups, such as those led by Ole Andreas Andreassen, Santiago Berrezueta-Guzmán, and Lei Chen, highlight regional collaborations spanning Europe, Latin America, and Asia. Overall, the structure suggests a well-established yet globally distributed network, where a few central figures drive the research while multiple emerging groups expand international cooperation in the field.

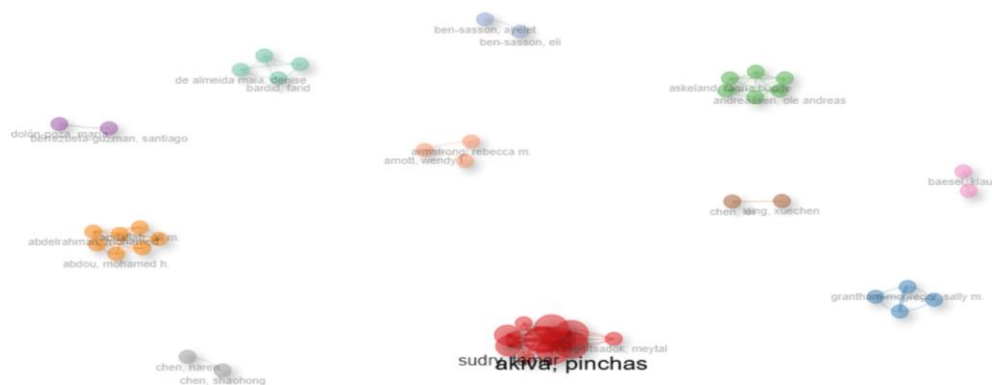


Figure 5: Author Collaboration Network.

3.3. Thematic Evolution

The motor themes quadrant represents the most developed and central topics in research on child development indicators within the context of childcare centers (Figure 6). Concepts such as developmental surveillance, developmental delay, and milestone achievement highlight a strong focus on early detection and progress monitoring. These themes represent a consolidated and mature research area that guides intervention strategies and developmental assessments in child psychology. Their high density and centrality indicate a solid theoretical and applied foundation.

The basic themes quadrant contains fundamental topics, such as developmental milestones, fine motor skills, and gross motor skills, which constitute the core elements upon which the study of developmental indicators is based. Their high importance but moderate density suggests that these concepts are widely referenced and essential to the field's structure. They represent the practical and measurable dimensions used to evaluate the motor

and cognitive growth of children in early education and care settings.

Regarding niche themes, these include the Denver Developmental Screening Test, the Bayley Scales, and learning algorithms, reflecting specialized but isolated research lines. These topics are methodologically robust, but their integration into broader research networks is limited. Their high density but low centrality suggests that while they advance technical or diagnostic precision, their influence remains confined to specific subfields of developmental assessment.

Finally, themes such as developmental language, preschool children, and child language are located in the emerging or declining quadrant, indicating fluctuating interest from researchers. These topics may be re-emerging due to the increasing recognition of language as a key developmental indicator or, conversely, may be losing prominence compared to motor and cognitive domains. Their position details an ongoing transformation, possibly influenced by new assessment approaches and interdisciplinary perspectives in child psychology.

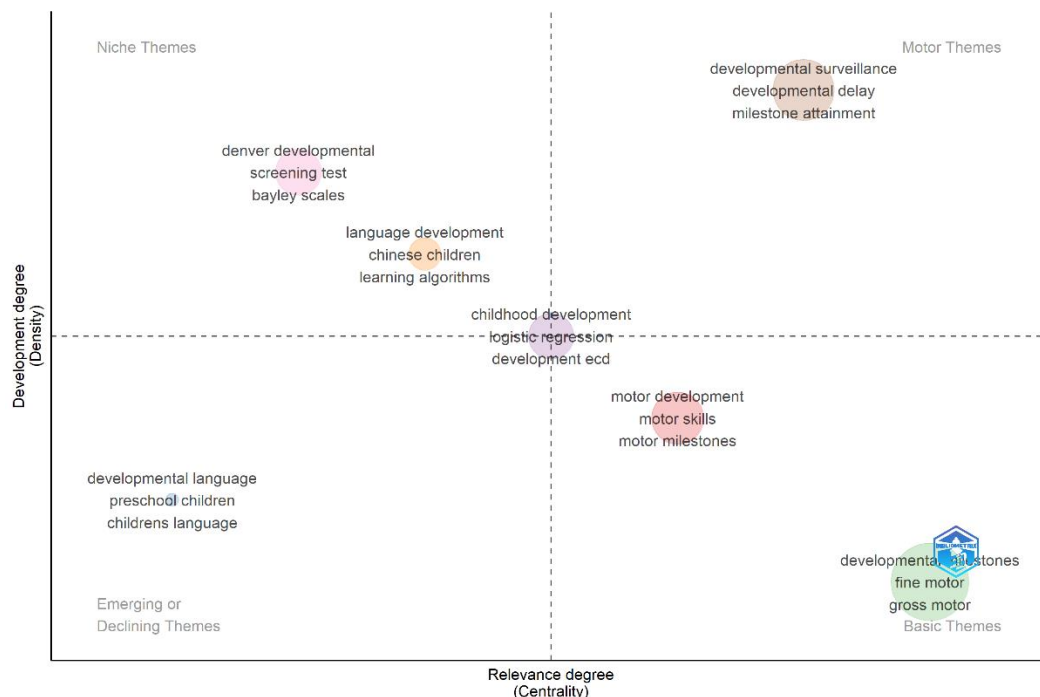


Figure 6: Thematic Map of Scientific Production.

4. DISCUSSION

The bibliometric results of this study reveal a modest but steadily growing body of literature on child development indicators from the perspective of child psychology within Child Development Centers

(CDCs) during the 2015–2025 period. The annual growth rate of 12.98% in publication output indicates a rising academic interest in this specialized field, while the relatively high average citation rate (13.9 per article) suggests that these works are, on average,

highly referenced. This upward trajectory aligns with broader bibliometric analyses of early childhood education and development research, such as the work of Çelik (2022), which found a substantial increase between 1976 and 2022. These findings emphasize that, despite being a specialized niche, the study of child development indicators within psychological and care center contexts is gaining momentum and visibility in the wider research ecosystem.

The mapping of keyword co-occurrence and author collaboration revealed a strongly interconnected core surrounding general terms related to development and measurement (e.g., "child," "developmental milestones," "questionnaire") and a dominant group of authors at its center, signifying a relatively consolidated research network focused on measurement and surveillance. Conversely, peripheral clusters address tool validation and specific domains (e.g., language or motor skills) but with lower centrality, indicating low integration. This pattern coincides with the findings of the study *Bibliometric Analysis of Psychomotricity Research Trends: The Current Role of Childhood*, which identified densely connected methodological clusters and less central content clusters in the field of psychomotricity indicators (Denche et al., 2022). Consequently, the field under study displays a similar structural network: a solid backbone of measurement and collaboration, with areas of specialization that remain marginal.

The thematic evolution indicates that central and well-developed topics include "developmental surveillance," "milestone achievement," and "early detection of delays," while fundamental themes, such as fine and gross motor skills, remain highly cited but less novel. Emerging or declining themes include language development and socio-emotional indicators. In this sense, the current field appears to be shifting from traditional motor-cognitive measurement toward more holistic and less explored domains, signaling a developing thematic agenda.

The theoretical and practical implications of these findings are manifold. Theoretically, the mapping of this literature reinforces the conceptualization of child development as a multidimensional process (cognitive, motor, social, linguistic) and underscores the need to ground measurement frameworks in psychological theory. In practice, evidence of international collaboration and author networks suggests that research in this field is moving toward a more robust and networked knowledge production. For CDCs, this presents an opportunity to adopt validated and standardized indicator

systems aligned with psychological science, thereby improving the capacity for evaluation, monitoring, and early intervention. Furthermore, center administrators can leverage these insights to design internal data systems, select appropriate tools, and engage in comparative benchmarking of empirical research.

Nevertheless, this study presents several limitations that should moderate its interpretation. First, the search was limited to the Scopus and Web of Science databases, which may have excluded relevant publications indexed only in regional or non-English databases (linguistic bias). Second, the keyword equation emphasized terms such as "child care center" and "child development indicators," which may have led to the omission of articles using alternative terminology (coverage bias). Third, the inclusion criteria focused on articles explicitly related to CDCs for children aged 1 to 3, which may have excluded studies in adjacent settings that utilize developmental indicators but do not explicitly mention the term "center." Finally, bibliometric techniques capture the quantity and structure of the network rather than the depth of content; therefore, the qualitative aspects of instrument validity and cultural adaptation are not addressed in this study.

5. CONCLUSIONS

This bibliometric analysis revealed steady scientific growth in research regarding child development indicators from the perspective of child psychology in CDCs over the last decade. The results highlighted a consistent annual growth rate characterized by high international collaboration and a strong concentration of publications across specific affiliations, countries, and multidisciplinary journals. Furthermore, mapping analyses identified a cohesive research core centered on developmental monitoring, milestone achievement, and early detection of delays, supported by robust institutional and international networks, demonstrating the progressive consolidation of this scientific field.

These findings provide a comprehensive overview of the intellectual structure, productivity, and thematic evolution of this research area, contributing to a better understanding of how psychological frameworks guide the assessment of child development in scientific research. The integration of global collaborations underscores the international commitment to improving measurement systems and standardizing developmental indicators. This study enriches the empirical basis of developmental psychology, offering valuable insights for scholars, policymakers,

and practitioners focused on optimizing early childhood assessment and intervention strategies.

Future studies should expand the bibliometric scope by incorporating additional databases to capture broader scientific contributions. Additionally, it is recommended to conduct qualitative and mixed-methods analyses to deepen the understanding of psychometric properties,

cultural adaptability, and the practical applicability of developmental indicators. Continued investigation into emerging topics, such as socio-emotional and linguistic indicators, will be essential to move toward a more holistic, interdisciplinary, and contextualized approach to early childhood developmental assessment.

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