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The Effects of Social Risk Conditions on Pediatric Type 1 Diabetes in Terms of Bibliometric Analysis

ABSTRACT

Objective: This study aims to deeply investigate the literature about effects of deprivation, poverty, inequality, low socioeconomic conditions, and vulnerability factors on pediatric type 1 diabetes using bibliometric analysis methods.

Method: The Web of Science database was searched using keywords. The titles and abstracts of the obtained publications were reviewed by a pediatric endocrinologist regarding their relevance to the intended subject and subjected to a second screening. Performance, co-citation, and co-occurrence analyses were applied to the publications that passed the screening. The analyses used R-based Bibliometrix software, Python, and Microsoft Excel.

Results: Initially, 469 articles were obtained, and after screening, 284 articles were found relevant to the researched subject. The co-citation analysis resulted in three main themes: (1) Management and Clinical Outcomes of Type 1 Diabetes, (2) Deprivation and Socioeconomic Determinants Related to Type 1 Diabetes, and (3) Cumulative Effects of Socioeconomic and Cultural Factors on the Management and Outcomes of Type 1 Diabetes. Following the co-occurrence analyses, thematic areas such as "Diabetes in Children/Adolescent Populations," "Epidemiological Dimensions of Diabetes," "Diabetes and Quality of Life," "Technological and Insured Solutions Related to Diabetes," "Pediatric Health and Diabetes," "Insulin Application and Glucose Monitoring Strategies," and "The Role of Health Policies in Diabetes Management" were identified.

Conclusions: These findings highlight health policymakers' need to develop more effective and inclusive strategies for socio-economically disadvantaged groups. Moreover, this study provides important data to explore how much emphasis researchers have placed on social determinants of health. This might serve as a basis for understanding how diabetes management and outcomes interact with socioeconomic and cultural factors. Thus, it will also serve as a foundation for awareness and method development at the healthcare provider level.

Keywords: Diabetes, Pediatrics, Social, Deprivation, Disparity, Poverty, Bibliometrics.

Bibliyometrik Analiz Açısından Sosyal Risk Koşullarının Pediatrik Tip 1 Diyabet Üzerine Etkileri

ÖZET

Amaç: Bu çalışma, yoksunluk, yoksulluk, eşitsizlik, düşük sosyo-ekonomik koşullar ve incinebilirlik faktörlerinin Pediatrik Tip 1 diyabet üzerindeki etkilerini bibliyometrik analiz yöntemleri ile derinlemesine incelemeyi amaçlamaktadır.

Yöntem: Web of Science veri tabanı anahtar sözcükler kullanılarak taranmıştır. Elde edilen yayınların başlıkları ve özetleri amaçlanan konuyla ilişkisi açısından çocuk endokrinolojisi uzmanı tarafından gözden geçirilerek ikinci bir elemeye tabi tutulmuştur. Elemeden geçen yayınlar üzerinden performans analizleri, co-citation, co-occurrence analizleri uygulanmıştır. Analizler, R tabanlı Bibliometrix yazılımı, Python ve Microsoft Excel kullanılarak yapılmıştır.

Bulgular: İlk taramada 469 sayıda makale elde edilmiş, elemeden sonra 284 makale araştırılan konuyla ilişkili bulunmuştur. Ortak atıf analizinin sonucunda üç ana temaya ulaşılmıştır: (1) Tip 1 Diyabet Yönetimi ve Klinik Sonuçlar, (2) Tip 1 Diyabetle İlgili Yoksunluk ve Sosyo-Ekonomik Determinantlar ve (3) Sosyo-Ekonomik ve Kültürel Faktörlerin Tip 1 Diyabet Yönetimi ve Sonuçları Üzerine Kümülatif Etkileri. Co-Occurrence analizlerinin ardından, "Diyabet ve Çocuk/Ergen Popülasyonları," "Diyabetin Epidemiyolojik Boyutları," "Diyabet ve Yaşam Kalitesi," "Diyabetle İlgili Teknolojik ve Sigortalı Çözümler," "Pediyatrik Sağlık ve Diyabet," "İnsülin Uygulama ve Glukoz Monitörleme Stratejileri" ve "Diyabet Yönetiminde Sağlık Politikalarının Rolü" gibi tematik alanlar belirlenmiştir.

Sonuç: Bu bulgular, sağlık politika yapıcılar için, özellikle sosyo-ekonomik dezavantajlı gruplara yönelik daha etkin ve kapsayıcı stratejiler geliştirilmesi gerekliliğini ortaya koymaktadır. Ayrıca, bu çalışma, diyabet yönetimi ve sonuçlarının sosyo-ekonomik ve kültürel faktörlerle nasıl etkileşime girdiğini anlamada önemli bir temel oluşturmaktadır. Bu nedenle sağlık hizmetini verenler düzeyinde de farkındalık ve yöntem geliştirme açısından dayanak oluşturacaktır.

Anahtar Kelimeler: Diyabet, Pediatri, Sosyal, Yoksunluk, Eşitsizlik, Yoksulluk, Düşük Bibliyometri.

INTRODUCTION

According to the Diabetes Atlas 2021 data, 537 million adults aged 20-79 live with diabetes, accounting for 1 in 10 adults. This number is projected to increase to 643 million by 2030 and 783 million by 2045. More than three-quarters of adults with diabetes reside in low- and middle-income countries. In 2021, diabetes was responsible for 6.7 million deaths, equating to one death every 5 seconds, and caused a minimum of USD 966 billion in health expenditure, marking a 316% increase over the past 15 years. Furthermore, Type 1 diabetes affects over 1 million children aged 0-18 years (1-3). 1.52 million of the 8.75 million people living with type 1 diabetes around the world in 2022 are less than 20 years old (1). Effective management of diabetes reflects long-term health outcomes at a societal level. However, the management and outcomes of diabetes are closely linked not only to biological factors but also to socioeconomic and cultural factors. These factors can significantly influence the challenges and outcomes faced in diabetes management (4).

Socioeconomic factors in diabetes management play a crucial role in patients' access to treatment, adherence to treatment, and overall outcomes (5). For example, individuals with low socioeconomic status may have less access to insulin treatment options and technological support, leading to increased HbA1c levels as well as diabetes complications.

Similarly, cultural factors can also impact diabetes management. Ethnic background, cultural beliefs, and traditions can influence diabetes treatment and dietary habits (6-7). Therefore, cultural sensitivity and patient education are very important in diabetes management.

Deprivation, Poverty, Inequality, Low Socioeconomic Conditions, and Vulnerability (DPLSEV) factors deeply affect the management and outcomes of Type 1 diabetes. Particularly, individuals with low socioeconomic status may struggle due to limited access to appropriate treatment and technology, leading to increased HbA1c levels and difficulties in managing diabetes complications. Additionally, these factors can exacerbate inequalities associated with diabetes, especially among different ethnic and racial groups. Poverty and low socioeconomic conditions have a definitive impact on long-term health outcomes, further complicating the long-term management of diabetes. Consequently, understanding and addressing inequalities in access to treatment and outcomes highlighted by DPLSEV factors is imperative.

This study aims to thoroughly investigate the literature related to the effects of DPLSEV factors on Type 1 diabetes using bibliometric analysis methods.

1. Who are the most prolific authors, most cited journals, institutions, countries, and trending topics in the DPLSEV field? What are the most cited articles?

2. What are the critical classic studies in the DPLSEV field? What dynamics are involved in the evolution of the field's intellectual structure?

3. Can the conceptual structure of the DPLSEV field be determined?

Bibliometric analysis is a valuable tool for deeply understanding high-volume data, revealing connections between publications in a field, discovering new research directions and building a robust foundation for the field. These analyses are particularly helpful in identifying current gaps in a field and developing new concepts. In academic circles, they are frequently used to evaluate article and journal performances, define collaboration networks, and detect trends in a field (8).

This research contributes to the literature in two main ways. Firstly, the inaugural study focuses on Type 1 Diabetes from a DPLSEV perspective. Secondly, through bibliometric and thematic analysis, we have provided valuable insights into the themes of co-citation analysis and co-occurrence of keyword analysis in the DPLSEV field. This aids in identifying research questions that will guide future studies. Additionally, we have generated numerous future research questions within both analyses.

MATERIAL AND METHODS

This study chose the Web of Science (WoS) database for bibliometric analysis. Scientists often prefer WoS for its detailed records; data sets suitable for bibliometric analysis, and the indexing of prestigious publications. Additionally, this database is one of the most frequently utilized sources for bibliometric analysis (9-10). WoS has a comprehensive collection that includes bibliographic lists, citation networks, and an array of full-text articles. Figure 1 illustrates the complete workflow of the analysis conducted.

On October 1, 2023, a search was conducted in the Web of Science (WoS) database for publications related to the effects of social conditions on childhood Type 1 Diabetes using 29 search terms as topics. Subsequently, only English-language articles were selected from the resulting dataset. Publication types such as Correction, Addition or Art Exhibit Review, Retraction, Retracted Publication, Biographical-Item, Note, Bibliography, Reprint, Data Paper, Book, News Item, Book Review, Letter, Book Chapters, Meeting Abstract, Proceeding Paper, and Editorial Material were excluded, ensuring that only articles, reviews, and early access publications were included. In the next phase, raw data were refined to include only articles containing the terms "Type 1 Diabetes" or "Diabetes Mellitus Type 1", and in the final stage, only the Pediatric patient group was selected.
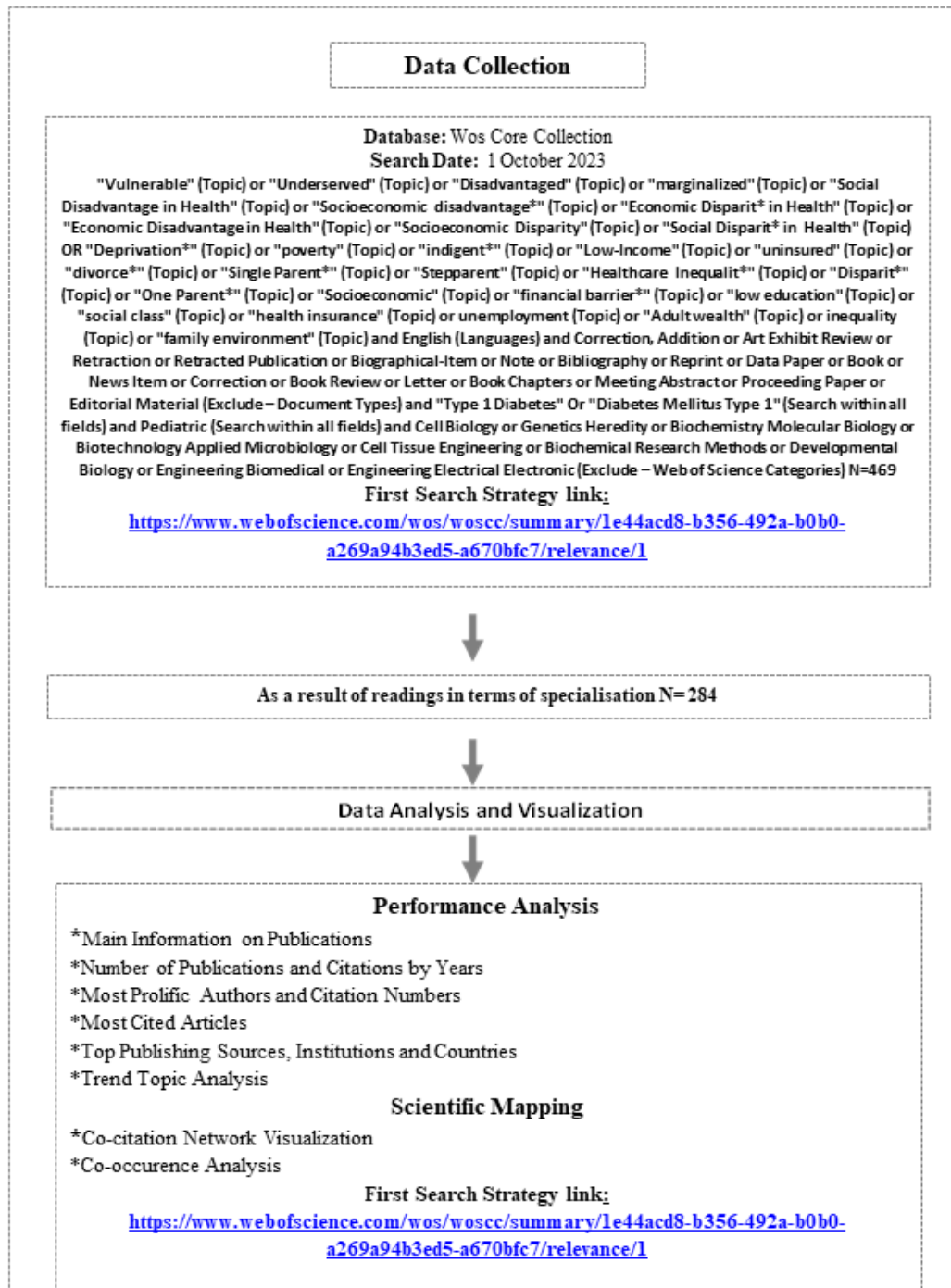
Data Collection

Database: Wos Core Collection
Search Date: 1 October 2023
"Vulnerable" (Topic) or "Underserved" (Topic) or "Disadvantaged" (Topic) or "marginalized" (Topic) or "Social Disadvantage in Health" (Topic) or "Socioeconomic disadvantage*" (Topic) or "Economic Disparit* in Health" (Topic) or "Economic Disadvantage in Health" (Topic) or "Socioeconomic Disparity" (Topic) or "Social Disparit* in Health" (Topic) OR "Deprivation*" (Topic) or "poverty" (Topic) or "indigent*" (Topic) or "Low-Income" (Topic) or "uninsured" (Topic) or "divorce*" (Topic) or "Single Parent*" (Topic) or "Stepparent" (Topic) or "Healthcare Inequalit*" (Topic) or "Disparit*" (Topic) or "One Parent*" (Topic) or "Socioeconomic" (Topic) or "financial barrier*" (Topic) or "low education" (Topic) or "social class" (Topic) or "health insurance" (Topic) or unemployment (Topic) or "Adult wealth" (Topic) or inequality (Topic) or "family environment" (Topic) and English (Languages) and Correction, Addition or Art Exhibit Review or Retraction or Retracted Publication or Biographical-Item or Note or Bibliography or Reprint or Data Paper or Book or News Item or Correction or Book Review or Letter or Book Chapters or Meeting Abstract or Proceeding Paper or Editorial Material (Exclude – Document Types) and "Type 1 Diabetes" Or "Diabetes Mellitus Type 1" (Search within all fields) and Pediatric (Search within all fields) and Cell Biology or Genetics Heredity or Biochemistry Molecular Biology or Biotechnology Applied Microbiology or Cell Tissue Engineering or Biochemical Research Methods or Developmental Biology or Engineering Biomedical or Engineering Electrical Electronic (Exclude – Web of Science Categories) N=469
First Search Strategy link:
https://www.webofscience.com/wos/woscc/summary/1e44acd8-b356-492a-b0b0-a269a94b3ed5-a670bfc7/relevance/1

As a result of readings in terms of specialisation N= 284

Data Analysis and Visualization

Performance Analysis
*Main Information on Publications
*Number of Publications and Citations by Years
*Most Prolific Authors and Citation Numbers
*Most Cited Articles
*Top Publishing Sources, Institutions and Countries
*Trend Topic Analysis
Scientific Mapping
*Co-citation Network Visualization
*Co-occurence Analysis
First Search Strategy link:
https://www.webofscience.com/wos/woscc/summary/1e44acd8-b356-492a-b0b0-a269a94b3ed5-a670bfc7/relevance/1

Figure 1. Flowchart of Data Collection, Data Analysis, and Data Visualization

Nevertheless, data from disciplines such as "Cell Biology, Genetics Heredity, Biochemistry Molecular Biology, Biotechnology Applied Microbiology, Cell Tissue Engineering, Biochemical Research Methods, Developmental Biology, Engineering Biomedical, Engineering Electrical Electronic" were excluded. This refinement process resulted in a dataset of 469 articles. In the second phase, abstracts, where two experts read the necessary full texts of these 469 articles to exclude those not covering social risk conditions, prepare the data for bibliometric analysis.

Visual mapping analyses were conducted on the final set of 284 publications using R-based, open-source Bibliometrix software (11-14). A performance analysis, including basic statistics, authors, publication numbers, journals, institutions, and countries, was initially conducted. Subsequently, a scientific map was created, encompassing co-citation networks, co-occurrence, and co-author analyses. The analysis was conducted without word consolidation. In the final stage, article abstracts and titles were scanned to determine the themes addressed by each health accreditation organization.

RESULTS

The findings section comprises performance analyses and scientific mapping analyses. Performance Analyses include key information, publication and citation counts by year, top publishing institutions, journals, and countries, corresponding author analysis, and the top ten most-cited articles.

Timespan	Sources	Documents	Annual Growth Rate
2001:2023	94	284	13.1 %

Authors	Authors of single-authored docs	International Co-Authorship	Co-Authors per Doc
1516	4	17.96 %	7.03

Author's Keywords (DE)	References	Document Average Age	Average citations per doc
534	7078	5.65	18.61

Figure 2. Main Information

Figure 2 summarizes scientific studies conducted between 2001 and 2023 on conditions affecting Type 1 diabetes. Initially, we observed 284 documents on this topic from 94 different sources. The annual growth rate reflecting the dynamic developments in the health sector and increasing interest is 13,1%. Additionally, the average age of the documents is 5.65 years, with an average of 18.61 citations per document, indicating a significant impact in the field. Keywords are also a crucial source of information. 'Keywords Plus (ID)' and 'Author's Keywords (DE)' are 580 and 534, respectively. This can give an idea of which researchers emphasize topics and which aspects of the research draw more attention. The number of authors is quite high, suggesting that the research topic might require a multidisciplinary approach (15-16). Only four authors have written single-authored articles, reflecting the complexity of the subject and the need for multidisciplinary collaboration. The average co-author number per document is 7.03, and the rate of international collaboration is 17.96%, indicating global interest and collaboration among experts from different countries.

Most document types are research articles ('article' 260 and 'article; early access' 4). Additionally, 20 review articles ('review') might indicate a need for an overview or synthesis in the field. In conclusion, the number and impact of research on conditions affecting Type 1 diabetes have increased over the years. This increase reflects the complexity and importance of the subject, as well as the need for a multidisciplinary and international approach.
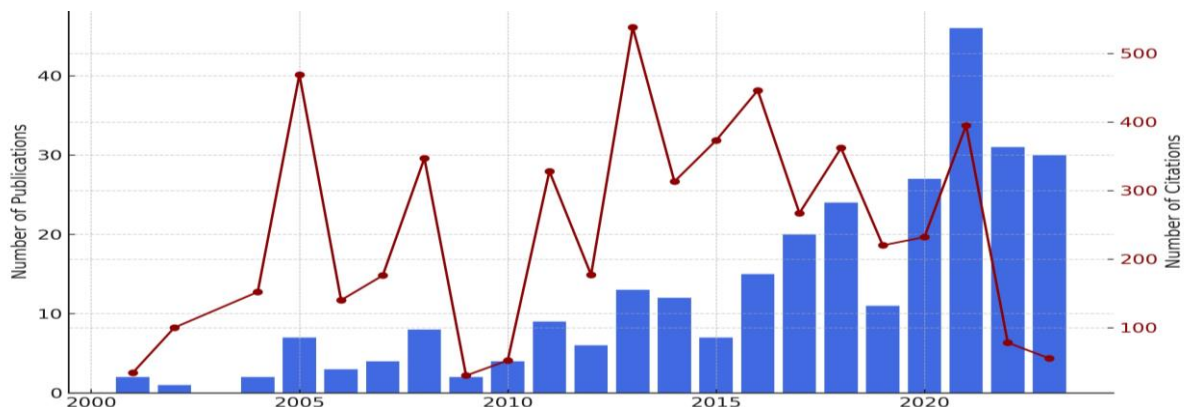

Figure 3. Publication and Citation Counts by Year

Publication and Citation Counts by Year: Analyzing the changes in publication and citation counts over the years reveals several key observations. Firstly, there is a general upward trend in the number of publications, with the most significant increase occurring in 2021 with 46 publications. However, it is noteworthy that there has been a slight decline in 2022 and 2023. This may indicate that while there is a general rise in research activities and academic interest in the field over time, this increase might not be sustainable. Secondly, total citation counts vary by year. Particularly, 2005 and 2013 stand out with higher citation counts than other years.

Conversely, despite increased publication numbers in 2021, 2022, and 2023, the citation counts have remained relatively low. This might suggest that the studies conducted in these years have not yet achieved a wide citation range or sufficient recognition. Finally, there is no automatic correlation between high publication and citation counts. For instance, despite a high number of

publications in 2021, the citation count relative to this number remains relatively low. Additionally, it should be considered that new publications often experience a "lag effect." New studies may take some time to receive citations, so the low citation counts observed in recent years could increase.
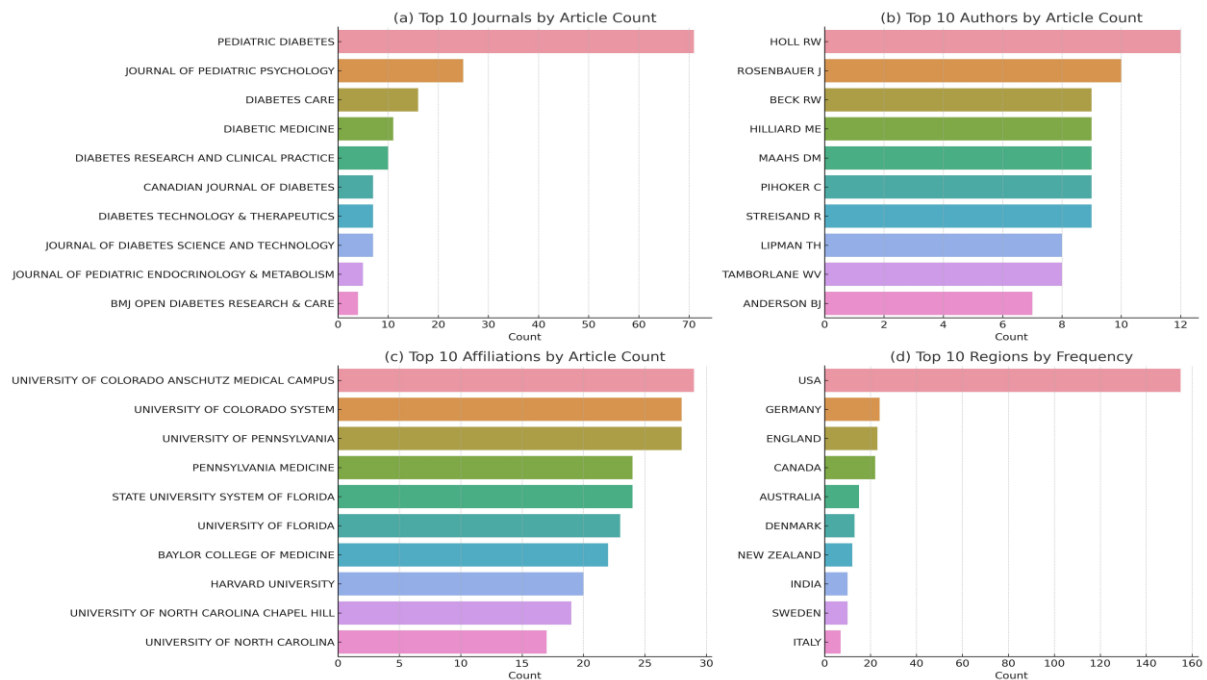

Figure 4. Top Publishing Journals, Institutions, Authors, and Countries

Top Publishing Journals, Institutions, Authors, and Countries:

(a) Top 10 Journals with the Most Articles: "Pediatric Diabetes" journal, with 71 articles, holds a dominant position in the field. This indicates that the journal is one of the primary sources in this area of research. The significant gap between this journal and others highlights its importance as a preferred publication medium for researchers in the field.

(b) Top 10 Authors with the Most Articles: "Holl RW" leads with 25 articles. However, the close number of articles among different authors suggests that various contributors actively participate in this field. This scenario underscores the importance of research diversity and varying perspectives.

(c) Top 10 Institutions with the Most Articles: "The University of Colorado Anschutz Medical Campus," with 29 articles, plays a significant role in the sector. However, institutions like the "University of Colorado System" and the "University of Pennsylvania" are notable contributors. This indicates that certain institutions do not monopolize research in this area, but various entities contribute substantially.

(d) Top Publishing Country: The United States, with a frequency of 155, is in a dominant position on a global scale. Germany follows with a frequency of 24. The high frequency for the US indicates its leadership in research in this field. However, significant contributions are also evident from Germany and the United Kingdom.
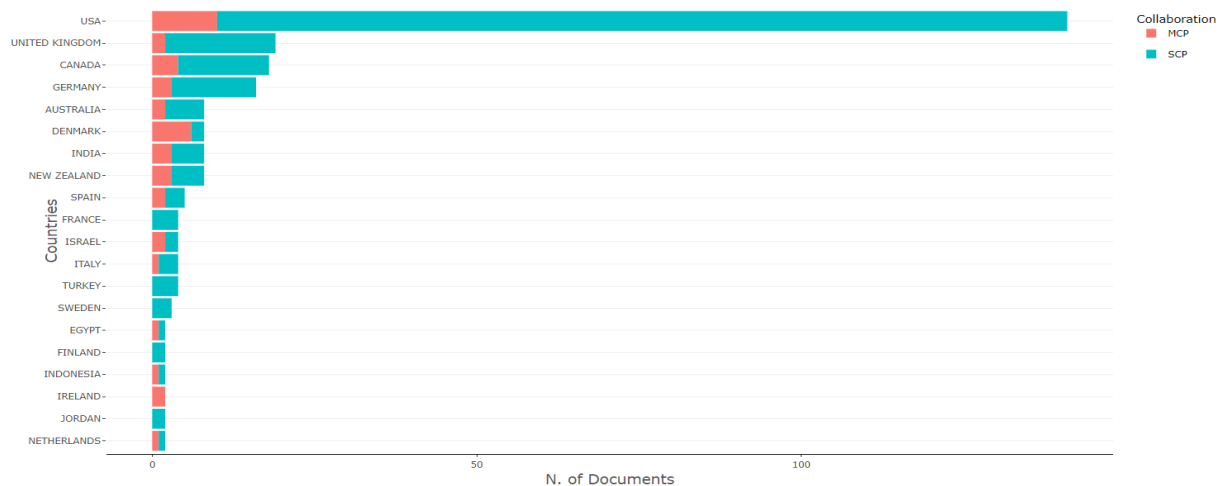

Figure 5. Corresponding Author Analysis

Based on the Multiple Country Publications (MCP) ratio according to the graph: Ireland (100%): All articles from Ireland are written in collaboration with multiple countries. This indicates that Ireland is highly active in international collaborations. Denmark (75%): 75% of Denmark's total publications are written with international cooperation. This high percentage signifies Denmark's active participation in international collaborations. Israel (50%), Egypt (50%), Indonesia (50%), Netherlands (50%), and Switzerland (50%): Half of the articles from these countries are written in collaboration with international partners. This shows significant progress in international cooperation from these countries. New Zealand (37.5%), India (37.5%), and Spain (40%): These countries have an MCP rate above 35%, indicating their commitment to international collaboration, though slightly less active compared to the countries mentioned above. Ireland's 100% rate is particularly noteworthy, highlighting its strong emphasis on international collaboration. However, a high MCP rate does not necessarily mean these countries are superior in scientific fields; it merely indicates their tendency to engage in international collaborations. In summary, countries with an MCP rate of over 50% (Ireland, Denmark, Israel, Egypt, Indonesia, Netherlands, and Switzerland) have made significant strides in international collaboration. This underscores their commitment to valuing and actively participating in global scientific research collaborations.
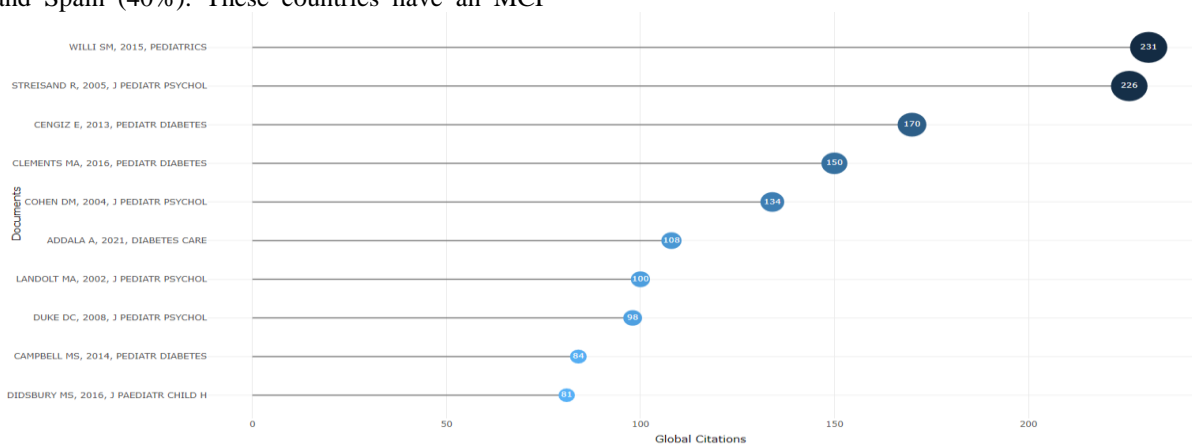
Figure 6. Top 10 Most Cited Studies

The management of Type 1 diabetes and its significant relationships with socioeconomic conditions have been the focus of these studies. Here are the summaries of these articles expressed in a more comprehensible manner:

- Willi et al. (2) examined the effects of racial and ethnic differences among pediatric patients with Type 1 diabetes. Findings indicate that these differences impact critical health outcomes such as access to insulin treatment options, glycemic control, and management of complications.

- Streisand et.al (15) explored the stress experienced by parents of children with Type 1 diabetes. Their study examined the effects of parental stress on children's health outcomes, showing that this stress varies depending on various factors.

- Cengiz and colleagues (16) investigated the frequency of severe hypoglycemia and diabetic ketoacidosis among adolescents with Type 1 diabetes. Findings revealed a correlation between these complications and factors such as ethnicity, economic status, and age.

- Clements et al. (17) studied the changes in Hemoglobin A1c (HbA1c) levels over time in adolescents with Type 1 diabetes. The study showed that glycemic control varies according to age, race/ethnicity, and economic status.

- Cohen et. al (18) found that children from families with low socioeconomic status face challenges in diabetes management and glycemic control, and these challenges are related to family functionality.

- Addala et al. (19) researched the relationship between the socioeconomic status of diabetes patients in the USA and Germany, their use of technology, and HbA1c levels. Their findings indicate that individuals with lower socioeconomic status have lower technology usage and higher HbA1c levels.

- Landolt et. al (20) examined the effects of post-traumatic stress disorder on the mothers and fathers of children newly diagnosed with Type 1 diabetes, showing that these children's parents are psychologically affected.

- Duke et al. (21) conducted a study investigating glycemic control in adolescents with Type 1 diabetes from low socioeconomic families. Their research aimed to assess the predicted and mediating relationships between perceived parental attitudes, CBCL (Child Behavior Checklist Externalizing Subscale) externalizing problem scores, adaptation, and HbA1c levels.

They concluded that adaptation partially mediates between critical parental attitude and HbA1c levels and that critical parental attitude and adaptation mediate between CBCL externalizing problem scores and HbA1c levels. However, CBCL externalizing problem scores did not directly mediate between critical parental attitude and HbA1c. This research contributes to understanding glycemic control in adolescents with Type 1 diabetes in low socioeconomic families. The finding that deprivation and socioeconomic conditions can affect adolescents' diabetes management and health outcomes is significant.

- Campbell et al. (22) compared pediatric Type 1 diabetes management in groups with excellent and poor glycemic control and explained how these differences relate to socioeconomic factors.
- Didsbury and team (23) investigated how the quality of life of children with chronic diseases is affected by socioeconomic factors, finding that children from lower socioeconomic backgrounds have a lower quality of life (23).

An attributive evaluation based on the summaries of these ten authors helps assess the relationship between Type 1 diabetes and deprivation (deficiencies caused by socioeconomic conditions). The studies shed light on the complex links between the treatment and management of Type 1 diabetes and socioeconomic factors, particularly highlighting the following:

- Access Issues: Individuals with lower socioeconomic status may have less access to insulin treatment options and technological support. Addala et al. (19) show that this lack can raise HbA1c levels. Deprivation could be a primary reason for these access issues.
- Stress and Psychological Effects: Streisand and team's (15) study indicates that the stress experienced by parents of children with Type 1 diabetes can negatively impact children's health outcomes. Family economic hardships might be a source of this stress.
- Management of Complications: Campbell et al. (22) compared groups with excellent and poor glycemic control, addressing the impact of socioeconomic factors on glycemic control. Individuals with lower socioeconomic status are likely to face more complications due to poor glycemic control.
- Quality of Life: Didsbury et al. (23) found that children from lower socioeconomic backgrounds have a lower quality of life. The management and treatment of Type 1 diabetes, when combined with deprivation, can further negatively impact quality of life.

Together, these studies indicate that deprivation can lead to adverse effects on the lives of individuals with Type 1 diabetes, and these effects reflect on health outcomes. Ensuring greater support and resource access for individuals with lower socioeconomic status could be crucial for diabetes management and health outcomes. Therefore, health policies and interventions should aim to reduce socioeconomic inequalities and assist individuals with Type 1 diabetes in achieving a better quality of life.

Scientific Mapping: In this section, co-citation and co-occurrence analyses have been conducted. Utilizing the prominent color clusters, each color has been named, and topics related to accreditation organizations in health services have been explored in terms of the intellectual structure, conceptual framework, and collaboration patterns of articles working on accreditation.

Co-citation Analyses

Red Cluster: Under the theme of "Type 1 Diabetes Management and Outcomes," various sub-themes can gain different meanings in the context of socioeconomic variables and deprivation. The impact of diabetes technology, especially considering its high cost, maybe more accessible for pediatric patients with better economic status (20). This situation could create significant differences in treatment and outcomes for children from economically disadvantaged families.

Insulin pump therapy is also typically a high-cost method (24-25). This can pose a significant access barrier for socio-economically disadvantaged groups. Similarly, continuous glucose monitoring systems can be expensive, limiting accessibility in deprived communities (26).

In the context of the relationship between COVID-19 and diabetes, socioeconomic factors and deprivation can also be decisive in hospitalization and mortality rates (27). Particularly, individuals living in high-risk areas with low income might face challenges in accessing healthcare services. Changes in HbA1c among young participants could also vary depending on the quality of education and social support systems, often less accessible in poor communities (17). Themes like social determinants and diabetes, psychological care, and ISPAD guidelines can further deepen pre-existing socioeconomic inequalities. For example, the lack or poor quality of psychological support can negatively affect diabetes management in individuals with low socioeconomic status (28,29).

In conclusion, when considering socioeconomic variables and deprivation under the theme of "Type 1 Diabetes Management and Outcomes," significant inequalities can arise between different groups. Accessibility, effectiveness, and quality can vary depending on socioeconomic status, necessitating health policies and practices to consider these factors.
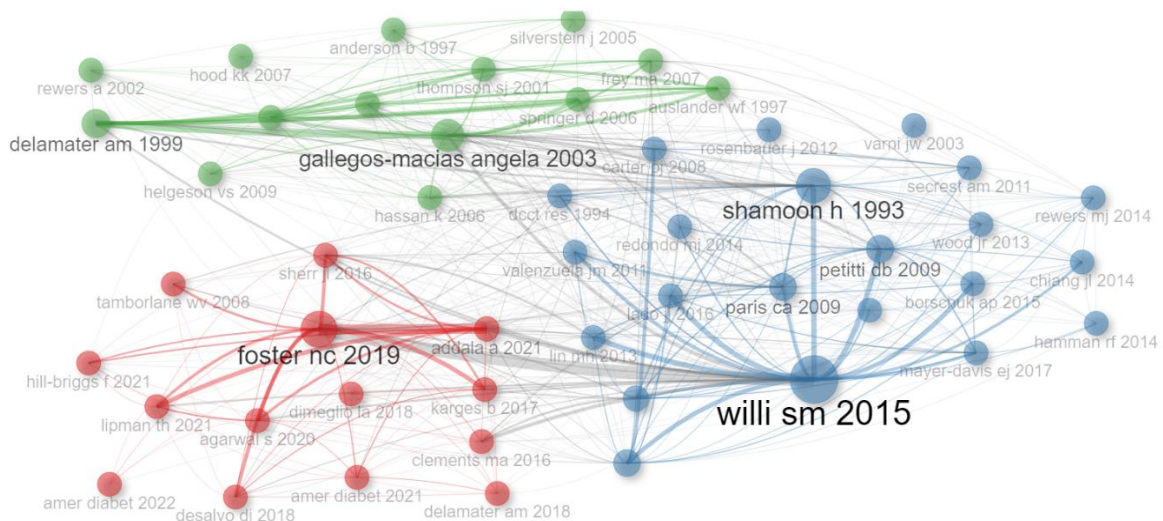
Figure 7. Co-citation Analysis

Green Cluster: "Type 1 Diabetes, Deprivation, and Socioeconomic Determinants" theme offers a multi-layered perspective on socioeconomic variables and deprivation. Studies examining the relationships between ethnic identity and glycemic control highlight the influence of socioeconomic factors and cultural elements on diabetes management (30,31). Economic and social disparities among ethnic groups can be decisive for glycemic control, necessitating interventions in areas where these groups are deprived.

Studies on socioeconomic status and diabetes management particularly show that factors like depression and quality of life are linked to economic status (32,33). A lower socioeconomic status can lead to higher rates of depression and, consequently, poorer levels of glycemic control.

Research on family involvement and diabetes management also reveals how family structure and dynamics, combined with socioeconomic status, affect diabetes management in children and adolescents (6,7). For instance, in low-income families, children's diabetes management might suffer due to the working hours of family members or lack of education.

Long-term prediction of metabolic control and family structure indicate that deprivation and socioeconomic factors can also be decisive for long-term health outcomes (34-36). For example, single-parent families may face more economic burdens, potentially leading to challenges in managing children's diabetes.

Blue Cluster: "The Effects of Socioeconomic and Cultural Factors on the Management and Outcomes of Type 1 Diabetes": Type 1 diabetes is a chronic condition requiring lifelong commitment to treatment and management. However, during this challenging process, patients and healthcare providers grapple with biological, socioeconomic, and cultural factors. This section addresses the overarching theme, "The Effects of

Socioeconomic and Cultural Factors on the Management and Outcomes of Type 1 Diabetes," encompassing sub-themes such as ethnic and racial factors, socioeconomic status, access to treatment, health policies, quality of life, and psycho-social factors.

The Role of Ethnic and Racial Factors: Ethnic and racial factors significantly manage type 1 diabetes. Studies by Willi et al. (2) and Lado et al. (3) demonstrate varying dynamics in the treatment and outcomes of diabetes among different ethnic and racial groups. These interactions highlight the need for health policies to be specific to ethnic and racial groups.

The Impact of Socioeconomic Status: Socioeconomic status significantly affects diabetes treatment and the management of complications. Research by Lin et al. (5) indicates that lower socioeconomic status limits access to technological treatment methods.

Access to Treatment and Health Policies: Socioeconomic status directly impacts access to treatment. Chiang et al. (37) noted that socioeconomic factors shape health policies. Policies such as financial support or payment plans must be developed for lower socioeconomic groups.

Quality of Life and Psycho-Social Factors: Finally, as highlighted by Varni et al. (38) deprivation and low socioeconomic status adversely affect the psychological well-being of patients and their families, reducing treatment adherence and quality of life.

Co-Occurrence Analysis: Co-occurrence analyses are a powerful tool for exploring themes within data and potential explanations regarding deficiencies and deprivation in socioeconomic conditions related to type 1 diabetes.

- Red Cluster (Cluster 1) - Adolescent Diabetes and Epidemiology: Keywords include adolescent, diabetes mellitus, child, type 1, and

epidemiology. This cluster focuses on the epidemiological aspects of type 1 diabetes in "adolescents" and "children." The term "epidemiology" emphasizes the prevalence and distribution of diabetes in these age groups. In terms of social risk factors, poverty, and low socioeconomic status may significantly impact the management and diagnosis of diabetes among adolescents and children. This cluster examines how the young population copes with diabetes and the role of social factors in this process.

- Purple Cluster (Cluster 2) - Childhood Diabetes Management and Quality of Life: Keywords include diabetes, children, adolescents, type 1 diabetes mellitus, and glycemic control. This cluster brings together "children" and "adolescents" with "type 1 diabetes mellitus" and "glycemic control." The theme addresses the impacts of diabetes on children and adolescents and its reflections on quality of life. Within social risk factors, disparities in access to healthcare services and economic difficulties are highlighted in their effects on diabetes management and glycemic control.

- Green Cluster (Cluster 3) - Access to Healthcare Services and Diabetes Technology: Keywords include pediatric type 1 diabetes and diabetes technology. This cluster contains "pediatric type 1 diabetes" and "diabetes technology." The theme focuses on access to health services for children with type 1 diabetes and technologies used in diabetes management. Regarding social risk factors, how poverty and low socioeconomic status affect access to these technologies and inequalities in health services are addressed.

- Blue Cluster (Cluster 4) - Socioeconomic Status and Health Disparities: Keywords are type 1 diabetes, socioeconomic status, ethnicity, and health disparities. This cluster includes terms like "type 1 diabetes," "socioeconomic status," "ethnicity," and "health disparities." The theme explores the relationship between diabetes and socioeconomic and ethnic factors. In terms of social risk factors, the effects of poverty, deprivation, and disparities on diabetes prevalence and management are discussed, especially in the context of inequalities in access to health services.

- Orange and Brown Clusters (Clusters 5 and 6) - Technology and Treatment Methods in Diabetes Treatment: The keywords are insulin pump, continuous glucose monitoring, and insulin. These clusters include technological tools used in diabetes treatment, such as "insulin pumps," "continuous glucose monitoring," and "insulin." The theme focuses on using these technologies and their role in diabetes treatment. From a social risk factor perspective, inequalities in access to these technologies and economic barriers are significant issues, particularly for individuals with low socioeconomic status accessing these treatment methods.

These analyses shed light on the relationship between type 1 diabetes and social risk factors in greater detail, emphasizing the importance of more in-depth research.
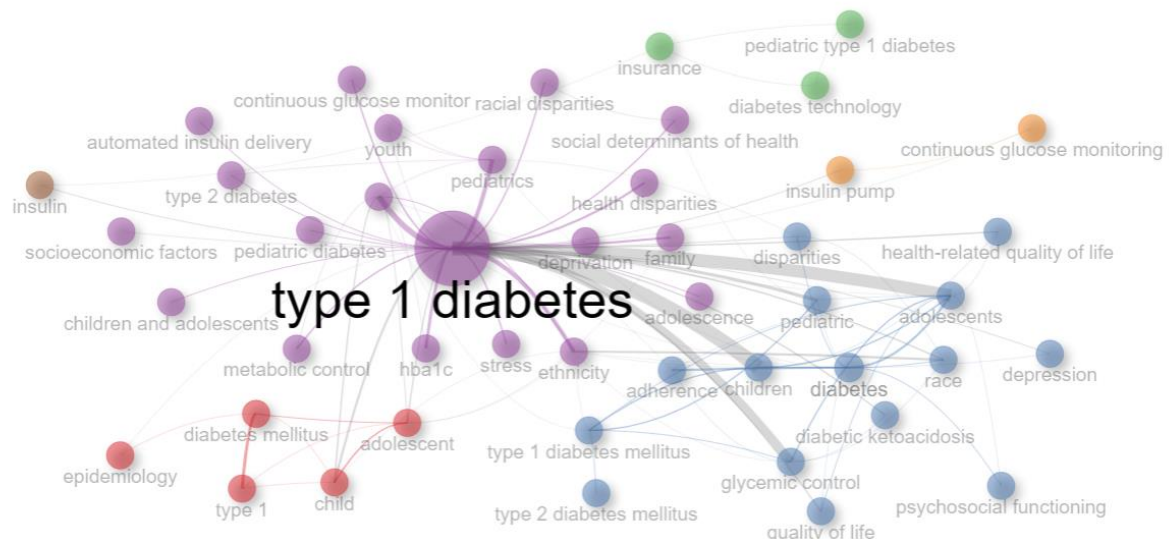

Figure 8. Co-Occurrence Network Analysis (Author Keywords)

DISCUSSION

Type 1 diabetes is a common chronic illness in pediatrics, and a multitude of social risk factors influence its management. Social determinants like poverty and low socioeconomic conditions particularly complicate pediatric diabetes management and the course of the disease. Intertwined with inequalities in access to health services, these effects further complicate diabetes management (4). This study posed the question

whether these facts are reflected considerably throughout the scientific publications. The assumption that the impacts of socioeconomic factors and exposure to social risks on type 1 diabetes management, identifying the significant role social risks play in treatment access and continuity, alongside other factors influencing the disease process was behind this question. The discussion section is subdivided into a general introduction, assessments specifically related to two bibliometric analyses (co-citation and co-occurrence), and a general evaluation, concluding with limitations related to the analysis.

The literature supports in general the above mentioned view strongly: The lifelong course and potential complications of type 1 diabetes are more closely associated with environmental factors than the individual's biological characteristics. The progression and complications of type 1 diabetes are closely linked to societal factors such as socioeconomic status. Individuals with lower income face a higher risk of diabetes and its complications, a risk that is more pronounced in impoverished neighborhoods. As income decreases, the prevalence of diabetes increases, indicating a widening of health inequalities related to income over time. This situation highlights the significance of the impact of societal risk factors on Type 1 diabetes (23,28).

Despite the generally accepted impact of socioeconomic factors on diabetes outcomes, the systematic collection of this information in health institutions is rare. While the significant role of economic and social statuses on health is known, routine data collection processes in primary care, as observed in the UK, neglect socioeconomic variables, focusing more on behavioral factors like diet and lifestyle. This underscores the need for comprehensive data collection to better understand social determinants in health (39). Ideally, according to the definitions of ISPAD (International Society for Pediatric and Adolescent Diabetes), a social service specialist should be a part of the pediatric diabetes team (40). However, this is only possible in a very limited number of pediatric diabetes centers in our country.

Technological advancements in type 1 diabetes treatment have improved children's quality of life and glycemic control (41). However, a study shows that children from low-income and ethnic minority groups are not sufficiently benefiting from these technological advancements, thus facing a higher risk of complications and adverse outcomes. Researchers examining Type 1 Diabetes registries in the USA and Germany between 2010-2012 and 2016-2018 found significant socioeconomic differences in these populations. The article also highlights that most clinics in the USA do not incorporate social determinants into routine diabetes care, indicating that interventions made without addressing the challenges faced by low-income families do not improve diabetes control (42).

There is evidence that HbA1c levels are considered the most valid indicator of good diabetes control and are directly related to complication frequency, which is influenced by regional and individual socioeconomic conditions(43). An Italian multicentric study examined the relationship between HbA1c levels and the socioeconomic and clinical characteristics of families of children and adolescents with type 1 diabetes. In this study, the family's socioeconomic status was measured using the Hollingshead Four Factor Social Status Index or parents' years of education. Logistic regression analysis results showed that high socioeconomic status and years of maternal education were significantly associated with achieving target HbA1c values (44). These findings highlight the influence of socioeconomic conditions and family characteristics on the metabolic control of children with type 1 diabetes and emphasize the need to consider this in developing diabetes management strategies.

A long-term study in Denmark observed significant differences in HbA1c levels among children grouped according to their mothers' education levels; particularly, children of mothers with at least a high school diploma had higher HbA1c levels compared to those whose mothers had at least a master's degree (45). These differences can be partly explained by observable characteristics, such as children of more educated mothers performing blood sugar tests more frequently.

These studies demonstrate that family background has a significant impact on the health outcomes of children with type 1 diabetes, and this impact persists even with universal access to health services. The negative effects of diabetes on social and economic outcomes, such as children's school performance and their employment and income status in adulthood, are also noted (46). These findings point to the significant role of socioeconomic factors in diabetes management and the need for these factors to be considered by healthcare providers and policymakers.

There are inadequacies in defining what is meant by socioeconomic conditions. Social risks, which need to be examined multi-dimensionally and multi-layered, are generally measured with a very limited number of variables in medical field journals. While some studies focus on deprivation scales (47), others focus on poverty parameters (48), and some focus solely on income insufficiency (49). In many studies conducted with the same motivation, various combinations of criteria that could be considered disadvantages have been used (17,28).

The management of type 1 diabetes is a complex process with rapid treatment and technological developments, as emphasized in a

consensus report by the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD) (50). This requires individuals to manage complex medication regimens and behavioral changes to prevent hypoglycemia. Additionally, as noted by the American Academy of Family Physicians (AAFP), hypoglycemia can lead to serious health issues, and managing severe acute complications like DKA involves having sufficient supplies and prescriptions and education about diabetes management during illness (51). These reports and studies reveal the critical nature of Type 1 diabetes management and the serious health risks that can arise quickly due to inadequate management.

Type 1 diabetes is one of the chronic illnesses most affected by socioeconomic conditions, especially in childhood (42). The reasons for this are generally as follows: 1) Unlike other chronic diseases such as cancer and cardiovascular diseases, which have similar importance in affecting public health, inadequate management of type 1 diabetes can lead to severe health problems not in months or years, but in minutes, hours, and days. 2) Compared to similar diseases, the advancement in treatment technologies is much faster, leading to the rapid deepening of inequalities. 3) Unlike in adult patients, in children, the concept of deprivation includes potential negative characteristics of the parent or caregiver and social environments like schools.

A cause-and-effect model was developed to examine the effects of social risk conditions on pediatric type 1 diabetes by utilizing the results of both co-citation analysis and co-occurrence analysis (Figure 9). The purpose of developing this model is to examine the effects of social risk factors—such as poverty, socioeconomic inequality, education level, ethnic origin, and cultural factors—on diabetes management and outcomes in pediatric type 1 diabetes. The independent variables, which are the social risk factors, include socioeconomic status (income level). This factor is incorporated into the model because low-income families often face challenges in accessing the necessary healthcare services required for effective diabetes management in children. Education level is another independent variable, representing the impact of parents' educational attainment on diabetes management and adherence to treatment protocols. Cultural factors and ethnic origin are included to account for cultural barriers in diabetes management, dietary habits, and perspectives on healthcare services. Additionally, family structure is considered, as single-parent families and those with multiple children may encounter specific difficulties in managing diabetes.
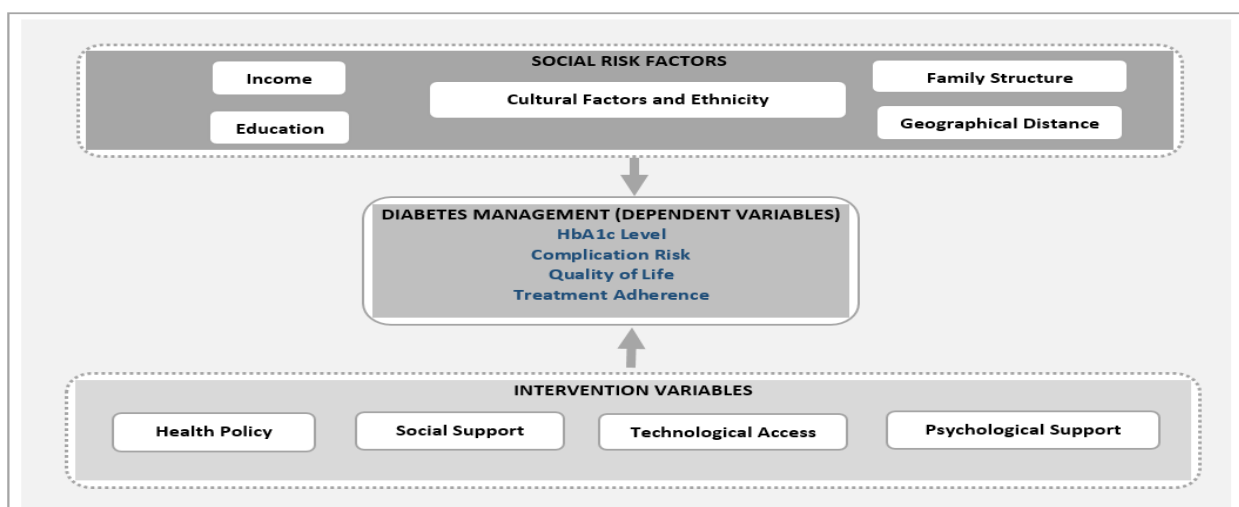

Figure 9. Social and Intervention Factors Influencing Diabetes Control and Treatment Adherence
DV: Dependent variables (Potential dependent variables in blue)
Notes: The references used in developing the model are publications numbered 16, 17, 26, 27, 28, 29, 30, 31, 34, 35, 36, 38, and 41.

Among the independent variables, intervention variables such as health policies and social support are included due to the influence of health insurance and government-provided health support programs. Technological access is added to the model to reflect the availability of technological devices necessary for diabetes management, such as insulin pumps and glucose monitors. Lastly, psychological support is incorporated to highlight the inadequacy of psychosocial support services provided to families and children, which can negatively impact outcomes in type 1 diabetes.

The dependent variables, which pertain to diabetes management and outcomes, include HbA1c levels, which measure long-term blood glucose control; the risk of complications, assessing the likelihood of developing diabetes-related complications; quality of life, evaluating the overall well-being of the child; and treatment adherence, reflecting the level of compliance with diabetes treatment protocols based on social risk conditions.

This model aims to provide a comprehensive understanding of how various social risk factors influence the management and outcomes of type 1 diabetes in children, thereby informing targeted interventions and policy-making to improve health outcomes.

Evaluation of Co-Citation Analyses: This study focuses on socioeconomic factors and deprivation impacting the management and outcomes of type 1 diabetes. Findings highlight significant variability in access to technological treatment methods and healthcare services based on socioeconomic status. As indicated by Addala et al. (19), economically advantaged groups have easier access to expensive diabetes technologies, whereas children from economically challenged families face significant disparities in treatment and health outcomes.

Studies by Sherr et al. (24) and Karges et al. (25) point out that the high cost of insulin pump therapy poses an access barrier for socio-economically disadvantaged groups. Similarly, the cost of continuous glucose monitoring systems limits accessibility in deprived communities (26).

Research by Agarwal et al. (27) documents the potential impacts of socioeconomic factors and deprivation on hospitalization and mortality rates among diabetic individuals during the COVID-19 pandemic, highlighting the struggles in accessing healthcare services for low-income individuals in high-risk areas.

The effects of the quality of education and social support systems on changes in HbA1c among young participants further clarify the impact of social determinants on diabetes (17). Studies by Hill-Briggs et al. (28) and Delamater et al. (29) on psychological care and ISPAD guidelines demonstrate the potential exacerbating effects of socioeconomic inequalities on diabetes management and health outcomes.

In light of these discussions, the following research questions can be proposed for future studies:

- How can disparities in diabetes management and health outcomes among children from economically disadvantaged families be reduced?
- What policies and programs could effectively address inequalities in treatment access arising from socioeconomic status?
- Is it feasible to reduce the cost of or subsidize diabetes technologies for children in low socioeconomic groups, and how would this impact health outcomes?
- How can the role of education and social support systems in diabetes management and health outcomes be strengthened?

Evaluation of Co-Occurrence Analyses: Co-occurrence analysis reveals the critical role of social determinants in managing and prevalence of type 1 diabetes. This analysis documents how poverty and low socioeconomic conditions significantly complicate adolescent diabetes management and early diagnosis. Key findings suggest that poverty and socioeconomic deprivation intersect with inequalities in access to healthcare services, adversely affecting diabetes management.

In this context, barriers to access to diabetes technologies exacerbate challenges faced by children from low-income families. Treatment methods like insulin pumps and continuous glucose monitoring, accessible mainly to those with sufficient economic resources, deepen health inequalities. It is also observed that access to these technologies is not even among socio-economically better-off groups. A comprehensive examination of ethnic and socioeconomic factors in diabetes management and access to healthcare services is clearly needed.

Additionally, understanding the impact of social risk factors on diabetes requires consideration of individual behavioral factors and societal structures. For instance, the sustainability of critical lifestyle factors for diabetes management, like healthy eating and regular exercise among individuals living in low socioeconomic conditions, could be a separate research topic.

In light of these findings, potential research questions for future studies could include:

- How can the role of socioeconomic factors in diabetes management and early diagnosis be optimized?
- What policies and practices can be developed to reduce the impact of inequalities in access to healthcare services on diabetes management?
- How can social equity in access to diabetes technologies be achieved, and what is the impact of these inequalities on health outcomes?
- How can the interaction of ethnic and socioeconomic factors on the prevalence and management of diabetes be examined more in-depth?

Limitations: This study has certain limitations. As with any bibliometric research, these analyses have advantages and disadvantages. For example, while citation analysis helps determine the scope of the study, it does not directly provide quality information. Secondly, this study relies solely on the Web of Science (WoS) database, omitting other databases. Thirdly, our keyword search was limited, and WoS did not provide access to articles before 1975.

Additionally, focusing only on English-language articles might not fully reflect global research outputs (52,53). Lastly, co-citation and co-occurrence analyses have their inherent limitations. Nevertheless, these limitations could serve as an incentive for future research. This article is not a meta-analysis or systematic review that specifically examines the impact of socioeconomic conditions on the prognosis of type 1 diabetes according to a systematic review and meta-analysis technique.

Also, no research questions have been prepared for either meta-analysis or systematic review.

CONCLUSION

The impact of socioeconomic factors and deprivation on the management and health outcomes of type 1 diabetes yields significant implications for public health and health policy. The prioritization of these factors within health policies is essential. Efforts to ensure equal access to healthcare services and address inequalities in treatment methods are vital for reducing health disparities. A deeper understanding of the effects of socioeconomic risk factors on type 1 diabetes will enable the development of more effective intervention methods for individuals and communities. The contributions of these interventions to efforts in achieving equity in diabetes management should represent a significant focal point for future research.

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