

Bibliometric Analysis on the Relationship of Data Science in the Mental Health of Child and Adolescent Population

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Abstract

Mental health is a state of well-being immersed in various factors that impact the different stages of human life, and essentially the child and adolescent population. In recent years it has become one of the focuses of attention, due to the various problems that have arisen around this concept. This concept has been approached from various angles of knowledge, generating an evolutionary process where data science has been related to this and other areas of knowledge. The present study aims to analyze the scientific production on the relationship of data science in mental health for the case of children and adolescents. For this, a bibliometric analysis was carried out, allowing the recognition of the articles related to the descriptors under study in the last 5 years, using the recognized PubMed database and making use of the statistical software R with the Biblioshiny application, the cual is immersed in the Bibliometrix library. Concluding, that despite the efforts made to increase scientific production on the relationship between the concepts of data science and mental health, work must continue to increase the debate on these issues together, in light of the fact that data science currently contributes to the understanding and optimal decision-making on mental health in children and adolescents.

Keywords: Health Mental; Data Science; PubMed; Children; Adolescents

Introduction

The World Health Organization [35], conceives mental health as that state of well-being in which the individual projects his abilities to cope with life and the complexities that it entails, in order to have a productive life that also contributes to community well-

being. In this sense there are certain population segments that in terms of both physical and mental health are mostly vulnerable, as is the case of the child and adolescent population, because these two stages of life correspond to crucial moments for human development, given that in these extensive changes are manifested in physical aspects, social and psychological [17].

That is why, for some years, a global alert has been generated to address mental health in the case of this population from various approaches and multiple factors, with the purpose of attacking problems that have been rooted for a long time behind and others that have arisen as a result of the Covid-19 pandemic [14,18,21,23,33].

In addition, the period of the pandemic derived from Covid-19 was a critical point worldwide. Ren and Guo (2020) [40] express that public mental health in the post-COVID-19 era should not be ignored, given that it has sounded the alarm globally in the field of mental health and psychology. This psychological crisis we must still pay attention in the future and explore the rules at the level of scientific research through longitudinal cohort studies for understanding as the solutions to persistent problems in each individual and potentiate the scientific field.

From this motivation and need, studies and research in the area have increased, taking into account that children and adolescents are identified as risk groups that require greater attention, as mentioned is in these early stages of human development in which indices of emotional development are defined. Healthy skills are generated for a positive quality of life and development with society [3,7,14,25].

On the other hand, these studies and research have been marking the idea of studying the problems in this area of mental health in an interdisciplinary way, where the advance of knowledge and technology have enhanced the use of tools, which in a simple way present, visualize and communicate the results obtained, which also contribute to the decision-making process and the implementation of solutions to social problems in the area [29,32].

Given this situation, many authors have begun to link statistical tools with their research, some of them make use of tools related to data science, which is an area that is booming and in the process of exploration. In the case of authors such as Naslund., *et al.* (2019) [32], they express that the generation of new methods and advanced techniques of analysis, which range from data science, are of great contribution to the researcher of the XXI century, in terms of the identification of patterns or trends in the behavior of variables of interest. Likewise, other authors Russ., *et al.* (2019) [41] express that data science approaches are becoming ubiquitous given the computational and statistical power it provides towards various areas of performance at the global level.

For the same author Naslund., *et al.* (2019) [32], data science is one of the sciences that have begun to provide applicable tools in terms of the study of mental health offering the opportunity to detect, analyze and predict disorders, diseases and problems associated with the mind. In addition, they highlighted the opportuni-

ties present to expand access to and use of digital technologies to advance mental health research and intervention, emphasizing the potential impact in low-resource research settings. Like the previous authors, some studies stand out for their interest in articulating data science and mental health [4,78,11,14,25,27,33,38,49].

In this sense, this study aims to articulate the fields of Data Science and Mental Health through a bibliometric analysis, in order to answer the problem question: What is the relationship of data science in the mental health of children and adolescents? This is due to the fact that it is considered that the application of data science in research in reference to mental health is still at an early stage compared to other areas, although the complexity of health and dental diseases makes it necessary to use more sophisticated approaches that are particularly suitable towards this area of knowledge [23,41].

Therefore, we proceed to carry out the bibliometric analysis given its applicability in different research fields and its importance for the understanding of the scientific panorama that has variables of interest [1,13]. From different disciplines, essentially data-driven science that involves different areas of knowledge in concepts, theories, processes, tools and technology, which enables the exploration of studies and ascendancy to knowledge and effective information such as prevention measures, problem solving, strategies, as well as other determinants for the increase and well-being of mental health at the end of the world. A structured database, emphasizing the deterioration of mental state [3,7,14,25].

Therefore, it allows to know the articles directly related to the participation of data science in mental health for the case of the child and adolescent population in the years 2017-2022, making use of the recognized database, PubMed, which according to Trueba-Gómez and Estrada-Lorenzo (2010) [45], is a database of free access and with great contribution in the area of health, with millions of bibliographic references, more than 5,000 scientific journals and with the participation of different countries, from which results will be derived such as articles most reported in this database, journals, authors and most active and productive countries, institutions and most productive organizations, conceptual structure (Keywords).

Methodology

The present research is based on a study of mixed nature, with a descriptive-correlational scope and with an intentional non-probabilistic sample, since this study involves a bibliometric analysis to quantitatively and qualitatively analyze the articles under study, in this case, related to data science and mental health [19], also uses an observational and retrospective design which systematically reviewed primary sources with an observation window of 5 years in a database of the health area [34].

This study was carried out a bibliometric analysis of the scientific literature [1,13,16] related to mental health in children and adolescents, using as a research tool and collection of information, the specialized database PubMed (<https://pubmed.ncbi.nlm.nih.gov>). The PubMed database is a free and constantly updated database, which has dentistry, nursing and medicine as its main areas, it has millions of bibliographic references, more than 5,000 scientific journals and from different countries, in which it is possible to make simple and complex queries from search functions by fields, with MeSH terms or with limits, taking into account that it has a friendly environment for the researcher and easy to manipulate. It also saves search strategies in different tools and formats, in the same way that they can create alerts and archive the results made [45].

Using the potential of the PubMed database, which allows to limit the chronological periods, types of publication, publications of greater impact and other parameters. The documents considered for this study were in "Full text" and "Free full text" mode with a criterion of analysis of the production in the last 5 years (2017-2022), related to Data Science in Mental Health applied to children and young people.

Search strategy and selection of articles

During the methodological process, a detailed search was carried out taking into account the descriptors of interest, establishing the function: "mental health" AND "Data Science" AND (children OR child OR infant OR infants OR adolescent OR adolescents OR young OR student OR students) with the help of connectors such as "AND" AND "OR" which allow greater effectiveness and certainty in the search, according to the results obtained, the outstanding publications on mental health in the chosen population were taken, the most important scientific journals, publications by countries, organizations and institutions, impact and relevance of authors (N = 242).

Among the 242 articles, 50 of them were delimited, for the construction of the results taking into account the following criteria

Inclusion criteria

The inclusion criteria stipulated in this review were

- Articles dealing with applications of Data Science in the various approaches and contexts related to mental health for the case of children and adolescents.
- Articles of greater trend and scientific impact.
- Articles with links to others and relevance of authors.

Figure 1: PRISMA flowchart in four levels, based on Molins and Serrano (2019) [31].

Exclusion criteria

In the case of exclusion criteria, the following were stipulated

- Articles that were not within the established search period were excluded.
- Articles in which there was no evidence of a research impact.
- Articles or documents with little or no relationship with respect to the subject.

Based on the above (Figure 1), the descriptors established in the function were identified and subsequently the inclusion and exclusion criteria stipulated above were applied. For this case, taking into account 50 delimited articles, a review process was carried out, in which they were classified into cuts of 10 articles to verify the relevance of the topic of study, obtaining as a result a filter of 16 articles, which meet the needs stipulated in this systematic review.

Data Analysis

We proceed to a statistical analysis and visualization of key elements from the Bibliometrix package (<http://www.bibliometrix.org>) [12], which is based on the programming language R [39], specialized for statistical analysis and data visualization, which makes it a trend in the use of researchers because it is open access. Generating a concrete panorama between keywords, dendrogram and others, which allowed to determine the relevance, impact and understanding of the research in relation to the treatment of data and the processing of variables such as: "Dataset", "Sources", "Authors", "Documents", "Conceptual structure", "Social Structure" and "Intellectual Structure".

During the analysis is a descriptive analysis, networking according to the conceptual structure, analysis of Multiple Correspondence [6,9,15,22,30,36,44,47,48], of the conceptual structure and dendrogram of the conceptual structure, which allowed to answer the research question highlighting relevant aspects such as the number of articles and journal, Keywords, citations, collaboration index, authors in the field of interest of this study and institutions and countries [2].

Results

This section illustrates the results obtained from a total of 242 references evaluated in the framework of the literature under study consulted in the *PubMed* database, specifically around the “Full Text” and “Free full text” type documents with an observation period of 5 years (2017-2022), which is related to some studies recently carried out around bibliometric analysis [1,24,43].

Most active journals, authors and institutions

First as a general description in figure 2. A) the existence of certain Journals that have greater relevance around the topics raised was identified, the top 5 of the most active are Plus One (12), followed by Human Brain Mappings (8), Neuroimaging (8), BMJ Open (7) and BMC Medicine (6). Also, B), among the most relevant authors are Vince D. Calhoun (21), Ole A. Andreassen (17), Dan J. Stein (14), Glahn DC (13) and Stefan Ehrlich (12). In addition, C), the institutions that have contributed the most to litigation in the last 5 years are evident, these are The University of California (159), The King College London (150), Stanford University (139), McGill University (128), University of Oslo (110), University of Oslo (110), University of Pennsylvania (101) and University New Wales (102).

Figure 2: A) Most relevant journals; B) Most relevant contributors; C) Most relevant affiliations.

More active countries and collaborations

On the other hand, figure 2 shows the analysis for countries more active in the topics under study, in this in turn international collaboration is observed, in which a division of two types is distinguished, one of articles published by the country without collaboration, where the authors and publications represent a single country (SCP) and another group of collaborative publications between countries (CCM) in which both Authors such as the publication represent an international collaboration.

In the specific case study, it was shown that the United States (USA) is the country that shows the most contributions published during the last 5 years, where the percentage of CCM and SCP are very similar; followed by the Netherlands (NETHERLANDS) and Australia, which have a higher percentage of SCP; and in fourth place is Canada, of which it is highlighted that 100% of the publications were with collaboration (CCM).

Figure 3: More active countries with international collaboration and without international collaboration.

Conceptual structure

In general, when including the 242 studies derived from the search carried out, it was possible to state through the analysis of networks that there are 5 groups of articles related by common themes, these were

- The Green Group which includes articles dealing with depression and social networks, making use of confidence intervals, logistic regressions and odds ratio analysis.
- A group represented with the color red that includes articles related to mental health in its most general scope and in the specific aspect topics such as anxiety, mental disorders, suicidal ideation, care and health outcomes effects of theCovid-19 pandemic, making use of Machine Learning.
- A purple group includes articles dealing with aspects of cognition, brain physiology, health checks, making use of image analysis and resonances by algorithms.
- Finally, the yellow and blue groups are evident, where issues related to mental and even physical health are discussed, in which age is taken into account, but do not involve aspects of data science.

Figure 4: Network of articles according to the conceptual structure.

In terms of the conceptual structure and specifically, a group of words delimited by clusters drawn in the factorial plane were identified, which were derived from the relationship between common aspects, for the case of the 50 articles with the highest contribution of the total of 242 initial articles, these clusters were applied using the techniques of Multiple Correspondence Analysis (MCA) and Grouping (Cluster) of K-means, which for this CASis represented by more than 50% in the first two dimensions.

Figure 5: A) Multiple Correspondence Analysis of the conceptual structure; B) Dendrogram conceptual structure.

In that sense there were 2 clusters identified in the plan, the first represented with the color red, which includes a set of articles that are related to the following concepts: mental health (specifically in topics such as idea suida, mental health in pregnancy, treatments, the genetic field, physiology of the brain, cognition), data science (specifically in topics such as Machine Learning, algorithm design, prevalence, longitudinal studies, transversal and retrospective) and finally sociodemographic aspects (age, gender and quality of life). Finally, cluster 2 represented by the color blue, which includes a group of articles related to topics such as Covid-19-Sars Cov2, pandemia, epidemiology and control of communicable diseases, given that the impact of the pandemic due to Covid-19 is a factor that cannot avoid leaking due to the great impact that this situation has had on all levels and areas of human health.

On the other hand, with respect to the thematic map, in which the groups of keywords derived from the articles under study and the existing connection between them are visualized, thematic categories are identified, such as motor themes, periporicorniche, emerging or in decline and basic or transversal [26].

For this case it is evident that motor issues are those related to risk factors in mental health, these topics are the most studied and that contribute most to the scientific foundation of the field of study. As for the peripheral issues, topics related to genetics, psychological disorders, the consumption of psychoactive substances, through methodologies such as meta-analysis, these have been developed internally in the scientific field, but have a marginal role within the field. On the other hand, emerging or declining issues, for this case only issues in decline are identified, such as mental health care and its relationship with pregnancies, these have been issues that have been in retreat of study. Finally, with respect to the basic and transversal topics, Data Science (Machine Learning Techniques and Multivariate Analysis), gender, neuroscience and the cognitive field are identified, these represent topics that are fundamental for the strengthening of the scientific field but that are little studied or developed.

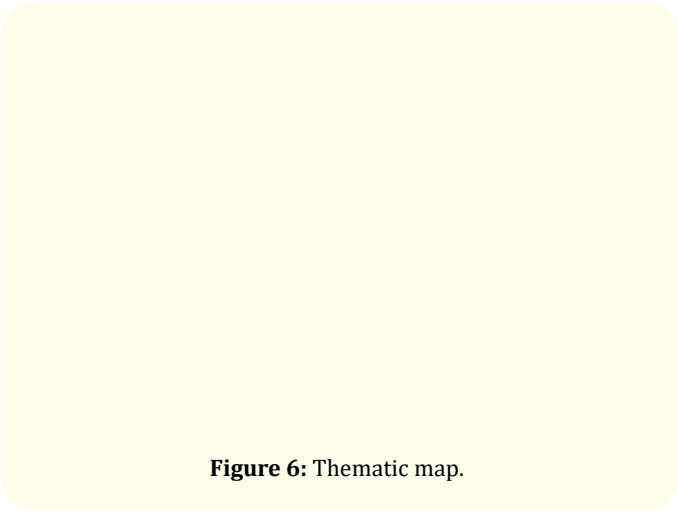


Figure 6: Thematic map.

Discussion

From the results presented in the previous section, it is possible to answer the problem question of this study, What is the relationship of data science in the mental health of the child and adolescent population?, where the existence of a relationship between data science and mental health is evidenced for the case of the child and adolescent population, bearing in mind that these two fields of knowledge are highlighted in the thematic map (Figure 6) and in the conceptual structures (Figure 5) as basic or transversal themes. In addition, they mark an important relationship between them in the scientific field. Despite this, at present there are few studies that articulate these two fields, this can be observed in the framework of the present research taking into account that the number of articles selected (16) at the end of the study was lower than initially found (242), highlighting that these articles filtered and that handle the two topics under study in a c ONJUNTA and were also carried out within the framework of the target population, are of great impact. Among them are some related ones below.

One of the most accepted investigations was that of Pierce, *et al.* (2020) [38]. They analysed the potential impact of the COVID-19 pandemic and examined changes in mental health in the UK population before and during lockdown. They conducted a longitudinal cohort study where they made a series of requirements and parameters of choice to participants with an age range between 16 years and forward, then evaluated through the General Health Questionnaire of 12 items (GHQ-12) developed a structured data system to record the information, thus they were able to demonstrate that mental health in the United Kingdom had deteriorated compared to trends prior to the COVID-19.

On the other hand, Ioannis Bakolis, *et al.* (2021) [3]. They studied changes in daily use of mental health (MH) services and mortality in response to the introduction and uptake of COVID-19 in the UK, used a discontinuous regression in time (RDIT) analysis design with service-level data extraction according to an adult-inclusive population, Elderly, child and teenager. Also, Niederkrotenthaler, *et al.* (2022) [33]. They examined the detrimental impacts of the pandemic on mental health in Austria, performed a multivariate regression analysis on the risk of groups specifically affected by pandemia and variations over time with a 16-year-old participant classification forward, employed a quota sampling methodology based on population statistics from Statistics Austria resulting in young people enes the increase of depression and anxiety.

In relation to the above, Bekkering, *et al.* (2021) [5]. In this study systematically compared the benefits and harms of primary and secondary school closures used different tools for database collection in the part of children’s mental health was assessed using General Health Questionnaire-12 (GHQ-12, lower scores reflect better mental health), examined data on chats with CLB (CLBch@t), a helpline for schoolchildren. The number of chats about anxiety, depression or suicidal thoughts was used as indicators of poor mental health consequently it is evident that Belgium studies suggest that school closures have a negative impact on children, in addition the recommendation is based on data collected through national surveillance or studies from Belgium and is supported by a quick literature review.

Verhulst, *et al.* (2022) [46], conducted a quick literature search to summarize common themes in mental health research in a population aged 10 to 19 years based on a “topic map”. The demand-driven methodology for setting the agenda presented was based on the 100 Questions initiative established by The GovLab’s Governance and Rapid Search Lab (journals, conference programs, reports and publicly available databases in English published between 2010 and 2020) where it is identified that 10 topics are available in English. The main ones in adolescent mental health, organized into categories at the system, community level and individual levels. The participation of cross-sectoral experts resulted

in validation of the mapping exercise, critical insights to refine the topic map, and a collaborative list of priorities for future research.

Cuijpers., *et al.* (2020) [10], searched four major bibliographic databases (PubMed, PsychINFO, Embase, and Cochra ne) for trials comparing psychotherapy for depression from children to older adults with control conditions for data extraction and synthesis We calculated effect sizes (hedges g) for all comparisons and pooled them with effect models Randomized studies concluded in this meta-analysis reported effect sizes of psychotherapies that were smaller in children than adults, probably also smaller in adolescents, that the effects may be somewhat greater in young adults and no significant differences between middle-aged adults, older adults, and older adults.

Taking into account the above, it is denoted that data science has been contributing to the development of research in the field of mental health, keeping between them a certain level of relationship, especially during the pandemic period and post-pandemic of COVID-19, taking into account the global significance and the physical, emotional and mental effects that it has caused in the child and adolescent population. Situation that led researchers to develop small, medium and large-scale studies to address the understanding and solution to these problems. However, the importance of increasing and magnifying the scale of scientific production among these topics is highlighted jointly, for which the use and accompaniment of tools, advanced statistical and technological software that contribute to the analysis and visualization of data is required, with which decision-making and the implementation of public policies or mechanism of prevention and support for individuals with health problems is enhanced. mental [3,5,7,8,11,14,18 ,20,23,25,27,28,33,37,38,42].

Conclusions

The present study evidences the relationship of data science in the field of mental health, through a descriptive, inferential and multivariate analysis that nourishes and characterizes the bibliometric analysis supported by the bibliometrix package that is based on the R language, which is strongly used to study aspects of data science. It is emphasized that although efforts have been brewing around research and studies that include these two thematic lines in the case of the child and adolescent population, these are still little studied together and the importance of following the development of these types of studies that allow understanding and presenting the relevant results on the understanding of mental health in this population segment is emphasized. which can be used to make optimal decisions based on data.

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