Research Article

Emerging trends in research on perineal trauma management: A bibliometric analysis of articles published since 1985

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ARTICLE INFO

ABSTRACT

Background: The purpose of this bibliometric analysis is to explore global trends in scientific research involving spontaneous perineal tears sustained during childbirth. This research is critical as a significant number of women have vaginal lacerations after birth resulting in complications such as pain and pelvic floor dysfunction.

Methods: The articles used in this bibliometric analysis were collected from PubMed, Web of Science, Cochrane library and Scopus. Analysis was carried out in Python and R programming languages with some visualizations created using VOS software. Apart from traditional methods, this analysis also involved time series forecasting and assessment of rolling correlations.

Results: Results indicate authors and institutions from the United Kingdom as the most productive in the research on this subject research. National level analyses for six countries showed that productivity was positively correlated with GDP/capita, average health expenditure and negatively associated with proportion of C-sections. Recent and emerging themes include those involving pharmacological interventions for pain management.

Conclusion: There is a growing global interest in the research on postnatal perineal trauma with authors from the UK playing a leading role so far. Countries with high vaginal birth rates, need to promote research in this field to minimise trauma-associated comorbidities.

Introduction

A perineal tear refers to a laceration or injury that occurs in the area between the vaginal opening and the anus, known as the perineum (Goh et al., 2018). Perineal tears most commonly occur during childbirth, particularly during a vaginal birth, when the baby's head puts pressure on the perineum, stretching it as it passes through the birth canal. They are a common complication of childbirth impacting women globally (Aguiar et al. 2019)Treatment for perineal tears typically involves suturing the tear to promote healing and prevent infection (MAHOMED et al., 1989). In some cases, more severe tears may require surgical repair (Frohlich and Kettle, 2015). Pain relief measures and proper wound care are also important components of postpartum care for women who have experienced a perineal tear. There are several factors associated with perineal tears during childbirth, including first vaginal birth, large baby and instrumental delivery (e.g., the use of forceps or a vacuum) (Riskin-Mashiah et al., 2002; Groutz et al., 2011; Maher et al., 2022).

Perineal trauma, especially severe perineal tears, can also increase the risk of pelvic floor dysfunction (PFD) where damage to these muscles can result in weakened support, leading to conditions such as urinary and faecal incontinence, pelvic organ prolapse, and pelvic pain (Huber et al., 2021). Studies have shown that women who experience severe perineal tears during childbirth are at a higher risk of developing pelvic floor dysfunction, compared with those who have an intact perineum or a first degree tear (Rikard-Bell et al., 2014). Based on a cross-sectional study of a nationally representative population of women in the United States (US), the prevalence of at least one PFD has been estimated at 23.7 % (Hallock and Handa, 2016). In the UK, pelvic floor dysfunction is seen in 50 % of women who have given birth and up to 40 % of the general female population aged 45 to 85 years (Leslie et al.). The estimated cost to the NHS of urinary incontinence was £233 million per year at 2017 (McGrother and Donaldson, 2018).

Perineal tears and poor healing can also have a negative impact on women psycho-socially; including maternal-infant attachment, body image, breastfeeding and partner/family relationships. Thus, the choice of an intervention for perineal wound care is crucial to mitigate future pain for the patients as well as to reduce psycho-social impact and cost to

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the health service provider (Steen and Diaz, 2018).

The management of perineal wound is subject to the severity of the tears. Perineal tears can be classified into four categories based on their severity, with first-degree tears being the least severe and fourth-degree tears being the most severe (Sayed Ahmed et al., 2017). As defined by the National Institute for Healthcare and Excellence (NICE), a first-degree tear involves the skin but does not include the muscle, while a second-degree tear will include damage to the perineal muscles but not anal sphincter. Third degree tears involve damage to the external anal sphincter and in more severe cases the internal anal sphincter and a 4th degree tear will include damage to the both the internal and external anal sphincter and anal epithelium (NICE 2023) . In the United Kingdom (UK), third- or fourth-degree tears, also known as an obstetric anal sphincter injury (OASI), can occur in 6 out of 100 births (6 %) for first time mothers (RCOG 2023). Similarly, around 1 in 7 births in England involves an episiotomy (NHS 2023). Overall, up to 9 in every 10 first time mothers who have a vaginal birth will experience some sort of tear, graze or episiotomy and up to 69 % of these will require suturing (Labour Ward Forum 2021) . The estimated cost of suturing includes the cost of sutures, equipment (e.g., scissors, steriliser, etc.) and labour (midwife/obstetrician).

The above introduction shows that perineal trauma sustained during childbirth is a significant global concern affecting women across several countries. The incidence of perineal tears during vaginal delivery extends beyond regional boundaries, impacting women across diverse socioeconomic and cultural contexts. Complications arising from perineal trauma, such as pain and pelvic floor dysfunction, have implications for maternal health and well-being globally. As such, understanding the trends and advancements in perineal trauma management on a global scale is imperative for informing evidence-based practices and interventions to improve postnatal care for women worldwide. Given the importance of this topic, it is vital to identify the current research productivity, geographical variability in research outputs, areas of extensive research, research gaps and under-researched areas. The study aims to achieve this through bibliometric analysis which is an increasingly popular method used in medical research (Kokol et al., 2021). Previous bibliometric analyses on the subject topic are conspicuous by their absence. As such this study can be an important contribution to inform future research directions in this domain.

Methods

This study used bibliometric analysis of studies on perineal tears and trauma management. Bibliometrics analysis is a quantitative method used to analyse patterns and trends in scientific literature. It involves the statistical analysis of publication data, including citation counts, authorship patterns, and collaboration networks, to gain insights into the structure and dynamics of research fields (Kokol et al., 2021; Donthu et al., 2021; Michalopoulos and Falagas, 2005). Bibliometric analysis is important as it provides a systematic and objective approach to assess the impact, visibility, and trends within a specific research domain. The articles used in this bibliometric analysis were collected from PubMed, Web of Science, Cochrane library and Scopus. These databases contain a majority of the studies on medicine and have been used extensively in the past to collect data for bibliometric analyses. Using only one of them might lead to a difference in results and as such all of them were used to identify relevant studies (Villatte et al., 2020). The query used for this research included the following string

perineal tear AND (suture OR suturing) AND childbirth

This resulted in the extraction of 473 articles from Scopus, 26 trials from the Cochrane library, 80 articles from PubMed and 60 articles from Web of Science. R programming software was used to remove duplicates and the results were assessed using an R Shiny app (Aria and Cuccurullo, 2017). Due to the small number of articles focusing on clinical trials and the potential of duplication, some of the results were not considered in this analysis. The retained data consisted of 479 documents published

across 231 sources between the years 1985 and 2023. These included 26 book chapters, 8 books and 4 conference papers while the remaining documents were predominantly journal publications.

In order to offer detailed insights, this study also employed time series modelling to explore the trend of publications over time. This is a sophisticated econometric technique which is applied in instances where regression analysis is not possible. In the present scenario another commonly used technique, the Auto-Regressive Integrated Moving Average (ARIMA) modelling technique was used (Juang et al., 2017). Additionally, to explore epidemiology, rolling correlations were also observed between different variables and publications disaggregated at the national scales (Tiwari et al., 2016). These variables included information regarding the economic countries in the selected countries as well as the prevalence of vaginal vs caesarean births (Kyu et al., 2013). As such, this study goes beyond the common bibliometric analyses and provides greater granularity in analysis and reporting.

Results and discussion

Initial results showed that the average age of the assessed documents was 9.93 years with an annual growth of 5.23 % for the study period. The total number of authors that contributed to the 479 articles was 1579 of which merely 3.22 % acted as single authors. The level of international co-authorship was also quite low at 0.63 %. Overall, average citations per document came out as 13.54.

Fig. 2 represents the time series modelling of publications on this topic. For this analysis an ARIMA (0,1,1) model was selected based on results from Ducky fuller tests using the Auto-Arima function in Python v.3 software (Schaffer et al., 2021). These parameters resulted in AIC and BIC values of 222.51 and 227.34 respectively which is indicative of a good fit. The model diagnostics have been presented in the form of a figure in the Supplementary file. In essence, Fig. 1 clearly shows that the number of publications on this topic will continue to increase in the future. The upper and lower bounds of the 95 % confidence interval have been shown as the grey shaded area.

Fig. 3 provides a heat map of the publications produced during the study period for corresponding countries. It can be seen that the United Kingdom (UK) stands out from the rest of the world due to a relatively high number of publications (94) in the subject domain. The UK is followed by the United States of America (USA), Australia, Brazil, France and Spain as the top five countries with 50, 39, 39, 31 and 31 publications respectively.

For a deeper analysis, the timeseries of publications were correlated with variables such as GDP/Capita, Health expenditure as proportion of GDP and proportion of C-sections (Fig. 4). The statistics for GDP/capita were obtained from the World Bank (The World Bank 2023), those for
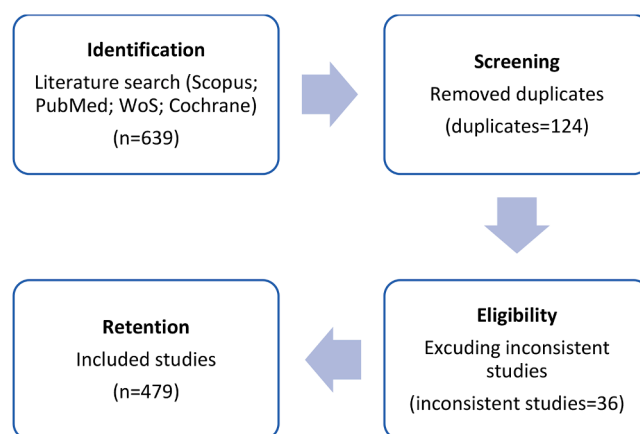

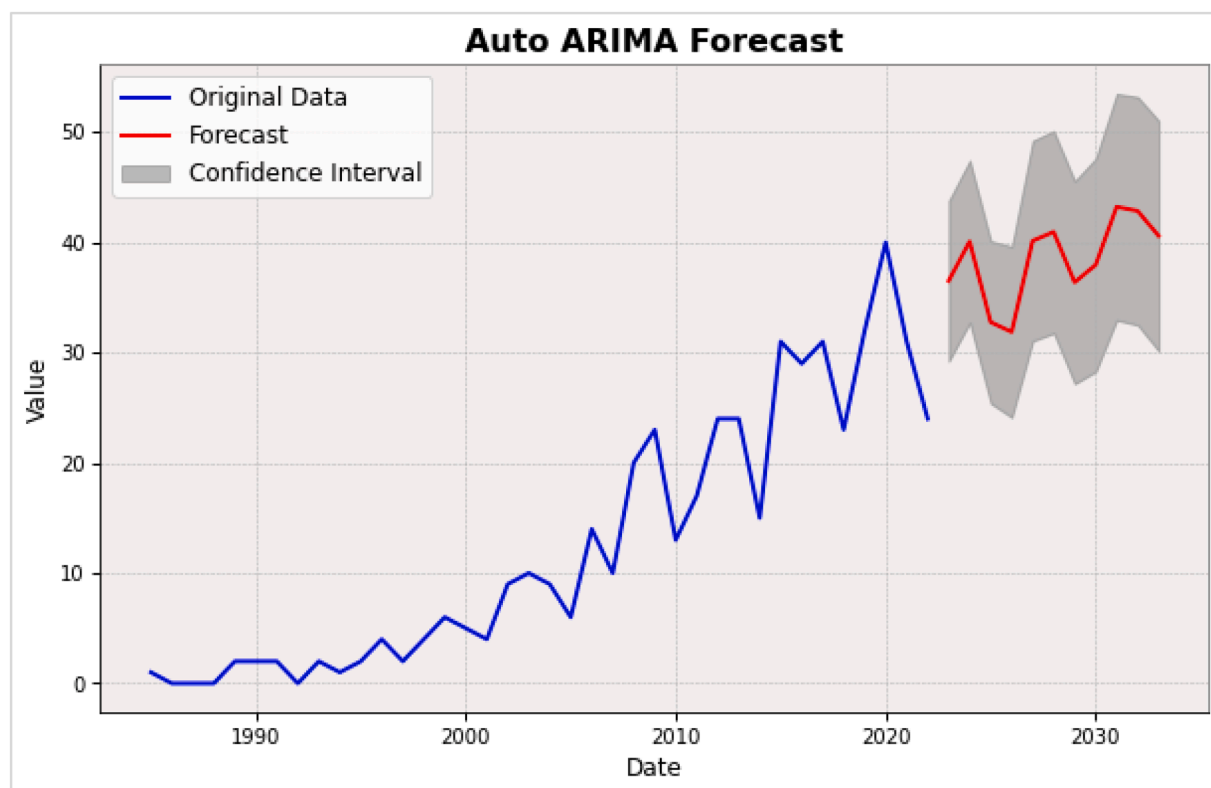**Fig. 1.** Flowchart for searching and shortlisting the studies for bibliometric analysis.

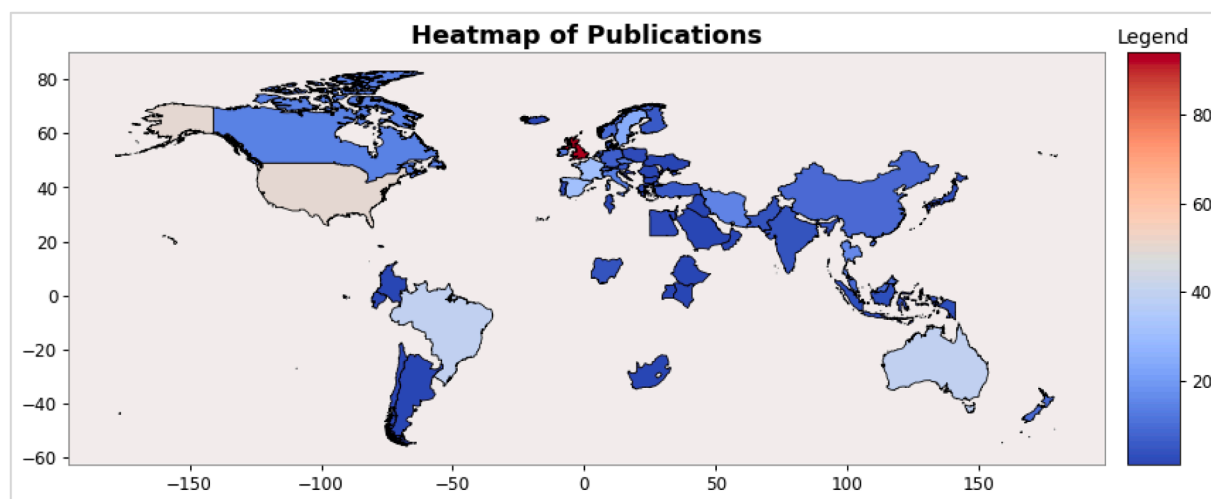**Fig. 2.** Auto ARIMA Forecast for 10 years from 2022 onwards.

Fig. 3. Heatmap of geographical distribution of publications displaying countries of origin for publications.

Health expenditure were extracted from the World Health Organization's database (World Health Organization 2023) and the proportion of caesarean sections were extracted from the supplementary file of a recent publication (Betran et al., 2021). Timeseries of the top 5 countries, identified above, were shortlisted for the analysis. It can be seen that the articles/publications were positively correlated with years meaning that the number of publications increase with time. They are also positively correlated with GDP/capita as corroborated by the presence of at-least 4 high income countries in the top 5 countries for publications. Correlations with proportion of caesarean sections are negative which is also understandable given that perineal tears are likely to be more common in vaginal births (Faridi et al., 2002). Finally, a weak positive correlation is also demonstrated for health expenditure as

a proportion of GDP. As the correlations change with time, plots of rolling correlations between different variables have also been provided in the Supplementary file for greater clarity.

Fig. 5 given below displays the 10 most prolific authors in this field with the size of the dots representing number of publications and the colour density indicating total citations. It can be seen that the author Sultan is at the top of the chart. This is because this author has overall 26 publications (7.4 % of total) on the topic followed by Thakar, Ismail, Kettle and Bick with 23 (6.8 %), 21 (4.9 %), 18 (4.8 %) and 11 (4.1 %) publications respectively. The percentage contributions of these authors is represented by the pie chart shown in Fig. 4.

It is important to mention that many of the highly productive authors were frequent collaborators on publications as indicated by Fig. 6 which
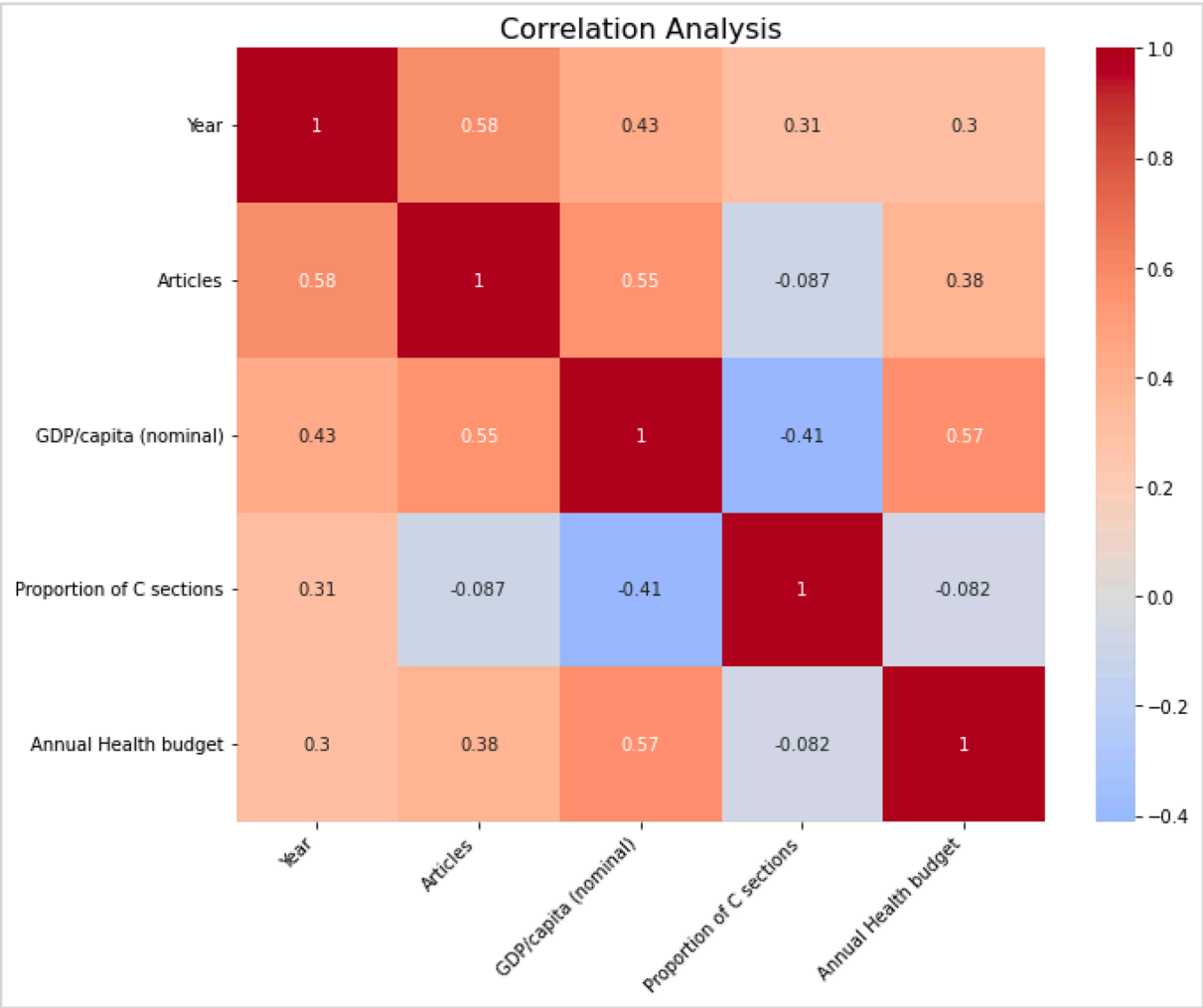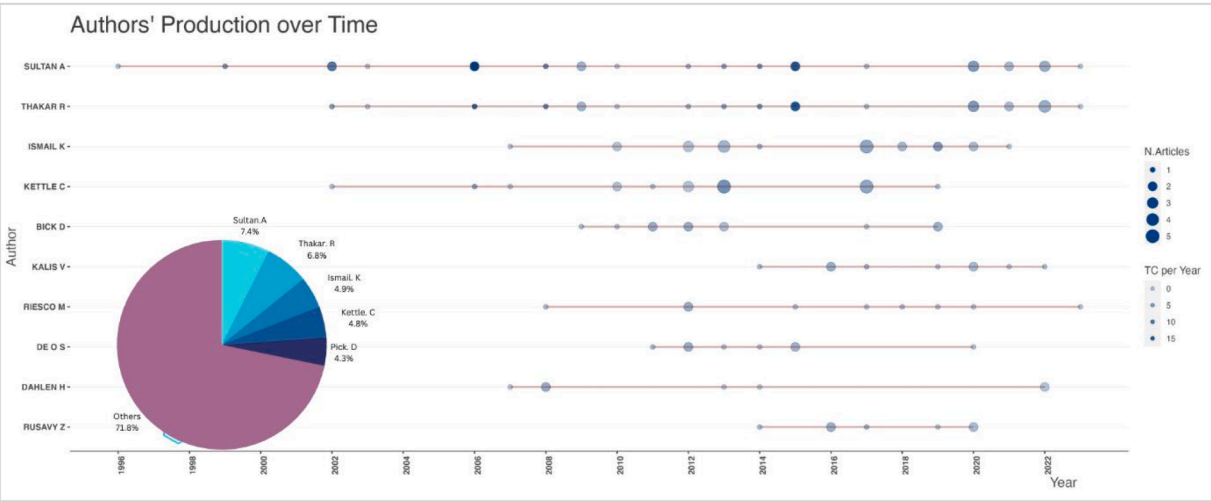
Fig. 4. Correlation plot.

Fig. 5. Prominent authors by publication numbers and citations.

shows the co-author network of highly productive authors. Once again, in Fig. 6, the size of the node represents the number of publications by an individual author whereas the thickness of the edges represents the number of collaborations.

Table 1 shows the most productive authors, institutions and countries in the subject field. It can be seen that the top-10 authors are the same as those shown in Fig. 6 above which points towards the importance of collaborations. They also include some of the highest cited
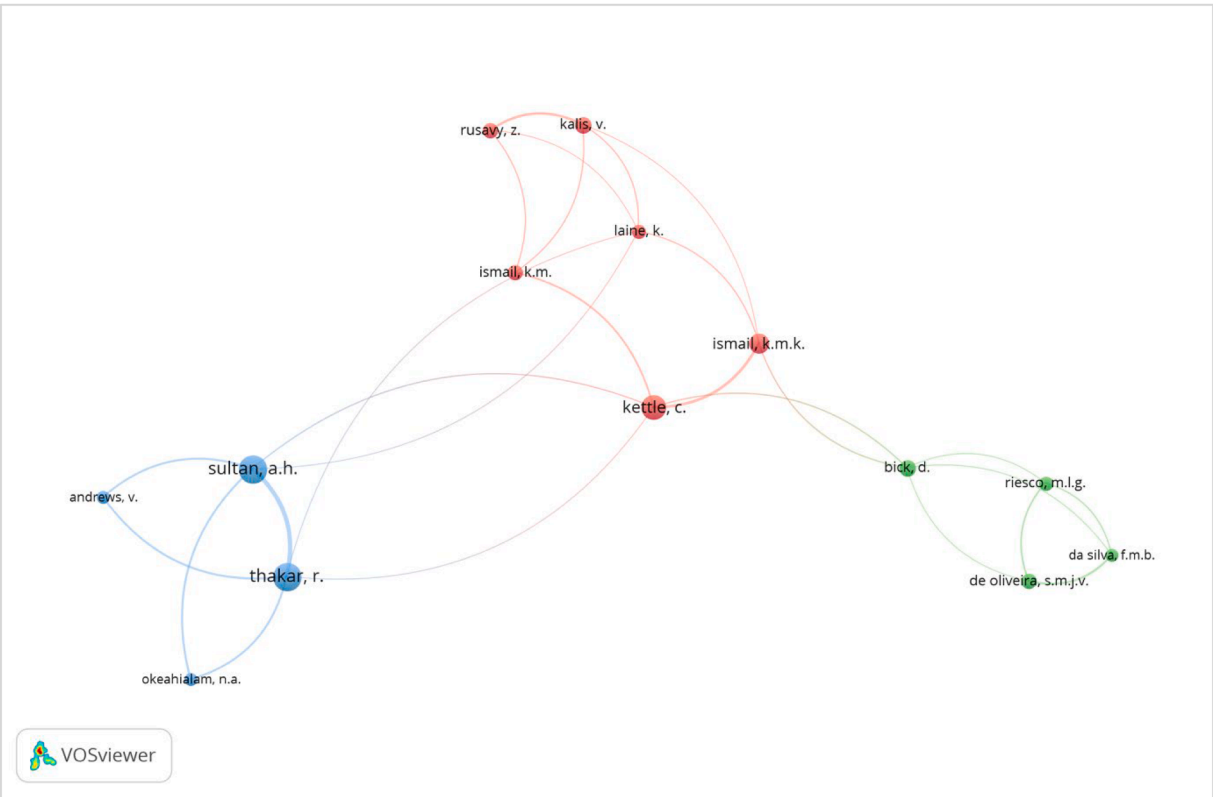
Fig. 6. Co-authorship network of prominent researchers.

Table 1
Top 10 Authors, Institutions and journals by number of publications.

Top authors	Number of publications by top authors	Top institution	Number of publications by top institutions	Top journals	Number of publications by top journals
Sultan AH	25	University OF Sao Paulo	23	Midwifery	20
Thakar R	24	Croydon University Hospital	17	British journal of midwifery	17
Kettle C	18	University of Birmingham	15	International Urogynecology journal	17
Ismail KMK	13	Mayday University Hospital	14	BJOG	14
Kalis V	10	Staffordshire University	12	Birth	11
Bick D	9	Shahid Beheshti University of Medical Sciences	11	BMC pregnancy and child birth	10
Ismail KM	8	Oslo University Hospital	9	European journal of obstetrics and gynecology and reproductive biology	8
Rusavy Z	8	Universidade de Sao Paulo	9	Acta obstetrician et gynecologica scandinavica	7
De Oliviera SMJV	7	King's College London	8	Archives of gynecology and obstetrics	7
Laine K	6	Keele University	7	Journal of obstetrics and gynecology	7

authors such as Thakur, Sultan and Ismail with citations of 137, 113 and 94 respectively within the evaluated studies. Most of the institutions with the highest number of publications came from the UK followed by those from Brazil. Table 1 also presents the journals with the highest number of publications on the topic. The top journals with more than 1000 citations included Obstetrics & Gynecology, Diseases of the Colon & Rectum, American Journal of Obstetrics & Gynecology and Neurology with citations of 1068, 1032, 1005 and 1002 respectively. The top 3 highest cited articles included (Renfrew et al., 2014), (Carroli and Mignini, 2009) and (Andrews et al., 2006) with 718, 683 and 280 citations respectively.

Fig. 7 below provides the co-occurrence network of keywords in the evaluated publications in the form of a network diagram visualized in VOS Viewer software. The size of the nodes indicates their number of occurrences and arrows indicate the most frequently co-occurring keywords. It can be seen from Fig. 6 that the major themes revolved around

pain management which in many instances was related to topics such as anal canal and faecal incontinence. Fig. 6 also indicates the change in keywords with the passage of years. It can be seen, for instance, that the focus of the publications, as indicated by the keywords, moved away from 'efficacy' to 'repair' and to certain types of drugs such as 'aspirin'. Thus, the current focus of research on the subject topic is pharmacological in nature. Overall, emerging themes however relate to topics such as manometry, anorectal pressure monitoring and anal surgery.

Conclusions

This bibliometric analysis aimed at exploring the trends in academic research on perineal trauma after child-birth. We can conclude that while research on the topic has been increasing with the passage of time, most of it revolves around pain management and has been dominated by researchers from the UK. Deeper analysis showed, however, that
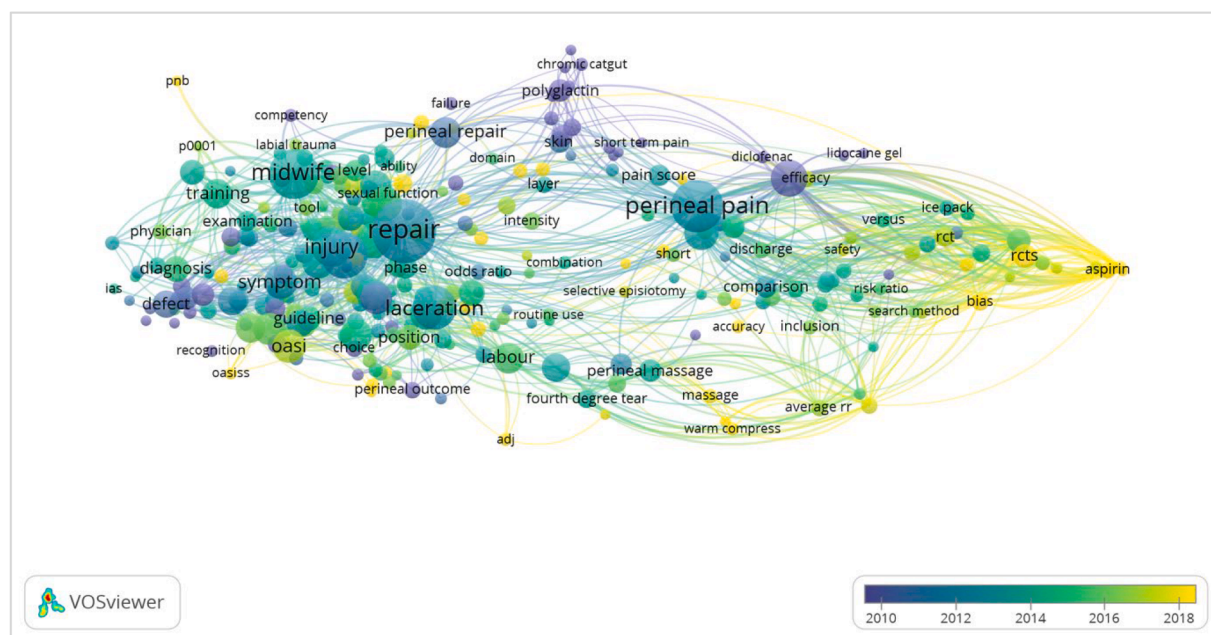
Fig. 7. Common co-occurrences of keywords over the years.

research in some developing countries (e.g., Brazil) has seen a recent upsurge in terms of the number of publications. This phenomenon can partly be explained by improvement in the economic conditions as demonstrated by the correlation between GDP/capita and number of publications (see Appendix). This also highlights the constraints faced by developing countries in public health research.

Strengths

The strength of this study lies in its comprehensive approach to analysing global research trends in perineal trauma management, spanning nearly four decades. By employing bibliometric techniques such as time series forecasting and correlation analysis, the study offers detailed insights into the patterns of research productivity and relationships with socioeconomic factors. Furthermore, the inclusion of emerging themes and assessment of collaboration networks enriches the understanding of the research landscape in this critical area of women's health.

Limitations

While bibliometric analysis provides valuable quantitative data, it may overlook qualitative aspects of research quality and impact. Additionally, the reliance on data from selected databases and search queries could introduce biases and overlook relevant publications. Furthermore, the study's focus on English-language publications may limit the representation of research from non-English speaking regions, potentially leading to gaps in the analysis. Despite these limitations, the study provides important insights and future research can uncover other variables that enable or hinder research on this topic for a deeper analysis.

Future research directions

Overall, this study can assist researchers and policymakers alike in formulating measures for improvement. To the best knowledge of the authors this is the first bibliometric study on the topic of perineal trauma management and as such fills an important gap in existing literature. Additionally, the sue of econometric methods may assist in method development to enrich bibliometric analyses further.

CRediT authorship contribution statement

Mustafa Ali: Writing – review & editing, Writing – original draft, Visualization, Software, Resources, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Valerie Fleming:** Writing – review & editing, Writing – original draft, Supervision, Project administration. **Clare Maxwell:** Writing – review & editing, Writing – original draft, Investigation.

Declaration of competing interest

This is to confirm that the authors declare no competing interests.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.midw.2024.104003.

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