

ORIGINAL RESEARCH

Global trends in penile aesthetic and sexual health procedures: a Google Trends analysis (2004–2024)

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Abstract

Background: Public interest in male sexual health, particularly penile aesthetic and enhancement procedures, has evolved over time under the influence of medical and societal factors. This study uses Google Trends data from 2004 to 2024 to investigate public search trends. **Methods:** A retrospective observational study was conducted using Google Trends to assess global search interest in penile aesthetic procedures over a 20-year period. The timeframe was divided into three intervals to evaluate temporal patterns. Search terms were selected via expert input and literature review. Statistical analyses included analysis of variance (ANOVA) and Kruskal-Wallis tests. **Results:** Interest in traditional terms like “Penis Enlargement” and “Penis Exercises” declined significantly, while more recent treatment terms such as “Penis Filler” and “Penis platelet-rich plasma (PRP)” showed marked increases ($p < 0.001$). “Penis Implants” remained stable ($p = 0.523$). Cost-related queries increased significantly, and geographic trends varied across regions. **Conclusions:** Public interest has shifted toward non-surgical penile enhancement methods, with a notable rise in cost awareness. These findings underscore the growing role of digital platforms in health-seeking behavior.

Keywords

Male sexual health; Penile filler; Penile PRP; Google Trends

Tendencias globales en procedimientos estéticos y de salud sexual masculina: un análisis de Google Trends (2004–2024)

Resumen

Antecedentes: El interés público por la salud sexual masculina, particularmente en los procedimientos estéticos y de aumento del pene, ha evolucionado con el tiempo bajo la influencia de factores médicos y sociales. Este estudio utiliza datos de Google Trends desde 2004 hasta 2024 para investigar las tendencias de búsqueda del público. **Métodos:** Se realizó un estudio observacional retrospectivo utilizando Google Trends para evaluar el interés global en procedimientos estéticos del pene durante un período de 20 años. El período se dividió en tres intervalos para evaluar los patrones temporales. Los términos de búsqueda se seleccionaron mediante aportes de expertos y revisión bibliográfica. Los análisis estadísticos incluyeron análisis de varianza (ANOVA) y pruebas de Kruskal-Wallis. **Resultados:** El interés por términos tradicionales como “Agrandamiento de pene” y “Ejercicios para el pene” disminuyó significativamente, mientras que tratamientos más recientes como “Relleno del pene” y plasma rico en plaquetas (PRP) del pene mostraron aumentos marcados ($p < 0.001$). El término “Implantes del pene” se mantuvo estable ($p = 0.523$). Las búsquedas relacionadas con el costo aumentaron significativamente, y las tendencias geográficas variaron entre regiones. **Conclusiones:** El interés del público se ha desplazado hacia métodos no quirúrgicos de aumento del pene, con un notable aumento en la conciencia sobre los costos. Estos hallazgos subrayan el papel creciente de las plataformas digitales en el comportamiento de búsqueda de salud.

Palabras Clave

Salud sexual masculina; Relleno peneano; PRP del pene; Google Trends

1. Introduction

Public interest in health is continually shaped by cultural dynamics, technological advancements and developments in medical science [1]. In the context of male sexual health, these medical innovations include a deeper understanding of the physiology of penile erection, the introduction of minimally invasive aesthetic procedures, and the emergence of novel regenerative therapies such as platelet-rich plasma (PRP) and shockwave therapy [2–5]. Male sexual health, encompassing concerns such as erectile dysfunction and penile health, is a crucial component of overall well-being [6]. However, societal stigmas often hinder open discussion, prompting individuals to seek information online rather than consulting healthcare providers [7]. Analyzing these online search behaviors can yield valuable insights into shifting societal attitudes and evolving health-related priorities.

Search engines like Google have become primary sources for accessing health-related information. This is mainly due to their ease of use, widespread availability and the anonymity they offer [8]. Especially in cases of stigmatized conditions, a significant proportion of individuals tend to delay or avoid professional medical consultation. Instead, they turn to the internet to investigate symptoms, explore treatment options and understand procedural details [9]. This trend highlights the relevance and growing utility of online search data as a proxy for gauging public health interests, particularly in sensitive domains such as male sexual health.

Google Trends, a tool that quantifies search volume on a scale from 0 to 100, offers a unique method for examining public interest over time and across various regions [10]. This tool has been utilized in health research to track trends in procedures such as breast augmentation [11] and to investigate the rising interest in female genital aesthetic procedures [12]. Furthermore, Google Trends has proven useful in monitoring public health crises such as the COVID-19 pandemic, further demonstrating its reliability in identifying shifts in public perception and interest [13].

Previous studies have indicated that individuals frequently research medical procedures, costs and treatment options online prior to consulting a healthcare provider. For instance, search queries related to “vaginal tightening” and “labiaplasty cost” have yielded valuable insights into public interest in female genital aesthetics, reflecting an increasing reliance on online platforms for preliminary health information [12]. These findings highlight the utility of Google Trends in anticipating healthcare needs and informing public health strategies.

This study primarily investigates public interest in penile aesthetics and sexual health procedures, as well as functional treatments such as penile implants. Although penile implants are traditionally considered therapeutic interventions for severe erectile dysfunction, they were included in this analysis due to their frequent appearance in public search behavior alongside aesthetic-related terms. This overlap suggests a convergence in public perception of functional and enhancement procedures within the domain of male sexual health. Notably, the study deliberately excludes search terms related to functional conditions such as erectile dysfunction and hypogonadism, as its primary focus lies in aesthetic and enhancement-

related procedures. Despite their growing popularity in media and consumer health discourse, these interventions remain underrepresented in academic literature, highlighting the need for focused investigation.

Our research identifies evolving trends in public interest by segmenting the analysis into three distinct periods (2004–2010, 2011–2017 and 2018–2024). Although a recent study has explored online interest in penile aesthetics, emphasizing the Penuma implant, our study differs by covering a 20-year global dataset and analyzing a broader range of search terms [14]. Through this approach, we aim to contribute to a deeper understanding of societal perceptions of male sexual health and the evolving landscape of related treatments.

2. Materials and methods

2.1 Study design

This retrospective observational study investigates public interest in penile aesthetic procedures by analyzing Google Trends data over a 20-year period (01 January 2004–31 December 2024). The dataset was stratified into three predefined intervals to assess longitudinal trends: 2004–2010, 2011–2017, 2018–2024.

Google Trends data collection infrastructure was launched in 2004. As a result, our study begins that year to ensure consistency in historical comparisons. Although Google Search has existed since 1998, no publicly accessible search volume data is available for the years 1998–2003. It is also important to note that internet usage has grown significantly, increasing global access and a broader, more diverse user base across the study periods. This evolution in digital behavior may influence overall search volumes and interest levels. Segmenting the study period into three equal intervals allows for a structured evaluation of evolving public interest while mitigating the impact of short-term fluctuations. Monthly relative search volume (RSV) data were extracted and analyzed to enhance temporal resolution and minimize variability.

2.2 Search term selection

Search terms were identified through a systematic literature review and expert consultations with specialists in andrology, reconstructive urology, and digital health analytics. Strict inclusion and exclusion criteria were applied to ensure methodological rigor and the relevance of the selected search terms to penile aesthetic procedures.

The inclusion criteria encompassed terms directly associated with penile augmentation and aesthetic procedures, search queries demonstrating consistent and measurable public interest (*i.e.*, non-zero RSV across multiple time frames), and widely recognized terminology with cross-linguistic applicability.

Conversely, the exclusion criteria eliminated terms with persistently low search volume (RSV = 0 across extended periods) or those below Google Trends’ reporting threshold, as well as terms related to functional male sexual health disorders, such as erectile dysfunction, low testosterone and prostate disease. Additionally, terms prone to semantic ambiguity or frequent misspellings, which could compromise data reliability,

ity, were excluded. Notably, general disease terms such as “erectile dysfunction” and “low testosterone” were omitted, as this study does not aim to track interest in broad functional disorders. However, specific procedures like penile implants, penile PRP and shockwave therapy were included due to their dual use in both functional and aesthetic contexts, and their growing relevance to consumer interest in male sexual health.

Moreover, while Google Trends automatically suggests related terms based on search behavior, only those aligning with the predefined inclusion criteria were incorporated. The final set of search terms included the following:

- “male sexual health”;
- “penis enlargement pills”;
- “penis enlargement”;
- “penis exercises”;
- “penis filler”;
- “penis implants”;
- “penis PRP”;
- “penis lengthening”;
- “penis shockwave therapy”;
- “penis surgery cost”.

2.3 Data collection

Google Trends was used to extract RSV data for each term, representing the proportional search interest normalized on a 0–100 scale. The following search settings were applied to ensure comprehensive data retrieval:

Geographic Scope: Worldwide (to capture global public interest);

Search Medium: Web Search (to encompass all relevant online queries).

In Google Trends, RSV = 100 denotes the peak popularity of a given term during the selected period, while RSV = 0 does not necessarily indicate an absence of searches but may reflect values below Google Trends’ reporting threshold [1]. Since Google Trends data is subject to dynamic normalization, multiple independent queries were performed at different time points to ensure data reproducibility and minimize algorithmic fluctuations.

To account for Google Trends’ data normalization process, identical queries were repeated across various retrieval intervals, and the resulting RSV values were averaged to improve robustness and mitigate potential data discrepancies.

2.4 Data validation and reliability

Google Trends normalizes RSV values dynamically, which may introduce minor inconsistencies depending on query timing. To mitigate potential biases, several methodological refinements were implemented. Data extraction was repeated multiple times for each search term over different periods, and the values were averaged to improve reliability. Comparative normalization checks were conducted by benchmarking queries across various retrieval dates to assess internal consistency. Additionally, cross-validation was performed with previous research, drawing upon established studies that validate Google Trends as a reliable epidemiological tool in health-related investigations [11, 12].

2.5 Statistical analysis

All statistical analyses were conducted using SPSS (version 25, IBM Corp., Armonk, NY, USA). The distribution of RSV values was assessed for normality using the Shapiro-Wilk test. Comparisons across the three study periods were conducted using one-way ANOVA if the data followed a normal distribution or the Kruskal-Wallis test if normality assumptions were not met, with the selection of the appropriate test based on pre-specified normality criteria. *Post hoc* analyses were performed to identify statistically significant pairwise differences among study periods, and statistical significance was set at $p < 0.05$.

3. Results

The analysis of Google Trends data from 2004 to 2024 revealed significant temporal and geographical variations for search interest in male sexual health terms. Search interest for general “Male Sexual Health” significantly declined over the three periods, decreasing from 43.9 in 2004–2010 to 20.7 in 2011–2017, followed by a slight increase to 25.3 in 2018–2024 ($p < 0.001$). Similar trends were observed for traditional terms such as “Penis Enlargement Pills”, “Penis Enlargement” and “Penis Exercises” all of which showed a marked reduction in search interest ($p < 0.001$). In contrast, search interest for “Penis Implant” remained stable across the three periods ($p = 0.523$) (Table 1).

3.1 Temporal trends

Searches for more recent treatments, including “Penis Filler”, “Penis PRP” and “Penis Shockwave Therapy”, increased significantly over time ($p < 0.001$) (Tables 1 and 2).

“Penis Filler” had no recorded search activity between 2004 and 2010 (RSV = 0.0) but search volume progressively increased in subsequent periods, reaching its highest level of interest between 2018 and 2024 (RSV = 36.43 ± 20.39). “Penis PRP” showed no search interest in the first period (RSV = 0.0), increased by 10.57 ± 13.72 during 2011–2017 and then further increased to 58.67 ± 15.29 in 2018–2024 ($p < 0.001$), indicating a strong upward trend. “Penis Shockwave Therapy” searches remained minimal before 2017 (RSV = 1.19 ± 10.91 in 2004–2010 and 0.87 ± 5.69 in 2011–2017) but rose sharply to 35.06 ± 29.50 in 2018–2024 ($p < 0.001$). “Penis Surgery Cost” queries also demonstrated a consistent increase, rising from 7.35 ± 10.05 in 2004–2010 to 24.49 ± 15.00 in 2011–2017, reaching 48.01 ± 25.75 in 2018–2024 ($p < 0.001$) (Fig. 1).

3.2 Geographical trends

Search interest for “Penis Enlargement” was highest in Indonesia, Russia, Czechia, Romania and Bangladesh between 2004 and 2010. From 2011 to 2017, interest shifted to South Africa, the Netherlands, the United Kingdom, Nigeria and Australia. During 2018–2024, the highest activity was recorded in China, South Africa, Nigeria, Kenya and the United Arab Emirates.

Search interest for “Penis Implant” was initially concentrated in Czechia, Japan, Hungary, Mexico and Spain between 2004 and 2010, later expanding to the United King-

TABLE 1. Temporal trends in search interest for male sexual health and related treatments (2004–2010, 2011–2017 and 2018–2024).

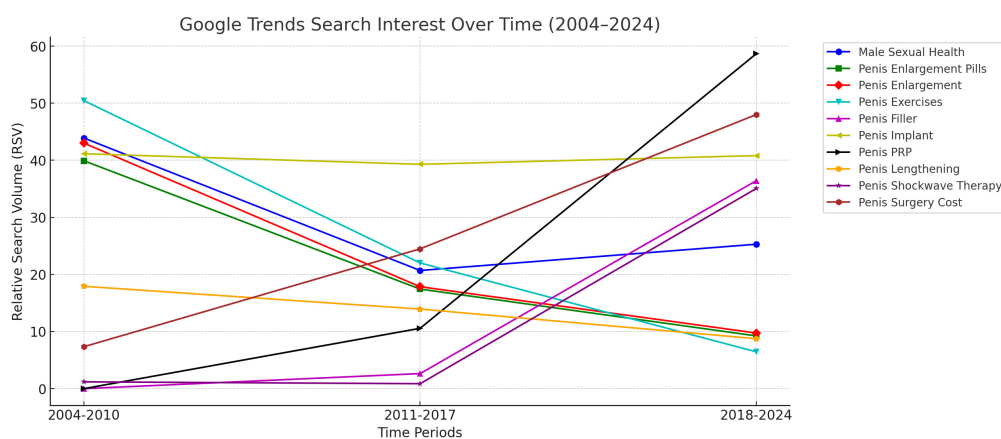
Term	2004–2010	2011–2017	2018–2024	p-value
Male Sexual Health	43.92 ± 22.65 ^a	20.70 ± 2.69 ^b	25.27 ± 7.88 ^b	<0.001
Penis Enlargement Pills	39.92 ± 18.26 ^a	17.44 ± 4.88 ^b	9.24 ± 3.04 ^c	<0.001
Penis Enlargement	43.01 ± 18.75 ^a	17.86 ± 3.81 ^b	9.74 ± 2.45 ^c	<0.001
Penis Exercises	50.45 ± 14.73 ^a	22.02 ± 8.08 ^b	6.45 ± 1.23 ^c	<0.001
Penis Filler	0.00 ± 0.00 ^a	2.64 ± 3.66 ^a	36.43 ± 20.39 ^b	<0.001
Penis Implants	41.15 ± 15.25 ^a	39.30 ± 8.75 ^a	40.82 ± 7.68 ^a	0.523
Penis PRP	0.00 ± 0.00 ^a	10.57 ± 13.72 ^b	58.67 ± 15.29 ^c	<0.001
Penis Lengthening	17.93 ± 17.91 ^a	13.94 ± 4.25 ^a	8.75 ± 1.48 ^b	0.042
Penis Shockwave Therapy	1.19 ± 10.91 ^a	0.87 ± 5.69 ^a	35.06 ± 29.50 ^b	<0.001
Penis Surgery Cost	7.35 ± 10.05 ^a	24.49 ± 15.00 ^b	48.01 ± 25.75 ^c	<0.001

Notes: Superscript lowercase letters (^{a,b,c}) indicate groups that differ significantly. Groups sharing the same letter (e.g., ^{a-a}) show no statistically significant difference, while groups with different letters (^{a-b}) indicate a significant difference ($p < 0.05$). Values are expressed as mean ± standard deviation. Group differences were assessed using Tukey's post hoc test. PRP: platelet-rich plasma.

TABLE 2. Percentage change in public search interest for male sexual health-related terms between successive time periods (2004–2024).

Term	Change% (2004–2010 to 2011–2017)	Change% (2011–2017 to 2018–2024)	Change% (2004–2010 to 2018–2024)
Male sexual health	–52.87%	22.08%	–42.46%
Penis enlargement pills	–56.31%	–47.02%	–76.85%
Penis enlargement	–58.47%	–45.46%	–77.35%
Penis exercises	–56.35%	–70.71%	–87.22%
Penis filler	N/A	1279.92%	N/A
Penis implants	–4.50%	3.87%	–0.80%
Penis PRP	N/A	455.06%	N/A
Penis lengthening	–22.25%	–37.23%	–51.20%
Penis shockwave therapy	–26.89%	3929.89%	2846.22%
Penis surgery cost	233.20%	96.04%	553.20%

Note: Values represent percentage changes in RSV between consecutive periods. “N/A” indicates that change could not be calculated due to an initial value of zero. PRP: platelet-rich plasma.

**FIGURE 1. Temporal trends in Google search interest for various male sexual health-related procedures from 2004 to 2024.** The figure displays relative search volumes (RSV) across three time periods (2004–2010, 2011–2017 and 2018–2024), demonstrating changes in public interest across various treatments over time. PRP: platelet-rich plasma.

dom, France, the Netherlands, the United States and Canada from 2011 to 2017. By 2018–2024, the highest interest was observed in Romania, Turkey, Australia and the United Kingdom.

“Penis Filler” searches were minimal between 2004 and 2010, with limited interest observed in a few European countries such as Finland. Between 2011 and 2017, interest expanded to regions including the United Arab Emirates, Australia, and Malaysia. By 2018–2024, notable increases were seen in the United Kingdom, the United States, and Finland, with new interest emerging in Brunei, Mongolia and Myanmar (Fig. 2).

4. Discussion

This study provides a comprehensive analysis of public interest in penile aesthetic procedures by utilizing Google Trends data spanning the period from 2004 to 2024. By examining search patterns across three distinct periods, this research highlights significant shifts in interest and emerging trends in treatments and procedures. The observed data reflect evolving societal perceptions and preferences regarding male sexual health and emphasize the critical role of online platforms in shaping healthcare-seeking behaviors, particularly in relation to stigmatized conditions.

A notable finding of this study is the increasing public interest in innovative penile augmentation treatments, such as PRP. This trend suggests a shift toward minimally invasive solutions for penile enhancement, reflecting the broader acceptance of non-surgical interventions in men’s aesthetic and sexual health. A recent study highlighted the rising demand for such procedures, particularly among individuals seeking non-surgical alternatives for penile augmentation and functional improvement [15]. The surge in searches for “Penis PRP” underscores a growing recognition of its potential benefits in addressing erectile dysfunction and enhancing sexual performance [16]. Recent literature suggests that PRP therapy contributes to penile vascularization, improves blood flow and facilitates tissue repair, thereby supporting its role as an effective regenerative treatment for erectile dysfunction [17]. These trends also appear to correspond with the timing of scientific and commercial introductions of these modalities.

PRP gained popularity in aesthetic medicine around 2010 and was adopted into urology shortly thereafter [17]. Similarly, early studies and media exposure related to penile fillers and shockwave therapy emerged in the early 2010s [18, 19]. These developments likely contributed to the surge in search interest observed during the second and third study periods.

Similarly, penile fillers have emerged as a popular aesthetic procedure, particularly in regions where cultural norms influence the demand for genital enhancement. Across various parts of the world, penile augmentation procedures have gained considerable momentum as men increasingly seek solutions for perceived penile size dissatisfaction [5]. The increasing preference for non-surgical options such as penile fillers reflects a broader trend toward minimally invasive aesthetic interventions, providing immediate results with minimal recovery time [20, 21]. This shift aligns with the growing popularity of non-invasive approaches in female genital aesthetic procedures, as documented in prior research on female genital enhancement [22]. The increasing interest in penile fillers from 2018 to 2024 further highlights a changing societal perspective, indicating a greater openness to non-surgical solutions for intimate health concerns.

Despite the rising popularity of more recent procedures, interest in penile implants remained stable across all the three analyzed periods. This consistency underscores the enduring role of penile implants as a definitive solution for severe erectile dysfunction [23]. The sustained interest likely reflects the proven reliability and efficacy of implants, which remain the gold standard for patients unresponsive to pharmacological treatments [24]. Clinical studies have demonstrated high patient satisfaction rates and long-term success following penile implant surgery, reinforcing its position as a key intervention for severe erectile dysfunction [25]. A study by Manfredi *et al.* [25] reported significant improvements in functional outcomes and quality of life among patients undergoing penile implant procedures, further reinforcing the clinical relevance of the procedure. While their clinical indication is primarily therapeutic, their inclusion in this study reflects their persistent visibility in online public interest data and their perceived association with sexual performance enhancement. These findings indicate that, while more recent minimally invasive treatments are gaining popularity, penile implants remain a

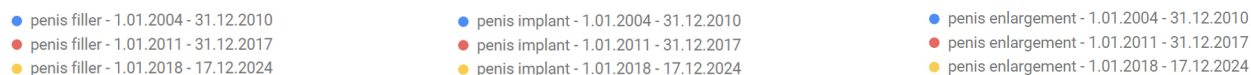


FIGURE 2. Geographical distribution of search interest for three representative terms: “Penis Filler”, “Penis Implant” and “Penis Enlargement” across the three study periods. Colors on the maps indicate the regions with the highest search volume for each term during the specified period.

cornerstone of therapeutic approaches to male sexual health. It should also be noted that search interest may not always correlate directly with clinical procedure rates. For instance, while public interest in penile implants appeared stable, actual implantation rates may have increased, possibly reflecting a population that directly consults specialists for such decisions rather than seeking online information [26]. This discrepancy highlights the distinction between public search behavior and medical treatment patterns.

Another important observation in this study is the marked increase in search queries related to the cost of penile surgery across all the three analyzed periods. This trend underscores the critical role of economic factors in shaping medical and aesthetic treatment decisions. Cost remains a major determinant in treatment accessibility, particularly for elective procedures. Previous studies have shown that individuals with lower income levels are less likely to undergo costly treatments despite their frequent interest in cost-related information [27]. Similarly, Goldman *et al.* [28] reported that a twofold increase in medication costs resulted in a 25% decline in usage, highlighting the sensitivity of treatment uptake to financial variables. Another study by Gupta and Naroo emphasized that financial considerations significantly influence patients' decisions when choosing between contact lenses and refractive surgery in ophthalmology. This suggests that similar cost-related factors may be at play in elective male sexual health treatments [29]. This pattern may also be partially explained by the aftermath of the 2008–2010 global economic crisis, which heightened public sensitivity to healthcare costs and likely increased cost-related searches during and after this period [30]. In alignment with these findings, the significant increase in searches for “Penis Surgery Cost” from 2004 to 2024 indicates that economic concerns remain central to decision-making in male sexual health interventions. Given this trend, healthcare providers and policymakers should prioritize price transparency and affordability to meet the increasing demand for cost-related information among patients.

While this study provides valuable insights, several limitations must be acknowledged. Google Trends data are based on RSV, representing proportional interest rather than absolute search counts. This means that the data reflect relative trends rather than direct numbers of searches, potentially limiting the ability to quantify public interest in absolute terms. It is also worth noting that not all search queries necessarily originate from patients themselves; some may be initiated by partners or individuals seeking information on behalf of someone else. This nuance complicates direct interpretation of online health interest and highlights the social context of sexual health decision-making. Additionally, RSV values are subject to fluctuations influenced by seasonal trends, media coverage and promotional campaigns, which may artificially inflate search interest for specific procedures over short periods. Moreover, the global scope of this analysis may obscure regional differences in healthcare access, cultural perceptions and economic factors, limiting the ability to draw context-specific conclusions applicable to specific populations. Finally, the influence of cultural norms, religious beliefs, and regional attitudes toward sexual health may substantially affect public search behavior. While this study included a global

dataset, such sociocultural dynamics were not analyzed in depth. Future studies may benefit from incorporating variables such as religious demographics or culturally specific indices to enhance the interpretation of geographic search differences.

Another methodological limitation is the reliance on predefined search terms, which, while essential for consistency, may have excluded emerging or colloquial terms that better capture evolving public interest. Furthermore, this study did not include certain traditional or culturally-rooted practices such as “jelqing”, which, despite their clinical relevance and potential harm, were not initially identified during the search term selection process. As such, popular non-clinical techniques may be underrepresented in the current analysis. Future studies could explore public interest in these alternative approaches more explicitly by incorporating colloquial or niche search terms into the dataset. Moreover, this study predominantly focuses on English-language queries, potentially overlooking search trends in non-English-speaking populations. Although Google Trends supports multilingual analysis, the exclusion of non-English terms may limit the generalizability of findings to English-speaking regions. Additionally, demographic biases may influence search behavior, as internet penetration and cultural differences impact access to digital health information. Changes in internet accessibility over time were not accounted for, which may have influenced regional search activity. Regulatory changes affecting the availability of penile aesthetic procedures in different countries could also be a confounding factor. Lastly, search activity recorded as “0” may not necessarily indicate no interest but could reflect Google Trends' reporting threshold.

Despite these limitations, this study provides valuable insights into the increasing public interest in penile aesthetic procedures and underscores the growing role of digital platforms in shaping health-seeking behaviors. A recent Google Trends study by Abou Chawareb *et al.* [14] also investigated search patterns related to penile aesthetic procedures. Still, it was limited to a narrow set of terms—particularly Penuma—within the U.S. context and over a shorter timeframe [14]. In contrast, our study broadens the scope both temporally and geographically, offering a more comprehensive global perspective on shifting public interest. These findings underscore the importance of further interdisciplinary research to contextualize search trends within broader sociocultural and economic frameworks, ensuring that healthcare strategies remain aligned with the evolving needs and interests of the public.

5. Conclusions

This study highlights the evolving public interest in male sexual health, with increasing attention to innovative treatments such as penile PRP and fillers, while penile implants remain a consistent point of focus. The rise in searches related to procedural costs underscores the significant impact of financial factors on healthcare decision-making. Despite its limitations, the study provides valuable insights into health-seeking behaviors and emphasizes the growing role of digital platforms in shaping patient engagement and informing future healthcare strategies.

AVAILABILITY OF DATA AND MATERIALS

The data presented in this study are available on reasonable request from the corresponding author.

AUTHOR CONTRIBUTIONS

MG and CO—designed the research study. AA and CD—performed the data curation. MG—analyzed the data. MG, CD and AA—performed the software analysis. MG and AA—wrote the original draft. NFG and CO—provided help and advice on the methodology and investigation. All authors contributed to editorial revisions. All authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study used only publicly available, anonymized Google Trends data and did not involve human subjects, clinical interventions, or patient-identifying information, so ethics committee approval was not required.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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