Journal of Midwifery & Reproductive Health

JMRH.mums.ac.ir

Forecasting Research Trends on Infertility-Related Content in Iran: An Opportunity for National Healthcare Providers

Reza Jafarzadeh Esfehani (MD, PhD)[1*]

[1] Assistant Professor, Blood Borne Infections Research Center, Academic Center for Education, Culture and Research (ACECR), Razavi Khorasan Branch, Mashhad, Iran

ARTICLE INFO

Article type:
Short Communications

Article History:
Received: 17-Nov-2023
Accepted: 20-Oct-2024

Key words:
Infertility
Fertility
Iran

ABSTRACT

Infertility is a major health problem and has a significant negative impact on people, society and the economy. Therefore, the study of fertility trend is one of the main interests of health researchers and policy makers. The aim of this study was to evaluate the interest in searching for infertility related contents in Persian language over the Internet. Our model forecasted an increase in search for terms related to infertility from September 2023 to November 2027 by 50.2%. Given the recent national reports on the fertility rate, we showed that the provinces with the highest rate of infertility had a higher interest in searching for terms related to infertility and the provinces with the lowest rate of infertility had a lower interest in searching. In addition, provinces with high Internet access showed lower interest in searching for fertility-related content, while provinces with lower Internet access had higher rates of fertility-related searches. Consequently, regional health care providers can offer more fertility-related content online for the provinces with high infertility rate as they are more likely to seek for fertility related content online. Moreover, increasing the Internet users in these regions can facilitate access to fertility-related topics for more infertile couples.

▶ *Please cite this paper as*:
Jafarzadeh Esfehani R. Forecasting Research Trends on Infertility-Related Content in Iran: An Opportunity for National Healthcare Providers. Journal of Midwifery and Reproductive Health. 2025; 13(4): 5120-5126. DOI: 10.22038/jmrh.2024.75817.2234

Introduction

Infertility is a significant health concern in numerous countries, causing significant negative personal, social, and economic impacts (1). The study of infertility trends is thus a primary focus for health researchers and policymakers. Understanding infertility trends aids in comprehending its causes, developing innovative treatments, enhancing access to care facilities, and raising awareness to alleviate the stigma associated with the condition (2). Iran's infertility trend has not been extensively studied, and the results of available studies remain controversial over time, unlike many other countries (3-7). The study uses online search content to evaluate infertility trends and forecasts health-related issues up to 2027, addressing limited data. Inconsistency in studies on infertility prevalence is likely due to the lack of uniform methodologies used in evaluating the prevalence of infertility across different time frames, potentially resulting in unreliable results. (4). Moreover, studying health trends, including infertility, necessitates a robust active data registry platform, which is costly for healthcare systems. Researchers are thus increasingly focused on studying disease trends using alternative approaches as a new area of interest (8). One of the methods employed involves utilizing publicly available data from "Google Trends" to assess the pattern of specific medical conditions (9-13). Therefore, in light of our prior research, we have opted to explore Google Trends data on infertility in Iran (10, 14). The aim of this study was to evaluate the

* *Corresponding author*; Reza Jafarzadeh Esfehani, Blood Borne Infections Research Center, Academic Center for Education, Culture and Research (ACECR), Razavi Khorasan Branch, Mashhad, Iran. Tel: 00989354851877; Email: drrezajafarzadeh@yahoo.com

interest in searching for infertility related contents in Persian language over the Internet.

Materials and Methods

This study used publicly available, aggregate search-interest data to evaluate and forecast Persian-language searching behavior for fertility-related topics in Iran. We extracted search-volume data from Google Trends (www.google.com/trends) for the period 2004 through 31 August 2023. Search terms were chosen to represent the three core concepts of interest including infertility, fertility and sterility using the common Persian-language equivalents and common colloquial synonyms identified through a literature review and by consultation with two reproductive-health specialists. All Google Trends queries were restricted to the geographic region "Iran", the category "Health", and the web-search modality. For each term we downloaded the time-series of relative search volumes (RSV; 0–100 normalized scale) at monthly resolution.

Because Google Trends reports normalized RSVs separately for each query, and to create a single composite index reflecting overall interest in fertility-related topics, we first harmonized the three term-level series by using their monthly RSV values and computing the arithmetic mean across the three terms for each month (i.e., composite monthly RSV = mean (RSV_term1, RSV_term2, RSV_term3)).

We used SPSS version 21 for time-series modeling because this software provides established ARIMA modeling workflows. Candidate forecasting models included non-seasonal ARIMA and seasonal ARIMA (SARIMA) specifications; model orders were guided by inspection of the sample autocorrelation function (ACF) and partial autocorrelation function (PACF) plots, and by results of the ADF test to determine required differencing and seasonal differencing. We fitted models by maximum likelihood estimation and compared competing models using multiple performance metrics: stationary R-squared, mean absolute error (MAE), mean absolute percentage error (MAPE), and normalized Bayesian information criterion (BIC). Residuals were inspected for independence and white-noise behavior using the Ljung–Box Q test and residual ACF plots; residual normality was assessed by visual QQ plots and Kolmogorov–Smirnov tests where indicated. The final forecasting model selected on the basis of best overall diagnostics and forecasts were generated for the period September 2023 through November 2027 with 95% prediction intervals (upper and lower control limits). Statistical significance was set at two-sided $p < 0.05$. All data used in this study are aggregated and publicly available; no individual-level or identifiable data were accessed.

To explore geographic variation in search interest and its relation to established epidemiologic and infrastructural indicators, we calculated the mean composite RSV for each Iranian province across the 2004–2023 study window. We obtained province-level infertility prevalence from the most recent national survey/report available (National Institute for Health Research, 2020) and used published statistics on internet user rankings by province (source cited in the manuscript). Provinces were categorized into high/moderate/low infertility prevalence groups following thresholds reported in the national survey; internet-access categories were defined according to the published ranking and grouped into tertiles for analysis.

Results

Through the implementation of multiplicative seasonal decomposition, it has been established that there has been a progressive increase in the demand for infertility-related terms in the Persian language since 2004 (Figure 1A). Based on the most suitable autoregressive integrated moving average (ARIMA) model, specifically ARIMA (0,1,6) (0,1,1), with a stationary R-squared value of 0.936, mean absolute error (MAE) of 0.324, mean absolute percentage error (MAPE) of 2.442, and normalized Bayesian information criterion (BIC) of -1.159, the analysis confirms a consistent upward trend in the search volume for infertility-related terms (Figure 1B).

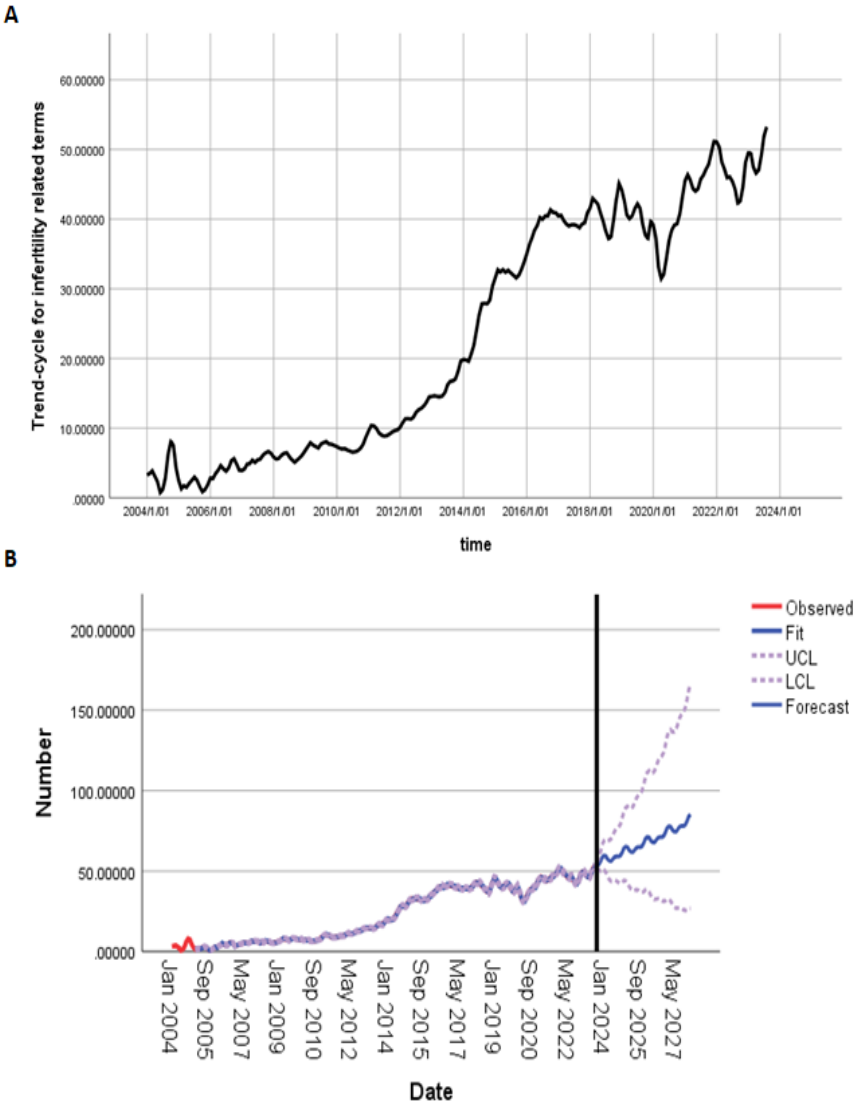

Figure 1. A. The trend of searching for fertility-related terms, including (infertility, sterility, and fertility), from 2004 to 2023. B. The forecasting model for searching for fertility-related terms from 2023 to 2027. UCL = Upper Control Limit. LCL = Lower Control Limit.

Furthermore, the forecast predicts a significant increase of 50.2% in the search volume for infertility-related terms from September 2023 to November 2027. The data presented in Table 1 illustrate the average search term associated with infertility for different provinces. Sistan and Baluchestan, Khuzestan, Ilam, and East Azerbaijan emerged as the provinces with the highest search volume, indicating a significant interest in infertility, whereas Gilan, Qom, Mazandaran, and Golestan had the fewest searches for infertility. Table 1 presents the average number of searches, internet usage, and prevalence of infertility, as reported by each nation.

Table 1. Searching interest, infertility prevalence, and widespread internet use among provinces

Prevalence of infertility based on national report	Mean number of search terms	Ranking of the number of internet users
High		
Sistan and Baluchestan	89.3	29
Khuzestan	89.0	6
Kermanshah	79.7	25
Ardabil	72.3	13
Hormozgan	66.3	7
Bushehr	60.7	12
Kohgiluyeh Va Boyer Ahmad	60.3	26
Golestan	59.0	17
Moderate to high		
Ilam	87.7	21
West Azerbaijan	83.3	23
Chaharmahal and Bakhtiari	82.0	11
Khorasan Razavi	74.0	16
Lorestan	69.3	30
Semnan	66.7	5
North Khorasan	61.7	31
Qom	57.0	4
Moderate		
East Azerbaijan	87.7	14
Kurdistan	78.0	18
Hamadan	75.0	19
Fars	72.7	8
Yazd	66.7	9
South Khorasan	64.7	27
Kerman	63.7	28
Mazandaran	58.7	1
Low		
Zanjan	79.3	15
Isfahan	74.7	3
Tehran	69.7	2
Qazvin	61.0	20
Markazi	59.3	22
Alborz	59.3	24
Gilan	56.3	10

Discussion

Although our findings may not accurately reflect the current trend of infertility in Iran, the growing number of searches for terms related to infertility suggests two significant implications in the realm of infertility research. Upon analyzing the upward trajectory of infertility rates, it becomes evident that the prevailing trend is one of increasing infertility. This observation is substantiated by various meta-analysis studies, which have consistently reported a rise in infertility cases. The prevalence of infertility differs across countries, ranging from 3.5% to 30%. However, a recent meta-analysis conducted in Iran revealed that 12.5% of the Iranian population experienced infertility. Despite the unchanged prevalence of infertility in Iran from 1990 to 2016, there was a notable decrease in the total fertility rate (3). Another systematic report evaluating Persian studies published from 2001 to 2011 reported the increasing prevalence of infertility at 13.2% (5). On the other hand, Direkvand-Moghadam et al.'s (2014) systematic review evaluating Iranian publications published from 2001 to 2011 reported that the prevalence of primary infertility is 5.2% (6). Although Safarinejad et al. (2008) conducted a study on a group of patients

and Direkvand-Moghadam et al. (2014) conducted a systematic review, making a direct comparison between these two studies may not be logical; however, it is worth noting that the rate of primary infertility from the 1995-2000 cohort, as reported by Safarinejad et al. (2008), remained consistent until the 2001-2011 data reported by Direkvand-Moghadam et al. (2014) (6-7). According to a meta-analysis conducted by Maharlouei et al. (2021), which evaluated Persian studies from 2001 to 2019, it was found that the prevalence of infertility in the Iranian population was 5% for primary infertility. This percentage was slightly lower compared to the findings of Direkvand-moghadam et al. (2014) and Safarinejad et al. (2008) (6-7, 15). Nonetheless, the most recent meta-analysis examining Persian studies revealed a primary infertility prevalence of 18.3%, which is significantly greater than the findings of the Maharlouei et al. (2021) study that assessed studies conducted during a similar time frame (3, 15).

Despite the studies evaluating the prevalence of infertility in Iran, there are only few studies evaluating the changes in the infertility rate in Iran. In 2008, the only study examining the fluctuations in infertility rate in Iran was published. The research conducted by Safarinejad et al. (2008) focused on assessing the primary infertility rate in different marriage cohorts. Their findings revealed a significant increase of 65.3% in the infertility rate from the 1985-1989 cohort to the 1990-1994 cohort. Furthermore, there was an additional rise of 27% in the infertility rate from the 1990-1994 cohort to the 1995-2000 cohort (7).

Iranians are showing a growing awareness of the issue of infertility and a desire to learn more about it or seek help from infertility clinics. Additionally, the frequency of search terms related to infertility can be correlated with internet accessibility and the prevalence of infertility in different provinces. According to the latest national report on infertility in Iran, the provinces have been classified into four categories based on the prevalence of infertility. These categories include provinces with a high prevalence of infertility, provinces with a moderate to high prevalence, provinces with a moderate prevalence, and provinces with a low prevalence of infertility (16). Our study provided compelling evidence that the search interest for infertility-related terms varied significantly based on the rates of infertility in different provinces. Provinces with higher rates of infertility displayed a heightened search interest in these terms, whereas provinces with lower rates of infertility demonstrated a relatively diminished search interest. After categorizing the provinces into high, moderate, and low internet access (17), provinces with greater internet access exhibit a decreased inclination towards exploring infertility-related topics, whereas provinces with limited internet access demonstrate a higher prevalence of searches related to infertility. In light of the growing inclination towards searching for infertility-related matters and the limited availability of reliable internet connections in provinces with a significant interest in such content, healthcare providers are encouraged to produce informative materials on infertility. This initiative aims to enhance awareness among couples struggling with infertility (14). Online infertility education offers essential and dependable resources concerning the diagnosis and treatment of infertility (15). Additionally, the improvement of internet availability in provinces with inadequate internet access and a strong inclination towards seeking infertility-related content will contribute to a heightened awareness regarding infertility (16). The provinces with a significant interest in infertility-related content are of great significance to national healthcare providers. This interest serves as a concerning indication of infertility and prompts the providers to coordinate healthcare resources to address this issue in specific regions of the country (17).

This study offers valuable insights into infertility-related search trends in Iran through innovative methodological approaches, though several limitations warrant consideration. Among its primary strengths is the utilization of Google Trends data as a cost-effective proxy for public interest in infertility, circumventing the need for expensive national registries. However, the study exhibits limitations that necessitate cautious interpretation. Google Trends data reflects information-seeking behavior rather than clinical prevalence, potentially influenced

by awareness campaigns, stigma, or non-clinical users. Reliance on only three Persian search terms may overlook nuanced queries. Additionally, the absence of clinical validation against hospital records or national registries weakens claims about actual infertility trends. Demographic drivers and confounding events during the study period were also unaddressed. Future studies may validate the search trends with clinical registries, survey data, or electronic health records to establish direct links between online behavior and epidemiological patterns.

Conclusion

The prevalence of infertility in Iran and its provinces can be correlated with the search trend for infertility-related terms, as regions with a higher number of searches tend to have a higher prevalence of infertility and lower internet access. The demand for online fertility-related content is particularly pronounced in provinces with higher infertility rates. Nonetheless, regional healthcare providers can capitalize on this trend by expanding their online offerings in this area. Furthermore, the expansion of internet usage in these regions could potentially enhance the availability of information on infertility for couples struggling with infertility.

Declarations

Acknowledgements

There is no financial source to acknowledge. There is no conflict of interest in this study.

Conflicts of interest

The authors declared no conflicts of interest.

Ethical considerations

The study did not include any human or animal subject and the free data available on the google trend was used.

Code of Ethics

N/A.

Use of Artificial Intelligence (AI)

N/A.

Funding

There is no source of funding to declare.

Authors' contribution

RJE conseptualisation, data acquisition, data analysis, writing the original and final draft of manuscript.

References

1. Rouchou B. Consequences of infertility in developing countries. Perspectives in Public Health. 2013; 133(3): 174-179.
2. Jafarzadeh-Kenarsari F, Ghahiri A, Zargham-Boroujeni A, Habibi M, Hashemi M. Patient-centered Fertility Care: From Theory to Practice. Journal of Midwifery and Reproductive Health. 2016; 4(3): 712-719.
3. Abangah GH, Rashidian T, Parizad Nasirkandy M, Azami M. A Meta-Analysis of The Prevalence and Etiology of Infertility in Iran. International Journal of Fertility & Sterility. 2023; 17(3): 160-173.
4. Akhondi MM, Ranjbar F, Shirzad M, Ardakani ZB, Kamali K, Mohammad K. Practical difficulties in estimating the prevalence of primary infertility in Iran. International Journal of Fertility & Sterility. 2019; 13(2): 113.
5. Moghadam AD, Delpisheh A, Sayehmiri K. The trend of infertility in Iran, an original review and meta-analysis. Nursing Practice Today. 2014; 1(1): 46-52.
6. Direkvand-Moghadam A, Moghadam, Delpisheh A, Sayehmiri K. The trend of infertility in Iran, an original review and meta-analysis Article Info Abstract. Nursing Practice Today. 2014; 1: 46-52.
7. Safarinejad MR. Infertility among couples in a population-based study in Iran: prevalence and associated risk factors. International Journal of Andrology. 2008; 31(3): 303-314.
8. Nuti SV, Wayda B, Ranasinghe I, Wang S, Dreyer RP, Chen SI, et al. The use of google trends in health care research: a systematic review. PLoS One. 2014; 9(10): e109583.
9. Esfehani RJ, Shariati M, Sadr-Nabavi A, Bidkhori HR. Evaluation of COVID-19 trend in Iran; Population response to the recent pandemic overtime. International Journal of Preventive Medicine. 2022; 13(1): 6.
10. Hedayati-Moghaddam MR, Esfehani RJ. Global and national trends toward hepatitis in COVID-19 Era: emerging pandemic and neglect of other diseases. Hepatitis Monthly. 2021; 21(10).
11. Jafarzadeh Esfehani R, Rezaei Ardani A, Rezaei Kalat A. Analyzing anxiety and treatment trends using google trends: validation of epidemiologic studies and forecasting. Quality & Quantity. 2025: 1-12.

12. Limilia P, Pratamawaty BB. Google trends and information seeking trend of COVID-19 in Indonesia. Jurnal Aspikom. 2020; 5(2): 188-205.
13. Mavragani A, Ochoa G. Google Trends in infodemiology and infoveillance: methodology framework. JMIR Public Health and Surveillance. 2019; 5(2): e13439.
14. Esfehani RJ, Shariati M, Sadr-Nabavi A, Bidkhori HR. Evaluation of COVID-19 trend in Iran; Population response to the recent pandemic overtime. International Journal of Preventive Medicine. 2022; 13.
15. Maharlouei N, Morshed Behbahani B, Doryanizadeh L, Kazemi M. Prevalence and pattern of infertility in Iran: A systematic review and meta-analysis study. Women's Health Bulletin. 2021; 8(2): 63-71.
16. National Institute for Health Research. (n.d.). National Survey of Non-Communicable Diseases. Tehran University of Medical Sciences. Retrieved [27/8/2025]. Available from: https://nihr.tums.ac.ir
17. Mehr News Agency. Table of provinces with the least and most internet users / The most popular type of network connection [Table]. 2014. Available from: https:// www. mehrnews.com/xpQx7