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Public interest in online searching of asthma information: insights from a Google trends analysis

Marsa Gholamzadeh¹¹, Mehrnaz Asadi Gharabaghi² and Hamidreza Abtahi^{3*}

Abstract

Background Google Trends (GT) is a free tool that provides insights into the public's interest and informationseeking behavior on specific topics. In this study, we utilized GT data on patients' search history to better understand their questions and information needs regarding asthma.

Methods We extracted the relative GT search volume (RSV) for keywords associated with asthma to explore information-seeking behaviors and assess internet search patterns regarding asthma disease from 2004 to 2024 in both English and Persian languages. In addition, a correlation analysis was conducted to assess terms correlated with asthma searches. Then, the AutoRegressive predictive models were developed to estimate future patterns of asthma-related searches and the information needs of individuals with asthma.

Results The analysis revealed that the mean total RSV for asthma-related keywords over the 20-year period was 41.79±6.07. The researchers found that while asthma-related search volume has shown a consistent upward trend in Persian-speaking countries over the last decade, English-speaking countries have experienced less variability in such searches except for a spike during the COVID-19 pandemic. The correlation analysis of related subjects showed that "air pollution", "infection", and "insomnia" have a positive correlation with asthma. Developing AutoRegressive predictive models on retrieved Google Trends data revealed a seasonal pattern in global asthma-related search interest. In contrast, the models forecasted a growing increase in information-seeking behaviors regarding asthma among Persian-speaking patients over the coming decades.

Conclusions There are significant differences in how people search for and access asthma information based on their language and regional context. In English-speaking countries, searches tend to focus on broader asthma-related topics like pollution and infections, likely due to the availability of comprehensive asthma resources. In contrast, Persian speakers prioritize understanding specific aspects of asthma-like symptoms, medications, and complementary treatments. To address these divergent information needs, health organizations should tailor content to these divergent needs.

Keywords Google trend, Time series analysis, Asthma, Public interest, Relative search volume

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Introduction

Asthma is a heterogeneous chronic respiratory disease characterized by airway obstruction [1–3]. According to the Global Burden of Disease, asthma affects approximately 262 million people worldwide, and each year, 250,000 people die due to asthma-related problems [4]. In 2023, the top three countries with the highest prevalence of asthma were the United States, the United Kingdom, and Portugal [5, 6]. Despite advances in asthma treatment and diagnosis, asthma remains poorly controlled in many countries due to several factors [7]. Uncontrolled asthma which leads to frequent hospitalizations, emergency room visits, absences from work or school, sleep disturbances, poor quality of life, and mental health issues, continues to be a major public health problem [8, 9].

One of the most effective ways to control asthma is to empower patients through self-management [10, 11]. Given the high importance of self-management, asthma management programs have focused on patient education and increasing public awareness by providing the necessary information to patients to enable their active participation in the management and controlling disease [12, 13]. By identifying the specific information needs of the patient population, healthcare providers can deliver appropriate educational interventions [14]. Equipping patients with this knowledge and the necessary self-management skills is crucial for achieving and maintaining optimal asthma control [15, 16]. However, patients may have difficulty expressing their information needs, leading to a potential gap between the information they are provided and the information they need [17]. There is evidence that asthmatic patients still have unmet information needs, highlighting the requirement for more effective approaches to determining and addressing patients' information needs in asthma care [18-20].

Given the importance of identifying patients' information needs in asthma, various studies have been conducted across different countries and patient populations [16, 18, 21–24]. Though the outcomes of these studies were not generalizable and came with many limitations. Evidence shows that patients prefer online resources over other sources because they are easy to access and provide a wealth of detailed information. Online resources offer comprehensive details about specific diseases, including typical treatment options, expected timelines, and guidance on properly using any prescribed medications [14]. This makes online resources the preferred choice for patients seeking to understand their condition and care plan [25–28].

According to Jia et al., 83% of health information consumers retrieve relevant information using a general search engine, such as Google [29]. Hence, analyzing Google Trends data on search volumes can effectively indicate public awareness and interest in specific health topics and diseases [30, 31]. Google Trends (GT) tracks the relative popularity of search terms over time, providing insights into emerging public concerns [32]. As one of the big data sources, GT provides a huge amount of data in time series format for quantitative and qualitative survey [33–35]. For instance, during COVID-19, researchers used Google Trends to monitor interest in preventive measures like masking [36]. This "infodemiology" approach utilize search data to predict and address evolving public health trends. By revealing informationseeking patterns, infodemiology offers valuable insights to inform targeted health interventions, education campaigns, and policymaking [37].

While numerous studies have used GT data to examine public interest and awareness of various health topics, no prior research has specifically analyzed public insights into asthma. This study aims to fill that gap by using GT's robust search volume data to evaluate the public's long-term information-seeking behavior and evolving interest in asthma over the past two decades. By applying this data-driven approach to the context of asthma, the current study seeks to uncover trends in how the general population has engaged with and sought information about this common respiratory condition. The findings could inform more targeted asthma education, outreach, and healthcare initiatives responsive to the evolving information priorities of patients and the broader public.

Methods

In this study, Google Trends (GT) was employed as a source of data to explore information-seeking behaviors of people worldwide regarding chronic asthma disease between 24 June 2004 and 1 July 2024. The GT search data analyzed in this study was collected and evaluated according to the standardized checklist proposed by Nuti et al. [38]. This systematic approach ensures the data is interpreted reliably when investigating trends in public information-seeking.

Data collection procedure

GT search analysis was conducted in two phases using the Pytrends library in Python. First, global English-language searches covered core asthma terms like "asthma," "asthma disease," and "asthmatic." This was followed by targeted Persian-language queries within Iran on the same topics. Beyond these core keywords, the researchers also retrieved related search queries and geographic trends. The retrieved information regarding the data points was downloaded in comma-separated values (CSV) format for further analysis. To avoid selection bias, repeated searches from the same person within a short period of time are removed by Google Trends. GT is one of the most popular open-source online tools for evaluating public internet search data and has several advantages [39]. Specifically, this tool automatically collects real-time data based on entire keywords and makes it available to researchers for free [40]. GT search volume data can be used to investigate and gain understanding of prevailing public interests and information-seeking behaviors [33]. This feature can show how many search terms have been entered into Google's search engine in relation to total search volume over time since 2004 and in different geographic locations. The search query index in this tool does not show raw levels of search queries, but rather provides a relative search volume index, Relative search volume (RSV) whose formula is defined by Aguilera et al. [41] in shown in the following:

$$RSV(q,r,t) = \frac{s(q,r,t)}{\sum_{q \in Q(r,t)} s(q,r,t)}$$
(1)

 \dagger Where s(q, r, t) represents the number of search queries for keyword q in a specific geographic location r at time t and Q(r, t) represents the set of all search queries in location r and in time interval t.

In consequence, RSV is calculated by normalizing the volume of a particular search retrieved during a specific period in a specific location compared to the volume of all searches at the same time and location [42]. GT uses a relative scale of 0 to 100 for RSV to represent search term popularity, rather than showing exact search volumes. On this scale, a score of 1 indicates the lowest relative popularity, while 100 denotes the highest. Importantly, a score of zero means there is insufficient data for that search term.

Exploratory data analysis (EDA) and statistical analysis

According to the retrieved data, the interest over time index was calculated for different time frames to determine peaks in interest for the searched terms. Then, for descriptive analysis, the mean, standard deviation (SD), median, maximum, and minimum were calculated for the relative search volume (RSV) of each searched key term. To verify the normality of the variables, the Kolmogorov– Smirnov test was used. Next, the trends in the retrieved GT data using interest over time index were visualized using to show to show that this data is a time series data type. All analyses were performed using Python in the Google Colab platform.

Since correlated search terms for each English and Persian keywords used in study areas were retrieved using Google Correlate, the correlation analysis of the key terms with the symptoms and factors related to asthma was performed using the Pearson correlation coefficient after removing the missed data and trend visualization.

Investigating trend and seasonality characteristics

One of the main and important characteristics of a time series is the stationarity or trend pattern. A time series is said to be stationary if its statistical properties such as mean and variance are constant over time [43]. If seasonality pattern was identified in in time-series data, we remove it from the data to make the time-series data more suitable for model [44].

In this phase, our time series data (GT data) was divided into its four main components, in order to determine the trend types. Finally, the data were also checked considering noise and autocorrelation. Then, if necessary, the data was transformed using the log function to bring the data distribution closer to a more stable condition [44]. After that, a data stationary test was conducted using Augmented Dickey-Fuller (ADF) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) techniques using p-value. ADF test is a widely used statistical method to determine whether a given time series is stationary or non-stationary. A p-value less than 0.05 from the ADF test indicates the time series is statistically significant and can be considered stationary [45].

After data decomposition, with the aid of the ADF test, the pattern of time series data was investigated in search volumes in English and Persian languages. The box-plot visualization showed the seasonal pattern of RSV for asthma. In addition, the autocorrelation function was employed to investigate the linear relationship between lagged values and the stationary status of data.

Forecasting search trends

For further investigation, the data were averaged in a fixed time window to generate new data based on the average of the previous data. This helps reduce the impact of random fluctuations on the analysis.

After converting the seasonal time series into a stationary time series, we used the Autoregressive integrated moving average (ARIMA) model to predict future trends in searches for keywords related to "asthma" in both Persian and English. The ARIMA model combines the autoregressive (AR) model, the integrated (I) model, and the moving average (MA) model to better fit and predict time series data that exhibit nonstationary or trends [46, 47]. The autoregressive component uses past values of RSV to predict future values for asthma keywords, the integrated component removes trends and fixes the seasonality of the data, and finally the moving average component uses past errors [48]. ARIMA was chosen because it is the most widely used method for forecasting public interest to predict monthly search volume in health sciences using GT data [48-53].

Two different models (SARIMAX, and Pmdarima) were developed on or data to find the best model for prediction in addition to ARIMA. However, ARIMA is one of the best models for forecasting time series data and is able to work with seasonal components even on nonstationary data, but the SARIMAX model stands for Seasonal AutoRegressive Integrated Moving Average with external variables, which is an extended format of the ARIMA model that calculates seasonal variation in a time series to forecast the future values [54, 55]. PMDArima is an open-source library in Python used for time series forecasting and also helps in creating time series graphs.

Results

Descriptive analysis

At first, the search results in Google were retrieved using the keywords asthma, allergy, and related words. Google's search engine data in English language retrieval since 2004 is depicted in Fig. 1.

A graph of the mean of RSV over time shows that before the COVID-19 pandemic, people's interest in asthma-related searches had decreased, but during the pandemic, by 2021, RSV gradually increased until it reached its highest level at the time of the declaration of COVID-19 as a pandemic by WHO and then faced a downward trend again, which is higher compared to the years 2015 to 2018. The mean of total RSV in 20 years of time frame regarding asthma was 41.79 ± 6.07 .

Examining the retrieved results in English in terms of geographical regions showed that most searches were done in Zambia, followed by Jamaica, the Philippines, Ghana, and Ethiopia. Among the next five countries, the most searches are for Australia, England, America, Ireland, and Kenya. The frequency of RSV shows that interest over time in the Persian language has faced an upward trend since 2012. The descriptive analysis of the extracted data shows that although the average RSV is lower than the global average of RSV, the interest in searching and finding information regarding asthma-related subjects in the Persian language has increased significantly in recent decades. As expected, in terms of geographical distribution, the largest RSV belongs to Iran, followed by Afghanistan.

Correlation analysis

The correlation analysis of related subjects showed that some terms have a positive correlation with asthma. The independent term's correlations and total Relative Search Volume (RSV) with asthma are described in Table 1 for each term.

Stationary and seasonability investigation of time series data

After data decomposition, with the aid of the Dickey-Fuller test, the analysis showed that search volumes in English (P-value = 0.15) and Persian languages (P-value = 0.35) have a non-stationary pattern. The boxplot visualization which showed the seasonal pattern of RSV for asthma is shown in Fig. 4.

In addition, the autocorrelation function (ACF) was employed to investigate the linear relationship between lagged values and the stationary status of data. The ACF plot can be used to identify the number of lags required



Fig. 1 Popularity for the terms for asthma and allergy in English language based on Mean of relative search volume (RSV) over time. Google's search engine data in English language retrieval since 2004 is depicted in this graph



Fig. 2 Geographical distribution of the volume of research in the English language (Darker colors indicate greater interest in searching, and lighter colored areas indicate less interest in searching in these areas.)



Fig. 3 Popularity for the terms for asthma and allergy in Persian language based on Mean of relative search volume (RSV) over time. Google's search engine data in Persian language retrieval since 2004 is depicted in this graph

Table 1 Pearson correlation of asthma-related terms in Englishand Persian languages

Term	Mean of total	Pearson correla-	P-
	RSV	tion coefficient	value
English language			
COVID-19	2.512 ± 7.496	r=0.405	< 0.05
Air pollution	5.040 ± 1.869	r=0.79852	< 0.001
Insomnia	28.725 ± 5.103	r=0.762	< 0.05
Infection	9.375 ± 1.624	r=0.675	< 0.05
Dyspnea	45.5 ± 10.3	r=0.351	< 0.05
Asthma attack	53.213 ± 7.460	r=0.295	< 0.05
Smoker	43.838 ± 5.224	<i>r</i> = -0.03	< 0.05
Sport	70.120 ± 9.083	<i>r</i> = -0.40	< 0.05
Persian language			
Ashma symptoms	175.5 ± 65.02	r=0.809	< 0.05
Pediatric asthma	213.5 ± 18.02	r=0.660	< 0.05
Shortness of breath	104.5 ± 2.09	r=0.45	< 0.05
Asthma treatment	87 ± 1.089	r=0.401	< 0.05
Asthma inhaler	57.032 ± 3.54	r=0.33	< 0.05
Asthma Cough	43.362 ± 4.09	r=0.21	< 0.05
Herbal treatments	25.89 ± 3.06	r=0.127	< 0.05

for a time series model. The autocorrelation and partial autocorrelation functions (PACF) plots are represented in Fig. 5 for English and Persian search results. The height of the bar indicates the correlation coefficient at that lag.

Predictive modeling development

To predict interest over time regarding asthma-related information, the ARIMA model was developed to predict RSV regarding asthma in English and Persian. First, suitable parameters for the ARIMA model were identified (AIC = 2563.72). The developed ARIMA forecast model for forecasting the online interest for searching asthma

related subjects in English language for 2014 to 2024 is represented in Fig. 6-a. The dark gray area in Fig. 6 -a represents the 95% prediction interval. The development of the prediction model shows that the model accuracy is at its peak in the first half of 2024, and then shows a steady trend in increasing RSV. Accordingly, the ARIMA forecast for 2024 to 2029 is shown in Fig. 6-b. Although its accuracy cannot yet be determined, the overall observations show a slow increase in RSV in following years. These graphs generally indicate a peak in asthma-related searches during the COVID-19 pandemic.

Then, ARIMA forecast model for forecasting the online interest for searching asthma related subjects in Persian language from 2023 and beyond is represented in Fig. 7. The dark gray area in Fig. 7-a represents the 95% prediction interval. The development of the prediction model shows that the model has a upward trend in increasing RSV (in red line).

In the next phase, we employed SARIMAX model to find the best model for prediction in addition to ARIMA. As we mentioned, SARIMAX is a statistical model designed to capture and forecast the underlying patterns, trends, and seasonality in seasonal time series data. Thus, forecasting GT data was done based on SARIMAX model using Pmdarima python library (Fig. 8). Among these three models, calculating the average absolute error percentage showed that the model developed based on SARIMA using the Pmdarima library has the lowest error percentage.

Analysis of prediction models for global asthmarelated searches in Persian language indicates that public interest in this topic is rising and will likely continue to trend upward in the future. In contrast, search volume



Fig. 4 The seasonal pattern in total search volumes related to asthma in which the X axis represents the years, and the Y axis represents the average changes in the RSV index per year using box-plot visualization



Fig. 5 The autocorrelation plots for English (**a**, **b**) and Persian (**c**, **d**) search results in which the X axis represents the lag in days, and the Y axis represents the autocorrelation coefficient for each lag. The height of the bar in the autocorrelation plots and partial autocorrelation functions (PACF) in Fig. 5 for English and Persian search results indicates the correlation coefficient at the lag

forecasts for English-speaking countries show less variation, suggesting a more stable trend.

Discussion

This study examined asthma-related internet search patterns and volume changes over a 20-year from 2004 to 2024, using data from Google Trends for both English and Persian language searches. Frequency and trend analyses were conducted on the extracted data. Additionally, correlation analysis was performed to evaluate the most frequently used asthma-related search terms over time. Based on the GT data, predictive models were developed to estimate future asthma-related search patterns for Persian and English languages. The models indicate that in Persian-speaking countries like Iran, asthma-related search volume has increased significantly over the past ten years and is likely to continue trending upward in the future. In contrast, English-speaking countries showed steady variation in asthma-related search volume, apart from a high peak during the COVID-19 pandemic. This rise was likely due to the fact that COVID-19 was identified as a respiratory illness. People with asthma—who were at higher risk for severe complications—were particularly concerned about their vulnerability. This anxiety likely drove an increase in searches for asthma symptoms, management, and preventive measures. Additionally, heightened concerns about the association of respiratory symptoms and conditions with COVID-19, combined with the overlap of many asthma symptoms with COVID-19 respiratory symptoms, prompted significant



Fig. 6 Predictability of ARIMA model (blue line) in forecasting the online interest in asthma versus actual Google trend's data (black line) for 2014 to 2029 with confidence intervals of 95% in English. The dark gray area in Fig. 6 -a represents the 95% prediction interval. Accordingly, the ARIMA forecast for 2024 to 2029 is shown in Fig. 6-b



Fig. 7 Predictability of ARIMA model (green line) in forecasting the online interest in asthma versus actual Google trend's data (red line) after 2023 with confidence intervals of 95% in Persian. The dark gray area in Fig. 7-a represents the 95% prediction interval. The development of the prediction model shows that the model has a upward trend in increasing RSV (in red line)

public interest in searches for asthma severity symptoms. Future search patterns in English-language appear to be more consistent.

Relative search volume or RSV index, a common output from Google Trends, is a normalized metric used to indicate search interest on a scale of 1 to 100, with a value of 0 indicating insufficient data [56]. The information provided by GT based on their search interest can be used as a time series data to examine changes in public interest and what they are curious about [57]. This is because people usually disclose their information needs using Internet searches, which can shed light on changes in the level of public interest in many of the phenomena under study [58]. As Alibudbud's study [59] has demonstrated GT data can be a valuable tool for investigating public concerns, interests, and behaviors regarding health phenomena. It can also help determine patients' information needs regarding specific diseases or health problems. In recent years, numerous studies in the medical field have employed GT data to explore public perceptions and



Fig. 8 Search volume prediction graphs (green line) for predicting online search interest for asthma versus actual Google trends data (blue line) using the Pmdarima library from 2021 to 2026

awareness regarding specific diseases or health issues [32, 33, 38, 45, 60-63]. Given these insights, we have chosen to utilize GT data as a source of data in our own study. According to the literature review, this study is one of the first studies that used time series analysis of Google search data in the field of asthma and allergies.

Numerous studies have demonstrated the benefits of using Google Trends (GT) data to investigate public awareness and provide valuable insights about diseases. For example, Ginsberg et al. [64] used GT data to track influenza-like illness in a population. Ocampo et al. [65] were among the first to use Google search data to monitor trends in malaria. Additionally, Glynn et al. [66] evaluated the relationship between breast cancer awareness campaigns and internet search activity from 2004 to 2009 using GT data. These studies collectively suggest that GT can serve as a valuable complement to traditional public health monitoring, offering enhanced understanding of the public's responses and sentiments towards diseases and disorders [63]. Regarding respiratory diseases, in 2019, Bohman et al. [67] investigated the general public's interest in searching for information about chronic obstructive pulmonary disease (COPD) through an analysis of Google Trends results.

Regarding the interest over time to asthma, the results of the RSV index study show that the search pattern and interest of people in English for information on asthma and related keywords are completely different from the search pattern in Persian. Trend analysis in Persian and English reveals significant differences in how people search for asthma-related information. In English-speaking countries, individuals are more likely to search for information on topics like air pollution, insomnia, and various infections. This is likely due to the availability of comprehensive information about asthma symptoms and medication management in these regions. In contrast, Persian-speakers tend to focus their searches on the nature of asthma, such as symptoms, medications, complications, and even complementary medicine treatments. To address these conflicting information needs, health organizations in English-speaking countries, such as the NIH (National Institutes of Health), GINA (Global Initiative for Asthma), and NIHR (National Institute for Health and Care Research), should provide more content about the relationship between asthma and subjects like insomnia, air pollution, and infections. This would help prevent English-speaking patients from relying on unreliable or inaccurate online information (misinformation) when seeking guidance on managing their asthma. Conversely, to raise awareness about asthma in Iran, organizations responsible for health information should make a difficult effort to provide Persian-speaking people with more detailed guidance on asthma diagnosis and treatment to better address their specific information needs.

The analysis of worldwide geographical search volume reveals that Zambia had the highest search interest for asthma, with other African countries like Ethiopia and Ghana also ranking among the top five regions. This aligns with the growing burden of chronic respiratory diseases, including asthma, across Africa over the past two decades [68, 69]. However, the true prevalence may be underestimated due to limited data, as many African governments have not adequately addressed this public health issue. The high level of asthma-related information seeking appears to stem from the fact that asthma is a major and increasingly common problem in Africa that has not received sufficient priority and attention from policymakers [68–70]. Search volume in other countries with high asthma prevalence rates, such as the UK and the US, was proportional. The results further indicate that residents of central Iranian cities, especially those in major metropolitan areas, displayed greater interest in searching for Persian-language information on asthma and allergies. This heightened search activity corresponds with the higher rates of asthma prevalence documented in Iranian urban centers.

GT data represents a type of time series information that allows us to identify trends in the most commonly searched keywords. Time series analysis can be used to model long-term movements or directional changes in the data over time [71]. This technique helps determine whether the data exhibits an upward (positive), downward (negative), or constant trend and the usefulness of this method has also been confirmed in other studies [43, 49, 62, 72]. The analysis of the forecasting models developed in this study revealed a periodic pattern in global asthma-related searches. The forecasting model for English-language searches indicated that public awareness in this area has increased in recent decades. Regarding Persian-language searches, the forecasting models showed that interest in asthma-related topics is likely to face an upward trend in the future. Based on these findings, it is recommended that policymakers adopt measures to provide Persian-speaking internet users with necessary selfcare information for asthma management. This would help raise awareness and better meet the information needs of this population.

Our study had several limitations stemming from the nature of the Google Trends tool itself. While it provides insights into general user interest in a topic, it cannot offer explanations about how people actually utilize the retrieved information. Additionally, Google Trends only captures search data from the Google search engine, excluding activity on other platforms. The results also do not reflect the actual number of users, instead showing relative search volumes. Furthermore, user demographics like age and gender cannot be tracked based on the Google Trends data.

Another challenge in developing countries is that many people may not use Google at all due to poor internet quality or limited internet access. This raises the possibility that increased Google search activity could simply reflect improved internet availability rather than heightened public interest. Beyond the limitations of the tool, this study was also constrained by a lack of official data on the information needs of asthma patients. As a result, we were unable to investigate the relationship between Google search trends and other relevant social factors.

Conclusion

In conclusion, our analysis of Google Trends data has revealed significant differences in asthma-related search behaviors between Persian-speaking and Englishspeaking populations. The ascending rise in search volume among Persian speakers indicates a critical gap in awareness and information availability regarding asthma within these communities. This unmet need highlights the urgent requirement for targeted health interventions and educational campaigns tailored specifically to Persian-speaking populations. In English-speaking countries, searches tend to focus on broader asthmarelated topics like pollution and infections, likely due to the availability of comprehensive asthma resources. In contrast, Persian speakers prioritize understanding specific aspects of asthma-like symptoms, medications, and complementary treatments. Furthermore, our findings demonstrate the utility of Google Trends data in assessing public health awareness, providing a valuable tool for health organizations in shaping effective strategies and resource allocation.

To optimize health outcomes, it is essential that future research delve deeper into the underlying factors influencing these search patterns and examine the broader implications for different health conditions. Ultimately, a deeper understanding of this information will empower health and wellness organizations to better serve various populations and ensure that all individuals have access to the information they need to effectively manage their asthma.

Abbreviations

 GT
 Google trend

 RSV
 Relative Search Volume

 ARIMA
 Autoregressive Integrated Moving Average

Author contributions

Conception and design of the study: Hamidreza Abtahi, Marsa Gholamzadeh, Mehrnaz Asadi Gharabaghi; Data acquisition: Marsa Gholamzadeh, Hamidreza Abtahi; Interpretation and/or analysis of data: Marsa Gholamzadeh, Hamidreza Abtahi, Mehrnaz Asadi Gharabagh; Drafting the manuscript: Marsa Gholamzadeh, Hamidreza Abtahi; Revising the manuscript critically for important intellectual content: All authors; Approval of the version of the manuscript to be published: All authors;

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Data availability

The datasets used and/or analysed during this study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

The research was approved by the Tehran University of Medical Sciences Ethics Committee (IR.TUMS.IKHC.REC.1402.213). All methods were performed based on the relevant guidelines and regulations. Consent for participation was deemed unnecessary according to an Institutional Review Board (IRB) of the Tehran University of Medical Sciences Ethics Committee.

Consent for publication

Consent for publication was deemed unnecessary according to an Institutional Review Board (IRB) of the Tehran University of Medical Sciences Ethics Committee.

Competing interests

The authors declare no competing interests.

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