

Evaluation of Internet Search Data for Pediatric Dentistry in Turkey and the Relationship with Oral Health: A Google Trends Analysis

Türkiye'de Çocuk Diş Hekimliği ile İlgili İnternet Arama Verilerinin Değerlendirilmesi ve Ağız-Diş Sağlığı ile İlişkisi: Google Trends Analizi

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ABSTRACT

INTRODUCTION: The aim is to investigate the relationship between Google Trends (GT) data of search terms related to pediatric dentistry and the Gross National Product (GNP) of cities, as well as the current caries index values (dmft/DMFT) in Turkey for the year 2023.

MATERIAL and METHODS: As publicly available data was utilized in the study, ethical approval was not necessary. Search terms related to pedodontics ("pedodontics", "pedodontist", "primary tooth", "pediatric dentist", "toothpaste", "toothbrush", "fluoride varnish", and "teething") were examined for 36 provinces in Turkey through GT. The correlation between internet search habits with GNP from the Turkish Statistical Institute and dmft/DMFT data for the 5-12 age group obtained from the Turkey Oral Health Profile Research Report were statistically examined using the Spearman correlation test.

RESULTS: Search terms "pedodontics", and "teething" were found to be associated with GNP; and "pedodontist", and "primary tooth" were found to be related to dmft values ($p < 0.05$). Furthermore, statistical differences were also found in dmft values between regions.

CONCLUSION: Google Trends is an effective tool for determining individuals' interest in pediatric dentistry, and these data can be associated with the oral health status of the population.

Keywords: Internet data, pediatric dentistry, preventive dentistry, primary teeth

ÖZ

GİRİŞ: Türkiye'de 2023 yılına ait çocuk diş hekimliği ile ilgili terimlerin Google Trends (GT) verileri ile (süt dişi, çocuk diş hekimi, pedodonti, pedodontist, çocuk diş macunu, çocuk diş fırçası, diş çıkarma, florürlü vernik), şehirlerin gayrisafi yurtiçi hasıla miktarları (GSYH) ve güncel çürük indeksi değerleri (dmft/DMFT) arasındaki ilişkisini incelemektir.

YÖNTEM ve GEREÇLER: Çalışmada kamuya açık veriler kullanıldığı için etik kurul onayı gerekmemektedir. GT üzerinden pedodonti ile ilgili, "pedodonti", "pedodontist", "süt dişi", "çocuk diş hekimi", "çocuk diş macunu", "çocuk diş fırçası", "florürlü vernik" ve "diş çıkarma" arama terimleri, Türkiye genelinde 36 il için incelenmiştir. İnternet arama alışkanlıkları, Türkiye İstatistik Kurumu'ndan alınan GSYH ve Türkiye Ağız Diş Sağlığı Profili Araştırma Raporu'ndan elde edilen 5-12 yaş grubuna ait dmft/DMFT verileri ile istatistiksel olarak Spearman korelasyon testi kullanılarak ilişkilendirilmiştir.

BULGULAR: Çalışmamızda, çocuk diş hekimliği ile ilgili "pedodonti" ve "diş çıkarma" arama terimlerinin GSYH; "pedodontist" ve "süt dişi" arama terimlerinin ise dmft değerleri ile ilişkili olduğu bulunmuştur ($p < 0,05$). Ayrıca bölgeler arası dmft değerleri arasında da istatistiksel farklar saptanmıştır.

SONUÇ: Bireylerin çocuk diş hekimliğine ilgilerini saptamada Google Trends etkin bir araçtır ve bu veriler toplumun ağız diş sağlığı durumu ile ilişkilendirilebilir.

Anahtar Kelimeler: Çocuk diş hekimliği, internet verileri, koruyucu diş tedavileri, süt dişi

INTRODUCTION

Dental caries is one of the most commonly observed oral health problems in children.¹ Although the development of dental caries is primarily dependent on host factors, microorganisms, diet and time, many environmental factors also influence its development.² One such environmental factor is the socioeconomic status of the patient. There is a direct and very strong causal relationship between the increased prevalence of dental caries and lower socioeconomic status.³

Pediatric dentistry provides comprehensive preventive and therapeutic oral health services to children from birth to adolescence. Pediatric dentists specialize in jaw and tooth development, the application of caries-preventive treatments in primary and permanent dentition, restorative and endodontic procedures, and the management of dental trauma.⁴ In preventing dental caries, pediatric dentists serve as the first-line healthcare providers, with the principal aim of preventing dental caries formation.⁴ Caries risk assessment, topical fluoride applications, fissure sealants, diet regulation, oral hygiene education, and regular dental check-ups are among the preventive dentistry approaches. Avoiding cariogenic foods and maintaining good oral hygiene can prevent the development of dental caries. Using a toothbrush and toothpaste appropriate for the child's age, under parental supervision can help achieve good oral care.⁵

Untreated and undiagnosed dental caries in children causes pain, difficulty chewing, loss of appetite and weight loss.³ Restorative treatment is possible for cavitated caries lesions, while deeper cavitation may affect the pulp, requiring endodontic treatment. If endodontic treatment is not possible, the tooth is extracted.¹ Indices have been developed to assess an individual's lifetime caries experience, of which the DMF score is the most widely used. The DMF score is the sum of the number of decayed (d), missing due to caries (m) and filled (f) teeth (t). The "dmft" value indicates caries experience in the primary dentition and ranges from 0 to 20, while the "DMFT" value indicates caries experience in the permanent dentition and ranges from 0 to 32.⁶ The "DMFT" value indicates caries experience in the permanent dentition and ranges from 0 to 32.

Among the resources parents use to obtain more information when their children have an oral or dental health problem is the internet. The internet is not only a source of health information for people who have certain symptoms and wish to educate themselves before consulting a doctor, but also for those who want to learn more about treatment options.⁷ ⁸ Google is the most widely used keyword-based search engine on the internet, offering an analytical service called "Google Trends" (GT) since 2004 to study population behaviors. GT, which is freely accessible, analyzes part of the

roughly three billion daily Google searches and provides geographic and temporal models of search volumes for specified terms.⁹ The popularity of searched terms is assessed regionally with a score between 0 and 100.¹⁰ However, Google Trends filters out certain types of searches, such as those conducted by very few people. Because Google Trends only shows data for popular terms, low volume searches will appear as "0".¹⁰

GT data are used in many studies related to healthcare. Health research can be divided into three categories: causal inference, descriptive studies, and monitoring.⁹ Examples include studies on dermatological problems,⁸ sleep-related breathing disorders,¹¹ rheumatic diseases,¹² and cardiovascular diseases,¹³ in which GT data derived from terms in these medical fields are examined. Within dentistry, the number of studies evaluating GT data is limited but includes terms such as "oral diseases,"¹⁴ "toothache,"¹⁵ "silver diamine fluoride,"¹⁶ "early childhood caries,"¹⁷ "dental trauma,"¹⁸ and "toothpaste."¹⁹

Oral health is also associated with socioeconomic status.²⁰ In public health studies, annual Gross Domestic Product (GDP) is utilized to assess socioeconomic levels in national populations.²¹ There are also studies investigating the correlation between GT data and socioeconomic status indicators such as GDP.²²

No studies have been found in the literature evaluating the GT data of selected terms related to pediatric dentistry in relation to caries indices (dmft/DMFT) and GDP. Yet, by identifying the public's interest in pediatric dentistry through these data, necessary public health measures can be implemented. This study aims to analyze, in Turkey for the year 2023, GT data for selected pediatric dentistry terms ("primary tooth," "pediatric dentist," "pedodontics," "pedodontist," "children's toothpaste," "children's toothbrush," "teething," "fluoride varnish"), along with the GDP values of cities and current caries index values (dmft/DMFT). Our hypothesis is that internet search data related to pediatric dentistry in Turkey yield results that are associated with the country's socioeconomic status and oral health.

MATERIAL and METHODS

As this study used publicly available data, ethical committee approval was not required. Internet data obtained from Google Trends for the search terms "pedodontics," "pedodontist," "primary tooth," "pediatric dentist," "children's toothpaste," "children's toothbrush," "fluoride varnish," and "teething" were examined across Turkey. The keywords were selected from terms that provided sufficient data on Google Trends. Data for the period from January 2023 to 2024 was accessed on 16 February 2024. As an example, Figure 1 shows the frequency of searches and the

provincial distribution within Turkey in the last 12 months for the term "pedodontics". Among the provinces used in this study, 36 provinces with sufficient GT data were selected, while those with insufficient data were excluded. In the analysis, GT automatically evaluates provinces capable of scoring between 1 and 100 for the searched term; those scoring 0—indicating low search volume—were excluded from the study due to insufficient data. The provinces were then grouped according to the Statistical Regional Units Classification (NUTS 2 in Turkish: İBBS). The data were correlated with the Gross Domestic Product (GDP, in annual US dollars) for 2021 from the Turkish Statistical Institute.²³ Additionally, provincial-level dmft/DMFT data for 2018 from the Turkey Oral and Dental Health Profile Research Report were used. This report examined the data for ages 5 and 12, which cover the primary and mixed dentitions.²⁴

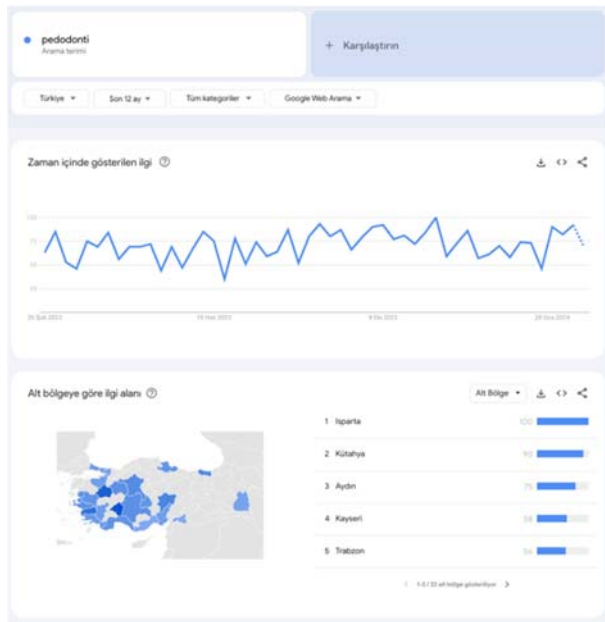


Figure 1. Search results for the term “pedodontics” in Turkey over the past 12 months

Statistical Analysis

A statistical analysis was conducted to examine the relationship between Google Trends search terms, population data, and the dmft/DMFT status in the 36 included provinces. Descriptive statistics (count, percentage, mean, standard deviation, median, minimum, maximum) were calculated. The Shapiro-Wilk test was employed to verify the normality assumption. The Spearman correlation test was used to measure the association between continuous variables that did not follow a normal distribution. Analyses were performed using IBM SPSS (Version 25, IBM Corp., USA).

RESULTS

The descriptive statistics of the search data obtained from Google Trends are shown in Table 1.

When the Google Trends data were grouped by regions in accordance with the Statistical Regional Units Classification (NUTS/İBBS), the following provinces were included:

- Mediterranean Region: Adana, Antalya, Hatay, Isparta, Kahramanmaraş, and Mersin
- Northeastern Anatolia Region: Van, Malatya, Elazığ
- Eastern Black Sea Region: Ordu, Trabzon
- Western Marmara Region: Çanakkale, Kırklareli, Tekirdağ
- Central Anatolia Region: Sivas, Kayseri, Aksaray
- Aegean Region: Aydın, Denizli, İzmir, Kütahya, Manisa
- Southeastern Anatolia Region: Şanlıurfa, Mardin, Gaziantep, Diyarbakır
- East Marmara Region: Bursa, Balıkesir, Eskişehir, Kocaeli
- West Anatolia Region: Konya, Ankara
- Northeast Anatolia Region: Erzurum

Table 1. Distribution of 12-month Google Trends data

	Minimum	Maximum	Mean	Standard Deviation	Median
GDP per Capita (USD, 2022 - TurkStat)	3274,77	18269,32	9055,18	3503,28	8467,42
5-year-old dmft	2,78	5,47	3,69	0,68	3,49
12-year-old DMFT	1,07	4	1,66	0,64	1,4
Pedodontics (12 Months)	22	100	39,14	17,61	34,5
Pedodontist (12 Months)	28	100	66,33	36,23	71
Primary Tooth (12 Months)	61	100	83,55	13,17	85
Pediatric Dentist (12 Months)	34	100	61	31,78	42
Children's Toothpaste (12 Months)	85	100	95	7,07	97,5
Children's Toothbrush (12 Months)	86	100	92,33	6,47	91
Teething (12 Months)	42	100	63,82	13,07	62

Istanbul is regarded as a region by itself in the NUTS classification and is included in the study in this manner.

The Spearman correlation test was applied to investigate the relationships among GDP, 5-year-old dmft, and 12-year-old DMFT. Statistically significant correlations were found between GDP and the search terms “pedodontics” and “teething” (Table 2). Analyses revealed a statistically significant, negative, moderate correlation between per capita GDP (in US dollars) and “pedodontics,” with a correlation coefficient of -0.523 ($p < 0.05$). There was a statistically significant, negative, moderate correlation of -0.390 between per capita GDP (in US dollars) and “teething” ($p < 0.05$).

Significant relationships were found between the 5-year-old dmft score and the search terms “pedodontist” and “primary tooth” (Table 2). A correlation coefficient of 1.000 was calculated between the 5-year-old dmft score and “pedodontist,” indicating a statistically significant, perfectly positive relationship ($p < 0.05$). A correlation coefficient of 0.630 was calculated between the 5-year-old dmft score and “primary tooth,” indicating a statistically significant, moderately positive relationship ($p < 0.05$). The distribution of these correlations is shown in Figure 2.

Table 2. Relationships between GDP, 5-year-old dmft, and 12-year-old DMFT

	2022 GDP per Capita (USD - TurkStat)		5-year-old dmft		12-year-old DMFT	
	r	p	r	p	r	p
Pedodontics	-0,523	0,013*	0,078	0,731	0,160	0,476
Pedodontist	0,271	0,825	1,000	0,000*	0,500	0,667
Primary Tooth	0,457	0,157	0,630	0,038*	0,528	0,095
Pediatric Dentist	-0,790	0,111	0,800	0,104	0,400	0,505
Children’s Toothpaste	0,383	0,617	-0,632	0,368	-0,949	0,051
Children’s Toothbrush	0,498	0,314	-0,179	0,734	-0,299	0,565
Teething	-0,390	0,023*	0,073	0,682	0,077	0,667

* $p < 0.05$, r = Spearman correlation coefficient.

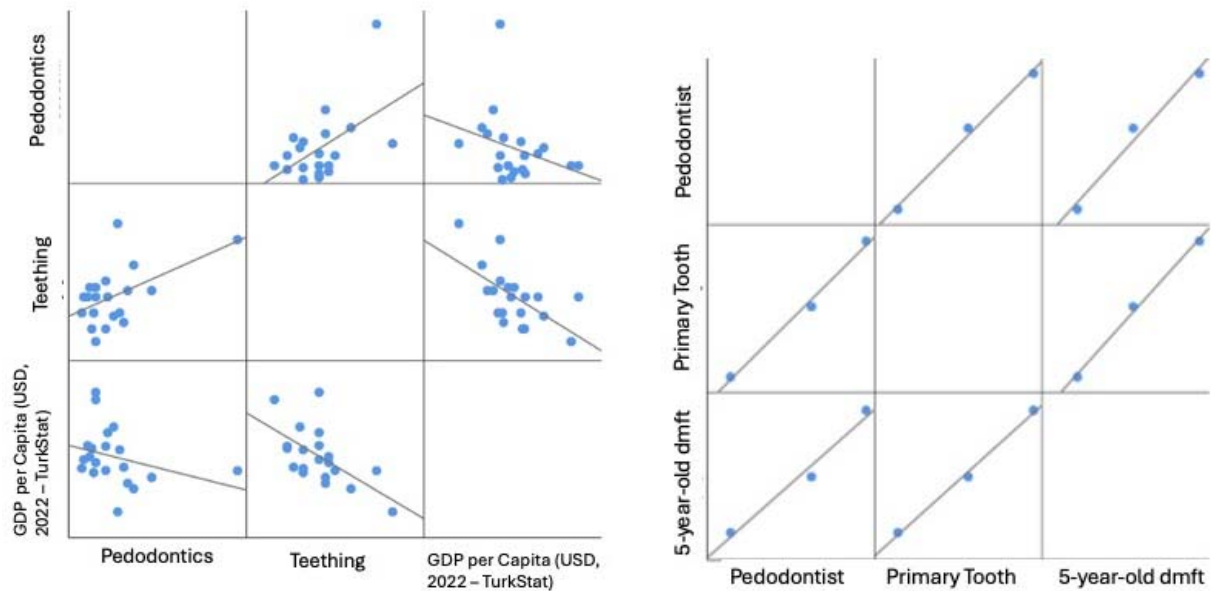


Figure 2. Scatter plot illustrating the relationships among GDP and 5-year-old dmft

Table 3. Distribution and comparison of relevant variables by region

		n	Min.	Max.	Mean	S.D.	Median	Test Statistic	p
Pedodontics	Mediterranean	6	23,00	67,00	38,00	19,85	31,00	6,753 ^β	0,344
	Eastern Anatolia	3	40,00	40,00	40,00	-	40,00		
	Aegean	6	26,00	100,00	45,67	29,01	32,00		
	Southeastern Anatolia	4	22,00	22,00	22,00	-	22,00		
	Central Anatolia	6	34,00	43,00	39,00	3,92	39,50		
	Black Sea	3	45,00	48,00	46,50	2,12	46,50		
	Marmara	9	25,00	41,00	31,00	6,93	29,00		
Pedodontist	Aegean	6	28,00	28,00	28,00	-	28,00	2,000 ^β	0,368
	Central Anatolia	6	100,00	100,00	100,00	-	100,00		
	Marmara	9	71,00	71,00	71,00	-	71,00		
Primary Tooth	Mediterranean	6	69,00	85,00	77,00	8,00	77,00	7,930 ^β	0,094
	Aegean	6	73,00	73,00	73,00	-	73,00		
	Southeastern Anatolia	4	61,00	77,00	69,00	11,31	69,00		
	Central Anatolia	6	95,00	100,00	97,50	3,54	97,50		
	Marmara	9	87,00	100,00	94,00	6,56	95,00		
Pediatric Dentist	Mediterranean	6	91,00	91,00	91,00	-	91,00	0,800 ^β	0,849
	Aegean	6	38,00	38,00	38,00	-	38,00		
	Central Anatolia	6	42,00	42,00	42,00	-	42,00		
	Marmara	9	34,00	100,00	67,00	46,67	67,00		
Children's Toothpaste	Aegean	6	100,00	100,00	100,00	-	100,00	2,667 ^β	0,264
	Central Anatolia	6	100,00	100,00	100,00	-	100,00		
	Marmara	9	85,00	95,00	90,00	7,07	90,00		
Children's Toothbrush	Mediterranean	6	86,00	86,00	86,00	-	86,00	2,525 ^β	0,471
	Aegean	6	100,00	100,00	100,00	-	100,00		
	Central Anatolia	6	93,00	93,00	93,00	-	93,00		
	Marmara	9	86,00	100,00	91,67	7,37	89,00		
Teething	Mediterranean	6	42,00	60,00	52,40	6,80	55,00	3,017 ^α	0,050
	Eastern Anatolia	3	79,00	83,00	81,00	2,83	81,00		
	Aegean	6	50,00	78,00	62,67	8,98	62,50		
	Southeastern Anatolia	4	55,00	100,00	77,00	18,74	76,50		
	Central Anatolia	6	52,00	65,00	57,40	5,73	54,00		
	Black Sea	3	62,00	77,00	69,67	7,51	70,00		
	Marmara	9	44,00	82,00	62,89	13,60	60,00		
GDP per Capita (USD)	Mediterranean	6	7057,90	11494,75	8578,57	1737,50	7887,88	6,888 ^α	p<0.001 *
	Eastern Anatolia	3	3274,77	6179,20	4956,57	1505,67	5415,73		
	Aegean	6	7590,80	13201,19	10023,89	2018,25	9831,82		
	Southeastern Anatolia	4	3886,87	8724,75	5788,42	2204,13	5271,03		
	Central Anatolia	6	5646,21	13919,12	8654,12	2835,98	8291,10		
	Black Sea	3	5078,02	6849,73	6033,24	893,97	6171,98		
	Marmara	9	9047,00	18269,32	12819,91	3343,80	11591,26		
5-year-old dmft	Mediterranean	6	3,42	3,42	3,42	0,00	3,42	25,595 ^β	p<0.001 *
	Eastern Anatolia	3	4,18	5,47	4,61	0,74	4,18		
	Aegean	6	2,78	2,78	2,78	0,00	2,78		
	Southeastern Anatolia	4	3,49	3,49	3,49	0,00	3,49		
	Central Anatolia	6	3,59	4,69	4,19	0,49	4,36		
	Black Sea	3	2,97	4,69	3,54	0,99	2,97		
	Marmara	9	3,15	4,35	3,96	0,48	4,35		
12-year-old DMFT	Mediterranean	6	1,40	1,40	1,40	0,00	1,40	29,640 ^β	p<0.001 *
	Eastern Anatolia	3	1,96	2,17	2,03	0,12	1,96		
	Aegean	6	1,29	1,29	1,29	0,00	1,29		
	Southeastern Anatolia	4	1,07	1,07	1,07	0,00	1,07		
	Central Anatolia	6	1,35	1,96	1,59	0,23	1,63		
	Black Sea	3	1,36	4,00	3,12	1,52	4,00		
	Marmara	9	1,66	1,82	1,80	0,05	1,82		

* (p<0,05) and α:Kruskal-Wallis test β: ANOVA test

ANOVA and Kruskal-Wallis tests were applied to compare these variables by region. The analyses revealed statistically significant differences among regions in per

capita GDP (in US dollars), 5-year-old dmft, and 12-year-old DMFT (p < 0.05) (Table 3). According to Bonferroni tests for GDP, there were statistically

significant differences between the Marmara region and the Eastern and Southeastern Anatolia regions ($p = 0.001$ and $p = 0.006$). Per capita income in the Marmara region is higher than in the Eastern and Southeastern Anatolia regions. According to Bonferroni tests for the 5-year-old dmft, there were statistically significant differences between the Aegean region and the Eastern Anatolia, Central Anatolia, and Marmara regions ($p = 0.012$, $p = 0.001$, and $p = 0.003$). The 5-year-old dmft value in Eastern Anatolia, Central Anatolia, and the Marmara region is higher than in the Aegean region. For the 12-year-old DMFT, Bonferroni tests revealed statistically significant differences between the Aegean region and the Eastern Anatolia and Marmara regions, and between the Southeastern Anatolia region and the Eastern Anatolia, Black Sea, and Marmara regions ($p = 0.012$, $p = 0.012$, $p = 0.003$, $p = 0.030$, and $p = 0.003$). The DMFT values in Eastern Anatolia and the Marmara region are higher than in the Aegean region, while the DMFT values in Eastern Anatolia, the Black Sea, and the Marmara region are higher than in the Southeastern Anatolia region. No statistically significant differences were observed among regions for “teething,” “pedodontics,” “pedodontist,” “primary tooth,” “pediatric dentist,” “children’s toothpaste,” or “children’s toothbrush” ($p > 0.05$).

DISCUSSION

In our study, it was found that the search terms “pedodontics” and “teething” are related to GDP, and the search terms “pedodontist” and “primary tooth” are related to dmft values. Consequently, our hypothesis for these terms is accepted within their respective categories.

Google Trends is widely used in health-related studies. Researchers employ these online data to analyze public interest and behavior and to evaluate seasonal variations in diseases and their symptoms.²⁵ Since search engines are a common source of health information for individuals seeking additional details about symptoms or treatment options, this database grows ever more important as a tool to examine large datasets and produce significant insights in health research.

In our study, a negative correlation was found between GDP and searches for “pedodontics” and “teething.” As the gross domestic product in Turkey decreases, the increase in “pedodontics” search trends in lower-income cities may reflect the population’s difficulty accessing pediatric dentists.²⁶ This may imply that people rely on internet searches to compensate for this deficiency. Moreover, in particular, the habit of regular dental checkups for monitoring physiological development may be lacking in lower-income communities.²⁷ This may help explain the negative correlation between “teething” and GDP. These findings provide valuable hints about how economic factors can

affect access to pediatric dental care. The data obtained shed light on identifying areas where access to dental care is inadequate, allowing for future targeted interventions.

In our study, as the dmft values for the 5-year-old group increased, there was a positive correlation showing increased online searches for the term “primary tooth.” Considering that the dmft values solely indicate decayed, missing, and filled primary teeth, it is expected that parents’ inclination to seek information on primary teeth would rise as their child’s oral and dental health problems intensify.

Dental caries in primary teeth cause pain, chewing difficulty, loss of appetite, and weight loss. Especially when untreated deep caries affect the pulp, symptoms such as abscess, swelling, and night pain occur.²⁸ As caries and the symptoms it causes become more severe in younger patients, the need for dental treatment also increases. Parents may search the internet for suitable pediatric dentists who can treat their children’s dental problems. We found that, accordingly, as the 5-year-old dmft value increases, searches for “pedodontist” likewise increased.

The dmft/DMFT values obtained from the Turkey Oral and Dental Health Profile Research Report appear as a secondary finding in our study. According to the 2022 Address-Based Population Registration System of the Turkish Statistical Institute, Şanlıurfa has the highest percentage of child population, at 44.9%. Şırnak follows at 41.4%, and Ağrı at 39.3%.²³ The high dmft/DMFT values of 5-year-olds and 12-year-olds in Eastern Anatolia can be explained by the substantial number of children in these areas and the resulting socioeconomic impact, such that not every child may receive adequate oral and dental health care.

Studies that use Google Trends often look at how the data for certain terms relate to economic indicators, population density, oral and dental health problems, and seasonal changes.^{17–19} In this study, Google Trends data for seven pediatric dentistry terms were examined in relation to economic income (GDP) and children’s caries experience (dmft/DMFT).

A systematic review by Nuti et al. emphasized the potential of Google Trends to provide meaningful insights into population behavior and connections between health and healthcare services, due to the free and simple access it provides to large sets of population search data. However, it was noted that Google Trends must become more transparent for it to be used as a reliable research tool, which would bolster the credibility of the results generated and their overall applicability to health research. Furthermore, researchers must clearly state their rationale and document their experiments to ensure reproducible findings.⁹

Although digital analyses of health interests and trends via Google Trends exist in various fields, there is a gap in knowledge regarding the correlation of these data specifically with pediatric dentistry-related terms. Our study contributes to the literature in this regard. Moreover, in this study, real-time data are collected anonymously and periodically, and the format of this data presentation helps reduce reporting bias.²⁹ However, such studies cannot replace traditional epidemiological methods, because this method only analyzes the behavior of unknown, remote Google users. It is impossible to identify the social and demographic characteristics of the users performing the searches. It is also uncertain whether all searches are conducted exclusively by affected individuals or whether these queries might be repeated by the same person using different electronic media. Another limitation of our study is that the data were collected from a single search engine. Other search engines such as Yahoo, Yandex, and Bing were not included. Therefore, focusing on data from people who use Google as their primary search engine raises a risk of selection bias, although this risk is minimized by the fact that Google accounts for more than two-thirds of all internet searches.

An additional limitation is that out of Turkey's 81 provinces, only 36 had sufficient data to be included in the study. This indicates that there is little interest in

pediatric dentistry on the internet in the excluded provinces. Furthermore, the most recent dmft data available for Turkey were from 2018, which is another limitation. Having a larger sample and more current dmft/DMFT values would enable more accurate and effective use of similar analytical studies.

CONCLUSION

According to the findings of this study, the pediatric dentistry-related search terms "pedodontics" and "teething" are associated with GDP, while "pedodontist" and "primary tooth" are associated with dmft values. Furthermore, significant differences are observed among regions in their dmft values. In light of these findings, it can be said that Google Trends is an effective and useful tool for analyzing Turkish individuals' interest in pediatric dentistry. However, more data from additional provinces are needed in order to make inferences on a national scale. These data can aid in understanding the relationship between children's oral and dental health and socioeconomic status in the country. They also facilitate identifying areas with insufficient dental health services so that preventive measures may be taken. Consequently, more analyses and reporting of up-to-date internet data are necessary to improve pediatric oral and dental health in society.

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