ORIGINAL ARTICLE / ARAŞTIRMA YAZISI

Nutrition and Dietetics / Beslenme ve Diyetetik

Can Online Dietitian Be a Novel Trend of Post-Pandemic Era in Turkey?

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ABSTRACT

Purpose: The aim of this study was to investigate weight management-related Google search trends in Turkey prompted by the pandemic.

Methods: Keywords were "diet", "dietitian", "body mass index", "exercise", "calorie", "weight gain", "healthy nutrition", "weight loss", "fat burning", "slimming", "online diet" and "online dietitian". Data collection and time series analysis were completed using the 4.1.0 version of the R Studio program and its gtrendsR, ggplot2, prophet, dplyr, forecast and ggforce packages. SPSS software version 17 was used for statistical analysis of keyword relative search volumes (RSVs) during the prepandemic, early pandemic and late pandemic periods.

Results: The RSV of "dietitian" keyword was significantly higher in the late pandemic period than in the early pandemic period $(p< 0.05)$. "Exercise" and "online diet" keywords had significantly higher RSVs in the early pandemic period than in the prepandemic period $(p< 0.05)$. The search queries for "healthy nutrition" were significantly lower in the late pandemic period than in the prepandemic period $(p< 0.05)$. According to the search volume for the previous 10 years, the predicted search trends of "body mass index", "exercise", "healthy nutrition", "online diet" and "online dietitian" tended to increase depending on the seasonal search profile.

Conclusion: A large increase in actual and predicted search queries of "online dietitian" can provide some cues about public tendencies in the postpandemic era in Turkey. Some guidelines, including web-based communication competencies in dietitian-patient relationships and follow-ups of the diet on the online platform, should be published for the postpandemic period by authorities.

Keywords: body weight, coronavirus, diet, nutritionist, pandemic

Çevrimiçi Diyetisyenlik Türkiye'de Pandemi Sonrası Dönemin Yeni Akımı Olabilir Mi?

ÖZET

Amaç: Bu çalışmanın amacı, pandemiyle tetiklenen ağırlık yönetimi ile ilgili Türkiye'deki Google arama trendlerini araştırmaktır.

Yöntemler: Anahtar kelimeler "diyet", "diyetisyen", "vücut kitle indeksi", "egzersiz", "kalori", "kilo alımı", "sağlıklı beslenme", "kilo verme", "yağ yakma", "zayıflama", "online diyet" ve "online diyetisyen" di. Veri toplama ve zaman serisi analizi, R Studio programının 4.1.0 sürümü ve bu sürümün gtrendsR, ggplot2, Prophet, dplyr, tahmin ve ggforce paketleri kullanılarak tamamlandı. Anahtar kelimelerin pandemi öncesi, erken pandemi ve geç pandemi dönemlerinde göreli arama hacimlerinin (GAH'ler) istatistiksel analizi için SPSS yazılımı sürüm 17 kullanıldı.

Bulgular: "Diyetisyen" anahtar kelimesinin GAH'ı geç pandemi döneminde erken pandemi dönemine göre anlamlı ölçüde daha yüksekti $(p< 0.05)$. "Egzersiz" ve "online diyet" anahtar kelimeleri erken pandemi döneminde pandemi öncesi döneme göre anlamlı ölçüde daha yüksek GAH'lara sahipti $(p< 0.05)$. "Sağlıklı beslenme" için yapılan arama sorguları, pandemi döneminin sonlarında, pandemi öncesi döneme göre anlamlı ölçüde daha düşüktü $(p< 0.05)$. Son 10 yıldaki arama hacmine göre, "vücut kitle indeksi", "egzersiz", "sağlıklı beslenme", "online diyet" ve "online diyetisyen" arama trendleri, mevsimsel arama profiline bağlı olarak artma eğilimindeydi.

Sonuç: "Online diyetisyen" için gerçek ve tahmin edilen arama sorgularındaki büyük artış, Türkiye'de pandemi sonrası dönemde halkın eğilimleri hakkında bazı ipuçları verebilir. Pandemi sonrası dönem için diyetisyen-hasta ilişkilerinde web tabanlı iletişim yetkinlikleri ve diyetin online platformda takibi gibi bazı kılavuzların otoritelerce yayınlanması gerekmektedir.

Anahtar Kelimeler: vücut ağırlığı, koronavirüs, diyet, diyetisyen, pandemi

Coronavirus disease (COVID-19) has become a global public health concern caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Due to the easy transmission of SARS-CoV-2 from human to human, the number of coronavirus cases has dramatically reached the alert level around the world, with a huge pandemic in Turkey (1).

Obesity is another serious public health concern worldwide and in Turkey. According to the European Health Interview Survey in 2014, Turkey is ranked among the top countries in Europe in terms of obesity, with a prevalence of 19.9% (2). Obesity causes an increased risk of noncommunicable diseases, such as type 2 diabetes, cardiovascular disease, hypertension and some cancers as well as increased rates of mortality. Obese individuals can suffer from metabolic dysfunctions, alterations in immune responses, pneumonia development, respiratory tract infections, abnormalities in the inflammatory process and mortality from critical inflammation (3). For these reasons, obesity is considered a risk factor for severe COVID-19 complications (4). Consistently, a systematic review and meta-analysis showed that obesity increased the risk of hospitalization, mechanical ventilation and disease severity in coronavirus (5). Similarly, the outcomes of Cornejo-Pareja et al.'s study showed that long-term complications of COVID-19 could appear more frequently and severely in obese patients (6).

To avoid obesity, behavioral treatments are regarded as preventive care and viable strategies during the outbreak. Rychter et al. strongly advised that each COVID-19 patient should complete the measurement of body weight to avoid obesity-related infections and mortality. Moreover, they emphasized the requirement of nutritional and behavioral guidelines for obese COVID-19 patients (7).

Google trends (GT) studies are commonly carried out to determine the public interest during pandemic conditions. It provides the search queries as the RSV of any keyword in a certain region for a specific time period. During the outbreak, researchers have addressed public interest in coronavirus, immunity, diet, foods, exercise, nutrients, specific disorders, lockdown and hygiene-related keywords around the world (8–11). McCarty and McGoldrick demonstrated that diabetes and weight loss keywords had significantly increased in search volume during the outbreak around the world. They suggested a potential relationship between metabolic health and the COVID-19 outbreak (9). On the other hand, the search profile could vary from one country to another. Although both coronavirus and obesity have appeared with a huge prevalence in Turkey, no detailed infodemiological analysis about the weight management-related internet queries in Turkey during the pandemic could be found.

This paper aimed to evaluate weight management-related web-based searches of internet users in Turkey. In addition, the RSVs of the prepandemic, early pandemic and late pandemic periods were compared. Additionally, potential search profiles of keywords were estimated for the future.

MATERIALS AND METHODS

Study Design
This research is an infodemiological study that was carried out with retrospective data between 2011 and 2021 of the GT search engine (https://trends.google.com) (12). Data about search queries can be obtained as RSVs from GT. RSV can be expressed from 0 to 100, depending on search interest ranking (13).

In this study design, the search region was "Turkey", so searches were completed in the Turkish language. Keywords were "diet", "dietitian", "body mass index", "exercise", "calorie", "weight gain", "healthy nutrition", "weight loss", "fat burning", "slimming", "online diet" and "online dietitian".

Data Collection
Data collection and time series analysis were carried out with the usage of the 4.1.0 version of the R Studio program and the gtrendsR, ggplot2, prophet, dplyr, forecast and ggforce packages of this program (R statistical software, www.R-project.org). In this context, the "gtrendsR" package was used to display the trends over time, which are also known as hits and geographic representations of query results. The grendsR package in the R program provides an interface to retrieve and view information returned online (14). The "ggplot2" package was used to determine how to map variables to aesthetics and which graphic principles to use (15). The "prophet" package was used to estimate further trends. The "prophet" package in the R program performs a procedure to predict the time series data based on an additional model where nonlinear trends are suitable for annual, weekly, and daily seasonality, as well as holiday effects (16). The dplyr package was used to create the data frames quickly and consistently, both in memory and nonmemory objects (17). The "forecast" package in the R program was used to provide methods and tools to display and analyze the univariate

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time series forecasts, including exponential smoothing through state space models and automatic ARIMA modeling (18). The "ggforce" package gives the search trends of certain periods within the search spectrum more closely. Therefore, the "ggforce" package was used to zoom in on ggplot plots for specific time periods (19).

In addition to time series analysis, we focused on the three periods of the pandemic within the scope of the study. These periods were the prepandemic period *(January 1, 2019 – June 1, 2019)*, early pandemic period *(January 1, 2020 – June 1, 2020)* and late pandemic period *(January 1, 2021 – June 1, 2021)*. The prepandemic period is important to compare the public interests before the pandemic and pandemic periods. The early pandemic period can represent the effect of strict pandemic conditions on the public in terms of lockdown, anxiety and uncertainty. The late pandemic period can be an indicator of the postpandemic process and new lifestyle conditions.

Statistical Analysis
SPSS software version 17 was used for statistical analysis of the prepandemic, early-pandemic and late-pandemic periods (SPSS Inc., Chicago, Illinois, USA). After the data were drawn with the R program from GT via gtrendsR, the consistency was tested for each keyword according to the inter-periods search volumes with the Friedman test. The Friedman test is a nonparametric test used for repeated measurements (20). The confidence interval was selected as 95%. $p < 0.05$ was accepted as significant in the tests.

The consistency level of search volumes was calculated by Kendall's W test as Kendall's coefficient of concordance (W). W ranges from 0.00 and 1.00 (0.00–0.20 very weak consistency, 0.21–0.40 weak consistency, 0.41–0.60 medium consistency, 0.61–0.80 strong consistency and 0.81–1.00 a very strong consistency) (21). The Wilcoxon rank sum test was used to compare the RSV means of two different periods. Analysis results were drawn as bar graphs by GraphPad Prism 9.

RESULTS

We focus on the public interest profile of keywords in the early-pandemic period within the spectrum of the previous 10-year period in Figure 1. Accordingly, the RSV trends of "dietitian", "body mass index", "weight gain" and "slimming" dramatically decreased in the first months of the early-pandemic period but later increased. The amounts of increase and decrease in the search queries were approximately equal to each other. The RSVs of "exercise" greatly increased in the first months of the early-pandemic period but later slightly decreased.

"Diet", "calorie", "weight loss" and "fat burning" keywords' RSVs had gradually increasing search profiles with slight fluctuations at the beginning of the lockdown. On the other hand, "healthy nutrition" keyword RSVs gradually decreased the search profile with slight fluctuations. Last, "online diet" and "online dietitian" keywords' RSVs peaked two times within the early-pandemic period (Figure 1).

According to the Friedman test, the search queries of only "healthy nutrition" keywords were determined to be significantly consistent between periods *(p< 0.05)*. Kendall's W test showed that there was moderate consistency of "dietitian", "exercise", "calorie" and "online diet'" RSV data during the selected periods (Kendall's coefficient of concordance score: 0.41–0.60). In addition, there was strong consistency in the "healthy nutrition" keyword RSVs during pandemic-related periods (Kendall's coefficient of concordance score: 0.61–0.80) (Table 1).

Wilcoxon rank sum test findings demonstrated that the mean RSV of the "dietitian" keyword was significantly higher in the late-pandemic period than in the early-pandemic period *(p< 0.05)*. The mean RSV of the "exercise" keyword in the early-pandemic period was significantly increased compared to that in the prepandemic period *(p< 0.05)*. This increased profile of "exercise" keywords continued during the late-pandemic period, but it was not statistically significant (p= 0.08). In addition, the mean RSV of the "calorie" keyword in the late-pandemic period was significantly higher than that in the prepandemic period *(p< 0.05)*. The average RSV of the "calorie" keyword was higher in the late pandemic than in the early-pandemic period, but it was not statistically significant (p= 0.08) (Figure 2a).

The mean search query of the "healthy nutrition" keyword was significantly lower in the late- pandemic period than in the prepandemic period *(p< 0.05)*. In addition, the mean RSV of "healthy nutrition" was higher in the early-pandemic period than in the late-pandemic period, but the difference was not statistically significant. The mean RSV of the "online diet" keyword was significantly higher in the early-pandemic period than in the prepandemic period *(p< 0.05)*. Last, the average RSV of the "online dietitian" keyword was higher in the late-pandemic period than in the prepandemic period, but the difference was not statistically significant (p= 0.08) (Figure 2b).
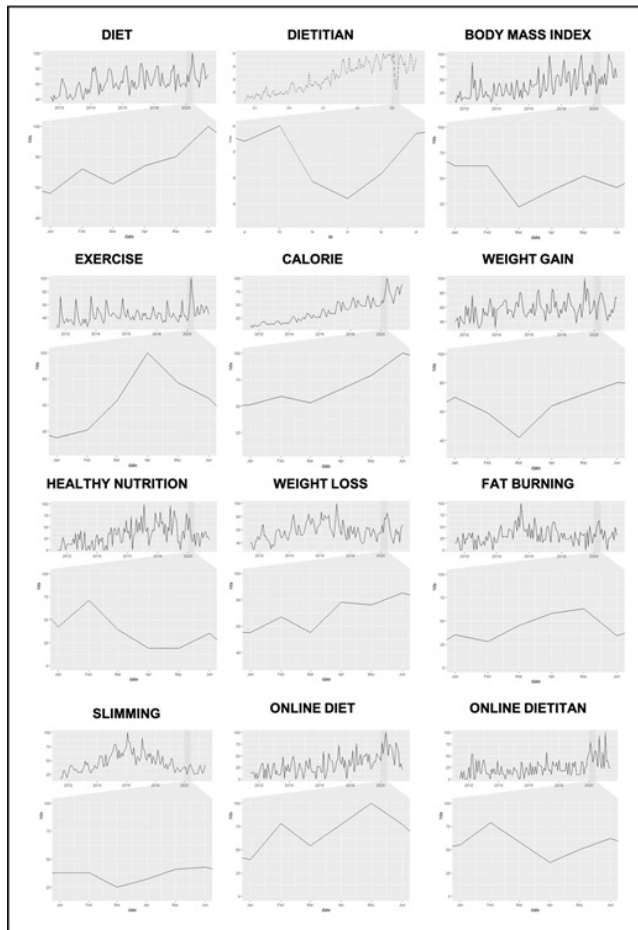
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Figure 1. The public interest profile of keywords in the early-pandemic period within the spectrum of the previous 10-year period.
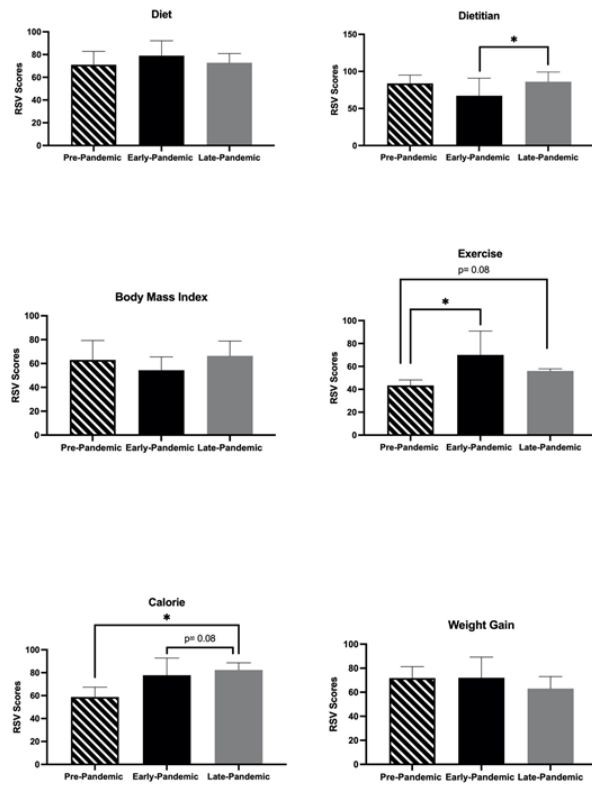

Figure 2. a) Wilcoxon rank sum test results of "diet", "dietitian", "body mass index", "exercise", "calorie" and "weight gain" keywords' RSVs during the pre-pandemic, early-pandemic and late-pandemic periods.
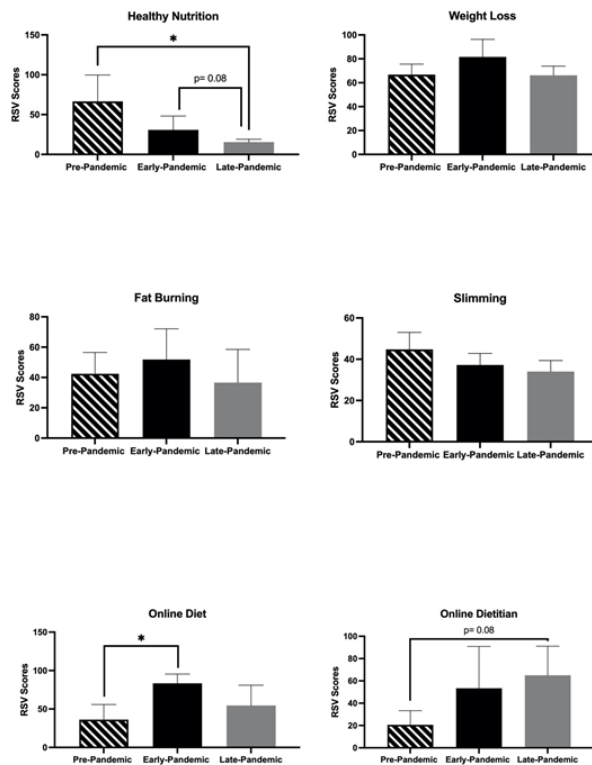

Figure 2 b) Wilcoxon rank sum test results of "healthy nutrition", "weight loss", "fat burning", "slimming", "online diet" and "online dietitian" keyword RSVs during the pre-pandemic, early-pandemic and late-pandemic periods.

Table 1. Friedman X^2 and Kendall's W analysis results of keyword RSVs during the pre-pandemic, early-pandemic and late-pandemic periods

Keywords	Friedman X^2	p	Kendall's W
Diet	0.105	0.940	0.011
Dietitian	6.000	0.05	**0.600**
Body Mass Index	1.600	0.449	0.160
Exercise	5.200	0.074	**0.520**
Calorie	6.000	0.05	**0.600**
Weight Gain	2.842	0.241	0.284
Healthy Nutrition	6.400	**0.041**	**0.640**
Weight Loss	1.600	0.449	0.160
Fat Burning	0.400	0.819	0.040
Slimming	2.800	0.247	0.280
Online Diet	5.200	0.074	**0.520**
Online Dietitian	1.200	0.549	0.120

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Figure 3 shows the predicted search profile of keywords for further periods. According to the search volume for the previous 10 years, the predicted search trends of "diet", "dietitian", "calorie", "weight gain" and "slimming" tended to greatly increase or decrease in the future when compared to the actual statement. The predicted search trends of "body mass index", "exercise", "healthy nutrition", "online diet" and "online dietitian" tended to increase depending on the limits of seasonal search trends in the future. In addition, the predicted search trends of weight loss mostly tended to be similar to their seasonal search trend for further periods.
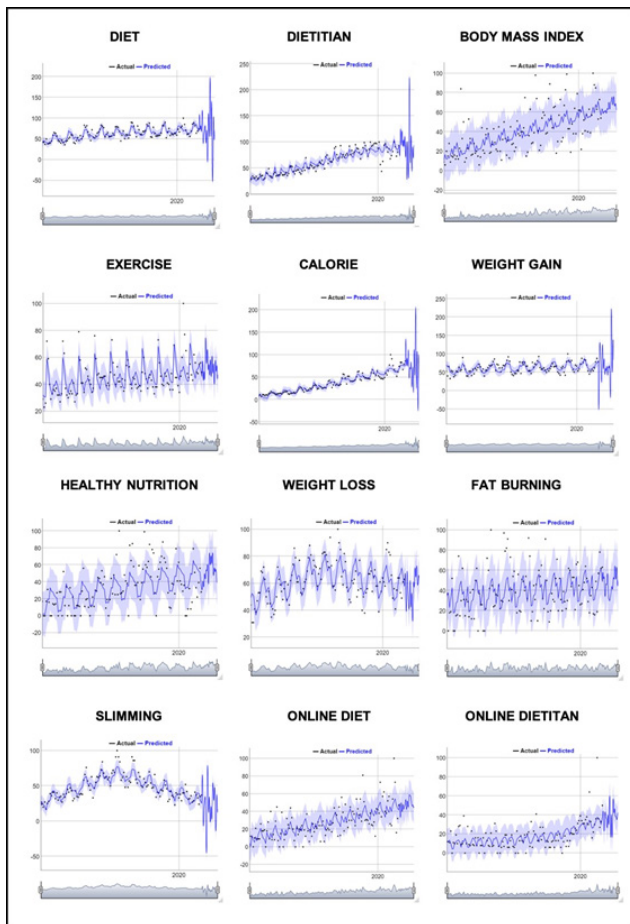

Figure 3. The previous 10 years' search data and predicted search profile of keywords for further period.

DISCUSSION

In our study, the search volumes of "dietitian", "body mass index", "weight gain" and "slimming" keywords sharply dropped, whereas those of "diet", "calorie", "weight loss" and "fat burning" slightly dropped in the first months of the early-pandemic period. In the literature, similar

findings were reported on a global scale. In this context, Ngoc and Kriengsinyos investigated the global search interests of "calorie", "weight loss", "weight gain" and "aerobic exercise" keywords from January 1, 2018 to December 13, 2020. Accordingly, the pandemic has significantly changed individual weight-related concerns. Consistent with our findings, global interest regarding "calorie", "weight loss" and "weight gain" dropped during the first month of the lockdown period (11). The global search profile of these keywords was quite similar to the search interests in Turkey for the same period.

In addition, "online diet" and "online dietitian" keywords' RSVs peaked two times within the early-pandemic period. No infodemiological data on this subject have been reported in previous studies. However, in some studies conducted in different countries, it was noted that similar practices were used during this period. For instance, in a study conducted with Canadian dietitians, online and telephone interviews were mentioned during the pandemic period. It was stated that these interviews had successful results in some patients, but people with low socioeconomic status did not have these technologies (22).

It is well known that nutritional status and physical activity are closely related to public health and disease processes. In this context, to effectively combat COVID-19 in patients with optimal body weight, healthy lifestyle activities, such as exercise during free time, maintaining a healthy body weight, ingesting sufficient fruit and vegetables and avoiding ultra-processed food consumption, should be performed (23). However, it is emphasized that unhealthy eating habits have become widespread in studies carried out in Turkey during the quarantine period (24-25). Consistently, "healthy nutrition" keyword RSVs gradually decreased in their search profile with slight fluctuations.

The reason for the significantly higher mean RSV of the "dietitian" keyword in the late-pandemic period than in the early-pandemic period can be related to increased weight gain due to lockdowns *(p< 0.05)*. The interest in the "dietitian" keyword of internet users suddenly decreased in the first months of the early-pandemic period. This situation confirmed the reduced interest of the public in weight management strategies, so weight gain may have increased in the early-pandemic process. Therefore, people who gained weight in the early-pandemic period may have wanted to lose weight in the late-pandemic period.

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Being physically active plays a significant role in weight control, maintaining immune competence, reducing the risk of illness. The lockdown process causes more difficulty in the sustainability of the physical activity schedule (26). In our study, the search volume of the "exercise" keyword dramatically increased at the beginning of the early-pandemic period but later slightly decreased. Nevertheless, it had significantly higher search queries in the early-pandemic period than in the prepandemic period (p< 0.05). We considered that this could be related to it covering home-based exercise due to lockdowns. Similarly, Mayasari et al. showed that worldwide RSVs of "exercise" keywords were positively correlated with COVID-19 daily confirmed cases (rs: 0.599, p< 0.001) and COVID-19 cumulative confirmed cases (rs: 0.611, p< 0.001) (10).

Whereas the mean RSV of the "calorie" keyword significantly increased from the prepandemic period to the late-pandemic period, the average RSV of the "healthy nutrition" keyword significantly decreased (p< 0.05). This situation can be explained by the fact that people may focus on short-term targets instead of long-term targets due to psychological issues during the pandemic.

In this study, the average RSV of the "online diet" keyword was significantly higher in the early-pandemic period than in the prepandemic period (p< 0.05). However, search queries about "online diet" slightly decreased in the late pandemic period. On the other hand, the average RSV of the "online dietitian" keyword increased gradually during the prepandemic and late-pandemic periods, but this elevation was not statistically significant (p= 0.08). Nevertheless, this increase is expected to continue for postpandemic periods, so it can be a novel trend of the public as a weight management strategy in Turkey. In that context, the pandemic process may be an opportunity for new mode of working in the dietetic profession. However, the success of nonverbal communication in the dietetic profession should be questioned at this point. The success of online diet intervention programs depends on various factors, such as participant-related parameters, intervention programs and the efficiency of interventions (27).

In fact, it was interesting that although "online diet" searches decreased in the late-pandemic period, "online dietitian" searches steadily increased. This may be because the online diet includes programs that are created with artificial intelligence and do not require any professional follow-up. Similar programs may be less successful in weight management than professional follow-up via online

dietitian, and this situation could give rise to a drop in the search queries of the "online diet" keyword. In the literature, Beleigoli et al. investigated the effect of a 24-week personalized web-based weight loss behavior change program with and without dietitian online coaching on overweight and obese adults. They suggested that engagement with the program was higher in the platform-plus coaching group than in the platform-only group. They claimed that platform-plus coaching was related to a significantly greater chance of weight loss that is clinically meaningful (28).

This study includes some cues about web-based search volumes of weight management-related keywords for the postpandemic process through predicted search profiles. According to the previous 10 years of data, there were no certain estimations about future search queries of "diet", "dietitian", "calorie" and "slimming" keywords. This situation could be explained by their previous RSVs being suddenly up and down due to external factors while having a regular search profile. These keywords may be searched a lot or not at all in the future depending on any factor. On the other hand, although "body mass index", "exercise", "healthy nutrition", "online diet" and "online dietitian" keywords had high or low RSV values at many times within the search spectrum, it is predicted that their future search queries can increase within the seasonal search profile in the future. The reason is that their predicted search trends for previous years tend to increase regularly and gradually. Last, as the seasonal search trend of the "weight loss" keyword has had a similar profile in the last 10 years, it may be predicted that its seasonal search trend can be similar in the future. The search queries about "weight loss" cannot be greatly affected by external factors.

This study has some strengths when compared to other infodemiological studies in the literature. First, other studies included only statistical analysis of retrospective data in some countries during the pandemic. This study found both current and predicted search volumes and statistical analysis of selected keywords. Second, other infodemiological studies have investigated global public interest in some weight-related issues during the pandemic. In addition to these keywords, our study also analyzed "diet", "dietitian", "online diet" and "online dietitian", and these keywords have vital importance in terms of understanding public preferences about professional weight management strategies for the postpandemic process.

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There are several limitations in this retrospective infodemiological study such as unknown of sociodemographic properties of participants, carried out only Turkey, limited with certain time period and linguistic restrictions.

CONCLUSION

In this study, a large increase in search queries about online dietitians in both actual and predicted data can provide an explanation of public orientation for the postpandemic era in Turkey. Even if the pandemic ends one day, its impacts on individuals' lives, behavior and habits can continue. Effective use of online platforms as professionals can be one of these impacts. In this context, guidelines that include web-based communication competencies in dietitian-patient relationships and follow-up of the diet on the online platform should be provided to regulations to effectively combat obesity in the postpandemic period. This public interest may lead to diet monitoring by nonprofessionals, and diets touted by nonprofessionals can threaten public health. Therefore, some authorities should develop policies that control whether the specialist is a dietitian on web-based platforms. Moreover, it should also be taken into account in the planning of nutrition and dietetic education for technology embracement and new opportunities for the future. In this way, it can be ensured that the public can access accurate and reliable information from professional dietitians.

DECLARATIONS

Funding
This study has not been funded by any institution.

Conflict of Interest
All authors declare that they have no conflicts of interest.

Ethics Approval
This study did not require ethical committee approval.

Availability of Data and Material
We can share the all data of the study.

Authors' Contributions
E.G. designed and coordinated the study and wrote the manuscript; Ö.Ç. collected the data, performed statistical analyses and revised the manuscript.

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