

ORIGINAL ARTICLE

Spanish population trends in Internet searches for information on different diets[☆]



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Big data;
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Intermittent fasting;
Vegan diet

Abstract

Objective: To use Google Trends to explore the trends of interest of the Spanish population regarding information related to different types of diets, focused on those that are popular and with evidence-based studies, over the last 10 years.

Material and methods: The search trends referred to the terms “Mediterranean diet”, “ketogenic diet”, “low fat diet”, “intermittent fasting” and “vegan diet” were analyzed. The relative search volumes (RSV) of the terms were compared. The direction of the trend was studied using the Spearman’s correlation coefficient (SC).

Results: “Mediterranean diet” was the most widely searched term, with a median RSV of 16 (interquartile range [IQR] 6; range 8–100), though it exhibited a decreasing chronological trend (SC = −0.216). It was followed by “ketogenic diet”, with an RSV of 8 (IQR 9; range 1–57); “vegan diet”, with an RSV of 4 (IQR 5; range 0–16); “intermittent fasting”, with an RSV of 2 (IQR 5; range 0–27), and “low fat diet”, with an RSV of 1.16 (IQR 0; range 0–2). The term with the best correlation over time was “intermittent fasting” (SC = 0.96), followed by “ketogenic diet” (SC = 0.91) and “vegan diet” (SC = 0.85).

Conclusions: In Spain, the interest of the population in information about the Mediterranean diet is greater than for other diets. However, in recent years there has been a progressive increase in interest (measured as RSV) in other diets such as the ketogenic diet, vegan diet or intermittent fasting, and there has been a decrease in interest in the Mediterranean diet. The low fat diet does not generate interest in the Spanish population.

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PALABRAS CLAVE

Big data;
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Dieta mediterránea;
Dieta cetogénica;
Dieta baja en grasas;
Ayuno intermitente;
Dieta vegana

Tendencia de la población española de búsqueda en internet sobre información relacionada con diferentes dietas

Resumen

Objetivo: Explorar a través Google Trends las tendencias del interés de la población española sobre información relacionada con diferentes tipos de dietas, focalizadas en las más populares y con estudios de evidencia, a lo largo de los últimos 10 años.

Material y método: Se analizaron las tendencias de búsqueda de los términos «dieta mediterránea», «dieta cetogénica», «dieta baja en grasas», «ayuno intermitente» y «dieta vegana». El volumen relativo de búsqueda (VRB) de cada término fue comparado. La dirección de la tendencia se estudió mediante la correlación de Spearman (CS).

Resultados: El término «dieta mediterránea» fue el más buscado, con una mediana de VRB de 16 (rango intercuartil [RI] 6; rango 8–100), aunque siguió una tendencia cronológica decreciente (CS = -0,216). Le siguieron «dieta cetogénica», con VRB de 8 (RI 9; rango 1–57); «dieta vegana», con VRB de 4 (RI 5; rango 0–16); «ayuno intermitente», con VRB de 2 (RI 5; rango 0–27), y «dieta baja en grasas», con VRB de 1,16 (RI 0; rango 0–2). El término con mejor correlación a lo largo del tiempo fue «ayuno intermitente» (CS = 0,96), seguido de «dieta cetogénica» (CS = 0,91) y «dieta vegana» (CS = 0,85).

Conclusión: En España, el interés de la población sobre la información acerca de la dieta mediterránea es mayor que para otras dietas. Sin embargo, en los últimos años se ha producido un incremento progresivo en el interés, medido como VRB, en otras dietas, como la dieta cetogénica, la dieta vegana o el ayuno intermitente, y se ha producido una reducción en el interés por la dieta mediterránea. La dieta baja en grasas no genera interés en la población española.

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Introduction

In recent years, scientific bodies, professionals in the field of nutrition, and the Spanish National Health Service (*Sistema Nacional de Salud* [SNS]) have all sought to consolidate healthy lifestyle and eating habits, in particular by promoting the Mediterranean diet¹ following the publication of the PREDIMED study (Prevention with the Mediterranean Diet), in which adherence to the Mediterranean diet was associated with lower cardiovascular risk.² However, the real impact of these campaigns and the interest they generate among the public are not known.

New tools are emerging in the era of Big Data to facilitate healthcare research. One form of Big Data is that which is accumulated in the course of online search activities.^{3,4} Data from Internet searches can provide valuable information about the epidemiological patterns of certain diseases, as well as the behavior and interests of the population.^{3,4} One tool that allows Internet users to interact with search data is *Google Trends*, a free and publicly accessible online portal by Google Inc. *Google Trends* scans a portion of the 3000 million daily Google searches and provides data on geospatial and time patterns in search volumes under the terms specified by the user.⁵

Previous studies have used *Google Trends* to monitor overall suicide risk,⁶ determine public interest in cancer screening,⁷ track seasonal patterns in urinary tract infections⁸ or assess the use of infiltrations in osteoarthritis.⁹ In the field of nutrition, search trends referring to bariatric surgery techniques have been studied.

Rahiri et al.¹⁰ observed a decrease in the search terms gastric band versus gastric sleeve; and these results were reproduced worldwide.¹¹ Tkachenko et al.¹² in turn studied how *Google Trends* may be useful for detecting early signs of diabetes by generating combinations of keywords. In relation to diet, a study has investigated the annual variation in Internet searches using *Google Trends* in the United States, referring to the term “diet”. The study found that searches conform to a constant 12 month linear model, reaching a peak in January (after New Year’s Eve) and then decreasing linearly until the process is repeated the following January.¹³ However, no articles were found evaluating searches on *Google Trends* for certain diets or assessing which diets are most searched for by users. The previous studies addressed trends globally or in countries other than Spain. We therefore considered there was a need for an individualized study focusing on Spain.

Our aim was to use *Google Trends* to explore the trends of interest to the Spanish population regarding information on different types of diet, focusing on the most popular diets and on evidence-based studies published over the past 10 years.

Material and methods

In order to analyze the trend in online searches for information on certain diets on the part of the Spanish population, one of the authors (IM), on 2 June 2019, used the software tool *Google Trends* in Spanish¹⁴ to analyze the data corre-

Table 1 Checklist of search specifications.

1 Subject	Diet
Search variables	
2 Country or region	Spain
3 Search period	1/1/2009–02/6/2019
4 Search category	All categories
5 Search type	Web search
6 Search terms	
6.1 Search term (general trend)	Diet
6.2 Search term (trend of different types of diet)	"Mediterranean diet" + "Mediterranean diet" –, gastronomy, –, gastronomy "Ketogenic diet" + "ketogenic diet" + "keto diet" "Low fat diet" + "low fat diet" "Intermittent fasting diet", + "intermittent fasting" "Vegan diet"

Checklist proposed by Nuti et al.³.

sponding to the previous 10 years (from June 2009 to June 2019).

Search strategy

"Spain" was selected as the country of interest, and "all categories" was selected since interest was general. The main search term was "diet", together with combinations of the different possible diets. The method proposed by Nuti et al.³ was used to improve the reproducibility of our study (Table 1).

Outcome variable

In *Google Trends*, the primary outcome variable is the so-called "relative search volume" (RSV), which represents the search rate (on a 0–100 scale) for a specific term in relation to the total of selected searches (maximum 5 comparisons). The data descriptions allow evaluations of rates of change and comparisons between search terms. The software tool provides the numerical value of the RSV for each time interval of those search terms that meet a minimum volume threshold. The search results are proportional to the time and geographic location of a search according to the following process¹⁵:

- 1) At each timepoint, the absolute volume of data is divided by the total searches of the geographic region in the time interval it represents, to compare relative popularity. If this were not done, the locations with the greatest volume of searches would always appear in the first places.
- 2) The RSV value is then obtained. To this end, the numbers resulting from the previous process are scaled from 0 to 100, based on the proportion of a given term with respect to the total searches referring to all the terms.
- 3) Exclusion is made of those searches performed for terms with a very low search volume, or made by very few users, which are shown with a value 0. Likewise, searches

performed by the same person repeatedly over a short period of time are also eliminated.

Evidence-based diet

In order to determine the 5 diets to be compared, based on the general term diet, we identified the most frequent related searches in Google. We were interested in knowing whether the most popular diets on Google had scientific evidence to support them. It was assumed that the diets with a greater number of publications in PubMed would serve as the cut-off point. For this reason we analyzed the timelines of the PubMed searches over the previous 10 years, and studied the number of publications that included the terms "Mediterranean diet", "ketogenic diet", "paleo diet", "vegan diet", "intermittent fasting", "Dukan diet" or "Nordic diet" in the title or abstract. The terms "Mediterranean diet", "ketogenic diet", "vegan diet" and "intermittent fasting" were the most popular and were selected. The term "low fat diet" was added to the search, for although it had a low number of Google searches and was not among the most popular diets, it featured in a large number of publications over this period (Fig. 1).

Statistical analysis

Trends were analyzed for each of the terms according to their RSV value. The RSV values for each term are presented as the median, interquartile range (IQR) and total range. Data distribution was assessed using the Kolmogorov–Smirnov test. All trends were evaluated by observing the correlation between time and RSV, based on the Spearman coefficient (SC), being very weak or absent for values of 0–0.25, weak for 0.26–0.50, moderate for 0.51–0.75, and strong for values of ≥ 0.76 . The RSV values between the different terms were compared using the Kruskal–Wallis test, and paired comparisons were made with Bonferroni correction. Statistical significance was considered for $p < 0.05$ in all cases.

Results

The term with the greatest RSV was Mediterranean diet ($p < 0.001$). Following Mediterranean diet, and in decreasing order of interest, we found ketogenic diet, vegan diet, intermittent fasting, and finally low fat diet (Table 2).

However, on examining the search trends over the previous 10 years (Fig. 2), we observed a very weakly descending trend in the term "Mediterranean diet". The term "low fat diet" showed no changes, with a zero trend. On the other hand, the terms ketogenic diet, intermittent fasting and vegan diet showed a strong increasing search trend (Fig. 3). The term intermittent fasting showed the best direct correlation with time, followed by ketogenic diet and vegan diet (Table 3).

Discussion

Our results indicate that the interest of the Spanish population in Internet searching for the Mediterranean diet is high,

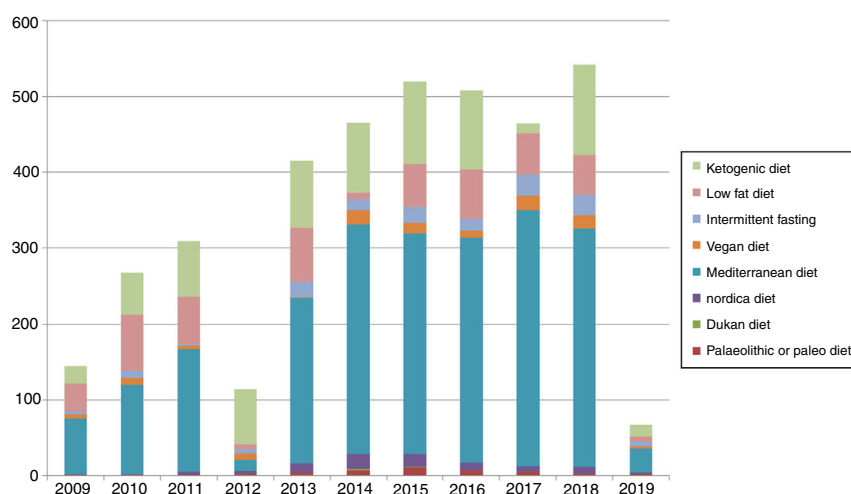


Figure 1 Number of publications in PubMed per year for each type of diet.

Table 2 Relative search volume (RSV) values for different diets over a period of 10 years.

Diet	Median	Range	IQR
Mediterranean diet	16.0	8–100	6.0
Ketogenic diet	8.0	1–57	9.0
Vegan diet	4.0	0–16	5.0
Intermittent fasting	2.0	0–27	5.0
Low fat diet	1.0	0–2	0.0

Ordered from highest to lowest, according to the median relative search volume (RSV).

IQR: interquartile range.

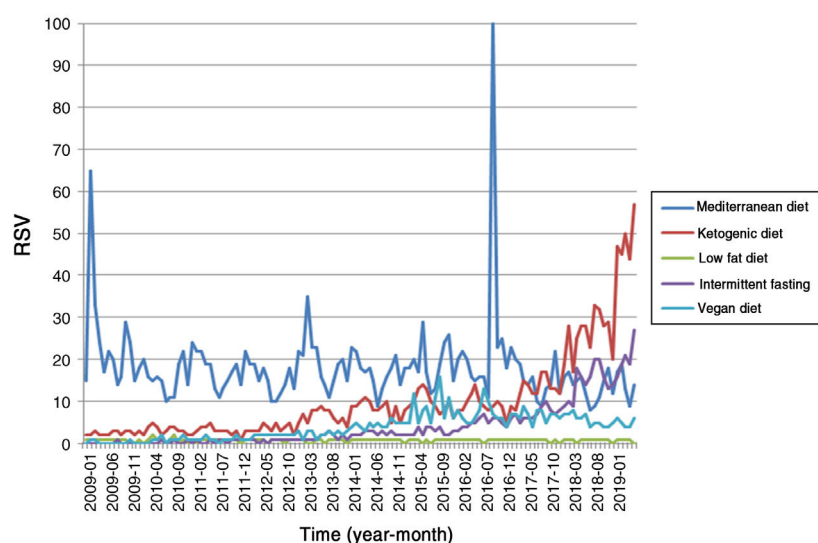


Figure 2 Chronological trend in relative search volume (RSV) of the different diets.

it having been the most consulted diet over the last 10 years. However, despite the growing scientific evidence regarding its benefits in terms of cardiovascular disease prevention,² the prevention or improvement of diabetes control,¹⁶ lipid

profile¹⁷ and even the reduction of all-cause mortality,¹⁸ the interest it generates exhibits a negative trend. This could be because such information is not adequately conveyed or is unable to stimulate sufficient interest among Internet users.

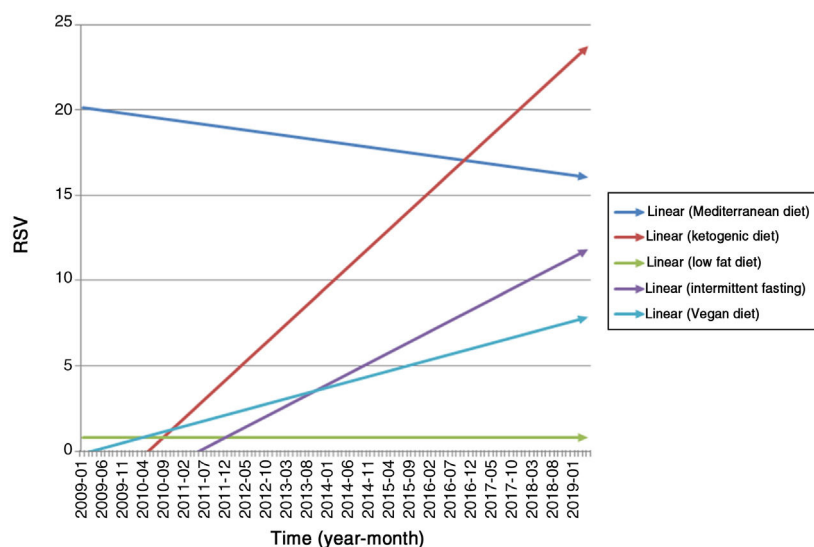


Figure 3 Chronological trend in relative search volume (RSV) of the different diets (expressed as trend line).

Table 3 Correlation of relative search volume (RSV) of the different diets over time.

Diet	Spearman coefficient	p
Intermittent fasting	0.964	<0.001
Ketogenic diet	0.915	<0.001
Vegan diet	0.850	<0.001
Low fat diet	0.008	0.932
Mediterranean diet	↓0.216	0.016

Ordered from highest to lowest, according to the Spearman correlation coefficient.

On the other hand, we observed that population interest in certain diets has increased significantly over the last 10 years. Specifically, intermittent fasting, followed by the ketogenic diet and finally the vegan diet, have generated increasing interest among the population, with a progressive increase in the number of searches over the evaluated time period. This observation is accompanied by the appearance in the last 10 years of scientific publications in favor of these diets.^{19–21}

It must be emphasized that Internet searches in the education of the population, and particularly of patients, play a very important role. Specifically, access to health information is particularly important in relation to diseases which can be self-diagnosed, such as overweight or obesity. Access to websites containing quality information on types of diet is particularly important for such patients, who may feel that the information provided by their physician is incomplete, or who are unable to access specialist care (waiting lists are estimated to range from 4 months to 2 years²²) and therefore resort to the Internet as their primary source of information. Lewis et al.²³ found that the Internet is a convenient source of support and information for obese people. However, many resort to the same failed online solutions, e.g., fad diets; it is therefore important to evaluate the accuracy of the information which

patients find online. A recent study showed that the quality of information related to the Mediterranean diet is highly variable, and is often poor. The authors concluded that anyone interested in the Mediterranean diet should seek advice from physicians or dietitians.²⁴ Based on the above, validating the quality of the information provided in relation to the different types of diet through search engines is an important step in improving the education of the population. In this respect, it should be the task of health professionals, and especially of dietitians, to help people to adequately search for and assess nutritional information online.²⁵

The increased interest we have observed in diets other than the Mediterranean diet may be related to the profile of the users who perform Internet searches. A number of studies have found that younger people with a higher educational level and income are more likely to use health applications. In turn, the use of such applications is associated with a personal intention to change diet and comply with the recommendations referring to physical activity.^{26–28} This could explain why there are population groups that seek a more novel dietary alternative than the more traditional approaches, such as the Mediterranean diet. However, *Google Trends* does not provide information on the profile of the user making the search, and there are no national reg-

istries providing data on the type of diets that are followed or predominantly prescribed.

The present study has limitations. The results may not fully consider those with limited resources or poor access to the Internet. We consider that our selection of the 5 diets to be compared was the correct one, since these are the diets with the greatest number of publications available among those most consulted by online users. In this regard, there are a great number of diets with different purposes, and the limitations of the tool did not allow us to compare all of them. Likewise, it is difficult to quantify the number of people who finally adhere to some type of diet among those considered in our study, since we know of no national registry allowing us to study this subject. Therefore, we cannot correlate the search activity to the actual use of diets and adherence to them. However, it should be noted that the aim of this study was to reflect the interests of the population.

Conclusions

In Spain, interest in information regarding the Mediterranean diet is greater than interest in other types of diet. However, in recent years there has been a gradual increase in interest (measured as RSV) in other types of diet such as the ketogenic diet, vegan diet or intermittent fasting, and a decrease in interest in the Mediterranean diet. The low fat diet does not generate interest among the Spanish population.

Conflicts of interest

The authors declare that they have no conflicts of interest.

References

- Lecube A, Monereo S, Rubio M, Martínez-de-Icaya P, Martí A, Salvador J, et al. Prevención, diagnóstico y tratamiento de la obesidad. Posicionamiento de la Sociedad Española para el Estudio de la Obesidad de 2016. *Endocrinol Diabetes Nutr.* 2017;64:15–22.
- Estruch R, Ros E, Salas-Salvadó J, Covas M, Corella D, Arós F, et al. Primary prevention of cardiovascular disease with a mediterranean diet. *N Engl J Med.* 2018;378:e34.
- Nuti S, Wayda B, Ranasinghe I, Wang S, Dreyer R, Chen S, et al. The use of Google Trends in health care research: a systematic review. *PLoS One.* 2014;9:e109583.
- Mavragani A, Ochoa G, Tzagarakis K. Assessing the methods, tools, and statistical approaches in Google Trends research: systematic review. *J Med Internet Res.* 2018;20:e270.
- Google Trends. 2019. Available from: <https://trends.google.es/trends/?geo=ES>. [Accessed 27 May 2019].
- Solano P, Ustulin M, Pizzorno E, Vichi M, Pompili M, Serafini G, et al. A Google-based approach for monitoring suicide risk. *Psychiatry Res.* 2016;246:581–6.
- Schootman M, Toor A, Cavazos-Rehg P, Jeffe D, McQueen A, Eberth J, et al. The utility of Google Trends data to examine interest in cancer screening. *BMJ Open.* 2015;5, e006678–16678.
- Rosignol L, Pelat C, Lambert B, Flahault A, Chartier-Kastler E, Hanslik T. A method to assess seasonality of urinary tract infections based on medication sales and Google Trends. *PLoS One.* 2013;8:e76020.
- Strotman PK, Novicoff WM, Nelson SJ, Browne JA. Increasing public interest in stem cell injections for osteoarthritis of the hip and knee: Google Trends analysis. *J Arthroplasty.* 2019;34:1053–7.
- Rahiri J, Barazanchi A, Furukawa S, MacCormick A, Harwood M, Hill A. Using Google Trends to explore the New Zealand public's interest in bariatric surgery. *ANZ J Surg.* 2018;88:1274–8.
- Linkov F, Bovbjerg D, Freese K, Ramanathan R, Eid G, Gourash W. Bariatric surgery interest around the world: what Google Trends can teach us. *Surg Obes Relat Dis.* 2014;10:533–8.
- Tkachenko N, Chotvijit S, Gupta N, Bradley E, Gilks C, Guo W, et al. Google Trends can improve surveillance of type 2 diabetes. *Sci Rep.* 2017;7:4993.
- Markey P, Markey C. Annual variation in Internet keyword searches: linking dieting interest to obesity and negative health outcomes. *J Health Psychol.* 2012;18:875–86.
- Google Trends. 2019. Available from: <https://trends.google.es/trends/?geo=ES>. [Accessed 2 June 2019].
- Cómo se ajustan los datos de Trends: ayuda de tendencias de búsqueda. Support.google.com; 2019. Available from: <https://support.google.com/trends>. [Accessed 2 June 2019].
- Esposito K, Giugliano D. Mediterranean diet and type 2 diabetes. *Diabetes Metab Res Rev.* 2014;1:34–40.
- Fleming J, Petersen K, Kris-Etherton P, Baer D. Effect of a mediterranean diet with varying quantities of lean beef on non-HDL and HDL lipid particles: a randomized controlled feeding cross-over trial (OR36-05-19). *Curr Dev Nutr.* 2019;13:3.
- Hershey M, Álvarez I, Gómez-Donoso C, Gea A, Martínez A, Martínez-González M, et al. Population impact of adhering to the Mediterranean diet and physical activity on all-cause mortality: the Seguimiento Universidad De Navarra (SUN) Cohort (P18-018-19). *Curr Dev Nutr.* 2019;3 Suppl 1.
- Abbasi J. Interest in the ketogenic diet grows for weight loss and type 2 diabetes. *JAMA.* 2018;319:215–7.
- Patterson RE, Sears DD. Metabolic effects of intermittent fasting. *Annu Rev Nutr.* 2017;37:371–93.
- Dinu M, Abbate R, Gensini GF, Casini A, Sofi F. Vegetarian, vegan diets and multiple health outcomes: a systematic review with meta-analysis of observational studies. *Crit Rev Food Sci Nutr.* 2017;57:3640–9.
- Russolillo G, Baladia E, Moñino M, Colomer M, García M, Basulto J, et al. Incorporación del dietista-nutricionista en el Sistema Nacional de Salud (SNS): Declaración de Postura de la Asociación Española de Dietistas-Nutricionistas (AEDN). *Actividad Dietética.* 2009;13:62–9.
- Lewis S, Thomas S, Blood R, Castle D, Hyde J, Komesaroff P. 'I'm searching for solutions': why are obese individuals turning to the Internet for help and support with 'being fat'? *Health Expect.* 2010;14:339–50.
- Hirasawa R, Saito K, Yachi Y, Ibe Y, Kodama S, Asumi M, et al. Quality of Internet information related to the Mediterranean diet. *Public Health Nutr.* 2011;15:885–93.
- Gkouskou K, Markaki A, Vasilaki M, Roidis A, Vlastos I. Quality of nutritional information on the Internet in health and disease. *Hippokratia.* 2011;15:304–7.
- Elavsky S, Smahel D, Machackova H. Who are mobile app users from healthy lifestyle websites? Analysis of patterns of app use and user characteristics. *Transl Behav Med.* 2017;7:891–901.

27. McCully SN, Don BP, Updegraff JA. Using the Internet to help with diet, weight, and physical activity: results from the Health Information National Trends Survey (HINTS). *J Med Internet Res.* 2013;15:e148.
28. Carroll JK, Moorhead A, Bond R, LeBlanc WG, Petrella RJ, Fiscella K. Who uses mobile phone health apps and does use matter? A secondary data analytics approach. *J Med Internet Res.* 2017;19:e125, <http://dx.doi.org/10.2196/jmir.5604>.