



Effect of the COVID-19 Pandemic on Interest in Home-Based Exercise: An Application of Digital Epidemiology

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Abstract

Background and aims: According to the World Health Organization (WHO), immediate self-quarantine is assumed as the best course of action for highly contagious diseases. Since the coronavirus disease 2019 (COVID-19) pandemic, many individuals have become overweight and are also suffering from physical problems. The present study aimed to evaluate the effect of the COVID-19 pandemic on interest in home-based exercise.

Methods: This digital epidemiological study used data sources outside the health system. This descriptive study with a comprehensive electronic systematic search in the Google Trends database using the keyword of "home-based exercise" retrieved the relevant data about the Internet search activity of Iranian community members. The data were accordingly obtained within two time intervals, i.e., from February 18, 2020 to October 18, 2020 and eight months prior to the outbreak of COVID-19 (June 18, 2019 to February 18, 2020). To analyze the data, the Wilcoxon test and the Spearman's correlation coefficient were used.

Results: The results showed significant increase in "home-based exercise" Google search in the eight-month time interval during COVID-19 compared with the same period before the pandemic ($P < 0.001$). Moreover, there was a significant correlation between "home-based exercise" Google search and positive COVID-19 cases in the time intervals of February 18, 2020 to April 18, 2020 ($r = 0.756$, $P = 0.0001$), April 18, 2020 to June 18, 2020 ($r = -0.461$, $P = 0.0001$), but not June 18, 2020 to August 18, 2020 ($r = 0.044$, $P = 0.737$), August 18, 2020 to October 18, 2020 ($r = 0.246$, $P = 0.056$), and over time ($r = -0.083$, $P = 0.0195$).

Conclusion: The prevalence rate of the COVID-19 pandemic and social constraints including self-quarantine seem to have raised people's interest in doing exercises, especially home-based exercises.

Keywords: COVID-19, Home-based exercise, Google Trends, Iran

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Introduction

By late December 2019, a new strain of coronavirus called coronavirus disease 2019 (COVID-19) was reported from Wuhan as the capital of Hubei Province in China.¹ With the rapid spread of the disease in China and later worldwide, great concerns and panic arose among people around the world.^{1,2} Since COVID-19 spread globally and even affected most countries, it was defined as a pandemic by the World Health Organization (WHO) in March 2020.³ The rapid spread of the virus as well as the lack of vaccines and definitive specific treatments have all challenged countries with a large number of infected individuals, leading to a rise in mortality rates and creating health-related, socioeconomic, and political problems.^{2,4} It is also important to note that with 4 billion people in lockdown in the world, COVID-19 outbreak may result in excessive sedentary time, especially in the population of vulnerable and disabled subjects.³ That is why the WHO declared a state of emergency around the world in a recent statement.⁴ According to the WHO,

immediate self-quarantine is the best course of action for highly contagious diseases with no vaccines or treatments.⁵ Given the fact that COVID-19 is highly infectious and is rapidly transmitting to other people through respiratory droplets and unprotected contacts with infected surfaces, and one of the appropriate options to deal with this condition is immediate quarantine of the centers of infections.^{2,6} To control the prevalence rate of COVID-19, most countries have also imposed social restrictions at the community level, and this widespread disruption in civic life has changed the lifestyles of individuals in different communities.⁷

In Iran, the outbreak of COVID-19 was officially announced on February 18, 2020, and following severe national restrictive measures such as closure of schools, universities, sports clubs, shopping centers, factories, etc., the entire country became a protected area.⁸ Accordingly, people had to stay at home and were only allowed to go out to buy foodstuff or for health reasons.⁹ All work activities except essential ones (healthcare services, food

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preparation and sales, city cleaning services, police, etc.) were suspended or turned into distant forms, known as telecommuting.⁹

The use of self-quarantine to combat the COVID-19 pandemic seems epidemiologically successful, but it has had serious negative consequences for other health-related measures.^{7,10} In particular, self-quarantine has adversely affected health status by a combination of deteriorating socioeconomic conditions, psychological security, and metabolic processes.^{11,12} To this end, several approaches have been designed to curb the prevalence rate of COVID-19, which may increase obesity and result in related metabolic diseases.⁷ The immune system is highly responsive to physical activity, with the extent of the response related to both duration and intensity of exercise¹³. A number of epidemiological studies suggest that regular physical activity is associated with decreased incidence of and mortality from influenza and pneumonia.¹³ No scientific data currently exists regarding the effects of exercise on coronaviruses.¹⁴ In terms of home-based exercise, a simple internet or YouTube search will reveal a large number of home programs of dance, aerobics, yoga, Pilates, strength workouts, and stretching. Aerobic exercise can be facilitated by the use of stairs and inclines; running on the spot; home exercise bikes, treadmills, and running machines; or laps of the backyard pool.¹⁴

According to relevant reports in this field, many people in different communities have become overweight and are suffering from physical problems following staying at home and being sedentary.¹⁵ However, it is not clear how much restrictions on self-quarantine have increased people's interest in doing exercises at home. Therefore, the present study aimed to investigate whether self-quarantine during the COVID-19 pandemic has raised personal interest in home-based exercise or not.

Materials and Methods

This is a digital epidemiological study that uses data sources outside the health system. This descriptive study with a comprehensive systematic electronic search in the Google Trends database using the keyword of "home-based exercise" retrieved the relevant data about the Internet search activity of Iranian community members, and compared it with the COVID-19 prevalence chart.

The search terms were also identified by performing an initial comparative search using the Google Trends search engine of home exercises including "home workouts, home training, home-based exercise, at-home resistance training, and home gym". Due to the low frequency of the searches in other terms, "home-based exercise" was recruited for the purpose of this study.

First, in Google Trends, one can search by "search terms" and "topics". In contrast to search terms, which captures queries based on specific words users' type without considering the underlying concept, search topics

encompass a group of terms that share the same concept in any language. For example, "exercise" as a search term may pick up irrelevant searches that included the word "exercise", such as "a thinking exercise", "exercise" as a topic should theoretically include all queries related to the concept of "exercise", whether or not the word "exercise" was mentioned, such as "workout" and "high-intensity interval training", without miss-identifying irrelevant searches with the term "exercise". Second, Google Trends does not provide the absolute number of search queries. Google Relative Search Rate (GRSR) represents the relative proportion of a search topic in relation to all search inquiries in a defined time frame and geography.¹⁶ Google Trends can present search data for one topic, where the highest proportional search on this topic during the defined period is defined as a value of 100, with the other data points shown as proportions of 100. Google Trends can also present comparative data on multiple topics in the same geographical area during the same time frame, where the highest proportionate search on any topic is defined as 100, and the other data points on all topics are presented relative to 100.¹⁶

Google Trends uses a fraction of searches for a particular term (keyword or search term), and then analyzes Google search. The result is analyzed and interpreted according to a specific and defined geographical location in the time period. The more keywords you repeat, the greater your share becomes. Also, Google Trends has been confirmed a reliable tool for digital epidemiology.¹⁷

A search was accordingly conducted on November 3, 2020, using the Google Trends database to obtain the search volume information using the composite search terms of "home-based exercise". The data were retrieved within two time intervals from February 18, 2020 to October 18, 2020 and eight months prior to the outbreak of COVID-19 (June 18, 2019 to February 18, 2020). The search was limited to Iran. The weekly search results were also downloaded in the comma-separated values (CSV) format produced by Google Trends. In addition, the daily prevalence statistics on COVID-19 from February 18, 2020, to October 18, 2020, in Iran were retrieved from the following address: <https://www.worldometers.info/coronavirus/country/iran/>.

It should be noted that the Google Trends database provides insights into individuals' search habits using the Google search engine.¹⁸ The Google Trends also shows how often the search terms have been entered in the Google search engine relative to the total search volume in a region or globally. Although it does not provide absolute search numbers, it offers a measure called the search volume over time.¹⁹ Thus, a value of 100 means the highest popularity of searching for a term, a value of 50 represents average popularity of searching for a term, and a value of zero denotes not enough data for a term.^{9,18} More information about Google Trends can be found at <https://support>.

To compare the Internet search volume of the keyword with the daily increase in the number of patients with COVID-19, the data analysis was conducted using the Spearman's rank correlation coefficient. Furthermore, the Wilcoxon signed-rank test was employed to investigate the Internet search volume of the keyword in eight months during and before the COVID-19 pandemic. The statistical significance was also set at $P < 0.05$. The data were further analyzed using the SPSS Statistics software (Version 22.0) for Windows (SPSS Inc., Chicago, IL, USA) and then expressed as mean \pm standard deviation (SD).

Results

The study results showed a significant growth in "home-based exercise" Google search in an eight-month period during the COVID-19 pandemic compared with the same time before the pandemic ($P = 0.0001$) (Figure 1, Table 1). The findings also revealed a significant correlation between "home-based exercise" Google search and positive COVID-19 cases in the time intervals of February 18, 2020 to April 18, 2020 (positive correlation; $r = 0.756$, $P = 0.0001$) and April 18, 2020 to June 18, 2020 (negative correlation; $r = -0.461$, $P = 0.0001$). However, no significant correlation was observed in the periods of June 18, 2020 to August 18, 2020 ($r = 0.044$, $P = 0.737$), August 18, 2020 to October 18, 2020 ($r = 0.246$, $P = 0.056$), and over time ($r = -0.083$, $P = 0.0195$) (Figures 2 and 3, Table 2)

Most "home-based exercise" Google searches were from Lorestan, Kurdistan, Semnan, Zanjan, and Yazd provinces with the keywords such as aerobic exercise at home, core exercise at home, and exercise education at home prior to COVID-19. After the pandemic, the bulk of "home-based exercise" Google searches were from Kurdistan, North Khorasan, Semnan, West Khorasan, and Golestan provinces with the keywords such as child exercise at home, stretch exercise at home, simple exercise at home, and morning exercise at home (Figure 4).

Besides, keywords such as aerobic exercise at home, core exercise at home, and exercise education at home were the keywords mostly used in google search prior to COVID-19

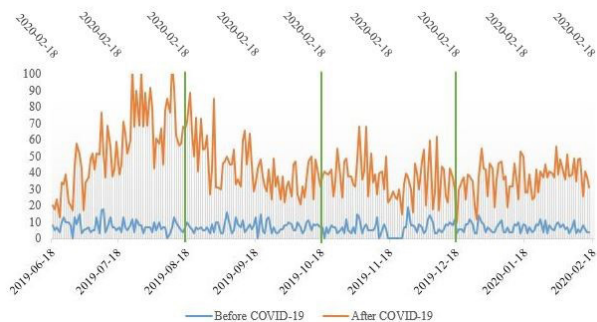


Figure 1. "Home -Based Exercise" Google Search in an Eight-Month Period After and Before COVID-19.

Table 1. Changes in Home-Based Exercise Google Search During and Before COVID-19

Search term	Before COVID-19	During COVID-19	Z	P value
Home-based exercise	6.902 \pm 3.550	36.196 \pm 17.351	-13.510	0.0001**

**Indicated significant change at $P \leq 0.01$.

Table 2. Spearman's Correlation Coefficient Between "Home-Based Exercise" Google Search and Positive COVID-19 Cases

Correlation	Home-Based Exercise				
	First 2 Months	Second 2 Months	Third 2 Months	Fourth 2 Months	Total (8 Months)
COVID-19 cases	R=0.756 $P=0.0001$ **	R=-0.461 $P=0.0001$ **	R=0.044 $P=0.737$	R=0.246 $P=0.056$	R=-0.083 $P=0.195$

**Indicated significant correlation at $P \leq 0.01$.

pandemic. In addition, after the pandemic, keywords such as child exercise at home, stretch exercise at home, simple exercise at home, and morning exercise at home were the mostly used google search keywords.

Discussion

The main purpose of this study was to investigate whether self-quarantine during the outbreak of COVID-19 pandemic increased personal interest in doing exercises at home or not. The study results illustrated a significant rising trend in "home-based exercise" Google search within eight months during COVID-19 compared with the same time before the pandemic. Moreover, the findings revealed a significant correlation between "home-based exercise" Google search and positive COVID-19 cases in the time intervals of February 18, 2020 to April 18, 2020 (positive correlation; $r = 0.756$, $P = 0.0001$) and April 18, 2020 to June 18, 2020 (negative correlation; $r = -0.461$, $P = 0.0001$). However, no significant correlation was observed in the periods of June 18, 2020 to August 18, 2020 ($r = 0.044$, $P = 0.737$), August 18, 2020 to October 18, 2020 ($r = 0.246$, $P = 0.056$), and over time ($r = -0.083$, $P = 0.0195$).

One of the main findings of this study was the increase in home-based exercise Google search during COVID-19 compared with the same time before the pandemic. The results also showed that the self-quarantine conditions and home-stay caused people seek for physical activity and exercise. In this regard, some studies suggested that self-quarantine and home-stay had augmented sedentary activities such as sitting and lying down for watching TV and increased bedtime for long periods.²⁰⁻²² It had been comparably reported that such sedentary activities were generally associated with higher calorie intakes.²³ It had been further confirmed that there were reductions in step counts in various countries (from 10000 to below 1500) with a concomitant weight gain and higher fat percentage alongside reduced insulin sensitivity in adults following the outbreak of the COVID-19 pandemic.²⁴ Because of less exercise and fewer than 2000 steps, a loss of 2.8% of muscle mass within two weeks had been correspondingly

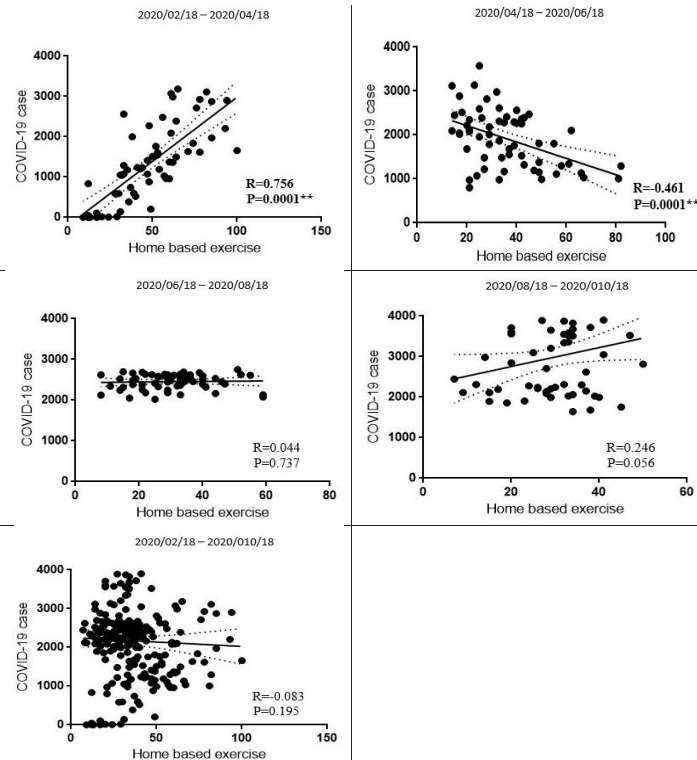


Figure 2. Correlation Between “Home-Based Exercise” Google Search and Positive COVID-19 Cases.

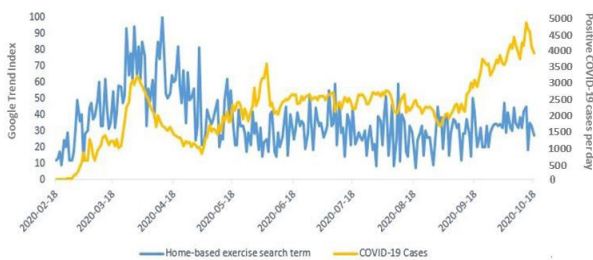


Figure 3. Diagrams of “Home-Based Exercise” Google Search and Positive COVID-19 Cases .

reported.²⁵⁻²⁷ Furthermore, a recent study illustrated an age-dependent decrease in leisure-time physical activity levels under self-quarantine conditions.²⁸ Although one premise was that physical activity had declined during the pandemic and it was likely to be true and evidenced by some mega-data from fitness trackers, there was also contrary evidence that physical activity might have either remained the same or possibly boosted.²⁹ Given the amount of prepublication and non-peer-reviewed evidence in this field, it is too early to indicate that physical activity has definitively dropped. In general, it became clear that inadequate access to sports and health clubs, aquatic sports centers, outdoor sports, and park fitness equipment, as well as other sports facilities and even no training partners had reduced the levels of physical activity in the community concerned.^{10,20,30} The results of present study also theoretically indicated a growing trend in attention to physical activity at home

during the COVID-19 pandemic compared with the same period before it, which was of great importance. Nevertheless, further surveys are needed to examine this hypothesis more closely, and it seems very optimistic that a growth in the search term for home-based exercise is directly related to an increase in physical activity. There is a current concern about the effects of physical inactivity on the general population and notably on at-risk/vulnerable groups for severe illness from COVID-19, such as older adults and people with cardiovascular and rheumatic diseases. The reduction in physical activity worsens the risks to these populations since there is an increasing risk factor burden. There is a strong recommendation for people to stay active during this critical period to maintain physical and mental health.³¹

Other important results of the present study included a positive relationship between the elevation in the positive COVID-19 cases and the rate of home exercise search in the first two months and a negative relationship in the second two months of the COVID-19 pandemic. It seems that, in the first two months and almost coinciding with the first peak of the COVID-19 pandemic, the search for a home-based exercise term had promoted. This could be due to more accurate media coverage in that period, as well as publication of a large number of articles during the pandemic, which may have encouraged people to pursue exercise and related information.³² Of course, national holidays related to the Iranian New Year and national self-quarantine could have affected these results,

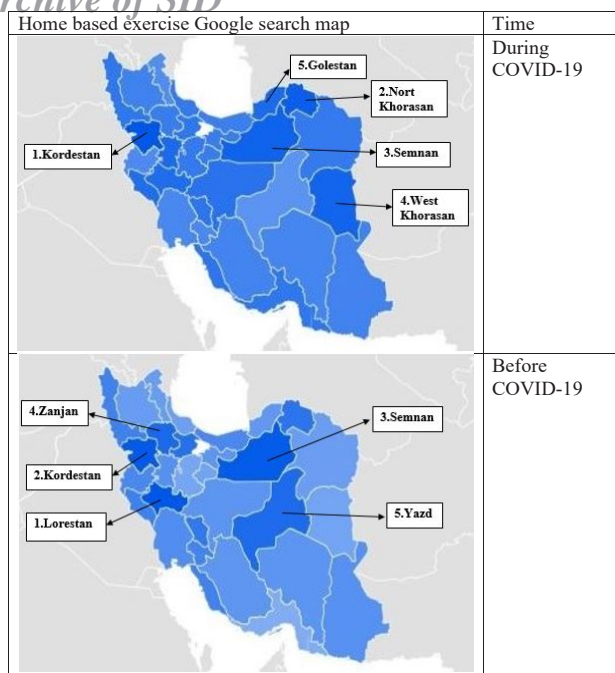


Figure 4. Provincial Search Rate Map of “Home-Based Exercise” Google Search.

because people had probably spent more time at home and had thus found it necessary to organize their physical activities and home-based exercises.^{29,33} After this period, i.e., following the first two months, it seems that people’s attention to exercise, especially home-based exercises, had decreased with the passage of global self-quarantines and their return to daily work, and on the other hand, the reduction of media coverage.^{34,35} People should be advised of the need to perform regular physical activity due to two major points related to the fundamental role of physical activity: mental health and the immune system. Significant evidence shows that physical activity enhances the immune system, as well as psychological well-being and anti-inflammatory effects.³⁶

Generally, Google Trends is a keyword research tool that provides near real-time trend data regarding interest as operationalized by the Internet search volume. Google Trends data also allow an exciting opportunity for research into real-time public interest in particular topics. Prior to this event, the given issue has been utilized in various areas of medical research such as multiple sclerosis,³⁷ cancer screening,³⁸ and most notably influenza surveillance.³⁹ It has become clear that the data from Google Trends does suffer from sampling bias, as the results are limited only to the Google search engine users. From the perspective of health care, it is also more likely to be used by younger generations who are perhaps more tech-savvy and embrace alternative avenues of medical advice. Therefore, this only allows gaining an insight into a further subset of this population. In this respect, the Office for National Statistics reported that only 38.7% of adults over the age of 75 had used the Internet in 2015 compared with 99.2%

of those aged between 16 and 24 years.⁴⁰

However, Google Trends data in this study represented an opportunity to gain an insight into people’s search habits.⁴⁰ This study not only added to the evidence regarding previous studies but also showed that it could be utilized for purposes such as the effects of pandemics on individuals’ common habits.

Several guidelines have been recently published on how Google Trends may be practiced in medical research.⁴⁰ Recent technological advances in data acquisition such as Google Trends may thus allow more timely data collection to learn about interest trends in various health-related topics.

Conclusion

In general, the prevalence rate of the COVID-19 pandemic and its subsequent social constraints including self-quarantine and physical distancing seem to have increased people’s interest in doing exercises, especially home-based exercises.

Conflict of Interest Disclosures

The authors have no conflict of interests associated with the material presented in this study.

Ethical Approval

No ethical approval was obtained, as the study was conducted using publically available data.

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References

- Phelan AL, Katz R, Gostin LO. The novel coronavirus originating in Wuhan, China: challenges for global health governance. *JAMA*. 2020;323(8):709-10. doi: 10.1001/jama.2020.1097.
- Cucinotta D, Vanelli M. WHO declares COVID-19 a pandemic. *Acta Biomed*. 2020;91(1):157-60. doi: 10.23750/abm.v91i1.9397.
- Lu R, Zhao X, Li J, Niu P, Yang B, Wu H, et al. Genomic characterisation and epidemiology of 2019 novel coronavirus: implications for virus origins and receptor binding. *Lancet*. 2020;395(10224):565-74. doi: 10.1016/s0140-6736(20)30251-8.
- Sanche S, Lin YT, Xu C, Romero-Severson E, Hengartner N, Ke R. High contagiousness and rapid spread of severe acute respiratory syndrome coronavirus 2. *Emerg Infect Dis*. 2020;26(7):1470-7. doi: 10.3201/eid2607.200282.
- World Health Organization (WHO). Chapter 10: controlling the spread of infectious diseases. In: *Advancing the Right to Health: The Vital Role of Law*. WHO; 2016.
- Pang J, Wang MX, Ang IYH, Tan SHX, Lewis RF, Chen JJ, et al. Potential rapid diagnostics, vaccine and therapeutics for 2019

- novel coronavirus (2019-nCoV): a systematic review. *J Clin Med.* 2020;9(3):623. doi: 10.3390/jcm9030623.
7. Clemmensen C, Petersen MB, Sørensen TIA. Will the COVID-19 pandemic worsen the obesity epidemic? *Nat Rev Endocrinol.* 2020;16(9):469-70. doi: 10.1038/s41574-020-0387-z.
 8. Tuite AR, Bogoch, II, Sherbo R, Watts A, Fisman D, Khan K. Estimation of coronavirus disease 2019 (COVID-19) burden and potential for international dissemination of infection from Iran. *Ann Intern Med.* 2020;172(10):699-701. doi: 10.7326/m20-0696.
 9. Effenberger M, Kronbichler A, Shin JI, Mayer G, Tilg H, Perco P. Association of the COVID-19 pandemic with internet search volumes: a Google Trends™ analysis. *Int J Infect Dis.* 2020;95:192-7. doi: 10.1016/j.ijid.2020.04.033.
 10. Wilder-Smith A, Freedman DO. Isolation, quarantine, social distancing and community containment: pivotal role for old-style public health measures in the novel coronavirus (2019-nCoV) outbreak. *J Travel Med.* 2020;27(2):taaa020. doi: 10.1093/jtm/taaa020.
 11. Mattioli AV, Ballerini Puviani M, Nasi M, Farinetti A. COVID-19 pandemic: the effects of quarantine on cardiovascular risk. *Eur J Clin Nutr.* 2020;74(6):852-5. doi: 10.1038/s41430-020-0646-z.
 12. Xin M, Luo S, She R, Yu Y, Li L, Wang S, et al. Negative cognitive and psychological correlates of mandatory quarantine during the initial COVID-19 outbreak in China. *Am Psychol.* 2020;75(5):607-17. doi: 10.1037/amp0000692.
 13. Nieman DC, Wentz LM. The compelling link between physical activity and the body's defense system. *J Sport Health Sci.* 2019;8(3):201-17. doi: 10.1016/j.jshs.2018.09.009.
 14. Fallon K. Exercise in the time of COVID-19. *Aust J Gen Pract.* 2020;49(Suppl 13):1-2. doi: 10.31128/ajgp-covid-13.
 15. Kriaucioniene V, Bagdonaviciene L, Rodríguez-Pérez C, Petkeviciene J. Associations between changes in health behaviours and body weight during the COVID-19 quarantine in Lithuania: the Lithuanian COVIDiet Study. *Nutrients.* 2020;12(10):3119. doi: 10.3390/nu12103119.
 16. Ding D, Del Pozo Cruz B, Green MA, Bauman AE. Is the COVID-19 lockdown nudging people to be more active: a big data analysis. *Br J Sports Med.* 2020;54(20):1183-4. doi: 10.1136/bjsports-2020-102575.
 17. Cervellini G, Comelli I, Lippi G. Is Google Trends a reliable tool for digital epidemiology? insights from different clinical settings. *J Epidemiol Glob Health.* 2017;7(3):185-9. doi: 10.1016/j.jegh.2017.06.001.
 18. Nuti SV, Wayda B, Ranasinghe I, Wang S, Dreyer RP, Chen SI, et al. The use of google trends in health care research: a systematic review. *PLoS One.* 2014;9(10):e109583. doi: 10.1371/journal.pone.0109583.
 19. Walker A, Hopkins C, Surda P. Use of Google Trends to investigate loss-of-smell-related searches during the COVID-19 outbreak. *Int Forum Allergy Rhinol.* 2020;10(7):839-47. doi: 10.1002/alr.22580.
 20. Mardaniyan Ghahfarrokhi M, Banitalebi E, Famarzani M, Ghorbanpoor Dashtaki M, Earnest CP. 2019 novel coronavirus: emphasis on maintaining optimal levels of physical activity under self-quarantine conditions. *Int J Epidemiol Res.* 2020;7(2):49-51. doi: 10.34172/ijer.2020.09.
 21. de Castro RR, da Silveira Neto JG, de Castro RR. Exercise training: a hero that can fight two pandemics at once. *Int J Cardiovasc Sci.* 2020;33(3):284-7. doi: 10.36660/ijcs.20200083.
 22. Hammami A, Harrabi B, Mohr M, Krstrup P. Physical activity and coronavirus disease 2019 (COVID-19): specific recommendations for home-based physical training. *Manag Sport Leis.* 2020:1-6. doi: 10.1080/23750472.2020.1757494.
 23. Chen P, Mao L, Nassis GP, Harmer P, Ainsworth BE, Li F. Coronavirus disease (COVID-19): the need to maintain regular physical activity while taking precautions. *J Sport Health Sci.* 2020;9(2):103-4. doi: 10.1016/j.jshs.2020.02.001.
 24. Tison GH, Avram R, Kuhar P, Abreau S, Marcus GM, Pletcher MJ, et al. Worldwide effect of COVID-19 on physical activity: a descriptive study. *Ann Intern Med.* 2020;173(9):767-70. doi: 10.7326/m20-2665.
 25. Wackerhage H, Everett R, Krüger K, Murgia M, Simon P, Gehlert S, et al. Sport, exercise and COVID-19, the disease caused by the SARS-CoV-2 coronavirus. *Dtsch Z Sportmed.* 2020;71(5):e1-12. doi: 10.5960/dzsm.2020.441.
 26. Oikawa SY, Holloway TM, Phillips SM. The impact of step reduction on muscle health in aging: protein and exercise as countermeasures. *Front Nutr.* 2019;6:75. doi: 10.3389/fnut.2019.00075.
 27. Claussen MC, Fröhlich S, Spörri J, Seifritz E, Markser VZ, Scherr J. Psyche und Sport in Zeiten von COVID-19. *Sport & Exercise Medicine Switzerland (SEMS).* 2020;71(5):e1-2.
 28. Mutz M, Gerke M. Sport and exercise in times of self-quarantine: how Germans changed their behaviour at the beginning of the Covid-19 pandemic. *Int Rev Sociol Sport.* 2021;56(3):305-16. doi: 10.1177/1012690220934335.
 29. Smith L, Jacob L, Butler L, Schuch F, Barnett Y, Grabovac I, et al. Prevalence and correlates of physical activity in a sample of UK adults observing social distancing during the COVID-19 pandemic. *BMJ Open Sport Exerc Med.* 2020;6(1):e000850. doi: 10.1136/bmjsem-2020-000850.
 30. Constandt B, Thibaut E, De Bosscher V, Scheerder J, Ricour M, Willem A. Exercising in Times of Lockdown: An Analysis of the Impact of COVID-19 on Levels and Patterns of Exercise among Adults in Belgium. *Int J Environ Res Public Health.* 2020;17(11):4144. doi: 10.3390/ijerph17114144.
 31. Dominski FH, Brandt R. Do the benefits of exercise in indoor and outdoor environments during the COVID-19 pandemic outweigh the risks of infection? *Sport Sci Health.* 2020;16(3):583-8. doi: 10.1007/s11332-020-00673-z.
 32. Levinger P, Hill KD. The impact of mass media campaigns on physical activity participation on a global scale: lessons learned from the COVID-19 pandemic. *J Phys Act Health.* 2020;17(9):857-8. doi: 10.1123/jpah.2020-0387.
 33. Peçanha T, Goessler KF, Roschel H, Gualano B. Social isolation during the COVID-19 pandemic can increase physical inactivity and the global burden of cardiovascular disease. *Am J Physiol Heart Circ Physiol.* 2020;318(6):H1441-H6. doi: 10.1152/ajpheart.00268.2020.
 34. Hayes M. Social media and inspiring physical activity during COVID-19 and beyond. *Manag Sport Leis.* 2020:1-8. doi: 10.1080/23750472.2020.1794939.
 35. Norbury A, Liu SH, Campaña-Montes JJ, Romero-Medrano L, Barrigón ML, Smith E, et al. Social media and smartphone app use predicts maintenance of physical activity during Covid-19 enforced isolation in psychiatric outpatients. *medRxiv.* 2020.

doi: 10.1101/2020.06.26.20141150.

36. Simpson RJ, Campbell JP, Gleeson M, Krüger K, Nieman DC, Pyne DB, et al. Can exercise affect immune function to increase susceptibility to infection? *Exerc Immunol Rev.* 2020;26:8-22.
37. Moccia M, Palladino R, Falco A, Saccà F, Lanzillo R, Brescia Morra V. Google Trends: new evidence for seasonality of multiple sclerosis. *J Neurol Neurosurg Psychiatry.* 2016;87(9):1028-9. doi: 10.1136/jnnp-2016-313260.
38. Schootman M, Toor A, Cavazos-Rehg P, Jeffe DB, McQueen A, Eberth J, et al. The utility of Google Trends data to examine interest in cancer screening. *BMJ Open.* 2015;5(6):e006678. doi: 10.1136/bmjopen-2014-006678.
39. Ginsberg J, Mohebbi MH, Patel RS, Brammer L, Smolinski MS, Brilliant L. Detecting influenza epidemics using search engine query data. *Nature.* 2009;457(7232):1012-4. doi: 10.1038/nature07634.
40. Dewan V, Sur H. Using google trends to assess for seasonal variation in knee injuries. *J Arthrosc Jt Surg.* 2018;5(3):175-8. doi: 10.1016/j.jajs.2018.02.002.