



Italian and Japanese public attention toward balneotherapy in the COVID-19 era

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Abstract

Italian and Japanese public widely use balneotherapy. The population interest in balneotherapy in coronavirus disease-2019 (COVID-19) era should be investigated. Therefore, we aimed to exploit Google Trends analysis, as a measure of peoples' interest in balneotherapy, in two countries, Italy and Japan. In this infodemiology study, Google Trends was queried for the lay terms widely used by the Italian population to refer to the balneotherapy setting (terme + termale) and by the Japanese to refer to the bathing place and balneotherapy facilities (温泉 + スパ). The internet searches in 2020 were compared to overlapping time spans in 2016–2019 and were correlated with new confirmed cases/deaths. This study demonstrated that from February 23 to June 20, 2020, and from October 4 to December 26, 2020, the internet searches of the Italian words corresponding to balneotherapy were statistically significantly decreased; however, the internet searches were not significantly different in June 21 to October 3, 2020, compared to overlapping time spans in 2016–2019 in Italy. The study also showed that from March 15 to September 5, 2020, and from November 29 to December 26, 2020, the internet searches of the Japanese words corresponding to balneotherapy were statistically significantly decreased; however, the internet searches were significantly increased in September 13 to November 7, 2020, and were not significantly different in November 8 to 28, 2020, compared to overlapping time spans in 2016–2019 in Japan. There were significant negative correlations between the relative search volume and number of new cases ($\rho = -0.634$; $p < 0.001$)/deaths ($\rho = -0.856$; $p < 0.001$) in Italy and the number of new deaths ($\rho = -0.348$; $p = 0.012$) in Japan. Population interest in balneotherapy has changed in the COVID-19 era both in Italy and Japan. During the early stage of pandemic (March to June), the interest was lower. After this early stage, the interest showed a recovery in both countries. In Italy, the population interest reached to its prior levels in late June through early October, with a peak in August. In Japan, the recovery exceeded the prior 4-year levels in mid-September through early November. Then, both countries demonstrated a decline in interest: began in early October in Italy and late November in Japan. This information would allow us to understand/address the population response in the pandemic in respect of the balneotherapy and would guide the preparedness of healthcare providers and planners both in this pandemic and future similar situations.

Keywords Google searches · Google Trends · Infodemiology · Internet · Balneotherapy · Spa therapy · COVID-19 · SARS-CoV-2

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Introduction

Balneotherapy is one of the most used therapies for the treatment of different pathological conditions in many European countries, as well as in Turkey, Israel, and Japan. It is based on the employment of mineral and/or thermal waters from natural springs, peloids (muds), and other environmental therapeutic factors (Fioravanti et al. 2017; Kardeş et al. 2019; Kamioka et al. 2019; Masiero et al. 2020a; Antonelli et al. 2021). The beneficial effects of balneotherapy in the prevention, treatment, and rehabilitation of various rheumatic disorders, such as osteoarthritis, fibromyalgia, low back pain, rheumatoid arthritis, and other chronic rheumatic diseases, have been well demonstrated (Fioravanti et al. 2015a, 2018; Fortunati et al. 2016; Forestier et al. 2010; Naumann and Sadaghiani 2014; Yücesoy et al. 2019; Santos et al. 2016). The positive effects of balneotherapy in this field include significant improvements of pain, function, and quality of life with concomitant reduction in symptomatic drug consumption. In addition, balneotherapy resulted a favorable cost-effectiveness approach, and its efficacy was demonstrated to persist over time, until 6–9 months after a cycle of treatment and balneotherapy (Ciani et al. 2017; Chelieschi et al. 2020).

At the end of 2019, the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) appeared in China. Subsequently, the novel coronavirus disease (COVID-19) had spread all around the world, and it had been declared a pandemic by the World Health Organization on March 11, 2020. In Europe, Italy was the first country to be affected by the COVID-19 pandemic: the first confirmed case was reported on January 31, 2020; in the successive days, clusters of cases were identified in the regions of Northern Italy, until arriving at the involvement of entire Italy by the beginning of March (Giovanetti et al. 2020; Armocida et al. 2020). On the other hand, Japan was one of the first affected countries in the world, with a first case being identified on January 16, 2020, and by the end of February, cases were confirmed in many regions of Japan with peaks in April and August (Amengual and Atsumi 2021). COVID-19 is continuing to spread; as of April 26, 2021, Italy reported 3,962,674 cases with 119,238 deaths, and Japan reported 566,863 confirmed cases of COVID-19 with 9972 deaths (World Health Organization 2021).

The COVID-19 pandemic had a huge impact on the global population, modifying interests, priorities, and habits and leading many activities to be delayed/neglected. Also, because of the reduction of the activities of health resorts in compliance with the authorities' guidelines, balneotherapy was hardly hit by the effects of the pandemic. Therefore, we wondered if also the population attention in balneotherapy varied in the pandemic period. Recently Google Trends is widely employed as epidemiologic datasets yielding insights into people's behavior and interests (Mavragani and Ochoa

2019). Also in the COVID-19 era, this dataset had been applied to predict the pandemic (Lippi et al. 2020), to examine psychological burdens during the pandemic (Rotter et al. 2021), and to assess peoples' interest in various health topics, such as rheumatology (Kardeş et al. 2020, 2021a, 2021b), dermatology (Kutlu 2020; Esen-Salman et al. 2021), pediatric neurosurgery (Güdük et al. 2021), and alternative medicine (Rokhmah et al. 2020). A previous study investigated modifications of Google Trends data related to interest in balneotherapy in pandemic period, considering only the Turkish population (Kardeş 2021a). As balneotherapy is widely preferred by Italian and Japanese people (Fioravanti et al. 2003; Bernetti et al. 2020; Kamioka et al. 2020a), the interest in these two countries should be investigated as well. This information would help healthcare providers and planners understand/address the population attention in balneotherapy during the pandemic. Therefore, we aimed to exploit Google Trends analysis, as a measure of peoples' interest in balneotherapy, in two countries, namely Italy and Japan, where such kind of treatment is widely used.

Materials and method

Study design

This infodemiology study, carried out in agreement with the Terms of Service and the Privacy Policy of Google, involved anonymous data freely accessible and did not include any personally identifiable information.

Google Trends and data gathering

In previously published papers (Mavragani and Ochoa 2019; Kardeş 2019), explanations on Google Trends data are provided. To summarize, Google Trends offers the relative search volume of words queried in the Google platform. Google Trends permits queries to be listed using time span and area filters. The frequency of a query is automatically normalized to all search queries, and the results are given from 0 to 100, where 100 indicate the highest relative searches. In Google Trends, the results can be specified for a selected country. Also, two keywords may be combined with a + operator; in this case, the results will include the searches containing either keyword.

In Italy, the words “terme” and “termale” are the lay terms widely used by the Italian population to refer to the balneotherapy setting, whereas in Japan, the words “温泉” and “スパ” are widely used by the Japanese to refer to the bathing place and balneotherapy facilities. On January 14, 2021, Google Trends was queried within Italy with a search term of terme + termale and within Japan with a search term of 温泉 + スパ from January 01, 2016, through January 14, 2021,

in “all categories.” The weekly dataset from Google Trends was downloaded for review.

COVID-19 cases and deaths data gathering

The number of daily new confirmed cases/deaths for Italy and Japan was downloaded from the World Health Organization (2021).

Statistical analysis

For the 4 years from 2016 to 2019, the mean value and 95% confidence intervals (CI) were calculated utilizing generalized estimating equations with gamma model. To illustrate the trends of relative searches related to balneotherapy terms in 2016–2019 (mean and 95% CI) and in 2020, a time series chart was conducted. The comparison of relative search volume in 2016–2019 and 2020 for each week was interpreted whether the 2020 value is within the limits of 95% CI values of 2016–2019, rather than relying on the *p* value (<0.05) for these each week. The downloaded daily data for the number of new confirmed cases and deaths were transformed to weekly data by summing the daily data of 7 days for each week in order to make the correlation possible with weekly relative search volume data. Normality of distribution of these measures was evaluated with the Shapiro-Wilk test. Due to the non-normal distribution of weekly number of new cases/deaths data, non-parametric Spearman’s correlation coefficient test was used to evaluate the correlation between the weekly number of new cases/deaths and the weekly relative search volume in 2020. Time series plot for relative search volumes in 2016–2019 and 2020 and scatter plot for the weekly number of new cases/deaths and the weekly relative search volume in 2020 were conducted in Microsoft Excel 2011. The statistical analyses (generalized estimating equations and correlation) were carried out through the SPSS software v. 21. A previously published comprehensive overview of statistical considerations guided how to present the results (Misra et al. 2021).

Results

Italy

Fig. 1 shows that from January 5, 2020, to February 22, 2020, the relative search volume of *terme + termale* was slightly higher; from February 23 to June 20, 2020, the relative search volume was lower; from June 21 to October 3, 2020, the relative search volume was not different; and from October 4 to December 26, 2020, the relative search volume was lower compared to mean and 95% CI of 4 years from 2016 to 2019 in Italy.

There were significant negative correlations between the weekly number of new cases and the weekly relative search volume ($\rho=-0.634$; $p<0.001$) (Fig. 2 A and B) and between the weekly number of new deaths and the weekly relative search volume of *terme + termale* ($\rho=-0.856$; $p<0.001$) (Fig. 2 C and D) in Italy.

Japan

Fig. 3 shows that from January 5, 2020, to March 14, 2020, the relative search volume of *温泉 + スパ* was not different; from March 15 to June 20, 2020, the relative search volume was lower; from June 21 to September 5, 2020, the relative search volume was lower in the majority of the weeks; from September 13 to November 7, 2020, the relative search volume was higher; from November 8 to November 28, 2020, the relative search volume was not different; and from November 29 to December 26, 2020, the relative search volume was lower compared to mean and 95% CI of 4 years from 2016 to 2019 in Japan.

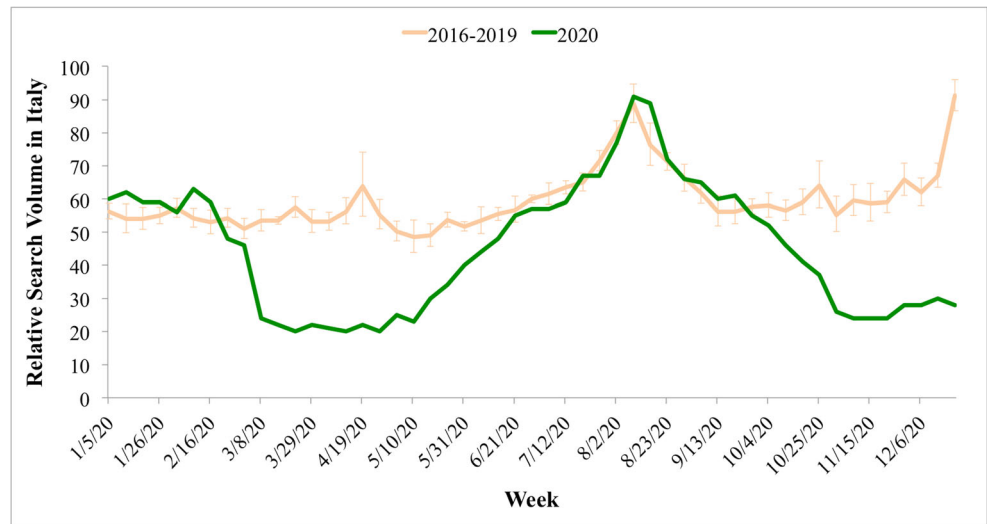
There was a non-significant negative correlation between the weekly number of new cases and the weekly relative search volume ($\rho=-0.054$; $p=0.708$) (Fig. 4 A and B) and a significant negative correlation between the weekly number of new deaths and the weekly relative search volume of *温泉 + スパ* ($\rho=-0.348$; $p=0.012$) (Fig. 4 C and D) in Japan.

Discussion

This study demonstrated that from February 23 to June 20, 2020, and from October 4 to December 26, 2020, the internet searches of the Italian words corresponding to balneotherapy were statistically significantly decreased; however, the internet searches were not significantly different in June 21 to October 3, 2020, compared to overlapping time spans in 2016–2019 in Italy. The study also showed that from March 15 to September 5, 2020, and from November 29 to December 26, 2020, the internet searches of the Japanese words corresponding to balneotherapy were statistically significantly decreased; however, the internet searches were significantly increased in September 13 to November 7, 2020, and were not significantly different in November 8 to 28, 2020, compared to overlapping time spans in 2016–2019 in Japan. Additionally, as the number of COVID-19 cases/deaths increased, the internet searches corresponding to balneotherapy decreased in Italy. A similar negative correlation was also observed in Japan between COVID-19 deaths and internet searches for the Japanese words corresponding to balneotherapy.

Population interest in balneotherapy has changed during the COVID-19 pandemic both in Italy and Japan. During the early stage of pandemic (i.e., March to June), the interest in

Fig. 1 Time series plot for relative search volume for search query terme + termale in Italy from January 5 to December 26, 2020, and overlapping time spans in 2016–2019. The words terme and termale are the lay terms widely used by the Italian population to refer to the balneotherapy setting. Data of 2016–2019 are means (95% CI).



balneotherapy was lower both in Italy and Japan; however, this finding was somewhat expected because in this stage of pandemic, a nationwide lockdown was implemented (March 9 to June 3, 2020) in Italy, and emergency was declared (April 7 to May 25, 2020) in Japan, which include the closure of spa health resorts. However, the decrease of public interest in balneotherapy appeared to precede and begin before the lockdown/emergency declarations; presumably public reacted to increased cases of SARS-CoV-2 and its resultant serious

outcome (i.e., death), as reflected by the results of our correlation analysis. After this early stage, the interest showed a recovery in both countries, with peaking in different periods between two countries. In Italy, the population interest reached to its prior levels in late June through early October, with a peak in August. In Japan, this recovery exceeded the prior 4-year levels in mid-September through early November. Then, both countries showed a decrease in interest, coinciding with the enforcement of new restrictive

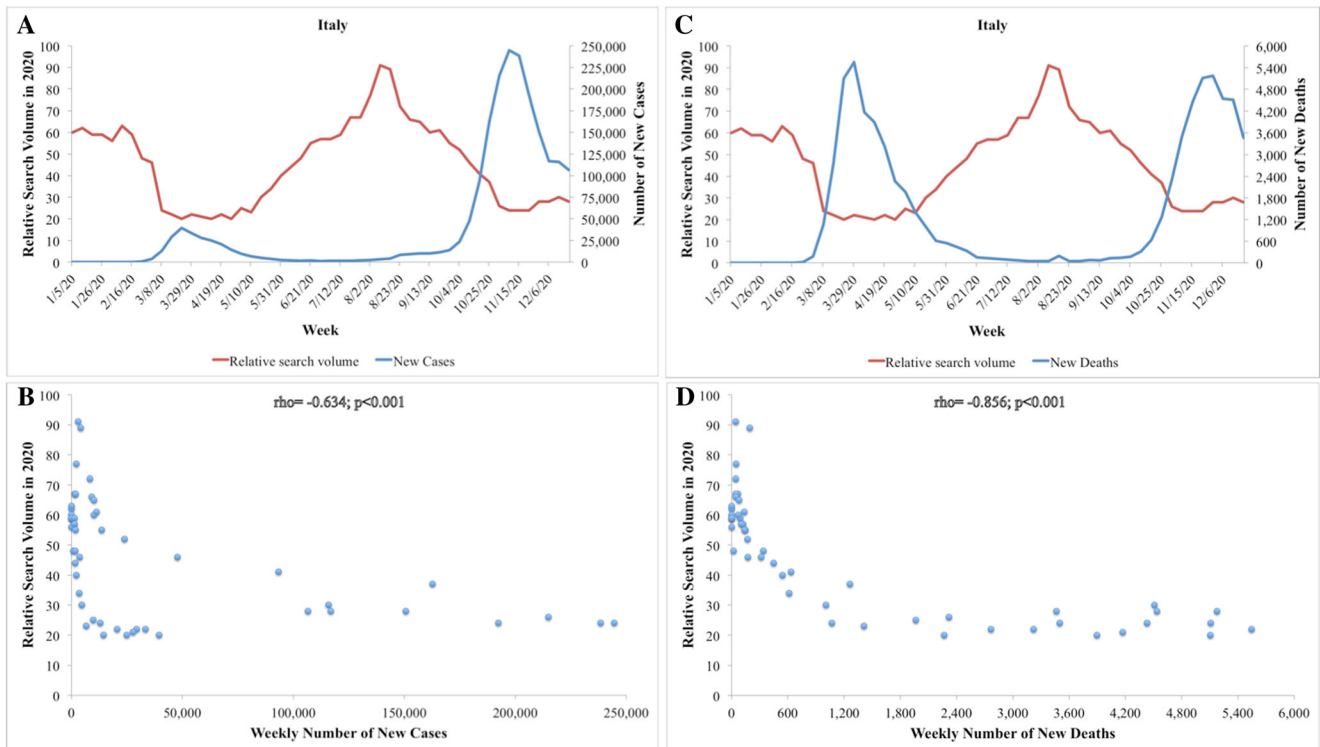
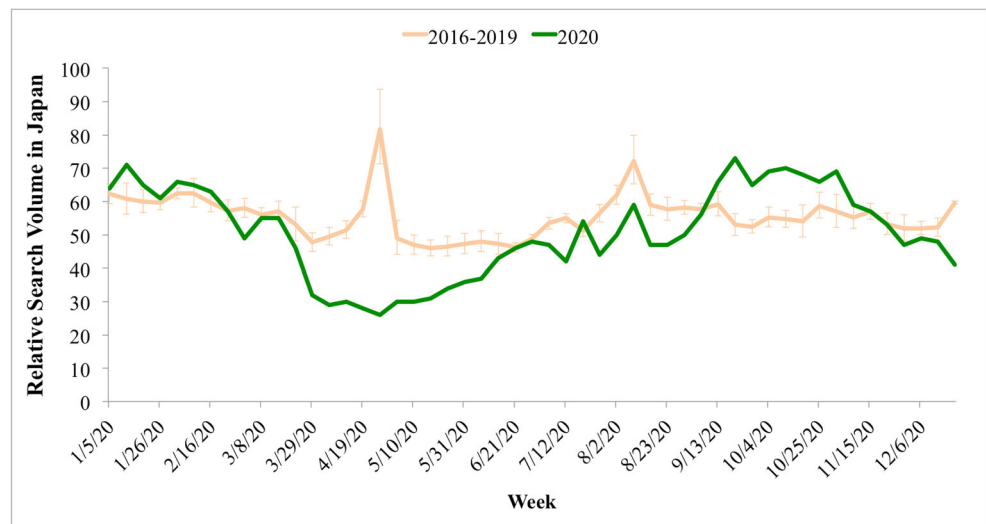


Fig. 2 The weekly relative search volume and the weekly number of new cases (A) and scatter plot of the weekly relative search volume and the weekly number of new cases (B) in Italy. The weekly relative search

volume and the weekly number of new deaths (C) and scatter plot of the weekly relative search volume and the weekly number of new deaths (D) in Italy. rho indicates Spearman’s correlation coefficient.

Fig. 3 Time series plot for relative search volume for search query 温泉 + スパ in Japan from January 5 to December 26, 2020, and overlapping time spans in 2016–2019. The words 温泉 + スパ are widely used by the Japanese to refer to the bathing place and balneotherapy facilities. Data of 2016–2019 are means (95% CI).



measures: it began in early October in Italy and in late November in Japan. Therefore, the population interest in balneotherapy can be interpreted/classified as three stages (i.e., early decrease, and then recovery, and then decrease again). This information would allow us to understand/address the population response in the pandemic in respect of the balneotherapy and would expand the preparedness of healthcare providers and planners both in this pandemic and future similar situations.

A previously published study, which investigated modifications of internet searches corresponding to balneotherapy in Turkey in the pandemic period, found that Turkish population interest in balneotherapy showed an early rapid reduction in mid-March through May, with a partial recovery in June–August 2020 period compared to overlapping time spans in 2016–2019 (Kardeş 2021a). The results of that previous study are in line with our present results that indicated an early decrease in interest and then recovery. Also, as the present

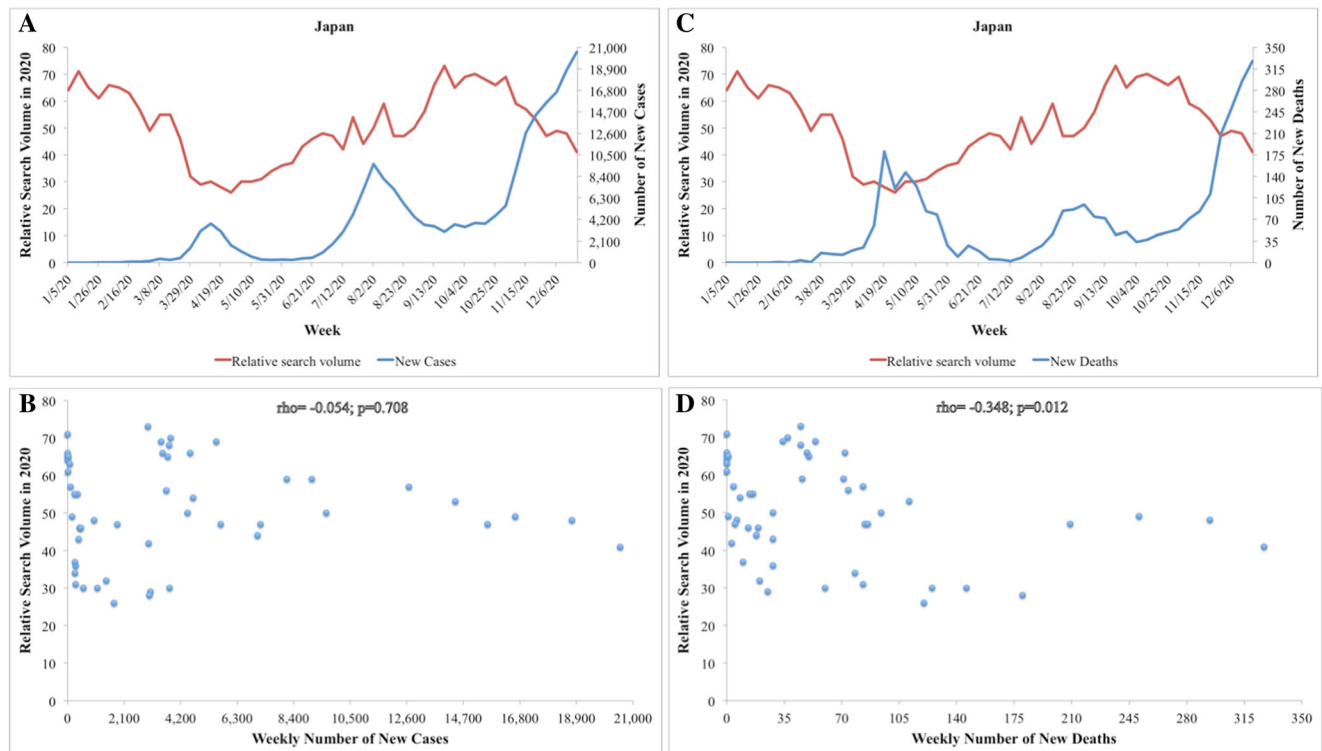


Fig. 4 The weekly relative search volume and the weekly number of new cases (A) and scatter plot of the weekly relative search volume and the weekly number of new cases (B) in Japan. The weekly relative search

volume and the weekly number of new deaths (C) and scatter plot of the weekly relative search volume and the weekly number of new deaths (D) in Japan. rho indicates Spearman’s correlation coefficient.

study was conducted later than the previous Turkish study, it was able to include a whole time span of 2020. Therefore, we showed a second decline in interest (began in early October in Italy and late November in Japan) after the recovery. The present study had managed to expand the previous Turkish study by providing insights into the interest in balneotherapy in the COVID-19 era by Italian and Japanese, who widely use balneotherapy.

The difficulty in traveling to spa health resorts and the reduction of balneotherapy activities during the pandemic surge might have contributed both in Italy and in Japan to the decrease in interest recorded. In addition, the pandemic had focused public attention, overshadowing even previously widespread activities. The reduction in interest in balneotherapy in the countries surveyed may suggest the need to rethink the role of health resorts in emergency situations (Clementi et al. 2020; Maccarone and Masiero 2021). For post-COVID-19 subjects, a comprehensive rehabilitative approach comprising a multidisciplinary and multi-professional team, offering neuromuscular, cardiorespiratory, and psychological interventions, is strongly recommended (Agostini et al. 2021). Considering the high number of patients with important outcomes from COVID-19 infection needing early rehabilitation (Agostini et al. 2021) and the lack of structures designed to offer comprehensive treatment to these subjects, it was hypothesized that spa health resorts could represent an appropriate setting in order to conduct rehabilitation programs for discharged subjects (Maccarone et al. 2020; Masiero et al. 2020b, 2020c; Antonelli and Donelli 2020; Kardeş 2021b). The balneotherapy setting, benefiting from a multidisciplinary team, offers the possibility to apply several interventions directed to the improvement of musculoskeletal, neuropsychological, pulmonary, and cardiac outcomes that could affect COVID-19 survivors. Therefore, balneotherapy setting could offer a feasible alternative to hospital rehabilitation, by lowering the burden on hospital facilities, now overwhelmed with COVID-19 patients' acute care.

Balneotherapy facilities could provide to post-COVID-19 subjects neuromotor rehabilitation with in-water muscle strength and balance exercises and walking recovery (Musumeci et al. 2018; Masiero et al. 2019; Morer et al. 2020) enhancing cardiac (Pagourelas et al. 2011; Sato et al. 2009; Yuan et al. 2019; Persiyanova-Dubrova et al. 2019; Karaarslan et al. 2018) or pulmonary performance (Baldi et al. 2015; Khaltaev et al. 2020). Moreover, balneotherapy may contribute to the management of comorbidities frequently existing in patients recovered from COVID-19: such as obesity and additional neurological and/or musculoskeletal conditions (Bender et al. 2014; Fioravanti et al. 2015b; Masiero et al. 2018; Özkuk and Dilekçi 2019; Munteanu et al. 2019; Özkuk and Uysal 2019; Koç et al. 2021; Eröksüz et al. 2020; Cantista and Maraver 2020; Takinacı et al. 2019; Dilekçi et al. 2019, 2020; Kamioka et al. 2020b;

Tenti et al. 2020; Özkuk and Ateş 2020; Yücesoy et al. 2021; Karaarslan et al. 2021). Finally, balneotherapy facilities could offer post-COVID-19 subjects with psychologically supportive interventions, reducing psychological consequences such as stress, anxiety, and depression (Stier-Jarmer et al. 2017; Yang et al. 2018; Özkuk et al. 2018; Naumann et al. 2020). Continuing the use of balneotherapy in a period of the pandemic could have a twofold impact: on the one hand, survivors of COVID-19 and non-COVID-19 patients may benefit from balneotherapy, and on the other hand, implementing balneotherapy into rehabilitation programs can reduce the COVID-19 financial burden on healthcare systems, particularly in countries such as Italy and Japan, where balneotherapy is commonly accessible (Kardeş 2021b).

Limitations and strengths

We must acknowledge the limitations inherent in studies utilizing the Google Trends data. First of all, Google platform was the only search engine used to conduct the analysis. That being said, as nearly 95% and 70% of internet users depend on Google to find out information in Italy and Japan, respectively (Statcounter 2021), the data included in this study seems to be representative of most of the Italian and Japanese interest. Second, Google Trends does not provide identifying details about individuals looking for a particular keyword. Thus, it was not possible to classify the population into specific subgroups based on demographic characteristics such as gender, age, and level of schooling, and consequently the findings of our research only refer to the general population interest. Third, we cannot determine the specific motivation behind the internet searches of balneotherapy-related terms; hence future studies are essential to provide knowledge on reasons underlain changes in population interest we demonstrated. Fourth, the design of the study does not provide any information whether the observed correlations are causal. Finally, the present analysis provides no evidence for the potential use of balneotherapy in the recovery of long-term outcomes in subjects healed from COVID-19 infection; further real-life studies are needed to investigate the therapeutic-rehabilitative possibilities of balneotherapy for post-COVID-19 patients. On the other hand, the present study also has several strengths. One is assessing a long time span of the pandemic period that allowed us to explore the trends in different stages of the pandemic. Another is that we analyzed the interest in two countries, Italy and Japan, where balneotherapy is widely preferred by their population.

Conclusion

Population interest in balneotherapy has changed in COVID-19 era both in Italy and Japan. During the early stage of

pandemic (March to June), the interest was lower. After this early stage, the interest showed a recovery in both countries. In Italy, the population interest reached to its prior levels in late June through early October, with a peak in August. In Japan, the recovery exceeded the prior 4-year levels in mid-September through early November. Then, both countries demonstrated a decline in interest: began in early October in Italy and late November in Japan. This information would allow us to understand/address the population response in the pandemic in respect of the balneotherapy and would guide the preparedness of healthcare providers and planners both in this pandemic and future similar situations.

Author contribution Design of the study, data collection, and data analysis: SK. Data interpretation: MCM, HK, SC, ST, SM, and SK. Drafting the article: MCM and SK. Critical revision of the article: MCM, HK, SC, ST, SM, and SK. Final approval of the version of the article to be published: MCM, HK, SC, ST, SM, and SK.

Data availability Data are available from corresponding author (SK) upon a reasonable request.

Declarations

Ethics approval and consent to participate Not applicable.

Consent for publication Not applicable.

Competing interests The authors declare no competing interests.

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