Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Information seeking behavior and COVID-19 pandemic: A snapshot of young, middle aged and senior individuals in Greece

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ABSTRACT

Background: The plethora of information in the contemporary digital age is enormous and beyond the capability of the average person to process all the information received. During the COVID-19 pandemic outbreak, huge amount of information is increasingly available in digital information sources and overwhelms the average person. The purpose of this research was to investigate public's information seeking behavior on COVID-19 in Greece.

Method: The study was conducted through a web-based survey, facilitated by the use of questionnaire posted on the Google Forms platform. The questionnaire consisted of closed-ended, 7-point Likert scale questions and multiple choice questions and was distributed to all over Greek Regions to almost 3.000 recipients, during the implementation of restrictive measures against the COVID-19 outbreak in Spring 2020. The data collected were subjected to a descriptive statistical analysis. The median was used to present the results. In order to perform analysis between genders, as well as age groups, the non-parametric criteria Mann-Whitney U and Kruskal-Wallis were applied to determine the existence of differences in participants' beliefs.

Results: Responses by 776 individuals were obtained. Individuals dedicated up to 2 h per day to be informed on COVID-19. Television, electronic press and news websites were reported by the participants as more reliable than social media, in obtaining information on COVID-19. Respondents paid attention to official sources of information (Ministry of Health, Civil Protection etc.). Family and friends played an additional role in the participants' information on COVID-19, while the personal doctor, other health workers and pharmacists did not appear to be most preferred sources of information on COVID-19. Participants' most common information seeking strategy in digital environment was keyword searching. Unreliable information, fake news and information overload were the most common difficulties that the participants encountered seeking information on COVID-19. The respondents' views seemed to differ significantly among age groups. The older the participants, the more often they were informed by television ($p < 0.001$) and the less often by the internet ($p < 0.001$). Females appear to use more frequently internet ($p < 0.001$) and social media ($p = 0.001$) out of habit and visit more often the Ministry of Health ($p < 0.001$) and the Civil Protection ($p=0.005$) websites, compared to males. Most of the participants seemed to worry about the fake news phenomenon and agreed that fake news on COVID-19 is being spread in the media and especially social networks.

Conclusion: The study revealed that, during the COVID-19 pandemic in Greece, participants obtained information about the disease mainly by television, electronic press and news websites. On the contrary, the limited use of social media demonstrates the participants awareness of the spread of fake news on social media. This observed information seeking behavior might has contributed to individuals' acceptance of the necessary behavioral changes that had led to the Greek success story in preventing spread of the disease.

1. Introduction

On January 30th 2020, the World Health Organization (WHO) declared COVID-19 a Public Health Emergency of International Concern [1]. The first confirmed case of novel coronavirus disease 2019 (COVID-19) occurred in Greece on February 26th, 2020. Greek health

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authorities and the civil protection announced a series of proactive measures to limit the spread of the disease [2]. Early lockdown has proved to be the appropriate policy to limit the spread of COVID-19. Greece was successful in preventing spread despite limited resources [3]. Slowing the transmission of the virus helped to reduce the burden of the disease, save lives, and reduce strain on the health care system. To be successful, this approach required people to undertake behavioral changes that may be personally costly [4]. Peoples' compliance to the government and scientific instructions to prevent the spread of the disease depends on how the individuals can integrate a huge amount of information into personal behavioral actions, as according to Chiolero [5] inappropriate information harms health related decisions.

On the web everyone can read, publish and share information which is transmitted at a high speed to millions of people around the world. Although the digital revolution has brought significant benefits to humans, the concerns expressed about the plethora of information that is readily available are important. The increased influence of internet-based information exchange and communication together with the increased capabilities of existing technology, provide many opportunities for abuse. Information reliability is constantly a subject of discussion because it is easily shared, but not easily verified. This happens because the internet is an effective vehicle for the dissemination and reproduction of fake news and misleading information dissemination [6]. This is especially true in times of crisis (earthquakes, extreme weather events, environmental disasters, economic crisis, disease epidemics, etc.), when rumours and incorrect information are recorded in emergency situations [7,8], such as the ongoing COVID-19 pandemic [9].

It is difficult to distinguish between valid and non-valid information as false information and rumours abound [10]. Fake news is a complex phenomenon with many definitions. In an attempt to summarize the various definitions of fake news in the literature, Gelfert [11] proposed the following as a definition: "Fake news is the deliberate presentation of (typically) false or misleading claims as news, where the claims are misleading by design". In other words, for a claim which is presented as news, to be regarded as an instance of fake news it is not sufficient to be misleading, but misleading by design, which reflects its systematic dimension.

Digital media have become increasingly important information sources for health and crisis communication during the COVID-19 pandemic [12]. The role of the media is particularly important in providing objective and valid information, as inaccurate and misleading information causes fear in such an important and serious health matter [13].

Information plays an important role in our daily professional and personal lives and we are constantly faced with the challenge of locating the appropriate information needed at work, in entertainment, in everyday decisions and tasks [14]. People seek and use information constantly. Individuals seek information about work, entertainment, health, family and many other topics, from a large number of information sources. Due to the rapid development of digital technology, new information searching skills and behaviours are needed [15]. According to Wilson [16], information seeking behavior is the purposive seeking for information as a consequence of a need to satisfy some goal. In the course of seeking, the individual may interact with analog information systems (such as a newspaper or a library), or with digital systems (internet). Kuhlthau [17] introduced the principle of uncertainty on how individuals process information, learn and make sense of their world. She states that uncertainty due to a lack of understanding, a gap in meaning, or a limited construct initiates the process of information seeking.

Information seeking and processing are driven by the motivation to reduce uncertainty [18]. Health information seeking contributes to participation in health decision making, by helping individuals identify available options, reduce uncertainty feelings and dilemmas [19]. The WHO [20] has put emphasis on prudent information seeking behavior to alleviate feelings of anxiety and distress. According to Medlock et al. [21], health professionals, pharmacists and the internet were the most used sources of health information in seniors who use the internet in the Netherlands. Leaflets, television, newspapers and health magazines were also important sources.

Concerning COVID-19 pandemic outbreak, uncertainty regarding what is true and false about the disease and its prevention, might affect public's information behavior [22]. Griffin et al. [23] proposed that more sustained information seeking and processing will be motivated when individuals' sufficiency threshold (i.e. what individuals' feel is sufficient knowledge for adequately managing a risk) is higher than the individuals' current level of information. Misinformation on COVID-19 can potentially make individuals feel overwhelmed with different and inconsistent recommendations on what prevents and cures the disease [22]. Interestingly, Kim et al. [22] showed that exposure to misinformation on COVID-19 was negatively associated with information insufficiency feelings. When people face misinformation, they perceive less information need for adequately managing the risks of the disease. The researchers suggested that in the early stages of a novel disease pandemic, such as COVID-19, exposure to general information on the unknown risk make individuals realize that they need more information, whereas the opposite is true for misinformation.

During the implementation of the restrictive measures against COVID-19 pandemic outbreak in Spring 2020, the disease and its effects were the most important issue in the media worldwide, due to its particular epidemiological characteristics. Therefore, the pandemic was headline news for a long time and it was of concern to the public daily, causing feelings of uncertainty and anxiety about the future [24]. Since a large volume of information was circulated during the pandemic [5], including fake news [25] as is often recorded in a crisis [7], the COVID-19 pandemic was expected to be linked to information overload or even fake news, in the public's perception.

The plethora of information on COVID-19 that overwhelms the average person [26], the constant use of the term "fake news" in the media and in public discourse in the recent years [27], as well as the disinformation disseminated during COVID-19 pandemic outbreak [25] are the reasons that led to the planning of this study. The purpose of this research was to investigate the general public's information seeking behavior on COVID-19 in Greece, during the implementation of restrictive measures that had been imposed against the COVID-19 outbreak in Spring 2020. To the best of our knowledge no similar study has been undertaken so far.

2. Material and methods

This study was conducted through a web-based survey. The data collection was facilitated by the use of questionnaire posted on the Google Forms platform (https://www.google.com/forms/). The survey questionnaire was sent by email, through Facebook's Messenger application and through the Viber application to about 3000 recipients. Through the duration of the survey, 776 completed questionnaires were obtained, a survey response rate of approximately 26 %. This sample size could not be expanded further due to the COVID-19 restrictive measures; so the survey was conducted only through an online questionnaire. It is worth mentioning that by using an online survey had as a result that certain group of people with low educational level, as well as the age group $\geq$61 years old may have been excluded.

The study, undertaken between 13th April and 15th May 2020, aimed to investigate the general public's information seeking behavior on COVID-19, as well as their views and beliefs on the information they receive about the disease, in Greece. The questionnaire was distributed at a time when the COVID-19 pandemic was ongoing and urgent restrictive measures to prevent the spread of the disease had already been imposed in our Country. The questionnaire was divided into three sections: a) Demographic data, b) Information sources on COVID-19 and information seeking behavior, c) Respondents' personal views on the

information they received.

The questionnaire included closed-ended, 7-point Likert-scale questions, as well as multiple-choice questions. For Likert-scale questions, participants were offered 7-point answer scales: 1 = never, 2 = rarely, 3 = usually not, 4 = sometimes, 5 = often, 6 = very often, 7 = many times a day, and 1 = strongly disagree, 2 = disagree, 3 = partly disagree, 4 = neither disagree/nor agree, 5 = partially agree, 6 = agree, 7 = strongly agree. The 7-point Likert scale was considered to be the most appropriate for capturing respondents' beliefs, as it allows the direction and neutrality to be measured, as well as the estimation of the intensity of beliefs on three levels, thus providing more information. Using more response categories enables more accurate and reliable recording of respondents' attitudes, beliefs and feelings [28].

In order to describe the characteristics of the sample and to present the results of the survey, the data collected from the questionnaires were subjected to a descriptive statistical analysis so that the information contained therein could be shown through tables. The median was used to present the results of the questionnaires, as for ordinal data it is considered a more appropriate central tendency measure [29,30]. Thus, for the purposes of this work, the results of the questionnaires are interpreted according to the median of the distributions of survey responses as a central tendency measure of the participants' beliefs.

The Cronbach's alpha reliability coefficient of internal consistency for all point scales [31,32] was calculated and reported.

The data collected from the questionnaires constitute ordinal data [30] and normality assumption is violated under the Shapiro-Wilk criterion, the results of which were deemed unnecessary for presentation in this paper. In addition, data distributions are strongly skewed due to the 7-point Likert scale used. For the above reasons the analysis of the data was carried out using non-parametric methods, as recommended in the literature [30].

Further analysis between genders was performed. The data collected from the questionnaires were analysed using the non-parametric criterion Mann-Whitney-Wilcoxon (Mann-Whitney U), which compares two independent samples [33] and is suitable for data with strongly skewed distribution, such as those derived from the 7-point Likert scale used in this survey [30]. Post-hoc power analysis was conducted taking into account the following effect sizes: small (d = 0.20), medium (d = 0.50) and large (d = 0.80). The alpha level was set < 0.05 and the obtained sample size of the survey 776 was used for the assessments. The post-hoc analyses revealed that the statistical power for the above comparisons between genders was 0.70 for detecting a small effect, whereas it exceeded 0.99 for the detection of moderate to large effect sizes.

In addition, in cases where analysis between age groups was required, the non-parametric criterion Kruskal-Wallis was applied, which controls differences between independent variables and is not affected by outliers and the existence of skewed distributions [33]. In the case of a statistically significant difference being found under the Kruskal-Wallis criterion, the Dunn post hoc test was applied for further analysis, in order to determine the existence of differences [34]. Post-hoc power analysis was conducted taking into account the following effect sizes: small (f = 0.10), medium (f = 0.25) and large (f = 0.40). The alpha level was set < 0.05 and the obtained sample size of the survey 776 was used for the assessments. The post-hoc analyses showed that the statistical power for comparisons among age-groups was 0.70 for detecting a small effect, whereas it exceeded 0.99 for the detection of moderate to large effect sizes.

The analysis was carried out using the open source statistical analysis software Jasp 0.14.0 (University of Amsterdam) [34]. Post-hoc power analysis was performed using the open source software G*Power 3.1.9.7.

Table 1
Sociodemographic characteristics of the respondents (N = 776).

Demographic variables		Frequency	Percentage
Gender	Female	543	70.0%
	Male	233	30.0 %
Age	13–30	236	30.4%
	31–60	517	66.6%
	≥ 61	23	3.0%
Education level	Less than high school	18	2.3%
	High school	81	10.4%
	Technical education	67	8.6%
	Bachelor's degree	419	54.0%
	Master's degree	151	19.5%
	Doctoral degree	40	5.2%
Profession	Civil servants	249	32.1%
	Private employees	172	22.2%
	Self-employed	115	14.8%
	Farmers	9	1.2%
	Unemployed	39	5.0%
	University students	163	21.0 %
	High school students	10	1.3%
	Retired	19	2.4%
Vulnerable groups	No	684	88.1%
	Yes	92	11.9%
Family members ≥ 65 years old	No	368	47.4%
	Yes	408	52.6 %

3. Results

3.1. Characteristics of survey participants

A total of 776 people participated in this study, from all Greek Regions. The respondents of the questionnaire were asked to answer about their gender and age, their educational level, profession, whether or not they were at higher risk for severe illness from COVID-19 and whether or not there were members in their family aged older than 65 years. The sociodemographic characteristics of the survey participants are presented in Table 1.

3.2. Information sources

In this section, respondents were asked to answer questions about the information sources from which they receive on COVID-19 and their beliefs about the reliability of these information sources.

Initially, participants were asked about the time they spend daily to be informed on COVID-19. From the data analysis, it appears that most of the participants (558 people, 71.9 %) dedicated up to 1 h per day to be informed about the disease and 166 participants (21.4 %) up to 2 h per day. Thirty three participants (4.3 %) spent up to 3 h, 11 participants (1.4 %) spent up to 4 h per day and 8 participants (1.0 %) spent more than 4 h per day. Further analysis revealed the existence of statistically significant differences between the three age groups (13–30, 31–60 and ≥61 years old) concerning the time the participants devote to be informed on COVID-19 (Kruskal-Wallis test, H = 30.620, $p<0.001$). Pairwise comparisons showed that the younger individuals (13–30 years old) seems to spend less time than the older ones (31–60 and ≥61 years old) (Dunn's post hoc test, $p = 0.003$ and $p < 0.001$ respectively). Likewise, participants in the age group of 31–60 years seems to devote less time compared to the older ones (≥61 years old) to be informed on COVID-19 ($p < 0.001$).

The frequency results of the answers to the questionnaire concerning the information sources of the participants about COVID-19 disease are presented in Table 2. The Cronbach's alpha reliability coefficient of the query items is 0.847. The data gathered show that at the level of central tendency, the participants to the survey often get informed by television, the electronic press and news websites. They sometimes get informed by reputable websites (e.g. Ministry of Health, Civil Protection), the Internet and Facebook. Finally, the participants stated that they are

Table 2
Participants' response frequencies of the seven-level Likert scale question about information sources preference (N = 776) (IQR: Intequartile range).

LIKERT SCALE	1 Never	2 Rarely (1 time per 2 months)	3 Usually not (1 time a month)	4 Sometimes (1 time per 15 days)	5 Often (3−4 times a week)	6 Very often (1−2 times a day)	7 Many times a day	Median	IQR
Newspapers/ magazines (printed press)	447	152	52	67	38	14	6	1	1
Radio	289	163	82	105	89	35	13	2	3
Television	62	44	32	85	194	226	133	5	2
Electronic press (e.g. electronic newspapers)	135	44	34	74	145	223	121	5	3
News websites (e.g. websites with news content)	74	43	39	91	162	233	134	5	2
Valid websites (e.g. Ministry of Health, Civil Protection)	126	78	69	123	151	155	74	4	4
Internet (e.g. general blogs, personal pages)	187	81	60	114	126	135	73	4	4
Social Networks in general	186	75	53	92	134	146	90	4	4
Facebook	244	71	54	83	102	136	86	4	5
Twitter	600	51	29	26	29	33	8	1	0
Instagram	549	54	34	39	38	36	26	1	1
YouTube	477	86	45	51	59	42	16	1	2
Reddit	681	28	18	26	19	4	0	1	0
Pinterest	678	33	18	25	14	8	0	1	0
WhatsApp	687	28	14	22	18	6	1	1	0

Table 3
Participants' response frequencies of the seven-level Likert scale question about information sources reliability (N = 776) (IQR: Intequartile range).

LIKERT SCALE	1 Strongly disagree	2 Disagree	3 Partly disagree	4 Neither disagree/Nor agree	5 Partly agree	6 Agree	7 Strongly agree	Median	IQR
Newspapers/ magazines (printed press)	56	51	76	203	232	147	11	5	1
Radio	42	40	84	216	266	115	13	5	1
Television	80	84	94	149	245	103	21	4	2
Electronic press (e.g. electronic newspapers)	39	36	89	204	279	120	9	5	1
Internet (e.g. general blogs, personal pages)	59	79	127	227	215	58	11	4	2
Facebook	199	136	125	203	87	20	6	3	3
Twitter	228	133	105	235	61	11	3	3	3
Instagram	246	143	96	230	50	8	3	2	3
YouTube	209	130	112	226	81	14	4	3	3
Reddit	264	145	82	241	41	2	1	2	3
Pinterest	272	153	85	228	34	2	2	2	3
WhatsApp	279	148	78	230	36	4	1	2	3

rarely informed by radio, they never prefer to be informed by newspapers (print media) and other social networks (Twitter, Instagram, Youtube, Reddit, Pinterest).

Further analysis showed that there was statistical difference between the three age groups on their preference to be informed on COVID-19 by television (Kruskal-Wallis test, H = 21.099, $p<0.001$). The older participants (≥61 years old) seem to be informed more frequently by television compared to the younger ones (13−30, 31−60 years old) (Dunn's post hoc test, $p = 0.001$ and $p < 0.001$ respectively). Similarly, participants in the age group of 31−60 years seems to watch television more frequently compared to the younger ones (13−30 years old) to be informed on COVID-19 ($p < 0.001$). Furthermore, respondents in the age group of 31−60 years seems to be informed on COVID-19 more often by electronic press than the ones in the age groups of 13−30 ($p < 0.001$) and ≥61 years ($p < 0.001$). Also, concerning the general internet use as a means of information on COVID-19 (blogs, personal pages etc.), there was statistical difference between the three age groups (Kruskal-Wallis test, H=14.597, $p<0.001$). Older people (≥61 years old) do not seem to use internet for information on the disease, compared to younger participants (13−30 and 31−60 years old) (Dunn's post hoc test, $p < 0.001$). On the contrary, the younger people (13−30 years) use internet more commonly than the participants in the 31−60 age group (Dunn's post hoc test, $p < 0.034$). As far as Facebook is concerned as a means of information on COVID-19, there was a significant difference between the older participants (≥61 years) and the younger ones (13−30, 31−60 years old) (Kruskal-Wallis test, H=17.927, $p<0.001$). Older participants use Facebook less frequently than the other two age groups (Dunn's post hoc test, $p < 0.001$ and $p < 0.001$ respectively), while there was no significant difference between the first two age groups ($p = 0.374$) concerning Facebook as a means of information on COVID-19.

Participants' beliefs about reliability of information sources are presented in Table 3. The Cronbach's alpha reliability coefficient is 0.922. In terms of central tendency, the results show that the participants in the research partly agree that the printed and electronic press, as well as radio provide reliable information on COVID-19 (median = 5). Almost half of the participants partly to strongly agree with the above statement (50.3 %, 52.6 % and 50.8 %, respectively). Neutrality (neither disagree/nor agree) is recorded in the participants' beliefs regarding television and the internet (blogs/personal pages). Finally, they partly disagree or disagree that social networks provide reliable information on COVID-19, depending on the particular network. The Kruskal-Wallis showed that there are significant differences among age groups concerning the participants' beliefs about the reliability of press (H = 8.880, $p = 0.012$). Pairwise comparisons revealed that older individuals (31−60 and ≥61 years old) seem to express more intensive agreement to the above statement, compared to younger participants (13−30 years

Table 4
Participants' response frequencies of the seven-level Likert scale question about additional information sources preference (N = 776) (IQR: Intequartile range).

LIKERT SCALE	1 Never	2 Rarely (1 time per 2 months)	3 Usually not (1 time a month)	4 Sometimes (1 time per 15 days)	5 Often (3–4 times a week)	6 Very often (1–2 times a day)	7 Many times a day	Median	IQR
Personal doctor	298	153	106	136	49	19	15	2	3
Health workers	207	146	105	154	99	42	23	3	3
Pharmacist	242	135	113	158	81	33	14	3	3
Family	95	78	88	127	200	112	76	4.5	2
Friends	103	93	90	150	208	88	44	4	3
Information scientists	225	86	64	117	138	96	50	4	4
From State experts (e.g. National Public Health Organization) that I can contact	304	102	80	95	63	80	52	2	4

Table 5
Participants' response frequencies of the seven-level Likert scale question about official information sources preference (N = 776) (IQR: Intequartile range).

LIKERT SCALE	1 Never	2 Rarely (1 time per 2 months)	3 Usually not (1 time a month)	4 Sometimes (1 time per 15 days)	5 Often (3–4 times a week)	6 Very often (1–2 times a day)	7 Many times a day	Median	IQR
National Public Health Organization	214	96	89	133	155	74	15	3	4
Ministry of Health	220	107	82	119	138	95	15	3	4
Civil Protection	235	99	78	132	131	88	13	3	4
European C.D.C.	352	104	71	113	89	38	9	2	3
WHO	253	108	100	103	128	66	18	3	4
Scientific journals	339	112	97	110	75	32	11	2	3
Open electronic, digital libraries	395	109	87	80	70	24	11	1	2
Johns Hopkins University	517	91	47	62	33	17	9	1	1
Libraries that offer information on COVID-19	441	124	68	61	51	26	5	1	2

old) (Dunn's post hoc test, $p = 0.006$ and $p < 0.015$ respectively). There was no significant difference between the age groups of 31–60 and ≥61 years old ($p = 0.097$). As far as the view that television is a reliable information source is concerned, further analysis showed that there are significant differences between age groups (Kruskal-Wallis H=52.119, $p < 0.01$). More specifically, the respondents in the age group ≥61 years old agree with the previous statement (median=6), individuals in the age group of 31–60 years old partly agree (median=5), while the younger participants (13–30 years old) seem to express neutrality (median=4) in terms of central tendency, to the above statement. The differences between each age group are statistically significant after pairwise comparisons (Dunn's post hoc test, $p < 0.001$ for each compared group).

Participants' answers to the questions about additional sources of information on COVID-19 are presented in Table 4. The Cronbach's alpha reliability coefficient is 0.734. The data analysis shows that the participants in the research prefer to be informed sometimes by family, sometimes by their friends and sometimes from information scientists. Also, it seems that participants rarely get informed by their personal doctor and State experts about COVID-19. Finally, the respondents are usually not informed by health workers or pharmacists.

Participants' replies concerning official websites as information sources are presented in Table 5. The Cronbach's alpha reliability coefficient is 0.909. The data analysis shows that, in level of central tendency, participants usually do not prefer to visit and be informed by official websites such as the National Public Health Organization, the Ministry of Health, the Civil Protection and the WHO The Mann-Whitney *U* test shows that female respondents seems to visit more frequently ("sometimes", median = 4) compared to male respondents ("usually not", median = 3) the National Public Health Organization's website (W = 56,264.0, $p = 0.05$) and the Ministry of Health website (W=53,340.5, $p < 0.001$). Similarly, females visit sometimes (median=4) the Civil Protection website compared to males who rarely visit it (median=2) (W=55,433.0, $p = 0.005$). As far as the WHO website is concerned, females usually do not visit it (median=3) which differs statistically from male responses who rarely visit the WHO website (median=2) (W=56,100.5, $p = 0.01$). Moreover, respondents rarely visit the European C.D.C. website as well as scientific journal websites. The participants, also, never prefer to visit and get informed by digital libraries and library websites that offer information on COVID-19. Finally, they do not visit the Johns Hopkins University website.

3.3. Reasons for choosing internet and social media as a source of information

In this section, survey participants were asked to answer questions about the specific reasons why they choose to be informed on the internet and social media, as well as the devices they use to access digital information on COVID -19. The Cronbach's alpha reliability coefficient is 0.549.

The data analysis reveals that, in terms of central tendency, participants agree that they choose the internet because it is practical and out of habit (median = 6). More specifically, the Mann-Whitney *U* test shows that female respondents seem to express a stronger agreement with the statement that they choose internet as a means of information out of habit ("agree", median = 6), compared to male respondents who partly agree with the above statement (median = 5) (W = 52,469.0, $p = 0.008$). Also, there is significant difference between age groups concerning this statement (Kruskal-Wallis test H=10.861, $p = 0.004$). Age groups 13–30 and 31–60 years old seem to partly agree or agree with the statement (median = 5 and median = 6, respectively). There is no significant difference between these age groups (Dunn's test, $p = 0.322$). Older individuals partly disagree (median=3), which differs significantly from both age groups 13–30 and 31–60 years old ($p < 0.001$). As far as the

view of choosing the internet as a reliable information source is concerned, neutrality was recorded (median=4). Finally, participants disagree with the statement that they choose the internet because they do not know where else to look for information (median=2).

Participants were asked an optional question about their choice of social media as a means of information on COVID-19. The Cronbach's alpha reliability coefficient is 0.853. The statistics show that, at the level of central tendency, respondents partly agree with the view that they choose social networks as a means of information on the disease, because they are active in social media, as well as because it is practical and also out of habit (median = 5). They partly disagree with the statement that they choose social networks for their credibility (median = 3). Finally, they disagree with the view that they choose social networks due to their unawareness where else to look for information (median = 2). The Mann-Whitney *U* test shows that female respondents appears to express a stronger agreement with the statement that they choose social media as a means of information out of habit ("partly agree", median = 5), compared to male respondents who are neutral to the above view (median = 4) (W = 49,886.0, $p = 0.001$).

Finally, participants' were asked to answer a question concerning the means and devices by which they get access to and use digital information on COVID-19. The Cronbach's alpha reliability coefficient is 0.424. The statistics show that, in central tendency terms, participants very often use their mobile phone (median 6) and often their laptop (median 5) to access digital information. They rarely use a desktop and they never use a tablet to access digital information. Also, it is worth noting that, the Mann-Whitney *U* test reveals that female participants declared that, in central tendency terms, they did not use a desktop ("never", median = 1), compared to male respondents who often used a desktop (median = 5) (W = 73,125.5, $p < 0.001$). Participants that belong to age groups of 13−30 and 31−60 years old seem to use very often mobile phones (median=6). There is no significant difference between these age groups (Dunn's test, $p = 0.474$). Older individuals (≥61 years old) appear to never (median=1) use mobile phones to get access to digital information, which differs significantly from individuals of the age groups of 13−30 and 31−60 years old ($p < 0.001$). Similar differences were recorded with regard to the use of laptop (W=13.439, $p<0.001$), as the older people (≥61 years old) seem to never use laptop, which differs significantly from people of the two other age groups ($p < 0.001$), who appear to use often a laptop in order to gain access to digital information.

3.4. Information seeking behavior

In this section, participants were asked to answer questions about the specific information retrieval strategy they follow and the difficulties they may encounter in finding valid information about COVID-19.

As far as the information retrieval strategy followed by the participants regarding COVID-19 is concerned, the data analysis shows that keyword search is the most commonly used strategy to retrieve information in a digital environment (60.3 %). Thematic search is the next most frequent preference of survey participants (50.5 %). Visiting websites that have been saved as fixed bookmarks (40.3 %) and searching with phrases (39.7 %) are their next most common choices. Thematic browsing and using of logical operators (AND, NO, OR) follow with lower frequencies (25.0 % and 11.09 %, respectively).

Participants were asked to answer a question about the differentiation of their strategy for seeking information on COVID-19 when the appropriate information has not been found. Scale reliability Cronbach's $\alpha = 0.664$. The analysis of the data reveals that, at the central tendency level, if the participants fail to find the desired search results, they often use different keywords (median = 5), sometimes use another database or search engine and also use different search strategy (e.g. use of logical operators or thematic search) (median = 4). Finally, they rarely abandon the search considering that they are unable to continue, as they also rarely turn to an information scientist or doctor / nurse to find the information they are looking for about the disease (median = 2).

Table 6
Participants' response frequencies and corresponding choice-percentages of multiple-choice question regarding the difficulties that they encounter when seeking information (N = 776).

	Selection frequency	Percentage % of participants
Lots of unreliable information	580	74.74%
Fake news spreading	544	70.10%
Information overload	465	59.92%
Science denial groups/movements	296	38.14%
Scientific community difficulties to have consensus presenting their views	232	29.90%
Famous people (politicians, celebrities) who deny science	204	26.29%
Difficulty understanding medical terms	188	24.23%
Lots of information unusable to me	157	20.23%
I face difficulty to understand the size of the problem	134	17.27%
Difficulty of scientists to present the disease/problem	128	16.49%
Media access problems	60	7.73%
I do not face any difficulties	3	0.39%

The difficulties that participants may face in their information seeking about COVID-19 are presented in Table 6. The statistics reveals that the most important difficulties the participants faced seeking for information on COVID-19 were the unreliable information they encounter (74.7 %), spreading of fake news (70.1 %), information overload (59.9 %) and various views of science denial groups or movements (38.1 %).

3.5. Participants' views about information on COVID-19

In this section, participants were asked questions about their beliefs concerning the information they receive about COVID-19.

Table 7 presents their responses concerning their beliefs about the information they receive on COVID-19. Scale reliability: Cronbach's $\alpha = 0.640$. The results showed that participants, at a central tendency level, agree with the statement that they worry about the spread of fake news. It is worth mentioning that there is no statistical difference among genders (Mann-Whitney W = 61,923.0, $p = 0.628$) and between age groups (Kruskal-Wallis H = 0.086, $p = 0.958$). They also agree with the view that fake news is spread in the print and electronic press and on social media. Furthermore, they agree with the importance of paying attention to the domain names of the websites they visit. Further analysis revealed that there is statistically significant differences between age groups (Kruskall-Wallis H = 11.704, $p = 0.003$). Specifically, the age groups 13−30 and 31−60 years old partly agree (median=5) and agree (median=6) with the above statement, respectively, with significant difference (Dunn's test p=0.012). The age group ≥61 years old seems to have neutral attitude (median = 4) concerning the above statement, which differs significantly compared to the first two groups ($p = 0.027$ and $p = 0.002$, respectively). Moreover, respondents partly agree that they check the information they read with other sources. They also partly agree that they pay attention to the credentials of the information source. Neutrality was recorded concerning the statements that it is easy to distinguish fake news, that they read only news headlines and that they would rather do other things than being informed about COVID-19. Finally, they disagree with the view that they ask information scientists for information about the disease. The Mann-Whitney *U* test shows that male respondents express a stronger agreement with the statement that it is easy to distinguish fake news (partly agree, median = 5), compared to female respondents who are neutral to the above view (median = 4) (W = 70,545.5, $p = 0.009$).

Participants' beliefs concerning the quality of information they receive about COVID-19 are depicted in Table 8. Scale reliability: Cronbach's $\alpha = 0.649$. The data analysis shows that, at a central

Table 7
Participants' response frequencies of the seven-level Likert scale question regarding their beliefs on information they receive (N = 776) (IQR: Intequartile range).

LIKERT SCALE	1 Strongly disagree	2 Disagree	3 Partly disagree	4 Neither disagree/ Nor agree	5 Partly agree	6 Agree	7 Strongly agree	Median	IQR
I cross-check the information I read	15	26	21	126	225	251	112	5	1
Fake news is being spread in the media (print-electronic press)	7	17	25	83	213	254	177	6	1
Fake news is mainly spread on social media	5	20	33	101	181	269	167	6	1
Fake news distinguishing is easy	28	91	118	202	182	102	53	4	2
I check the domain names of the websites I visit (e.g. gov, edu, org)	45	27	35	127	128	276	138	6	2
I check the credentials of the information sources	45	39	40	174	169	228	81	5	2
I'm worried about the spread of fake news	13	15	25	107	163	278	175	6	1
I read only news headlines	81	129	122	184	168	66	26	4	3
I'd rather do other things than be informed about COVID-19	91	107	88	175	139	107	69	4	3
I ask my library information scientist	287	140	62	172	66	40	9	2	3

Table 8
Participants' response frequencies of the seven-level Likert scale question regarding their views about information quality they receive (N = 776) (IQR: Intequartile range).

LIKERT SCALE	1 Strongly disagree	2 Disagree	3 Partly disagree	4 Neither disagree/ Nor agree	5 Partly agree	6 Agree	7 Strongly agree	Median	IQR
Information is easily understandable	15	32	71	123	257	228	50	5	2
Information is reliable	28	57	94	200	249	133	15	5	1
Information is comprehensive	28	61	90	191	245	144	17	5	1
I feel like the truth is being hidden.	30	79	84	181	192	115	95	5	2
I need to know more	17	56	49	152	193	201	108	5	2
Information scientists play an important role in the quality of information	11	24	28	123	180	266	144	6	1
Information should be provided from official sources	8	10	13	64	122	266	293	6	2
The information I receive is too much and I can't process it	49	86	76	200	182	124	59	4	2
Journalists play an important role in the quality of information	36	32	47	133	174	216	138	5	2

tendency level, participants agree that information should be provided by official sources, and information scientists play an important role in the quality of information. They partly agree that journalists play an important role in information quality. In addition, participants partly agree that the information they receive is understandable and reliable. Additionally, in terms of central tendency, respondents partly agree that the information they receive is comprehensive, they feel that the truth is being hidden and they need to learn more about the disease. Further analysis, showed that male respondents express a stronger agreement with the statement that the information on COVID-19 they receive is reliable ("partly agree", median = 5), compared to female respondents who are neutral to the above view (median = 4) (Mann-Whitney U test W = 70,862.0, $p = 0.006$). Correspondingly, males' neutrality was recorded to the view that they feel the truth is being hidden (median=4), while females partly agree (median=5) (W=51,765.0, $p < 0.001$). Concerning the statement that there is information overload that they cannot process, neutrality was recorded, in terms of central tendency. However, further analysis revealed significant differences among age groups (Kruskal-Wallis test, H=9.157, $p = 0.010$), with the participants in the group age ≥61 years old partly agreeing with the previous statement, which is statistically different to the views of the members in the age groups 13−30 and 31−60 years old who express neutrality (Dunn's post hoc test $p = 0.001$ and $p = 0.002$, respectively).

4. Discussion

This study was conducted to investigate the information seeking behavior about COVID-19 of the general public in Greece, during the implementation of restrictive measures to prevent the spread of COVID-19, in Spring 2020. This survey has recorded 776 participants' replies from all geographical regions of Greece. Applying the post-hoc analysis, it was found that the study had relatively high power for detecting a small effect size and very high power for detecting moderate and large effect sizes.

According to a public opinion survey commissioned by the European Parliament during COVID-19 first wave outbreak, more than three-quarters of Greek respondents were satisfied with measures taken by the Greek government (77 %). Also, it was found that scientists were chosen as a trusted source of information by most of the respondents (58 %), followed by World Health Organization 40 % and national health authorities 38 % [35,36].

Our results show that the majority of the individuals (93.3 %) dedicated up to 2 h per day to be informed on COVID-19. Younger respondents spent less time than older ones keeping up-to- date on the disease. Television and internet news media were the most common sources of information for study respondents. In cases of crisis situations, the public usually relies on official news organizations to obtain reliable information [7,37]. Television (71.3 %), electronic press (63.0 %) and news websites (68.2 %) were the most common sources of information that were preferred by the survey participants. The majority of the participants declared that they used to watch television often to many times a day. The data analysis showed that older people seemed to watch television significantly more frequently than younger ones, which is consistent with our results on the significantly reduced use of the internet as a means of information on the disease by older people. Our results correspond with previous reports concerning the increased television audience during the COVID-19 pandemic [38]. Television has been the most widespread source of information on COVID-19

worldwide and generally the second most reliable source after governmental updates [37].

General internet sources (blogs, personal pages etc.) and Facebook were preferred by 43.1 % and 41.8 % of the respondents, respectively, while other social media were never preferred (Twitter, Instagram, Youtube etc.). Facebook was preferred more frequently as a means of information on COVID-19 by younger rather than the older participants. Adesegun et al. [39] reported that in Nigeria traditional and Internet media was the predominant source of information for respondents to their survey and nearly all of them were on social media during COVID-19 outbreak, with WhatsApp, Twitter, Instagram and Facebook being the most common platforms for knowledge sharing on COVID-19.

Radio had apparently low use as information source on COVID-19 by the respondents, as similar results have been reported by Túñez-López et al. [37]. In addition, a similar low use of the printed press was recorded as information source on COVID-19, which contradicts the finding of Dreisiebner et al. [40], who reported that in German-speaking countries there was an increased use of newspapers during the pandemic. However, this low use observed in our study could be attributed to the people's limited outdoor activities during the survey period.

The ease and convenience of using the internet sources and social media in addition to their active participation in the latter, were the main reasons why some participants preferred them as information sources about COVID-19. The reliability of the internet and social media, as a possible reason for choosing it, is a subject for which neutrality or partial disagreement was recorded at the central tendency level, among the respondents. Female participants seem to visit internet and social media resources more out of habit to inform themselves about COVID-19, compared to male respondents. Participants appear to have had access to digital information primarily using a mobile phone and laptop, as reported in our survey. Desktops were rarely used, although males preferred to use them more frequently than females, while tablets seemed to be very low in the respondents preferences.

The dissemination of information on the internet and social networks has been a field for the reproduction of fake news [41,42]. Veglis et al. [43] using qualitative content analysis on 25 articles from Greek mainstream media websites and from five online mainstream English-language news websites during COVID-19 first wave outbreak, have shown that approximately 30 % of the articles were found to misrepresent the topic, by providing information that is misleading or deficient. The authors concluded that the articles seemed to include some inaccurate information in otherwise truthful content. This fact makes it harder for the reader to detect false information. In our study, almost half of the participants considered the press (printed and electronic) to be reliable sources of information on COVID-19 (50.3 % and 52.6 %, respectively) and in terms of central tendency, they seem to express neutrality concerning the press reliability. On the contrary, 36.6 % and 14.6 % of the participants considered that the internet and Facebook are reliable sources, respectively. Moreover, in central tendency level, they partly disagree or disagree to the view that social media (Facebook, Twitter etc.) are reliable means of information, indicating that the participants are aware of the dimensions of the spread of fake news on social media. Similar results in social media acceptance (14.0 %) as a reliable source of information on COVID-19 have also been reported earlier [38,37].

In terms of the reliability of television, age seems to influence the beliefs of the participants. The older the participants, the more positive their attitude to the view that television is a reliable means of information on COVID-19.

Family and friends (50.5 % and 43.8 %, respectively) seem to play an additional role in the participants' information on COVID-19, while the personal doctor (10.7 %) and other health workers (21.1 %) and pharmacists (16.5 %) do not appear to be most preferred sources of information on COVID-19. These results should be interpreted in the light of the particular circumstances prevailing during the investigation, due to the burdened working programme of health staff and the limited public's outdoor activities.

The results show also that the participants were used to visit sometimes official websites at central tendency level. In a general question with regard to official websites, approximately half (49.0 %) of them indicated visiting official websites often to many times a day. Following a detailed question about visiting the websites of the Ministry of Health, National Public Health Organization, Civil Protection and the WHO, almost one third of the respondents declared visiting them often to many times a day (32.0 %, 31.4 %, 29.9 % and 27.3 %, respectively). The corresponding percentages for the websites of the European Centre for Disease Prevention and Control, scientific journals, digital Libraries that offer information on COVID-19 and the Johns Hopkins University was 17.5 %, 15.2 %, 10.6 % and 7.6 %, respectively. These results suggest that at the time of the investigation, the public in Greece was probably quite unfamiliar with the above official websites as sources of information on COVID-19. This may be due to the fact that the pandemic and the imposition of coercive restrictive measures was an unprecedented experience for Greek residents.

Differences between genders were found. Females appeared to visit official websites more often than males did to acquire COVID-19 information. Nevertheless, these results suggest that there is a need for more intense promotion of official organizations' websites, because they provide high quality information as indicated by Hernández-García and Giménez-Júlvez [44]. Moreover, the respondents did not seem to visit digital libraries and library websites that offer information on COVID-19. This leads us to assume that the role of libraries may not has yet been widely accepted as reliable information sources in Greece.

With regard to the respondents' information-seeking behavior, their most common strategy to retrieve information in a digital environment was keyword searching, followed by thematic search, visiting websites that have been previously saved in the browser, as well as searching with phrases. Keyword searching is the basic strategy for digital information seeking in the web, but is unsuitable in cases when the users have unclear search objectives, complex tasks to perform, or have insufficient former knowledge [45–47]. Therefore, the need to change the information search strategy is inevitable when it has not produced the desired results. When the participants were asked how they modify their search strategy if the initial attempt to reduce the uncertainty did not bring satisfactory results, most of them (56.6 %) often to always choose different keywords, 34.0 % use a different search strategy (logical operators, thematic search etc.) and 30.0 % choose another database or search engine.

During a pandemic, people often encounter huge volumes of information [48]. According to Young and Seggern [49] information overload and reliability are the two main obstacles concerning finding information. Our results support these findings, as the main difficulties respondents reported facing when seeking information include unreliable information, fake news and information overload. Furthermore, science denial movements were reported by participants as another important challenge to them when they are seeking information.

Reuter et al. [50] in a study concerning public's perceptions on fake news, reported that more than 80 % of the participants agreed that fake news poses a threat and 78 % saw fake news as harming democracy. During the recent COVID-19 pandemic first outbreak, the authorities had to confront not only the disease itself, but possibly an even more threatening storm of inaccurate information, the so called "infodemic" [51]. Moscadelli et al. [26] reported that the percentage of untrue information increased likewise the news about the outbreak raised and that fake news had a much higher likelihood of being shared and known. In the present study, participants' beliefs were also recorded concerning fake news. Respondents seem to worry about the fake news phenomenon. The results show that 79.4 % partly to strongly agree with the statement. Accordingly, concerning the view that fake news is being spread in the media (print and electronic) and social media, most of the respondents (83.0 % and 79.5 %, respectively) partly to strongly agree

Summary table

What was already known

- In the digital age there is a huge amount of information that overwhelms the average person.
- During COVID-19 pandemic outbreak a plethora of information was disseminated through mainly digital information sources.

What this paper has added

- This study has depicted that the main information sources about the COVID-19 in Greece was television, electronic press and news websites.
- Social media had limited acceptance as information sources on COVID-19.
- In times of health crisis individuals consider that information should be provided by official sources.
- A widespread concern about the phenomenon of fake news has been recorded.

with it. Comparing these results with the participants' replies to the question about the reliability of the social media, it seems that there is a stronger belief among the respondents about the view of fake news spreading in these media, than the view that they are reliable means of information (Mann-Whitney W = 537,074.0, df = 1,550, $p < 0.001$).

When participants were asked about their views on the quality of information on COVID-19 they received during the first outbreak in Greece, the following results were obtained. Most of the participants (87.8 %) believe that the information on COVID-19 should be provided by official sources. But, as it was mentioned above, almost half (49.0 %) of them declared that they often to many times a day visit official websites (e.g. Ministry of Health, Civil Protection etc.), which differs significantly with the above result (Mann-Whitney W = 135,346.5, df = 1,550, $p < 0.001$). Respondents, also felt the need to know more (64.7 %), they considered the information they received easily understandable (68.9 %), but almost half of the participants believed that the information was reliable (51.2 %), comprehensive (52.3 %) and that the truth was being hidden (51.8 %). Females expressed a stronger belief that the truth was hidden and on the contrary, concerning the reliability of information, they expressed less intense agreement, than male respondents.

In our study, several limitations should be taken into consideration. First, our results were acquired using online survey and inevitably people who do not use internet were excluded. These individuals might have a low educational level and belong to older age groups. This is probably the reason why the age group ≥61 years old were not represented adequately in the present study and so the results on this age group should be carefully interpreted. Second, the questionnaires were disseminated by email, as well as Messenger and Viber applications, due to the fact that the study was conducted during the COVID-19 pandemic and the implementation of precautionary restrictive measures, which inevitably indicates a targeted dissemination to an audience that uses these means of communication. Third, the survey participants' synthesis has a bias in favor of females, which could be attributed to that females use internet and social media more out of habit than males, as it has been shown in the present study. Forth, although responses were collected from all geographical areas of Greece, it is worth noting that in the Regions of Epirus and the Ionian Islands very low participation rates were recorded, while the largest percentages were recorded in the Regions of Central Macedonia and Attica. Finally, the data were obtained from self-reported opinions without knowing the veracity of the answers.

5. Conclusions

The increasing use of the internet and mobile communication devices is at the heart of technological developments. In the modern information era, societies are no longer separated, since with the use of technology individuals are able to communicate and share ideas. In times of crisis, reliable information is a primary issue for effective management and response to problems.

Our results show that, during the first wave of the COVID-19 pandemic outbreak in Greece, participants used traditional media (television) and online information sources (electronic newspapers and news websites) to be informed about the disease. On the contrary, limited use of Facebook and negligible use of other social networks (Twitter, Instagram, Youtube, Pinteret, WhatsApp, Redit) were recorded. This observed information seeking behavior might has helped individuals to accept the necessary behavioral changes that had contributed to the Greek success story in preventing spread of the disease despite limited resources.

Authors' statement

Informed consent was obtained for experimentation with human subjects.

Authors' contributions

PES Data acquisition, data analysis and interpretation, drafting and revising the manuscript. EG Conceptualizing the study, designing the research, revising and approving the manuscript.

Declaration of Competing Interest

The authors declare no conflict of interest.

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