

The early impact of the Coronavirus (Covid-19) pandemic on migraine patients: A scoping review

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Abstract

Migraine is a neurological disorder that significantly impacts patients and society, even though it remains undiagnosed and untreated. The Covid-19 pandemic is a public health concern and has created unprecedented consequences for patients with neurological disorders, including migraine patients. The purpose of this scoping review was to explore in-depth and report the evidence of what is already known from the literature of the unique impact that the Covid-19 pandemic had on individuals with a migraine within a timeframe of one year (March 2020 - March 2021). The authors conducted a scoping literature review based on PRISMA guidelines in 4 databases (PubMed, Google Scholar, Embase, and CINAHL) for studies regarding the impact of Covid-19 on migraine patients. Fourteen published studies were included from a total of 883 records retrieved.

This ongoing pandemic has affected migraine patients in a multi-faceted way, either positively or negatively. Multi-faceted effects and changes on migraine patients at the medical, psychosocial, and working-economic level emerged during the pandemic and subsequent lockdown.

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Future studies should focus on assessing the long-term consequences of the Covid-19 pandemic on migraine patients.

Keywords: Coronavirus; COVID-19; Pandemic; Migraine; Scoping review.

1. Introduction

At the end of December 2019, a severe acute respiratory syndrome Coronavirus 2, known as SARS-CoV-2, was first detected in Wuhan, China (Del Rio & Malani, 2020; Huang, Wang, Li, Ren, Zhao, Hu *et al.*, 2020). The illness, referred to as Coronavirus disease 2019 (Covid-19) was declared a global pandemic by the World Health Organization (WHO) on March 11, 2020 (WHO, 2020). During 2020, this pandemic kept on rapidly spreading (Orsini, Corsi, Santangelo, Riva, Peroni, Foadelli *et al.*, 2020) and created an unprecedented crisis on public health care delivery systems at a global level (Boyras & Legros, 2020; López-Bravo, García-Azorín, Belvís, González-Oria, Latorre, Santos-Lasaosa *et al.*, 2020; Piccininni, Rohmann, Foresti, Lurani, & Kurth, 2020).

The new reality that has evolved has undoubtedly and unexpectedly altered people's daily life routine. Several governments imposed compulsory quarantine policies. The emergency lockdown program applied overall (Altamura, Cevoli, Aurilia, Egeo, Fofi, Torelli *et al.*, 2020; Shevlin, McBride, Murphy, Miller, Hartman, Levita *et al.*, 2020) included severe non-essential movement restrictions (Lima, de Medeiros Carvalho, Lima, de Oliveira Nunes, Saraiva, de Souza *et al.*, 2020; Shevlin *et al.*, 2020; Silvestro, Tessitore, Tedeschi, & Russo, 2020) as well as measures of social distance (Anastasiou & Duquenne, 2021). As a result, the Covid-19 pandemic has unexpectedly altered individuals' daily routines, as well as determining changes in the economy and social fabric of the global society (Cao, Fang, Hou, Han, Xu, Dong *et al.*, 2020; Shevlin *et al.*, 2020; Umucu & Lee, 2020). The pandemic has disturbed people's working environment with significant work-related alterations (Anastasiou & Duquenne, 2021; Saleh, 2020). Even today it constitutes a challenge for populations' social cohesion (Anastasiou & Duquenne, 2021) due to loneliness and social isolation (Gica, Kavakli, Durduran, & Ak, 2020; Anastasiou & Duquenne, 2021). There is growing evidence that the pandemic negatively impacts people's physical well-being and health, while there is an increase in mental health problems (Ammar, Trabelsi, Brach, Chtourou, Boukhris, Masmoudi *et al.*, 2020; Galea, Merchant, & Lurie, 2020; Raihan, 2020; Saleh, 2020; Shevlin *et al.*, 2020) due to psychological pressure (Xiong, Lipsitz, Nasri, Lui, Gill, Phan *et al.*, 2020). According to the literature available on psychiatric disorders and on the Covid-19 pandemic, the Covid-19 diagnosis reinforces the risk of the appearance of these disorders (Zhang, Li, & Zhong, 2021). It has shown to be associated with high levels of psychological

problems, including anxiety, depression, and stress (Hyland, Shevlin, McBride, Murphy, Karatzias, Bentall *et al.*, 2020; Lima *et al.*, 2020; Shevlin *et al.*, 2020; Wang, Pan, Wan, Tan, Xu, Ho *et al.*, 2020), insomnia, anger and fear (Horesh & Brown, 2020; Khanna, Honavar, Metla, Bhattacharya, & Maulik, 2020). Specifically, in Winkler and colleagues' (Winkler, Formanek, Mlada, Kagstrom, Mohrova, Mohr *et al.*, 2020) recent study, which involved more than 3.000 adults, at least one common psychiatric disorder increased significantly, a finding that was confirmed by relevant studies in the UK (Pierce, Hope, Ford, Hatch, Hotopf, John *et al.*, 2020) and USA (Czeisler, Lane, Petrosky, Wiley, Christensen, Njai *et al.*, 2020). A study from Japan investigated the impact of the first wave of the Covid-19 pandemic on 606 migraine sufferers and revealed an increase in the stress levels, connected to the pandemic, as well as changes in mood and sleep (Suzuki, Takeshima, Igarashi, Imai, Danno, Yamamoto *et al.*, 2021).

This massive outbreak has caused worry among healthcare professionals (López-Bravo *et al.*, 2020) and has significantly affected healthcare. Because of this emerging situation, neurology departments were unable to provide the appropriate care and treatment to the patients with chronic diseases (López-Bravo *et al.*, 2020), including patients with migraine (Chowdhury & Datta, 2020), although this population consists of a critical group of high vulnerability (Louvardi, Pelekasis, Chrousos, & Darviri, 2020).

Migraine is a chronic paroxysmal neurological disorder that can be disabling and is the most common form among the primary headache disorders in the world (International Classification of Headache Disorders [ICHD-3 beta], 2018) and the most expensive among the disorders of the nervous system (Stovner & André, 2008). According to research findings from the Global Burden of Disease Study 2019 – GBD 2019 (Global Burden of Disease Collaborative Network, 2021), migraine is ranked as the second most common disorder among the world's causes of disability (Vos, Lim, Abbafati, Abbas, Abbasi, Abbasifard *et al.*, 2020) and, in general, it seems that the prevalence of migraine is constantly increasing (Stovner, Hagen, Linde, & Steiner, 2022). Due to the paroxysmal character of migraine, some patients were shown to suffer from an increased incidence of migraine attacks during winter (Hoffmann, Lo, Neeb, Martus, & Reuter, 2011), while according to another relevant study, the peak period of attacks was spring and summer (Szyszkowicz, Kaplan, Grafstein, & Rowe, 2009). Females aged 15-49 years remain first and constitute the top cause of disability-adjusted life years (DALYs) (Steiner, Stovner, Jensen, Uluduz, & Katsarava,

2020). Migraine presents a high prevalence during the peak productive age of individuals between the ages of 25 and 55 (Burch, Loder, Loder, & Smitherman, 2015; Burch, Rizzoli, & Loder, 2018), affecting about 10% of the adult workforce population (Burton, Chen, Li, McCluskey, Erickson, & Schultz, 2016).

Migraine is considered a universal cause of disability (Agosti, 2018; Altieri, Fratino, Maestrini, Puma, & Di Piero, 2020) and a severe public health problem (Wong, Alias, Bhoo-Pathy, Chung, Chong, Kalra *et al.*, 2020). It imposes a substantial burden worldwide (Rohmann, Rist, Buring, & Kurth, 2020). In Japan, a cross-sectional, observational, population-based web survey, in which 17,071 people with migraine participated, revealed that about 20.7% of the participants mentioned moderate-to-severe disability (Matsumori, Ueda, Komori, Zagar, Kim, Jaffe *et al.*, 2022). Migraine is a lifelong illness causing temporary disability (Bigal, Lipton, & Stewart, 2004; Al-Hashel, Ahmed, & Alroughani, 2017), along with a significant healthcare and financial impact on patients as well as on society (Al-Hashel *et al.*, 2017; Agosti, 2018; Bonafede, Sapra, Shah, Tepper, Cappell, & Desai, 2018; Gilligan, Foster, Sainski-Nguyen, Sedgley, Smith, & Morrow, 2018; D'Amico, Grazzi, Grignani, Leonardi, Sansone, Raggi *et al.*, 2020) in terms of direct and indirect costs (Raggi, Giovannetti, Quintas, D'Amico, Cieza, Sabariego *et al.*, 2012; Bonafede *et al.*, 2018; Gilligan *et al.*, 2018; Burch, Buse, & Lipton, 2019). Migraine causes pain (Ayele & Yifru, 2018) and challenges in daily functioning (Martelletti, Schwedt, Lanteri-Minet, Quintana, Carboni, Diener *et al.*, 2018). In addition, it also has a remarkable impact on migraine patients' psychological difficulties (Bloudek, Stokes, Buse, Wilcox, Lipton, Goadsby *et al.*, 2012). Migraine is also correlated with a wide range of psychiatric comorbidities (Ayele & Yifru, 2018), including depression, anxiety, post-traumatic stress (Minen, De Dhaem, Van Diest, Powers, Schwedt, Lipton *et al.*, 2016), mental health disorders, bipolar disorder, panic disorder, social phobia (Jette, Patten, Williams, Becker, & Wiebe, 2008), cardiovascular disease and sleep disorders (Burch *et al.*, 2019). Additionally, migraine affects family and social relationships (Allena, Steiner, Sances, Carugno, Balsamo, Nappi *et al.*, 2015). Migraine is annoying for the most productive segment of the population (Al-Hashel *et al.*, 2017). The consequences of migraine lie in the impairment of patients' ability to work and in reduced or impaired productivity in the workplace (Raggi, Covelli, Leonardi, Grazzi, Curone, & D'Amico, 2014; D'Amico, Grazzi, Curone, Di Fiore, Cecchini, Leonardi *et al.*, 2015; Burton *et al.*,

2016; Wong *et al.*, 2020). Another equally affected domain is the quality of life (Al-Hashel *et al.*, 2017; Ayele & Yifru, 2018; Burch *et al.*, 2019).

2. Aims and hypothesis

There is a strong need to examine from the existing literature the actual impact of Coronavirus disease on migraine patients in order to draw general conclusions. Migraine is known to consist of a disabling, underdiagnosed, and undertreated disorder, which is underestimated (Agosti, 2018), despite the growing number of migraine sufferers who have been affected by this global health pandemic (Silvestro *et al.*, 2020). In light of the above, the aim of the present study was to study more in depth and present the results of the research on the impact of the Covid-19 infection and the consequent quarantine on migraine patients, anticipating to highlight many aspects of people's life.

3. Methods

3.1. Study design and search progress

The authors chose a scoping review as the purpose was to broadly explore the emerging peer-reviewed literature of the last year (March 2020 - March 2021) regarding the impact of the Covid-19 pandemic and the subsequent lockdown and quarantine on migraine patients and to show the research gaps (Munn, Peters, Stern, Tufanaru, McArthur, & Aromataris, 2018; Tricco, Lillie, Zarin, O'Brien, Colquhoun, Levac *et al.*, 2018). The authors chose this period as a time frame since the epidemic of Covid-19 was a public healthcare threat and the effects of the Covid-19 pandemic, and subsequent lockdown, were enormous in different spheres on a global scale. The authors pursued the framework of Arksey and O'Malley (2005) in this scoping review to impose the research aims, explore for appropriate studies, select studies, and then analyze the results.

This scoping review was performed based on the Preferred Reporting Items for Systematic reviews and Meta-analyses extension for Scoping Reviews (PRISMA-ScR) guidelines (Tricco *et al.*, 2018). The authors systematically and extensively searched the literature using the biomedical and psychological databases (PubMed, Google Scholar, Embase, and CINAHL), limiting the search to articles published between March 2020 and March 2021 to locate relevant scientific evidence. According to Hartling and

co-workers (Hartling, Featherstone, Nuspl, Shave, Dryden, & Vandermeer, 2016, p. 9), “the vast majority of relevant studies appear within a limited number of databases” in systematic reviews. The authors performed the literature search in the selected databases using keywords based on terminology related to the effects of the Covid-19 pandemic and the subsequent lockdown and quarantine on migraine patients in general. The search was divided into three main concepts. The first concerned the understudy population, i.e., migraine patients, the second was about the Covid-19 pandemic, and the third was about the effects of the Covid-19 pandemic on the life of people suffering from migraine. In other words, the authors used the search terms “patients with migraine”, “impact/effects”, and “Coronavirus (Covid-19)/pandemic” and their synonyms and compiled them in an iterative process. The term “patients with migraine” included people with migraines with aura or without aura with a diagnosis according to the ICHD criteria. The term Covid-19 was used to explore the related results of this pandemic on the specific group. According to the person as a unit, the terms “impact/effects” were used to locate the medical, psychosocial, economic, and working-level outcomes, the patients’ family members, and the caregivers. Furthermore, the authors boosted the reference section through a manual search of the reference lists of selected articles for possible additional relevant studies.

3.2. Study selection

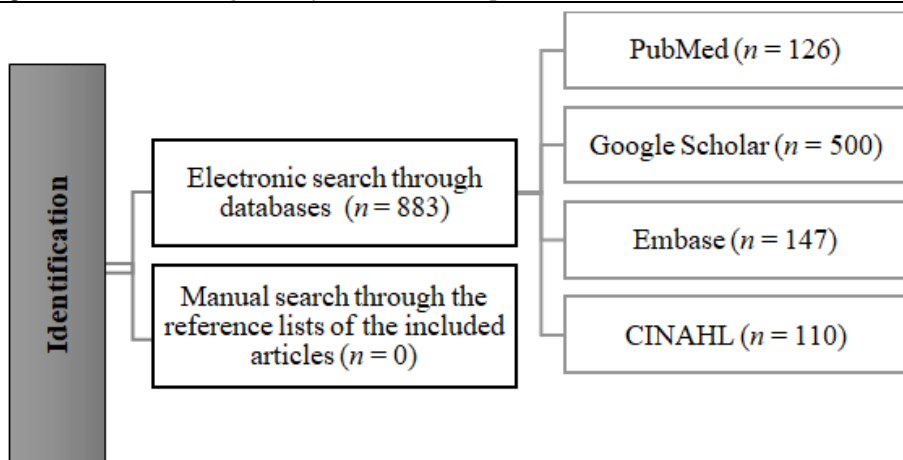
The authors divided the selection of the articles into three consecutive phases. The initial screening phase was based on the title and abstract for the inclusion and exclusion of the studies, following eligibility criteria. The authors developed specific inclusion and exclusion criteria for selecting the articles. Hence, studies were included in the review if they fulfilled the following inclusion criteria: (1) publication in a peer-reviewed journal between March 2020 – March 2021; (2) analysis of a study population of children, adolescents, and adults with migraine based on the ICHD criteria; (3) publication in English; (4) focus of the research on the impact of the new pandemic, and (5) focus of the studies on the deep impact of the pandemic in different aspects of the daily life of migraine patients. The exclusion criteria were instead the following: (1) publications that were qualitative or quantitative empirical research reviews, commentaries, editorials, books, and reviews as different study designs can lead to confusing results and publications not in a peer-reviewed journal due to the fact that the literature

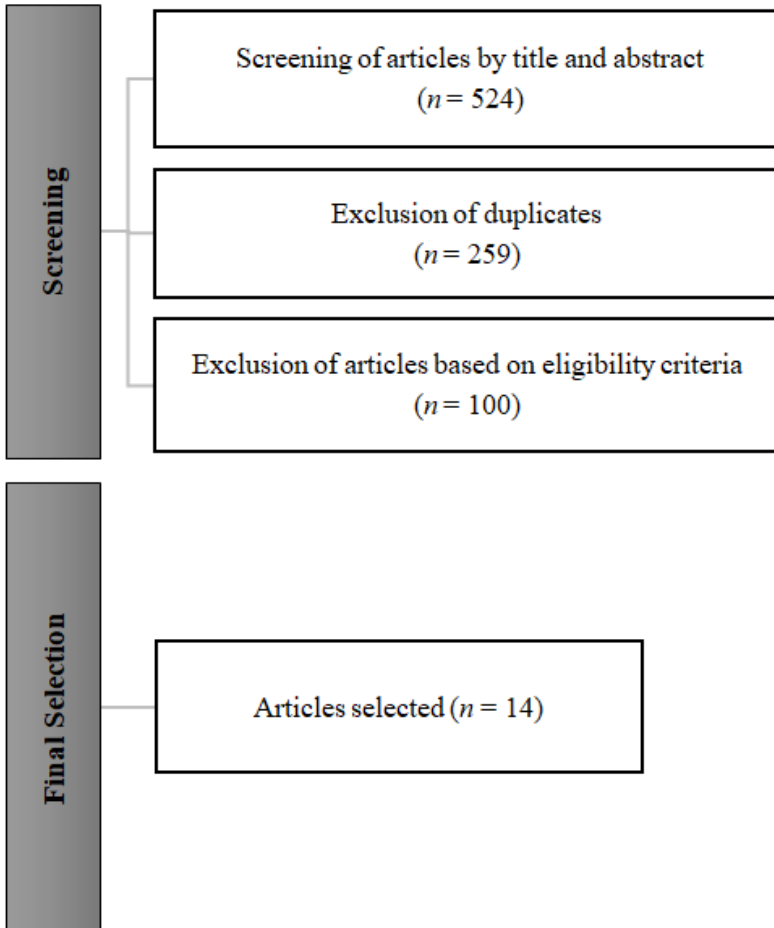
sources may not be scientifically accurate, and (2) no scope of our research aims with results that could help meet the research objectives. Studies with no clear objective and methodology were also excluded. In addition, studies with a very small sample size ($n < 50$) were included due to the limited number of studies in the timeframe of this review. No kind of cultural, geographical, race, or gender limits was considered in the current review.

The second phase consisted of rating the full text of the studies, while the third and last phase consisted of performing a methodological quality assessment of the full-text studies. The methodological quality of the studies included was evaluated for quality and risk of bias using the Effective Public Health Practice Project (EPHPP) quality assessment tool of quantitative studies (Armijo-Olivo, Stiles, Hagen, Biondo, & Cummings, 2012).

All these phases were implemented by the two authors, who independently screened all the relevant titles and abstracts based on the inclusion and exclusion criteria. The following two selection phases were also conducted by both authors, who worked separately and afterwards collected one of the other’s outcomes and compared them. The authors solved any discrepancies or remaining doubts by discussing them till they reached a consensus. The details of the research procedure described are shown step by step in Figure 1 below, which depicts a flow chart of the whole process.

Figure 1 – Flow diagram of the research process





3.3. Data extraction

The authors used a data extraction to chart and organize the following data from each of the 14 studies included in the final dataset: (1) name of the lead author and lead year of publication, (2) title of the publication, (3) country of the population, (4) sample size and characteristics, (5) mode of assessment, (5) objective of the study and (6) main findings of the study (refer to Tab. 1 for more details). The results of this research procedure are presented below.

Table 1 – Overview of the characteristics of the studies included in the analysis

Lead Author/ year	Title	Country	Sample size and characteristics	Mode of assessment	Objective	Main findings
Al-Hashel & Ibrahim, 2020	Impact of coronavirus disease 2019 (COVID-19) pandemic on patients with migraine: a web-based survey study	Kuwait	1018 patients with migraine. 859 females, 159 males	A 25-item online self-reported questionnaire	Investigate the widespread impact of the Covid-19 pandemic on migraine patients in Kuwait.	Migraine participants highlighted the generally negative impact of this pandemic, especially at the medical level, reporting disruption of sleep and eating habits, anxiety, and depression.
Altamura <i>et al.</i> , 2020	Locking down the CGRP pathway during the COVID-19 pandemic: the PandeMig study	Italy	147 patients with migraine. Gender not mentioned	A questionnaire – Monthly Migraine Days (MMDs), Monthly Painkiller Intake (MPI), HIT-6 disability	Examine if the Covid-19 and subsequent lockdown affected migraine frequency and disability in patients on therapy with monoclonal antibodies.	Outcomes indicated that patients receiving monoclonal antibodies were not negatively impacted by this pandemic but reported an improvement.
Altieri <i>et al.</i> , 2020	It is time to consider even chronic migraine as a real chronic disease	Italy	65 patients with chronic migraine. 48 females, 17 males	A 36-item self-report questionnaire	Investigate the possible impact of the Covid-19 pandemic on migraine patients.	Findings indicated general and disease-related concerns and future expectations regarding working activity and social demands.
Chaix <i>et al.</i> , 2020	Psychological distress during the COVID-19 pandemic in France: a national assessment of at-risk populations	France	455 patients with migraine. Gender not mentioned	Psychological Distress Inventory (PDI)	Explore the impact of Covid-19 on the level of posttraumatic distress on migraine patients.	Covid-19 harms psychological distress in migraine patients.
Consonni <i>et al.</i> , 2021	Life with chronic pain during COVID-19 lockdown: the case of patients with small fibre neuropathy and chronic migraine	Italy	42 patients with chronic migraine. 39 females, 3 males	A newly developed questionnaire – Other Psychometric Scales	Investigate the extent of possible physical and psychological health changes on migraine patients due to the Covid-19 pandemic.	The Covid-19 pandemic impacted both the physical and mental health of migraine patients.
Dallavalle <i>et al.</i> , 2020	Migraine symptoms improvement during the COVID-19 lockdown in a cohort of children and adolescents	Italy	142 infant and adolescent patients (52 patients with migraine with aura and 90 without aura). 72 females, 70 males	An online survey	Examine the effects of Covid-19 at the medical level among children and adolescents with migraine.	Findings indicated a reduction in severity and frequency of migraine. Lockdown caused a reduction of possible stress factors.
Delussi <i>et al.</i> , 2020a	Investigating the effects of COVID-19 quarantine in migraine: an observational cross-sectional study from the Italian National Headache Registry (RICE)	Italy	433 patients with migraine. 333 females, 100 males	A web-supported questionnaire	Explore the impact of Covid-19 during the lockdown at the medical level and investigate the significant changes in the daily life of people suffering from migraine.	Quarantine has a positive impact on migraine patients in terms of reduction in headache frequency and severity.

Lead Author/ year	Title	Country	Sample size and characteristics	Mode of assessment	Objective	Main findings
Dhussi <i>et al.</i> , 2020b	Investigating the effects of COVID-19 quarantine on migraine: Data from the Italian National Headache Registry (RiCe)	Italy	433 patients with migraine. 333 females, 100 males	A telephone interview – a web-supported questionnaire	Examine the effects of the Covid-19 pandemic at the medical level and the range of changes on migraine patients in different aspects of their daily life.	Participants reported a reduction in headache frequency and severity and days with acute medication.
Gonzalez-Martinez <i>et al.</i> , 2021	Evaluation of the impact of the COVID-19 lockdown in the clinical course of migraine	Spain	222 patients with migraine. 201 females, 21 males	A 108-item web-based survey	Examine the significant effects of Covid-19 on migraine patients in terms of clinical course and at a psychological level.	Findings identified the negative influence of Covid-19 on migraine patients, indicating a worsening of the clinical course as well as high levels of post-traumatic stress, anxiety, and depression.
Ma <i>et al.</i> , 2020	The status and high-risk factors of severe psychological distress in migraine patients during nCoV-2019 outbreak in Southwest China: a cross-sectional study	China	144 patients with migraine without aura. 112 females, 32 males	An online questionnaire about demographic and clinical characteristics, Kessler 6-item Psychological Distress Scale (K-6)	Evaluate the extent of psychological distress of migraine patients and the associated risk factors.	Migraine was associated with severe psychological distress during the pandemic. The most high-risk factors were the frequency of migraine attacks and the attention on media coverage of the pandemic.
Parodi <i>et al.</i> , 2020	Impact of quarantine due to COVID infection on migraine: a survey in Genova, Italy	Italy	49 patients with migraine (10 patients with migraine without aura and 39 with aura). 39 females, 10 males	A telephonic interview – Psychometric Scales	Investigate the impact of the pandemic outbreak and anxiety and depressive changes in migraine patients.	Findings indicated a better clinical condition for migraine patients and a moderate level of symptoms of depression.
Sharawat <i>et al.</i> , 2021	Caregiver satisfaction and effectiveness of teleconsultation in children and adolescents with migraine during the ongoing COVID-19 pandemic	India	51 pediatric migraine patients (24 patients with migraine without aura and 27 with aura, of which 4 with brain stem aura). 27 females, 24 males	Telephonic consultations	Evaluate whether teleconsultations are an effective tool for children with migraine.	A teleconsultation was shown to be a valuable tool for migraine patients during the pandemic outbreak.
Smith <i>et al.</i> , 2021	Early impact of the COVID-19 pandemic on outpatient migraine care in Hawaii: results of a quality improvement survey	USA	133 patients with migraine. 102 females, 31 males	A telephone survey using a structured questionnaire	Understand the impact of the pandemic on migraine patients.	Findings reported worsening of well-being, disruption of sleep, anxiety, depression and financial and work-related concerns.
Verhagen <i>et al.</i> , 2021	Effect of lockdown during COVID-19 on migraine: A longitudinal cohort study	The Netherlands	592 patients with migraine (141 patients with migraine with aura, 370 without aura and 81 with chronic migraine). 483 females, 109 males	Headache e-diaries	Evaluate whether changes were noticed in migraine-related issues during the lockdown.	Lockdown affected migraine patients in a positive way because of teleworking and scaling down from social demands. Telemedicine is a valuable tool, also.

4. Results

The present research yielded significant results addressing the real impact of the Covid-19 pandemic on patients with migraines of all ages. After initially having investigated the databases and the manual research, a result of potential studies covering a broad range of topics was reached: 126 from PubMed, 500 from Google Scholar, 147 from Embase, and 110 from CINAHL, namely 883 publications (see Fig. 1 for more details). No records were added after screening the reference lists of the studies included in the review.

Duplicates were excluded before the retrieval of references. More specifically, in the primary data filtering, 259 records were removed due to duplication.

After removing duplications, the authors reviewed the remaining articles (i.e. 624 articles) based on their title and abstract for further screening and excluded 524 studies. Thus, the authors extracted 100 articles by using the inclusion criteria. As a final step, the authors cut down the articles to 14 in the scoping review from the search in the selected electronic databases together with a manual reference search, published in 2020 and 2021, and their entire content was reviewed and analyzed in detail (see Fig. 1 for the PRISMA-ScR flow diagram).

4.1. Characteristics of the studies included

Table 1 presents the results of the current review as a synthesis of the records included in the final dataset. The present research resulted in 14 publications. It is noteworthy that most of them took place in Italy ($n = 7$), with a few records published in other European countries, such as France ($n = 1$), Spain ($n = 1$) and The Netherlands ($n = 1$). Three were conducted in Asia and specifically in China ($n = 1$), India ($n = 1$) and Kuwait ($n = 1$), while the last published was conducted in the USA ($n = 1$). The sample size (total $n = 3.926$) ranged between 42 in Italy and 1.018 participants in Kuwait. Studies included only patients with migraines with or without aura based on the types of migraines assessed among the participants. All the articles were based on quantitative methods, specifically online questionnaires, and various psychometric scales, except for one which adopted telephonic consultations to gather the data on a range of issues impacting the migraine patients due to Covid-19. Two publications used a combination of samples from which only the population with a migraine

diagnosis was examined in this review. The study population consisted of children, adolescents, and employed or unemployed adults with migraine. One study concerned pediatric neurology specialists and the caregivers of children with migraine concerning any clinical problem identified. Finally, in one study, the parents of children had to respond to the survey's questions.

4.2. Outcomes of the studies included

As mentioned below, the selected studies showed that the Covid-19 pandemic affected the life of migraine patients in several ways. According to the first analysis of the articles selected, three main themes emerged, leading to the classification of the outcomes in the following categories: (1) medical aspects, (2) psychosocial aspects, and (3) working and economic aspects. The authors presented the results of this scoping review based on these three categories.

4.2.1. Medical aspects

The lockdown was shown to bring to contrasting effects on migraine patients. In some cases, in fact, lockdown negatively affected the clinical course of migraine in a significant percentage of patients due to considerable alterations in their everyday life in terms of worsened physical and mental health (Al-Hashel & Ibrahim, 2020; Consonni, Telesca, Grazi, Cazzato, & Lauria, 2021; Gonzalez-Martinez, Planchuelo-Gómez, Guerrero, García-Azorín, Santos-Lasaosa, Navarro-Pérez *et al.*, 2021). However, in other cases, scientific data supported that changes in habits of everyday life due to lockdown could bring to a benefit in migraine patients, as they had the opportunity to work from home and organize their time as they wished, experiencing less stress (Verhagen, van Casteren, Lentsch, & Terwindt, 2021). Considering the survey data, it was reported that migraine had a significant negative impact, mainly on females, as migraine symptoms worsened (Al-Hashel & Ibrahim, 2020). Several studies mentioned an increase in migraine frequency and severity during the period of the Covid-19 pandemic (Al-Hashel & Ibrahim, 2020; Gonzalez-Martinez *et al.*, 2021; Smith, Nakamoto, Crocker, Tiffany Morden, Liu, Ma *et al.*, 2021). In contrast, in other surveys, migraine patients presented a reduction in the number of migraine days (Dallavalle, Pezzotti, Provenzi, Toni, Carpani, & Borgatti, 2020; Delussi, Gentile, Coppola, Prudenzano, Rainero, Sances *et al.*, 2020a; Delussi, Gentile, Coppola, Prudenzano, Rainero, Sances *et al.*,

2020b; Parodi, Poeta, Assini, Schirinzi, & Del Sette, 2020; Verhagen *et al.*, 2021) and in the pain expressed (Parodi *et al.*, 2020). Despite these findings, patients with episodic migraines tended to transform to chronic migraines during Covid-19 (Al-Hashel & Ibrahim, 2020; Delussi *et al.*, 2020a). Moreover, many migraine patients declared worsening of their pain during their migraine episode (Gonzalez-Martinez *et al.*, 2021), changes in the treatment procedure (Consonni *et al.*, 2021), in terms of lack of communication with the treating neurologists (Al-Hashel & Ibrahim, 2020; Consonni *et al.*, 2021), and missing or rescheduling visits or therapeutic sessions (Consonni *et al.*, 2021). It was crucial for migraine patients to have their treatment in time during the Covid-19 pandemic (Ma, Fang, Li, Bao, Zhang, Chen *et al.*, 2020). Patients in various studies reported overuse of analgesics and acute migraine treatments (Al-Hashel & Ibrahim, 2020) or more abortive therapy (Smith *et al.*, 2021) or non-compliance to treatment (Al-Hashel & Ibrahim, 2020), and cancellation or postponement of OnabotulinumtoxinA treatment (Al-Hashel & Ibrahim, 2020). However, it is worth mentioning that women continued their pharmacological treatment normally, even during decreasing migraine days (Altamura *et al.*, 2020). Disturbance of eating habits (Al-Hashel & Ibrahim, 2020) and of sleep (Al-Hashel & Ibrahim, 2020; Smith *et al.*, 2021) were also reported, although this finding was not mentioned in the study of Delussi and colleagues (2020a).

4.2.2. Psychosocial aspects

In terms of the possible psychosocial impact of the Covid-19 crisis, a few studies pointed out that the Covid-19 pandemic was a psychological burden for migraine patients (Chaix, Delamon, Guillemassé, Brouard, & Bibault, 2020; Ma *et al.*, 2020). In comparison to the pre-pandemic period, the authors mentioned not only the prevalence of anxiety and depressive symptoms (Parodi *et al.*, 2020) but also the worsening of the same (Al-Hashel & Ibrahim, 2020; Consonni *et al.*, 2021; Smith *et al.*, 2021) due to quarantine (Parodi *et al.*, 2020). Furthermore, the pandemic affected migraine patients emotionally (Altieri *et al.*, 2020). Participants with migraines felt more agitated than before the outbreak of the Covid-19 pandemic (Consonni *et al.*, 2021), they had negative emotions (Altamura *et al.*, 2020), and had mood deterioration (Delussi *et al.*, 2020b). These feelings were due to behavioral changes (Consonni *et al.*, 2021), stress (Al-Hashel & Ibrahim, 2020; Consonni *et al.*, 2021; Dallavalle *et al.*, 2020;

Gonzalez-Martinez *et al.*, 2021), and fear of infection as well as headache worsening (Al-Hashel & Ibrahim, 2020). Finally, an increase in general well-being during lockdown was noticed (Verhagen *et al.*, 2021), which, however, was in contrast to the negative impact on the quality of life of the individuals (Consonni *et al.*, 2021; Smith *et al.*, 2021).

4.2.3. Working and economic aspects

Regarding the effect of the Covid-19 pandemic on the working sector, it is essential to understand the rising of financial and work-related concerns (Al-Hashel & Ibrahim, 2020). As shown in the study by Smith and collaborators (2021), migraine patients were impacted economically caused by losing their job and thus by the lower family income (Ma *et al.*, 2020). Less workload (Al-Hashel & Ibrahim, 2020; Altamura *et al.*, 2020; Verhagen *et al.*, 2021), a reduced work-related pressure (Al-Hashel & Ibrahim, 2020), the cancellation of activities (Al-Hashel & Ibrahim, 2020), changes in work (Consonni *et al.*, 2021), and fewer stressor triggers (Al-Hashel & Ibrahim, 2020) could be positive in decreasing migraine attacks (Parodi *et al.*, 2020). In contrast, changes in the employment status and high work pressure could negatively affect migraine patients because of the worsening of the clinical condition of migraine in terms of severity and frequency of migraine attacks (Gonzalez-Martinez *et al.*, 2021). According to Al-Hashel & Ibrahim's (2020) study, working during the outbreak of this pandemic caused worsening symptoms during migraine episodes, especially in women. This finding could be attributed to increased work-related concerns and high work pressure and stress.

5. Discussion

To the best of our knowledge, this is the first review that explored the relationship between the Covid-19 pandemic and migraine patients. Research regarding the effects of the Covid-19 pandemic on migraine patients is a recent discipline since only a limited number of relevant published studies are known to date. Therefore, the exploration conducted thus far presents a framework on what is currently known on the subject and points to the true impact of the global pandemic, Covid-19, on migraine patients in a critical way. The authors identified 14 articles after reviewing the available literature published over the past year.

The Covid-19 pandemic can be considered a public health emergency of international concern, transforming multiple facets of people's lives and society (Horesh & Brown, 2020). Covid-19 posed new medical, psychosocial, and working challenges to specific groups, such as migraine patients, who may be more vulnerable. Additionally, mass quarantine raised various stressors, such as fear of infection, frustration, financial concerns, job insecurity, and stigma (Brooks, Webster, Smith, Woodland, Wessely, Greenberg *et al.*, 2020), and generally significant concerns about the outbreak, like a contagion, lockdown, social isolation, and information overdose (Al-Hashel & Ibrahim, 2020). It is worth mentioning that stigma was a significant post-quarantine stressor, provoking fear, suspicion, and social criticism (Singh, Bhutani, & Fatima, 2020).

Based on the present findings, patients with migraines were affected drastically by this large outbreak in a short period of approximately one year plus (Altamura *et al.*, 2020; Del Rio & Malani, 2020). This ongoing pandemic affected migraine patients in a multi-faceted way, proving that the Covid-19 pandemic had a widespread impact on migraine patients, negatively but even positively. However, as usually happens with high emergencies, the deleterious effects outweighed the positive ones due to the aggravating character of the new rapidly evolving pandemic. Considering the survey data, a relatively large portion of the respondents reported a worsening of migraine frequency and severity, changes in clinical management, difficulties in communicating with treating physicians or avoiding seeking medical help for new health problems, as well as disturbance of their eating and sleeping habits. In Yuksel, Kenar, Gursoy and Bektas's (2022) recent study, patients with migraine mentioned that the intensive wearing of a face mask and using scalp contact masks and double masks was among the causes of aggravation of migraine. According to migraine and headache participants, a national web-based survey, advertised by the Portuguese Headache Society and National Headache and Migraine patient's organization, found that personal protective equipment appeared to be responsible for headache worsening (Oliveira, Plácido, Pereira, Machado, Parreira, & Gil-Gouveia, 2022). Additionally, the use of disinfectants worsened migraine episodes for patients who felt that the smell of chemicals was a trigger point of migraine (Yuksel *et al.*, 2022). Several studies documented the prevalence of depression, anxiety, and stress (Raihan, 2020; Wang *et al.*, 2020), which was considered one of the most frequent triggers of migraine attacks (Sauro & Becker, 2009; Lui, Young, Ebbert, Rosedahl, & Philpot, 2020). Furthermore, many participants experienced extreme

changes in everyday life and out-of-home habits, highlighting work-related concerns and, consequently, financial cost and impoverishment of quality of life. The Covid-19 pandemic affected people's financial well-being, severely impacting the labor market worldwide (Danquah, Schotte, & Sen, 2020). Studies also reported that the Covid-19 pandemic brought to alterations in the distribution of people's daily activity, social obligations, access to education, workplace changes, etc. (Saleh, 2020). The positive impact of Covid-19 on migraine patients was linked instead to a possible increase in general well-being and a decrease in migraine attacks due to reduced workload, work-related pressure, and stressor triggers (Al-Hashel & Ibrahim, 2020; Altamura *et al.*, 2020; Parodi *et al.*, 2020; Verhagen *et al.*, 2021).

The females and young people with migraine had the most substantial negative impact. This result could be attributed to the demanding and, at the same time, stressful physical, mental, social, and work-related functioning of these migraine patients in their everyday personal life. Family obligations, leisure activities, and work activities could explain why this section of the population was the one most strongly affected due to high pressure and stress levels. In addition to this, this pandemic can be considered a health crisis that provokes stress and directly impacts physical and mental health (Orsini *et al.*, 2020; Raihan, 2020), especially among young adults than older people (Saleh, 2020).

The widespread impact of Covid-19 on migraine patients followed a multi-faced impact of other emerging diseases. Previous studies reported that emerging infectious diseases, such as the Ebola virus disease (EVD) and the severe acute respiratory syndrome (SARS), had an impact on patients' health and well-being (Delussi *et al.*, 2020a) and namely patients with chronic neurological disorders (Orsini *et al.*, 2020). Prevalence of anxiety, depression, and post-traumatic stress symptoms was associated with the Ebola epidemic experience (Jalloh, Li, Bunnell, Ethier, O'Leary, Hageman *et al.*, 2018). Prevalence of psychiatric morbidity was also documented in a population-based survey in Taiwan after SARS (Peng, Lee, Tsai, Yang, Morisky, Tsai *et al.*, 2010). Ebola survivors experienced fear-related behaviors and stigmatization from the community (O'Leary, Jalloh, & Neria, 2018).

The treatment of migraine patients during this pandemic remains an issue of great concern. In this regard, telehealth and telemedicine are considered effective solutions for headache specialists to treat patients with chronic pain (Puntillo, Giglio, Brienza, Viswanath, Urits, Kaye *et al.*, 2020; Szperka,

Ailani, Barmherzig, Klein, Minen, Halker Singh *et al.*, 2020). It is worth mentioning that during Covid-19, migraine patients had at their disposal telemedicine, headache e-diaries, and teleconsultation, which were all valuable solutions for continuing therapies and communication with their physicians (Gonzalez-Martinez *et al.*, 2021; Sharawat & Panda, 2021; Smith *et al.*, 2021; Verhagen *et al.*, 2021). The countries of the European Union (EU) and the European Economic Area (EEA) nowadays have incorporated on their agendas not only the prevention but also the management of infectious diseases in the context of global health (Cassini, Colzani, Pini, Mangen, Plass, McDonald *et al.*, 2018).

Regarding this review, some limitations might affect the conclusions and, consequently, must be taken into consideration. Initially, the search process was limited to four online databases, and papers from non-English speaking countries were excluded, limiting the scientific data. Moreover, most of the participants were females, whereas the age range was wide, limiting the generalizability of these findings. The authors focused only on migraine patients, excluding patients with other primary headache disorders, such as tension-type headaches, which are considered equally vulnerable to this pandemic. Furthermore, this review systematically examined the relationship between the Covid-19 pandemic and migraine patients across different facets of their life, such as physical health, mental health, and work.

The present review has underlined the existing literature gap concerning the difficulties this ongoing pandemic has created for migraine patients of all ages since the survey for the Covid-19 pandemic is still open. It can reinforce the public awareness of migraine, which is a highly prevalent disorder in the working population's most productive section. This scoping review can promote a better understanding of the needs of migraine patients, mainly at a medical level, and consequently, how the healthcare system should be improved by locating the specific difficulties this vulnerable group population experienced in terms of access to services during this rapidly evolving situation. The Covid-19 pandemic could be an opportunity for the decision-makers of governments, the public health policies, and the professionals of the healthcare system, particularly in developed countries, to minimize the negative impact of an emergency condition in the future by designing and adopting the appropriate strategies and interventions towards health improvement. This review could be the starting point for further research in this field in the future to acquire a deeper understanding of this situation and enable conclusive findings. Future studies are essential to

determine the impact and long-term consequences of the Covid-19 pandemic on the population with migraine, even after the subsequent lockdown and the end/evolution of this pandemic. To this end, the correlation between the onset of headache and the use of a mask or the type of mask used during the pandemic should be investigated in more detail. Future studies related to the frequency of migraine attacks in different periods of the year should estimate the possible peak period during the Covid-19 pandemic. In general, the successful management of infectious diseases can change the whole of society at the social, financial, and political level (Fauci, 2001).

References

Agosti, R. (2018). Migraine burden of disease: From the patient's experience to a socio economic view. *Headache: The Journal of Head and Face Pain*, 58, 17-32. <https://doi.org/10.1111/head.13301>.

Al-Hashel, J. Y., Ahmed, S. F., & Alroughani, R. (2017). Burden of migraine in a Kuwaiti population: a door-to-door survey. *The Journal of Headache and Pain*, 18 (1), 1-6. <https://doi.org/10.1186/s10194-017-0814-2>.

Al-Hashel, J. Y., & Ibrahim, I. I. (2020). Impact of coronavirus disease 2019 (COVID-19) pandemic on patients with migraine: a web-based survey study. *The Journal of Headache and Pain*, 21 (1), 1-9. <https://doi.org/10.1186/s10194-020-01183-6>.

Allena, M., Steiner, T. J., Sances, G., Carugno, B., Balsamo, F., Nappi, G., André, C., & Tassorelli, C. (2015). Impact of headache disorders in Italy and the public-health and policy implications: a population-based study within the Eurolight Project. *The Journal of Headache and Pain*, 16 (1), 1-9. <https://doi.org/10.1186/s10194-015-0584-7>.

Altamura, C., Cevoli, S., Aurilia, C., Egeo, G., Fofi, L., Torelli, P., Brunelli, N., Pierangeli, G., Favoni, V., Fallacara, A., Pensato, U., Barbanti, P., & Vernieri, F. (2020). Locking down the CGRP pathway during the COVID-19 pandemic lockdown: the PandeMig study. *Neurological Sciences*, 41 (12), 3385-3389. <https://doi.org/10.1007/s10072-020-04767-x>.

Altieri, M., Fratino, M., Maestrini, I., Puma, M., & Di Piero, V. (2020). It is time to consider even chronic migraine as a real chronic disease. *Cephalalgia*, *41* (5), 631-633. <https://doi.org/10.1177/0333102420953108>.

Ammar, A., Trabelsi, K., Brach, M., Chtourou, H., Boukhris, O., Masmoudi, L., ... & Hoekelmann, A. (2020). Effects of home confinement on mental health and lifestyle behaviours during the COVID-19 outbreak: Insight from the “ECLB-COVID19” multi countries survey. *Biology of Sport*, *38* (1), 9-21. <https://doi.org/10.5114/biol sport.2020.96857>.

Anastasiou, E., & Duquenne, M. N. (2021). What about the “Social Aspect of COVID”? Exploring the Determinants of Social Isolation on the Greek Population during the COVID-19 Lockdown. *Social Sciences*, *10* (1): 27. <https://doi.org/10.3390/socsci10010027>.

Arksey, H., & O'Malley, L. (2005). Scoping studies: towards a methodological framework. *International Journal of Social Research Methodology*, *8* (1), 19-32. <https://doi.org/10.1080/1364557032000119616>.

Armijo-Olivo, S., Stiles, C. R., Hagen, N. A., Biondo, P. D., & Cummings, G. G. (2012). Assessment of study quality for systematic reviews: a comparison of the Cochrane Collaboration Risk of Bias Tool and the Effective Public Health Practice Project Quality Assessment Tool: methodological research. *Journal of Evaluation in Clinical Practice*, *18* (1), 12-18. <https://doi.org/10.1111/j.1365-2753.2010.01516.x>.

Ayele, B. A., & Yifru, Y. M. (2018). Migraine-related disability and co-morbid depression among migraineurs in Ethiopia: a cross-sectional study. *BMC Neurology Journal*, *18* (1), 1-7. <https://doi.org/10.1186/s12883-018-1095-3>.

Bigal, M. E., Lipton, R. B., & Stewart, W. F. (2004). The epidemiology and impact of migraine. *Current Neurology and Neuroscience Reports*, *4* (2), 98-104.

Bloudek, L. M., Stokes, M., Buse, D. C., Wilcox, T. K., Lipton, R. B., Goadsby, P. J., Varon, S. F., Blumenfeld, A. M., Katsarava, Z., Pascual, J., Lanteri-Minet, M., Cortelli, P., & Martelletti, P. (2012). Cost of healthcare for patients with migraine in five European countries: results from the International Burden of Migraine Study (IBMS). *The Journal of Headache and Pain, 13* (5), 361-378. <https://doi.org/10.1007/s10194-012-0460-7>.

Bonafede, M., Sapra, S., Shah, N., Tepper, S., Cappell, K., & Desai, P. (2018). Direct and indirect healthcare resource utilization and costs among migraine patients in the United States. *Headache: The Journal of Head and Face Pain, 58* (5), 700-714. <https://doi.org/10.1111/head.13275>.

Boyratz, G., & Legros, D. N. (2020). Coronavirus disease (COVID-19) and traumatic stress: probable risk factors and correlates of posttraumatic stress disorder. *Journal of Loss and Trauma, 25* (6-7), 503-522. <https://doi.org/10.1080/15325024.2020.1763556>.

Brooks, S. K., Webster, R. K., Smith, L. E., Woodland, L., Wessely, S., Greenberg, N., & Rubin, G. J. (2020). The psychological impact of quarantine and how to reduce it: rapid review of the evidence. *The Lancet, 395* (10227), 912-920. [https://doi.org/10.1016/S0140-6736\(20\)30460-8](https://doi.org/10.1016/S0140-6736(20)30460-8).

Burch, R. C., Buse, D. C., & Lipton, R. B. (2019). Migraine: epidemiology, burden, and comorbidity. *Neurologic Clinics, 37* (4), 631-649. <https://doi.org/10.1016/j.ncl.2019.06.001>.

Burch, R. C., Loder, S., Loder, E., & Smitherman, T. A. (2015). The prevalence and burden of migraine and severe headache in the United States: updated statistics from government health surveillance studies. *Headache: The Journal of Head and Face Pain, 55* (1), 21-34. <https://doi.org/10.1111/head.12482>.

Burch, R. C., Rizzoli, P., & Loder, E. (2018). The prevalence and impact of migraine and severe headache in the United States: figures and trends from government health studies. *Headache: The Journal of Head and Face Pain, 58* (4), 496-505. <https://doi.org/10.1111/head.13281>.

Burton, W. N., Chen, C. Y., Li, X., McCluskey, M., Erickson, D., & Schultz, A. B. (2016). Evaluation of a workplace-based migraine education program. *Journal of Occupational and Environmental Medicine*, 58 (8), 790-795. <https://doi.org/10.1097/JOM.0000000000000781>.

Cao, W., Fang, Z., Hou, G., Han, M., Xu, X., Dong, J., & Zheng, J. (2020). The psychological impact of the COVID-19 epidemic on college students in China. *Psychiatry Research*, 287: 112934. <https://doi.org/10.1016/j.psychres.2020.112934>.

Cassini, A., Colzani, E., Pini, A., Mangen, M. J. J., Plass, D., McDonald, S. A., Maringhini, G., van Lier, A., Haagsma, J. A., Havelaar, A. H., Kramarz, P., & Kretzschmar, M. E. (2018). Impact of infectious diseases on population health using incidence-based disability-adjusted life years (DALYs): results from the Burden of Communicable Diseases in Europe study, European Union and European Economic Area countries, 2009 to 2013. *Eurosurveillance*, 23 (16):pii=17-00454. <https://doi.org/10.2807/1560-7917.ES.2018.23.16.17-00454>.

Chaix, B., Delamon, G., Guillemassé, A., Brouard, B., & Bibault, J. E. (2020). Psychological distress during the COVID-19 pandemic in France: a national assessment of at-risk populations. *General Psychiatry*, 33 (6): e100349. <https://doi.org/10.1136/gpsych-2020-100349>.

Chowdhury, D., & Datta, D. (2020). Managing migraine in the times of COVID-19 pandemic. *Annals of Indian Academy of Neurology*, 23 (Suppl. 1), S33-S39. https://doi.org/10.4103/aian.AIAN_296_20.

Consonni, M., Telesca, A., Grazi, L., Cazzato, D., & Lauria, G. (2021). Life with chronic pain during COVID-19 lockdown: the case of patients with small fibre neuropathy and chronic migraine. *Neurological Sciences*, 42 (2), 389-397. <https://doi.org/10.1007/s10072-020-04890-9>.

Czeisler, M. É., Lane, R. I., Petrosky, E., Wiley, J. F., Christensen, A., Njai, R., Weaver, M., Robbins, R., Facer-Childs, E., Barger, L., Czeisler, C., Howard, M., & Rajaratnam, S. M. (2020). Mental health, substance use, and suicidal ideation during the COVID-19 pandemic – United States, June 24-30, 2020. *Morbidity and Mortality Weekly Report*, 69 (32), 1049-1057.

D'Amico, D., Grazzi, L., Curone, M., Di Fiore, P., Cecchini, A. P., Leonardi, M., Scaratti, C., & Raggi, A. (2015). Difficulties in work activities and the pervasive effect over disability in patients with episodic and chronic migraine. *Neurological Sciences*, *36* (1), 9-11. <https://doi.org/10.1007/s10072-015-2130-4>.

D'Amico, D., Grazzi, L., Grignani, E., Leonardi, M., Sansone, E., Raggi, A., HEADWORK Study Group. (2020). HEADWORK Questionnaire: Why Do We Need a New Tool to Assess Work-Related Disability in Patients With Migraine? *Headache: The Journal of Head and Face Pain*, *60* (2), 497-504. <https://doi.org/10.1111/head.13735>.

Dallavalle, G., Pezzotti, E., Provenzi, L., Toni, F., Carpani, A., & Borgatti, R. (2020). Migraine symptoms improvement during the COVID-19 lockdown in a cohort of children and adolescents. *Frontiers in Neurology*, *11*: 579047. <https://doi.org/10.3389/fneur.2020.579047>.

Danquah, M., Schotte, S., & Sen, K. (2020). COVID-19 and Employment: Insights from the Sub-Saharan African Experience. *The Indian Journal of Labour Economics*, *63* (1), 23-30. <https://doi.org/10.1007/s41027-020-00251-4>.

Del Rio, C., & Malani, P. N. (2020). COVID-19 – New insights on a rapidly changing epidemic. *JAMA*, *323* (14), 1339-1340. <https://doi.org/10.1001/jama.2020.3072>.

Delussi, M., Gentile, E., Coppola, G., Prudenzano, A. M. P., Rainero, I., Sances, G., Abagnale, C., Caponnetto, V., De Cesaris, F., Frattale, I., Guaschino, E., Marcinnò, A., Ornello, R., Pistoia, F., Putortì, A., Roca, M. E., Roveta, F., Lupi, C., Trojano, M., Pierelli, F., Geppetti, P., Sacco, S., & de Tommaso, M. (2020a). Investigating the effects of COVID-19 quarantine in migraine: an observational cross-sectional study from the Italian National Headache Registry (RiCe). *Frontiers in Neurology*, *11*: 1383. <https://doi.org/10.3389/fneur.2020.597881>.

Delussi, M., Gentile, E., Coppola, G., Prudenzeno, A. M. P., Rainero, I., Sances, G., Abagnale, C., Caponnetto, V., De Cesaris, F., Lupi, C., Frattale, I., Guaschino, E., Marcinnò, A., Ornello, R., Pistoia, F., Putortì, A., Roca, M. E., Roveta, F., Trojano, M., Pierelli, F., Geppetti, P., Sacco, S., & de Tommaso, M. (2020b). Investigating the Effects of COVID-19 Quarantine on Migraine: data from the Italian National Headache Registry (RICE). *Frontiers in Neurology*, *11*: 597881. <https://doi.org/10.21203/rs.3.rs-39228/v1>.

Fauci, A. S. (2001). Infectious diseases: considerations for the 21st century. *Clinical Infectious Diseases*, *32* (5), 675-685. <https://doi.org/10.1086/319235>.

Galea, S., Merchant, R. M., & Lurie, N. (2020). The mental health consequences of COVID-19 and physical distancing: the need for prevention and early intervention. *JAMA Internal Medicine*, *180* (6), 817-818. <https://doi.org/10.1001/jamainternmed.2020.1562>.

Gica, S., Kavakli, M., Durduran, Y., & Ak, M. (2020). The Effect of COVID-19 pandemic on psychosomatic complaints and investigation of the mediating role of intolerance to uncertainty, biological rhythm changes and perceived COVID-19 threat in this relationship: A web-based community survey. *Psychiatry and Clinical Psychopharmacology*, *30* (2), 89-96. <https://doi.org/10.5455PCP20200514033022>.

Gilligan, A. M., Foster, S. A., Sainski-Nguyen, A., Sedgley, R., Smith, D., & Morrow, P. (2018). Direct and indirect costs among United States commercially insured employees with migraine. *Journal of Occupational and Environmental Medicine*, *60* (12), 1120-1127. <https://doi.org/10.1097/JOM.0000000000001450>.

Global Burden of Disease Collaborative Network (2021). *Global Burden of Disease Study 2019 – GBD 2019. Reference Life Table*. Seattle, United States of America: Institute for Health Metrics and Evaluation (IHME). doi: 10.6069/1D4Y-YQ37.

Gonzalez-Martinez, A., Planchuelo-Gómez, Á., Guerrero, Á. L., García-Azorín, D., Santos-Lasaosa, S., Navarro-Pérez, M. P., Odriozola-Gonzalez, P., Iruria, M. J., Quintas, S., de Luis-García, R., & Gago-Veiga, A. B. (2021). Evaluation of the Impact of the COVID-19 Lockdown in the Clinical Course of Migraine. *Pain Medicine*, 22 (9), 2079-2091. <https://doi.org/10.1093/pm/pnaa449>.

Hartling, L., Featherstone, R., Nuspl, M., Shave, K., Dryden, D. M., & Vandermeer, B. (2016). The contribution of databases to the results of systematic reviews: a cross-sectional study. *BMC Medical Research Methodology*, 16 (1), 1-13. <https://doi.org/10.1186/s12874-016-0232-1>.

Headache Classification Committee of The International Headache Society (IHS) (2018). The International Classification of Headache Disorders, 3rd edition (beta version). *Cephalalgia*, 38 (1), 1-211. <https://doi.org/10.1177/0333102417738202>.

Hoffmann, J., Lo, H., Neeb, L., Martus, P., & Reuter, U. (2011). Weather sensitivity in migraineurs. *Journal of Neurology*, 258 (4), 596-602. <https://doi.org/10.1007/s00415-010-5798-7>.

Horesh, D., & Brown, A. D. (2020). Traumatic stress in the age of COVID-19: a call to close critical gaps and adapt to new realities. *Psychological Trauma: Theory, Research, Practice, and Policy*, 12 (4), 331-335. <https://doi.org/10.1037/tra0000592>.

Huang, C., Wang, Y., Li, X., Ren, L., Zhao, J., Hu, Y., Zhang, L., Fan, G., Xu, J., Gu, X., Cheng, Z., Yu, T., Xia, J., Wei, Y., Wu, W., Xie, X., Yin, W., Li, H., Liu, M., Xiao, Y., Gao, H., Guo, L., Xie, J., Wang, G., Jiang, R., Gao, Z., Jin, Q., Wang, J., & Cao, B. (2020). Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *The Lancet*, 395 (10223), 497-506. [https://doi.org/10.1016/S0140-6736\(20\)30183-5](https://doi.org/10.1016/S0140-6736(20)30183-5).

Hyland, P., Shevlin, M., McBride, O., Murphy, J., Karatzias, T., Bentall, R. P., Martinez, A., & Vallières, F. (2020). Anxiety and depression in the Republic of Ireland during the COVID-19 pandemic. *Acta Psychiatrica Scandinavica*, 142 (3), 249-256. <https://doi.org/10.1111/acps.13219>.

- Jalloh, M. F., Li, W., Bunnell, R. E., Ethier, K. A., O’Leary, A., Hageman, K. M., Sengeh, P., Jalloh, M. B., Morgan, O., Hersey, S., Marston, B. J., Dafaie, F., & Redd, J. T. (2018). Impact of Ebola experiences and risk perceptions on mental health in Sierra Leone, July 2015. *BMJ Global Health*, 3: e000471. doi:10.1136/bmjgh-2017-000471.
- Jette, N., Patten, S., Williams, J., Becker, W., & Wiebe, S. (2008). Comorbidity of migraine and psychiatric disorders – A national population-based study. *Headache: The Journal of Head and Face Pain*, 48 (4), 501-516. <https://doi.org/10.1111/j.1526-4610.2007.00993.x>.
- Khanna, R. C., Honavar, S. G., Metla, A. L., Bhattacharya, A., & Maulik, P. K. (2020). Psychological impact of COVID-19 on ophthalmologists-in-training and practising ophthalmologists in India. *Indian Journal of Ophthalmology*, 68 (6), 994-998. https://doi.org/10.4103/ij.o.IJO_1458_20.
- Lima, C. K. T., de Medeiros Carvalho, P. M., Lima, I. D. A. A. S., de Oliveira Nunes, J. V. A., Saraiva, J. S., de Souza, R. I., da Silva, C. G. L., & Neto, M. L. R. (2020). The emotional impact of Coronavirus 2019-nCoV (new Coronavirus disease). *Psychiatry Research*, 287: 112915. <https://doi.org/10.1016/j.psychres.2020.112915>.
- López-Bravo, A., García-Azorín, D., Belvís, R., González-Oria, C., Latorre, G., Santos-Lasaosa, S., & Guerrero-Peral, Á. L. (2020). Impact of the COVID-19 pandemic on headache management in Spain: an analysis of the current situation and future perspectives. *Neurología (English Edition)*, 35 (6), 372-380. <https://doi.org/10.1016/j.nrleng.2020.05.012>.
- Louvardi, M., Pelekasis, P., Chrousos, G. P., & Darviri, C. (2020). Mental health in chronic disease patients during the COVID-19 quarantine in Greece. *Palliative & Supportive Care*, 18 (4), 394-399. <https://doi.org/10.1017/S1478951520000528>.
- Lui, J. Z., Young, N. P., Ebbert, J. O., Rosedahl, J. K., & Philpot, L. M. (2020). Loneliness and migraine self-management: a cross-sectional assessment. *Journal of Primary Care & Community Health*, 11, 1-9. <https://doi.org/10.1177/2150132720924874>.

Ma, M., Fang, J., Li, C., Bao, J., Zhang, Y., Chen, N., Guo, J., & He, L. (2020). The status and high risk factors of severe psychological distress in migraine patients during nCOV-2019 outbreak in Southwest China: a cross-sectional study. *The Journal of Headache and Pain*, 21 (100), 1-7. <https://doi.org/10.1186/s10194-020-01168-5>.

Martelletti, P., Schwedt, T. J., Lanteri-Minet, M., Quintana, R., Carboni, V., Diener, H. C., de la Torre, E. R., Craven, A., Rasmussen, A. V., Evans, S., Laflamme, A. K., Fink, R., Walsh, D., Dumas, P., & Vo, P. (2018). My Migraine Voice survey: a global study of disease burden among individuals with migraine for whom preventive treatments have failed. *The Journal of Headache and Pain*, 19 (1), 1-10. <https://doi.org/10.1186/s10194-018-0946-z>.

Matsumori, Y., Ueda, K., Komori, M., Zagar, A. J., Kim, Y., Jaffe, D. H., Takeshima, T., & Hirata, K. (2022). Burden of Migraine in Japan: Results of the Observational Survey of the Epidemiology, treatment, and Care Of Migraine (OVERCOME [Japan]) Study. *Neurology and Therapy*, 11 (1), 205-222. <https://doi.org/10.1007/s40120-021-00305-9>.

Minen, M. T., De Dhaem, O. B., Van Diest, A. K., Powers, S., Schwedt, T. J., Lipton, R., & Silbersweig, D. (2016). Migraine and its psychiatric comorbidities. *Journal of Neurology, Neurosurgery & Psychiatry*, 87 (7), 741-749. <https://dx.doi.org/10.1136/jnnp-2015-312233>.

Munn, Z., Peters, M. D. J., Stern, C., Tufanaru, C., McArthur, A., & Aromataris, E. (2018). Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. *BMC Medical Research Methodology*, 18 (1): 143. <https://doi.org/10.1186/s12874-018-0611-x>.

O'Leary, A., Jalloh, M. F., & Neria, Y. (2018). Fear and culture: contextualising mental health impact of the 2014-2016 Ebola epidemic in West Africa. *BMJ Global Health*, 3 (3): e000924. <http://dx.doi.org/10.1136/bmjgh-2018-000924>.

Oliveira, R., Plácido, M., Pereira, L., Machado, S., Parreira, E., & Gil-Gouveia, R. (2022). Headaches and the use of personal protective equipment in the general population during the COVID-19 pandemic. *Cephalalgia*, *42* (7), 608-617. <https://doi.org/10.1177/03331024211067787>.

Orsini, A., Corsi, M., Santangelo, A., Riva, A., Peroni, D., Foiadelli, T., Savasta, S., & Striano, P. (2020). Challenges and management of neurological and psychiatric manifestations in SARS-CoV-2 (COVID-19) patients. *Neurological Sciences*, *41*, 2353-2366. <https://doi.org/10.1007/s10072-020-04544-w>.

Parodi, I. C., Poeta, M. G., Assini, A., Schirinzi, E., & Del Sette, P. (2020). Impact of quarantine due to COVID infection on migraine: a survey in Genova, Italy. *Neurological Sciences*, *41* (8), 2025-2027. <https://doi.org/10.1007/s10072-020-04543-x>.

Peng, E. Y. C., Lee, M. B., Tsai, S. T., Yang, C. C., Morisky, D. E., Tsai, L. T., Yang, C. C., Morisky, D. E., Tsai, L. T., Weng, Y. L., & Lyu, S. Y. (2010). Population-based post-crisis psychological distress: an example from the SARS outbreak in Taiwan. *Journal of the Formosan Medical Association*, *109* (7), 524-532. [https://doi.org/10.1016/S0929-6646\(10\)60087-3](https://doi.org/10.1016/S0929-6646(10)60087-3).

Piccininni, M., Rohmann, J. L., Foresti, L., Lurani, C., & Kurth, T. (2020). Use of all cause mortality to quantify the consequences of covid-19 in Nembro, Lombardy: descriptive study. *BMJ*, *369*: m1835. doi: 10.1136/bmj.m1835.

Pierce, M., Hope, H., Ford, T., Hatch, S., Hotopf, M., John, A., Kontopantelis, E., Webb, R., Wessely, S., McManus, S., & Abel, K. M. (2020). Mental health before and during the COVID-19 pandemic: a longitudinal probability sample survey of the UK population. *The Lancet Psychiatry*, *7* (10), 883-892. [https://doi.org/10.1016/S2215-0366\(20\)30308-4](https://doi.org/10.1016/S2215-0366(20)30308-4).

Puntillo, F., Giglio, M., Brienza, N., Viswanath, O., Urits, I., Kaye, A. D., Pergolizzi, J., Paladini, A., & Varrassi, G. (2020). Impact of COVID-19 pandemic on chronic pain management: looking for the best way to deliver care. *Best Practice & Research Clinical Anaesthesiology*, *34* (3), 529-537. <https://doi.org/10.1016/j.bpa.2020.07.001>.

Raggi, A., Covelli, V., Leonardi, M., Grazzi, L., Curone, M., & D'Amico, D. (2014). Difficulties in work-related activities among migraineurs are scarcely collected: results from a literature review. *Neurological Sciences*, *35* (1), 23-26. <https://doi.org/10.1007/s10072-014-1736-2>.

Raggi, A., Giovannetti, A. M., Quintas, R., D'Amico, D., Cieza, A., Sabariego, C., Bickenbach, J. E., & Leonardi, M. (2012). A systematic review of the psychosocial difficulties relevant to patients with migraine. *The Journal of Headache and Pain*, *13* (8), 595-606. <https://doi.org/10.1007/s10194-012-0482-1>.

Raihan, M. M. H. (2020). Mental health consequences of COVID-19 pandemic on adult population: a systematic review. *Mental Health Review Journal*, *26* (1), 42-54. <https://doi.org/10.1108/MHRJ-07-2020-0044>.

Rohmann, J. L., Rist, P. M., Buring, J. E., & Kurth, T. (2020). Migraine, headache, and mortality in women: a cohort study. *The Journal of Headache and Pain*, *21* (1), 1-8. <https://doi.org/10.1186/s10194-020-01091-9>.

Saleh, M. S. (2020). The “stay at home” orders effect on mental health of Egyptian adults during the COVID-19 pandemic partial lockdown. *International Journal of Human Rights in Healthcare*, *15* (1), 75-85. <https://doi.org/10.1108/IJHRH-08-2020-0065>.

Sauro, K. M., & Becker, W. J. (2009). The stress and migraine interaction. *Headache: The Journal of Head and Face Pain*, *49* (9), 1378-1386. <https://doi.org/10.1111/j.1526-4610.2009.01486.x>.

Sharawat, I. K., & Panda, P. K. (2021). Caregiver satisfaction and effectiveness of teleconsultation in children and adolescents with migraine during the ongoing COVID-19 pandemic. *Journal of Child Neurology*, *36* (4), 296-303. <https://doi.org/10.1177/0883073820968653>.

Shevlin, M., McBride, O., Murphy, J., Miller, J. G., Hartman, T. K., Levita, L., Mason, L., Martinez, A. P., McKay, R., Stocks, T. V. A., Bennett, K. M., Hyland, P., Karatzias, T., & Bentall, R. P. (2020). Anxiety, depression, traumatic stress and COVID-19-related anxiety in the UK general population during the COVID-19 pandemic. *BJPpsych Open*, 6 (6), 1-9. <https://doi.org/10.1192/bjo.2020.109>.

Silvestro, M., Tessitore, A., Tedeschi, G., & Russo, A. (2020). Migraine in the time of COVID-19. *Headache*, 60 (5), 988-989. <https://doi.org/10.1111/head.13803>.

Singh, S., Bhutani, S., & Fatima, H. (2020). Surviving the stigma: lessons learnt for the prevention of COVID-19 stigma and its mental health impact. *Mental Health and Social Inclusion*, 24 (3), 145-149. <https://doi.org/10.1108/MHSI-05-2020-0030>.

Smith, M., Nakamoto, M., Crocker, J., Tiffany Morden, F. T., Liu, K., Ma, E., Chong, A., Van, N., Vajjala, V., Carrazana, E., Viereck, J., & Liow, K. (2021). Early impact of the COVID-19 pandemic on outpatient migraine care in Hawaii: results of a quality improvement survey. *Headache: The Journal of Head and Face Pain*, 61 (1), 149-156. <https://doi.org/10.1111/head.14030>.

Steiner, T. J., Stovner, L. J., Jensen, R., Uluduz, D., & Katsarava, Z. (2020). Migraine remains second among the world's causes of disability, and first among young women: findings from GBD2019. *The Journal of Head and Pain*, 21 (1): 137. <https://doi.org/10.1186/s10194-020-01208-0>.

Stovner, L. J., & André, C. (2008). Impact of headache in Europe: a review for the Eurolight project. *The Journal of Headache and Pain*, 9 (3), 139-146. <https://doi.org/10.1007/s10194-008-0038-6>.

Stovner, L. J., Hagen, K., Linde, M., & Steiner, T. J. (2022). The global prevalence of headache: an update, with analysis of the influences of methodological factors on prevalence estimates. *The Journal of Headache and Pain*, 23 (1), 1-17. <https://doi.org/10.1186/s10194-022-01402-2>.

Suzuki, K., Takeshima, T., Igarashi, H., Imai, N., Danno, D., Yamamoto, T., Nagata, E., Haruyama, Y., Mitsufuji, T., Suzuki, S., Ito, Y., Shibata, M., Kowa, H., Kikui, S., Shiina, T., Okamura, M., Tatsumoto, M., & Hirata, K. (2021). Impact of the COVID-19 pandemic on migraine in Japan: a multicentre cross-sectional study. *The Journal of Headache and Pain*, 22 (1), 1-10. <https://doi.org/10.1186/s10194-021-01263-1>.

Szperka, C. L., Ailani, J., Barmherzig, R., Klein, B. C., Minen, M. T., Halker Singh, R. B., & Shapiro, R. E. (2020). Migraine care in the era of COVID-19: clinical pearls and plea to insurers. *Headache: The Journal of Head and Face Pain*, 60 (5), 833-842. <https://doi.org/10.1111/head.13810>.

Szyszkowicz, M., Kaplan, G. G., Grafstein, E., & Rowe, B. H. (2009). Emergency department visits for migraine and headache: A multi-city study. *International Journal of Occupational Medicine and Environmental Health*, 22 (3), 235-242. <https://doi.org/10.2478/v10001-009-0024-5>.

Tricco, A. C., Lillie, E., Zarin, W., O'Brien, K. K., Colquhoun, H., Levac, D., Moher, D., Peters, M. D. J., Horsley, T., Weeks, L., Hempel, S., Akl, E. A., Chang, C., McGowan, J., Stewart, L., Hartling, L., Aldcroft, A., Wilson, M. G., Garritty, C., Lewin, S., Godfrey, C. M., Macdonald, M. T., Langlois, E. V., Soares-Weiser, K., Moriarty, J., Clifford, T., Tuncalp, Ö., & Straus, S. E. (2018). PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation. *Annals of Internal Medicine*, 169 (7), 467-473. <https://doi.org/10.7326/M18-0850>.

Umucu, E., & Lee, B. (2020). Examining the impact of COVID-19 on stress and coping strategies in individuals with disabilities and chronic conditions. *Rehabilitation Psychology*, 65 (3), 193-198. <https://doi.org/10.1037/rep0000328>.

Verhagen, I. E., van Casteren, D. S., Lentsch, S. D. V., & Terwindt, G. M. (2021). Effect of lockdown during COVID-19 on migraine: a longitudinal cohort study. *Cephalalgia*, 41 (7), 865-870. <https://doi.org/10.1177/0333102420981739>.

Vos, T., Lim, S. S., Abbafati, C., Abbas, K. M., Abbasi, M., Abbasifard, M., Abbasi-Kangevari, M., Abbastabar, H., Abd-Allah, F., Abdelalim, A., Abdollahi, M., Abdollahpour, I., Abolhassani, H., Aboyans, V., Abrams, E. M., Guimaraes Abreu, L., Abrigo, M. R. M., Jamal Abu-Raddad, L., Abushouk, A. I., ..., & Murray, C. J. L. (2020). Global burden of 369 diseases and injuries in 204 countries and territories, 1990-2019: a systematic analysis for the Global Burden of Disease Study 2019. *The Lancet*, 396 (10258), 1204-1222. [https://doi.org/10.1016/S0140-6736\(20\)30925-9](https://doi.org/10.1016/S0140-6736(20)30925-9).

Wang, C., Pan, R., Wan, X., Tan, Y., Xu, L., Ho, C. S., & Ho, R. C. (2020). Immediate psychological responses and associated factors during the initial stage of the 2019 coronavirus disease (COVID-19) epidemic among the general population in China. *International Journal of Environmental Research and Public Health*, 17 (5): 1729. <https://doi.org/10.3390/ijerph17051729>.

Winkler, P., Formanek, T., Mlada, K., Kagstrom, A., Mohrova, Z., Mohr, P., & Csemy, L. (2020). Increase in prevalence of current mental disorders in the context of COVID-19: analysis of repeated nationwide cross-sectional surveys. *Epidemiology and Psychiatric Sciences*, 29 (173), 1-8. <https://doi.org/10.1017/S2045796020000888>.

Wong, L. P., Alias, H., Bhoo-Pathy, N., Chung, I., Chong, Y. C., Kalra, S., & Shah, Z. U. B. S. (2020). Impact of migraine on workplace productivity and monetary loss: a study of employees in banking sector in Malaysia. *The Journal of Headache and Pain*, 21 (68), 1-11. <https://doi.org/10.1186/s10194-020-01144-z>.

World Health Organization (2020). *WHO Director-General's opening remarks at the media briefing on COVID-19 – 11 March 2020*. Retrieved from: <https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020>.

Xiong, J., Lipsitz, O., Nasri, F., Lui, L. M., Gill, H., Phan, L., Chen-Li, D., Iacobucci, M., Ho, R., Majeed, A., & McIntyre, R. S. (2020). Impact of COVID-19 pandemic on mental health in the general population: a systematic review. *Journal of Affective Disorders*, 277 (1), 55-64. <https://doi.org/10.1016/j.jad.2020.08.001>.

Yuksel, H., Kenar, S. G., Gursoy, G. T., & Bektas, H. (2022). The impacts of masks and disinfectants on migraine patients in the COVID-19 pandemic. *Journal of Clinical Neuroscience: Official Journal of the Neurosurgical Society of Australasia*, 97, 87-92. <https://doi.org/10.1016/j.jocn.2022.01.006>.

Zhang, Q. Q., Li, L., & Zhong, B. L. (2021). Prevalence of Insomnia Symptoms in Older Chinese Adults During the COVID-19 Pandemic: A Meta-Analysis. *Frontiers in medicine*, 8: 779914. <https://doi.org/10.3389/fmed.2021.779914>.