

## Review Article

# The COVID-19 pandemic increased poor lifestyles and worsen mental health: a systematic review

Zhe Zhao<sup>1</sup>, Lu Li<sup>2</sup>, Yufei Sang<sup>3</sup>

<sup>1</sup>Department of Medical Oncology, Beijing Hospital, National Center of Gerontology, Institute of Geriatric Medicine, Chinese Academy of Medical Sciences, Beijing 100730, China; <sup>2</sup>Department of Health Service, Guard Bureau of The Joint Staff Department, Beijing 100017, China; <sup>3</sup>Department of Health Service, 95246 Unit of The Chinese People's Liberation Army, Nanning 530007, Guangxi, China

Received February 3, 2023; Accepted April 3, 2023; Epub May 15, 2023; Published May 30, 2023

**Abstract:** Objective: The pandemic of Coronavirus Disease 2019 (COVID-19) has drastically changed the daily lifestyle of people around the world. This paper aims to analyze and summarize the impact of the COVID-19 pandemic on poor lifestyles and mental health. Materials and methods: A comprehensive examination of the existing literature was conducted, wherein a description was provided regarding the poor lifestyles and mental health issues of individuals during the COVID-19 pandemic. Results: The available literature delineates the impact of the COVID-19 pandemic on unhealthy lifestyle patterns, which encompasses reduced physical activity, increased sedentary behavior, augmented screen time, disturbed work and sleep schedules, more smoking and alcohol consumption, and mental health disorders, such as anxiety and depression. Conclusions: It is imperative for both governments and individuals to be cognizant of the detrimental impact of the COVID-19 pandemic on lifestyle as well as physical and mental health. Prompt interventions must be implemented to address these issues.

**Keywords:** COVID-19, pandemic, bad lifestyle, health, impact

## Introduction

The pandemic of Coronavirus Disease 2019 (COVID-19) caused by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) has persisted since March 2020, with the emergence of new SARS-CoV-2 variants. The global COVID-19 pandemic has affected over 650 million individuals worldwide by the end of 2022. To curb the spread of the disease, various countries have implemented measures to restrict non-essential activities. Despite their success in reducing the transmission of the novel coronavirus among individuals, the restrictions have also resulted in detrimental effects on individuals' lifestyles as well as physical and mental health [1, 2]. As a consequence, a considerable proportion of the population is presently experiencing sub-optimal health status, necessitating immediate and appropriate intervention [3]. The COMET study, one of the largest quasi-epidemiological projects in psychiatry, assessed the impact of the

COVID-19 pandemic and its associated lockdown conditions on the mental health of populations in 40 countries, with support from the World Psychiatric Association [4, 5]. The findings demonstrate that the pandemic not only poses a threat to physical health but also brings severe stress, widely affecting people's mental health and social lifestyles. Since the early days of the pandemic in 2020, its negative impact on the mental health of different vulnerable groups has been described [6]. The main lifestyle and mental health changes during COVID-19 are shown in **Figure 1**.

### Decrease in physical activity and increase in sedentary behavior

Physical activity has multiple health benefits for people of all ages [7], including a reduction in all-cause mortality [8, 9]. Even small amounts of physical activity can be advantageous and offer health benefits regardless of the level of participation [10]. However, study data suggest

## Lifestyles and mental health in the COVID-19 pandemic



**Figure 1.** The lifestyle and mental health changes during COVID-19.

that the COVID-19 pandemic negatively affected all levels of physical activity [2, 11-13]. Large datasets from Australia ( $n=5,469$ ), Spain ( $n=2,447$ ) and France ( $n=37,252$ ) reported that between 43% and 61% of the population had reduced physical activity during COVID-19 self-isolation [11, 12, 14]. Furthermore, a survey involving 2,709 participants showed that the proportion of the population of individuals engaging in  $\geq 30$  minutes of physical activity per day decreased from 56.4% to 45.4%, and the average time spent on physical activity per day decreased from 38.65 minutes to 32.06 minutes during the pandemic ( $P < 0.001$ ) [1]. The frequency of various physical activities, such as running, walking, swimming, and gym training, decreased during the COVID-19 epidemic [15]. Despite the availability of physical activity instruction sessions on social media, the current results suggest that individuals are unlikely to sustain their usual activity patterns during home-based activities.

Declines in physical activity are frequently associated with an increase in sedentary behavior, which refers to any waking activity with energy expenditure  $\leq 1.5$  metabolic equivalents when seated, leaning, or lying down [16].

Sedentary behavior is an independent risk factor for adverse health outcomes, which is more concerning than decreased physical activity [17]. According to a cross-sectional study of 37,252 participants from France, 63.2% of the participants reported increased sedentary time during COVID-19 closed isolation, with an average of 7 hours per day [11]. An online survey of 1,047 participants in Europe, North Africa, West Asia, and the Americas reported a 28.6% increase in daily sitting time during COVID-19 home isolation, as well as a rise in the proportion of individuals who were sedentary for more than 8 hours per day from 16% to 40% [13].

### Increased screen time and disturbed sleep schedule

Screen time is the amount of time individuals spend using screen-based devices (e.g. smartphones, tablets, computers, TVs) in any environment (e.g. school, work, entertainment) [16]. Increased sedentary behavior may be partly attributed to increased screen time. A Middle East and North Africa study revealed that the proportion of individuals who spent more than 5 hours per day watching screens for entertainment purposes increased from 14.6% before the COVID-19 outbreak to 37.5% during the pandemic [18]. Studies have also given more specific data, indicating that screen time increased from 5.06 to 6.79 hours per day during the pandemic compared to the pre-pandemic period ( $P < 0.001$ ) [1], and the problem is equally prominent among adolescents [19]. According to the International Society and the Brazilian Society of Paediatrics, adolescents should spend less than two hours a day viewing a screen, excluding distance learning activities. However, during home isolation, 58.7% of adolescents reported spending more than eight hours per day viewing screens [20], and mobile phones are more popular than desktop/laptop computers because of the ability to gossip, check news, and update social media and online courses [21].

The confinement at home due to COVID-19 may disrupt the circadian regulation of sleep by reducing exposure to daytime light and physical activity, resulting in sleep disturbances and abnormal sleep patterns. This may cause individuals to sleep anywhere from four to eight hours and feel drowsy during the day, with factors such as stress, anxiety and bedtime screen exposure [21]. One study showed 69.6% of respondents reported difficulty sleeping during the COVID-19 pandemic, with frequent waking being the most common problem [22]. Furthermore, oversleeping and longer nap times were observed among students ( $3.1 \pm 1.23$  h/day) and office workers ( $2.5 \pm 1.86$  h/day) [21]. During confinement, people tended to go to sleep later at night and woke up later in the morning, as external cues such as commuting to work, taking children to school, and attending social events were significantly reduced. These factors, including a lack of exposure to natural light, disrupt individuals' circadian rhythms, which control sleep-wake cycles and other physiological processes [23].

### **Unhealthy dietary behaviors and increased smoking and alcohol consumption**

The COVID-19 pandemic and related regulations have had a significant impact on dietary behavior and food consumption patterns. During the epidemic closure and quarantine, unhealthy dietary behaviors such as binge eating, emotional eating, reduced intake of fruits and vegetables, reduced daily water intake, increased intake of sugary drinks, and higher consumption of unhealthy foods became more common [15, 24-27]. A cross-sectional study involving 2,970 adult residents in 18 countries showed that more than 30% of people gained weight compared to the pre-pandemic period of COVID-19, the proportion of people eating 5 or more meals per day increased from 2.2% to 6.2% ( $P < 0.001$ ), and 48.8% of people did not eat any fruit per day [18]. Being confined at home limits access to fresh foods (e.g. fruits, vegetables, etc.), leading to increased consumption of more energy-dense foods of lower nutritional quality, including processed foods such as snacks or convenience foods [28]. Unhealthy eating behaviour is of great concern as it increases the risk of obesity, type 2 diabetes, cardiovascular disease and other harmful health effects.

Relevant cross-sectional studies in different countries [1, 29-31] found that both tobacco and alcohol consumption has increased during COVID-19. More than 17% of respondents increased their alcohol consumption, particularly men, individuals with higher education and those living in large urban centres. The percentage of heavy drinkers ( $\geq 5$  drinks/week) has increased from 20.9% before the epidemic to 25.7% during the pandemic. Among smokers, 30% of the population increased their cigarette consumption, with an average of 5.6 cigarettes daily. A small proportion of quitters (0.6%) have started smoking again, and heavy smokers ( $\geq 11$  cigarettes/day) have increased from 5.8% before the pandemic to 7.9% during the pandemic. The increased consumption of both alcohol and smoking as risk factors is a concern since they are risk factors for many adverse health outcomes and have deleterious effects on the immune system, which may increase the risk of contracting the novel coronavirus and the severity of disease [32].

### **More mental health problems**

The COVID-19 pandemic and associated measures such as isolation or home-based requirements have disrupted normal life, affecting physical activities and severely impacting the mental health of individuals [33, 34]. Several studies [18, 35-39] have suggested that individuals affected by COVID-19 may experience more mental health problems, including anxiety, depression, stress, panic, irritability, impulsivity, somatization disorders, abnormal sexual behavior, depressed mood, post-traumatic stress symptoms and suicidal behavior, and there is evidence that isolation may trigger these mental disorders [40]. The main common mental health problems are anxiety (6.5% to 63%) and depression (4% to 31%) [39]. A meta-analysis that included 43 studies found that the prevalence of anxiety in the general population during the COVID-19 pandemic may have been more than three times higher than it was previously [35]. Post-traumatic stress disorder (PTSD) is also a significant concern and is significantly more prevalent in patients admitted to intensive care units compared to those in wards [41]. In addition, a study that included 980 cases found that a small proportion of the population (6.3%) developed sexual dysfunction, such as erectile dysfunction or loss of libi-

do, that was not previously present [42]. A survey of 2,064 adolescents by Buzzi et al. showed that the COVID-19 pandemic affected adolescents' moods and lifestyles and affected their relationships with peers and parents' relationships [43]. The pandemic has led to an increase in abuse, self-harm, and suicidal/self-harm thoughts due to prolonged stress and closed isolation. Data from a social study (n=44775) showed that 4,121 participants (9%) in the UK reported experiencing psychological or physical abuse during the first month of the COVID-19 pandemic, 7,984 participants (18%) reported having suicidal or self-harming thoughts, 2,174 participants (5%) harmed themselves at least once, with approximately 50% of those who experienced psychological or physical abuse had suicidal or self-harming thoughts [44]. A study of Polish university students showed that 8.8% reported an increase in self-harming behavior [42].

### Effective interventions

Fortunately, not all experiences of stressful events associated with the COVID-19 pandemic have resulted in adverse consequences. In this regard, coping refers to the cognitive and behavioral effort to respond to a specific stressful situation, thereby minimizing its potential negative effects. Physical exercise, yoga, and self-care activities in daily life are beneficial [45]. The most commonly employed coping or adjustment mechanisms are avoidance-oriented stress coping, emotion-oriented coping, and task-oriented coping. Interestingly, inhibition has been found to be an adaptive response to uncertainty-related concerns, at least in the short-term context. Healthcare workers most commonly report coping strategies that include individual/group psychosocial support, family/kinship support, training/orientation, and adequacy of personal protective equipment [46]. COVID-19 patients experience high anxiety and poor sleep quality due to isolation treatment, and studies have shown that progressive muscle relaxation as an adjunct can reduce anxiety and improve sleep quality in COVID-19 patients [47].

The global health emergency caused by the COVID-19 pandemic poses unprecedented challenges to healthcare workers, who face a heavy workload in psychologically difficult situ-

ations. A study conducted in Spanish evaluated the effectiveness of psychoeducational, mindfulness-based mobile health interventions and showed that PsyCovidApp reduced mental health problems at 2 weeks only among healthcare workers with COVID-19 who received psychotherapy or psychotropic medications [47]. In addition, studies have shown that Computerized CBT programs are effective non-pharmacological treatments for anxiety, depression, and insomnia symptoms in people with COVID-19 [48].

### Conclusions

The COVID-19 pandemic remains ongoing, and while the adverse lifestyle and health behavior changes observed above remain limited, the cumulative impact of such negative changes over a period of months or more could have widespread consequences. The stress and boredom associated with prolonged isolation and the difficulties of daily life intensified by the pandemic may be contributing factors to these negative changes. Both governments and individuals should take these negative changes seriously, and more and healthier lifestyle interventions need to be called for in the future. However, there are still some limitations to this research of related fields. The COVID-19 pandemic is difficult to control and its impact on individuals varies. In addition, there was little lifestyle and mental health-related data collected before the pandemic, and there was a lack of comparison. The multifaceted and variable nature of the pandemic's impact on lifestyle and mental health makes assessment challenging. In the future, it is necessary to consolidate knowledge and strengthen the defense line of psychological construction and psychological intervention plans.

### Acknowledgements

This review was supported by the National Health Commission (Grant No. 2020YB06) of China.

### Disclosure of conflict of interest

None.

**Address correspondence to:** Lu Li, Department of Health Service, Guard Bureau of The Joint Staff

## Lifestyles and mental health in the COVID-19 pandemic

Department, Beijing 100017, China. E-mail: 15501053786@163.com

### References

- [1] Chen L, Li J, Xia T, Matthews TA, Tseng TS, Shi L, Zhang D, Chen Z, Han X, Li Y, Li H, Wen M and Su D. Changes of exercise, screen time, fast food consumption, alcohol, and cigarette smoking during the COVID-19 pandemic among adults in the United States. *Nutrients* 2021; 13: 3359.
- [2] Zeigler Z. COVID-19 self-quarantine and weight gain risk factors in adults. *Curr Obes Rep* 2021; 10: 423-433.
- [3] Pan Y, Yan J, Lu W and Shan M. Sub-health status survey and influential factor analysis in Chinese during coronavirus disease 2019 pandemic. *J Korean Acad Nurs* 2021; 51: 5-14.
- [4] Vadon NB, Elek LP, Szigeti M, Erdelyi-Hamza B, Smirnova D, Fountoulakis KN and Gonda X. Association between lifestyle- and circadian rhythm-related changes, and different depression symptom clusters during COVID-19. *Psychiatr Danub* 2022; 34 Suppl 8: 81-89.
- [5] Malandain L, Fountoulakis KN, Syunyakov T, Malashonkova E, Smirnova D and Thibaut F. Psychoactive substance use, internet use and mental health changes during the COVID-19 lockdown in a French population: a study of gender effect. *Front Psychiatry* 2022; 13: 958988.
- [6] Dos Santos CF, Picó-Pérez M and Morgado P. COVID-19 and mental health-what do we know so far? *Front Psychiatry* 2020; 11: 565698.
- [7] Piercy KL, Troiano RP, Ballard RM, Carlson SA, Fulton JE, Galuska DA, George SM and Olson RD. The physical activity guidelines for Americans. *JAMA* 2018; 320: 2020-2028.
- [8] Martínez-Gómez D, Guallar-Castillon P, García-Esquinas E, Bandinelli S and Rodríguez-Artalejo F. Physical activity and the effect of multimorbidity on all-cause mortality in older adults. *Mayo Clin Proc* 2017; 92: 376-382.
- [9] LaMonte MJ, Buchner DM, Rillamas-Sun E, Di C, Evenson KR, Bellettiere J, Lewis CE, Lee IM, Tinker LF, Seguin R, Zaslowsky O, Eaton CB, Stefanick ML and LaCroix AZ. Accelerometer-measured physical activity and mortality in women aged 63 to 99. *J Am Geriatr Soc* 2018; 66: 886-894.
- [10] Barengo NC, Antikainen R, Borodulin K, Harald K and Jousilahti P. Leisure-time physical activity reduces total and cardiovascular mortality and cardiovascular disease incidence in older adults. *J Am Geriatr Soc* 2017; 65: 504-510.
- [11] Deschasaux-Tanguy M, Druesne-Pecollo N, Es-seddik Y, de Edelenyi FS, Allès B, Andreeva VA, Baudry J, Charreire H, Deschamps V, Egnell M, Fezeu LK, Galan P, Julia C, Kesse-Guyot E, Latino-Martel P, Oppert JM, Péneau S, Verdor C, Hercberg S and Touvier M. Diet and physical activity during the coronavirus disease 2019 (COVID-19) lockdown (March-May 2020): results from the French NutriNet-Santé cohort study. *Am J Clin Nutr* 2021; 113: 924-938.
- [12] Phillipou A, Meyer D, Neill E, Tan EJ, Toh WL, Van Rheenen TE and Russell SL. Eating and exercise behaviors in eating disorders and the general population during the COVID-19 pandemic in Australia: initial results from the COL-LATE project. *Int J Eat Disord* 2020; 53: 1158-1165.
- [13] Ammar A, Brach M, Trabelsi K, Chtourou H, Boukhris O, Masmoudi L, Bouaziz B, Bentley E, How D, Ahmed M, Müller P, Müller N, Aloui A, Hammouda O, Paineiras-Domingos LL, Braakman-Jansen A, Wrede C, Bastoni S, Pernambuco CS, Mataruna L, Taheri M, Irandoust K, Khacharem A, Bragazzi NL, Chamari K, Glenn JM, Bott NT, Gargouri F, Chaari L, Batatia H, Ali GM, Abdelkarim O, Jarraya M, Abed KE, Souissi N, Van Gemert-Pijnen L, Riemann BL, Riemann L, Moalla W, Gómez-Raja J, Epstein M, Sanderman R, Schulz SV, Jerg A, Al-Horani R, Mansi T, Jmail M, Barbosa F, Ferreira-Santos F, Šimunič B, Pišot R, Gaggioli A, Bailey SJ, Steinacker JM, Driss T and Hoekelmann A. Effects of COVID-19 home confinement on eating behaviour and physical activity: results of the ECLB-COVID19 international online survey. *Nutrients* 2020; 12: 1583.
- [14] Kriaucionienė V, Bagdonavičienė L, Rodríguez-Pérez C and Petkevičienė J. Associations between changes in health behaviours and body weight during the COVID-19 quarantine in Lithuania: the Lithuanian COVIDiet study. *Nutrients* 2020; 12: 3119.
- [15] Di Renzo L, Gualtieri P, Pivari F, Soldati L, Attinà A, Cinelli G, Leggeri C, Caparello G, Barrea L, Scerbo F, Esposito E and De Lorenzo A. Eating habits and lifestyle changes during COVID-19 lockdown: an Italian survey. *J Transl Med* 2020; 18: 229.
- [16] Tremblay MS, Aubert S, Barnes JD, Saunders TJ, Carson V, Latimer-Cheung AE, Chastin SFM, Altenburg TM and Chinapaw MJM; SBRN Terminology Consensus Project Participants. Sedentary behavior research network (SBRN) - terminology consensus project process and outcome. *Int J Behav Nutr Phys Act* 2017; 14: 75.
- [17] Bann D, Hire D, Manini T, Cooper R, Botosenanu A, McDermott MM, Pahor M, Glynn NW, Fielding R, King AC, Church T, Ambrosius WT and Gill TM; LIFE Study Group. Light intensity physical activity and sedentary behavior in relation to body mass index and grip strength in

## Lifestyles and mental health in the COVID-19 pandemic

- older adults: cross-sectional findings from the lifestyle interventions and independence for elders (LIFE) study. *PLoS One* 2015; 10: e0116058.
- [18] Cheikh Ismail L, Osaili TM, Mohamad MN, Al Marzouqi A, Jarrar AH, Zampelas A, Habib-Mourad C, Omar Abu Jamous D, Ali HI, Al Sabbah H, Hasan H, AlMarzooqi LMR, Stojanovska L, Hashim M, Shaker Obaid RR, Elfeky S, Saleh ST, Shawar ZAM and Al Dhaheri AS. Assessment of eating habits and lifestyle during the coronavirus 2019 pandemic in the Middle East and North Africa region: a cross-sectional study. *Br J Nutr* 2021; 126: 757-766.
- [19] Moore SA, Faulkner G, Rhodes RE, Brussoni M, Chulak-Bozzer T, Ferguson LJ, Mitra R, O'Reilly N, Spence JC, Vanderloo LM and Tremblay MS. Impact of the COVID-19 virus outbreak on movement and play behaviours of Canadian children and youth: a national survey. *Int J Behav Nutr Phys Act* 2020; 17: 85.
- [20] Giannini DT, Tavares CM, Takey M, Aloise MLR, da Costa AJ, de Carvalho DS, da Silva SC, Pontes MHP and Monteiro CB. Adolescents emotional state and behavioral and dietary habit changes during isolation due to the COVID-19 pandemic. *J Am Nutr Assoc* 2022; 41: 415-423.
- [21] Majumdar P, Biswas A and Sahu S. COVID-19 pandemic and lockdown: cause of sleep disruption, depression, somatic pain, and increased screen exposure of office workers and students of India. *Chronobiol Int* 2020; 37: 1191-1200.
- [22] Pinto J, van Zeller M, Amorim P, Pimentel A, Dantas P, Eusébio E, Neves A, Pipa J, Santa Clara E, Santiago T, Viana P and Drummond M. Sleep quality in times of COVID-19 pandemic. *Sleep Med* 2020; 74: 81-85.
- [23] Majumdar P and Sahu S. Morningness orientation is an important determinant to circadian misalignment and tolerance: an Asian perspective. *Chronobiol Int* 2020; 37: 2-28.
- [24] Scarmozzino F and Visioli F. COVID-19 and the subsequent lockdown modified dietary habits of almost half the population in an Italian sample. *Foods* 2020; 9: 675.
- [25] Gryszczyńska B, Budzyń M, Grupińska J, Kasprzak MP and Gryszczyńska A. Nutritional behaviors, vitamin supplementation and physical activity among polish adults during the COVID-19 pandemic. *Nutrients* 2022; 14: 331.
- [26] Casas R, Raidó-Quintana B, Ruiz-León AM, Castro-Barquero S, Bertomeu I, Gonzalez-Juste J, Campolier M and Estruch R. Changes in Spanish lifestyle and dietary habits during the COVID-19 lockdown. *Eur J Nutr* 2022; 61: 2417-2434.
- [27] Kayaoglu SA and Sert OZ. Constipation in the period of limited isolation during COVID-19 pandemic. *Rev Assoc Med Bras* (1992) 2022; 68: 196-201.
- [28] Batlle-Bayer L, Aldaco R, Bala A, Puig R, Laso J, Margallo M, Vázquez-Rowe I, Antó JM and Fullana-I-Palmer P. Environmental and nutritional impacts of dietary changes in Spain during the COVID-19 lockdown. *Sci Total Environ* 2020; 748: 141410.
- [29] Ferrante G, Camussi E, Piccinelli C, Senore C, Armaroli P, Ortale A, Garena F and Giordano L. Did social isolation during the SARS-CoV-2 epidemic have an impact on the lifestyles of citizens? *Epidemiol Prev* 2020; 44: 353-362.
- [30] Sidor A and Rzymiski P. Dietary choices and habits during COVID-19 lockdown: experience from Poland. *Nutrients* 2020; 12: 1657.
- [31] Grossman ER, Benjamin-neelon SE and Sonnenschein S. Alcohol consumption during the COVID-19 pandemic: a cross-sectional survey of US adults. *Int J Environ Res Public Health* 2020; 17: 9189.
- [32] Grundy EJ, Suddek T, Filippidis FT, Majeed A and Coronini-Cronberg S. Smoking, SARS-CoV-2 and COVID-19: a review of reviews considering implications for public health policy and practice. *Tob Induc Dis* 2020; 18: 58.
- [33] Nicola M, Alsaifi Z, Sohrabi C, Kerwan A, Al-Jabir A, Iosifidis C, Agha M and Agha R. The socio-economic implications of the coronavirus pandemic (COVID-19): a review. *Int J Surg* 2020; 78: 185-193.
- [34] Hossain MM, Tasnim S, Sultana A, Faizah F, Mazumder H, Zou L, McKyer ELJ, Ahmed HU and Ma P. Epidemiology of mental health problems in COVID-19: a review. *F1000Res* 2020; 9: 636.
- [35] Santabárbara J, Lasheras I, Lipnicki DM, Bueno-Notivol J, Pérez-Moreno M, López-Antón R, De la Cámara C, Lobo A and Gracia-García P. Prevalence of anxiety in the COVID-19 pandemic: an updated meta-analysis of community-based studies. *Prog Neuropsychopharmacol Biol Psychiatry* 2021; 109: 110207.
- [36] Huang Y and Zhao N. Generalized anxiety disorder, depressive symptoms and sleep quality during COVID-19 outbreak in China: a web-based cross-sectional survey. *Psychiatry Res* 2020; 288: 112954.
- [37] Hossain MM, Sultana A and Purohit N. Mental health outcomes of quarantine and isolation for infection prevention: a systematic umbrella review of the global evidence. *Epidemiol Health* 2020; 42: e2020038.
- [38] Rogers JP, Chesney E, Oliver D, Pollak TA, McGuire P, Fusar-Poli P, Zandi MS, Lewis G and David AS. Psychiatric and neuropsychiatric presentations associated with severe coronavirus infections: a systematic review and meta-analysis with comparison to the COVID-19 pandemic. *Lancet Psychiatry* 2020; 7: 611-627.

## Lifestyles and mental health in the COVID-19 pandemic

- [39] Shanbehzadeh S, Tavahomi M, Zanjari N, Ebrahimi-Takamjani I and Amiri-Arimi S. Physical and mental health complications post-COVID-19: scoping review. *J Psychosom Res* 2021; 147: 110525.
- [40] Brooks SK, Webster RK, Smith LE, Woodland L, Wessely S, Greenberg N and Rubin GJ. The psychological impact of quarantine and how to reduce it: rapid review of the evidence. *Lancet* 2020; 395: 912-920.
- [41] Halpin SJ, McIvor C, Whyatt G, Adams A, Harvey O, McLean L, Walshaw C, Kemp S, Corrado J, Singh R, Collins T, O'Connor RJ and Sivan M. Postdischarge symptoms and rehabilitation needs in survivors of COVID-19 infection: a cross-sectional evaluation. *J Med Virol* 2021; 93: 1013-1022.
- [42] Fila-Witecka K, Senczyszyn A, Kołodziejczyk A, Ciułkiewicz M, Maciaszek J, Misiak B, Szcześniak D and Rymaszewska J. Lifestyle changes among polish university students during the COVID-19 pandemic. *Int J Environ Res Public Health* 2021; 18: 9571.
- [43] Buzzi C, Tucci M, Ciprandi R, Brambilla I, Caimmi S, Ciprandi G and Marseglia GL. The psycho-social effects of COVID-19 on Italian adolescents' attitudes and behaviors. *Ital J Pediatr* 2020; 46: 69.
- [44] Iob E, Steptoe A and Fancourt D. Abuse, self-harm and suicidal ideation in the UK during the COVID-19 pandemic. *Br J Psychiatry* 2020; 217: 543-546.
- [45] Zhu W, Xu D, Li H, Xu G, Tian J, Lyu L, Wan N, Wei L, Rong W, Liu C, Wu B, Bian X and Lyu A. Impact of long-term home quarantine on mental health and physical activity of people in Shanghai during the COVID-19 pandemic. *Front Psychiatry* 2021; 12: 782753.
- [46] Chutiya M, Cheong AMY, Salihu D, Bello UM, Ndwiaga D, Maharaj R, Naidoo K, Kolo MA, Jacob P, Chhina N, Ku TK, Devar L, Pratitha P and Kannan P. COVID-19 pandemic and overall mental health of healthcare professionals globally: a meta-review of systematic reviews. *Front Psychiatry* 2021; 12: 804525.
- [47] Fiol-DeRoque MA, Serrano-Ripoll MJ, Jiménez R, Zamanillo-Campos R, Yáñez-Juan AM, Ben-nasar-Veny M, Leiva A, Gervilla E, García-Buades ME, García-Toro M, Alonso-Coello P, Pastor-Moreno G, Ruiz-Pérez I, Sitges C, García-Campayo J, Llobera-Cánaves J and Ricci-Cabello I. A mobile phone-based intervention to reduce mental health problems in health care workers during the COVID-19 pandemic (PsyCovidApp): randomized controlled trial. *JMIR Mhealth Uhealth* 2021; 9: e27039.
- [48] Liu Z, Qiao D, Xu Y, Zhao W, Yang Y, Wen D, Li X, Nie X, Dong Y, Tang S, Jiang Y, Wang Y, Zhao J and Xu Y. The efficacy of computerized cognitive behavioral therapy for depressive and anxiety symptoms in patients with COVID-19: randomized controlled trial. *J Med Internet Res* 2021; 23: e26883.