



Review Article

The Influence of COVID-19 on the Psychological Well-being of Different Populations in China

Haiyan Chen¹, Xin Xiao^{2*} , Weihong Wang¹, Zhaowei Tong¹, Longqi Zhang¹, Jianfeng Zhong¹, Xiaofeng Li¹, Xianshan Zhang¹, Yong Tong¹, Bin Shen¹, Qingqiu Zeng¹ and Xiaofang Cheng¹

¹Department of Infectious Diseases, Huzhou Central Hospital, Huzhou Hospital Affiliated to Zhejiang University, Huzhou, China; ²Liver and Kidney Disease Research Center, Huzhou Central Hospital, Huzhou Hospital Affiliated to Zhejiang University, Huzhou, China

Received: November 19, 2020 | Revised: January 06, 2021 | Accepted: January 28, 2021 | Published: March 3, 2021

Abstract

An unprecedented outbreak of pneumonia caused by severe acute respiratory syndrome coronavirus 2 (SARS-COV-2) infection appeared in Wuhan, Hubei Province, China, in December 2019. On 11 February 2020, the World Health Organization (WHO) officially attributed the disease to infection with SARS-COV-2 as coronavirus disease 2019 (COVID-19). SARS-COV-2 is highly contagious, and people are generally susceptible to infection. Since the outbreak of the pandemic, which has changed the way most people live and work, the Chinese government and scientific community have acted quickly and taken measures to contain the pandemic. This review aims to look at the psychological impact of the outbreak on a specific segment of the population (*e.g.*, students, recent college graduates, medical staff, older people, pregnant women, children, the general public, and others), and to isolate the mechanisms by which social isolation could cause loneliness, to improve our understanding of the emerging epidemic's impact on people's mental health, and therefore, to focus attention on mental health care.

Introduction

At the end of 2019, an unprecedented outbreak of novel coronavirus (SARS-COV-2) pneumonia appeared in Wuhan, Hubei, China, which fascinated worldwide attention. In February 2020, the coronavirus disease was designated as COVID-19 by the World Health Organization (WHO).¹ In China, human-to-human transmission of the COVID-19 virus occurred in families.² In addition, the virus has proved to be highly contagious and can be fatal.³ For most people, the unprecedented outbreak of COVID-19 is a symbol of how fragile and unpredictable lives can be. The virus has completely modified how most of us live, work, or perform our daily functions.³

Keywords: COVID-19; SARS-COV-2; Loneliness mechanism; Mental health; Epidemiology; Prevention and management.

Abbreviations: SARS-COV-2, severe acute respiratory syndrome coronavirus 2; COVID-19, coronavirus disease 2019.

*Correspondence to: Xin Xiao, Liver and Kidney Disease Research Center, Huzhou Central Hospital, Huzhou Hospital Affiliated to Zhejiang University, 1558 Third Ring North Road, Wuxing District, Huzhou 313000, China. ORCID: <https://orcid.org/0000-0001-6685-0938>. Tel: +86-178-5836-0213, E-mail: xiaoxin90@163.com

How to cite this article: Chen H, Xiao X, Wang W, Tong Z, Zhang L, Zhong J, *et al.* The Influence of COVID-19 on the Psychological Well-being of Different Populations in China. *Exploratory Research and Hypothesis in Medicine* 2021;6(3):118–124. doi: 10.14218/ERHM.2020.00067.

In addition, it is known that infectious diseases outbreaks, such as COVID-19, involve enormous stress, extreme fear, and unavoidable anxiety. This might be far-reaching among high-risk groups, such as healthcare workers and other frontline workers that include policemen, armed forces, bankers, and others.⁴

A study in China led by Wang found that in the primary stage of the COVID-19 outbreak, a moderate to severe psychological influence was assessed in >50% of interviewees, and approximately 33% respondents were evaluated to have moderate to severe concern. Women, students, and those with specific physical symptoms experienced more serious psychological effects of the outbreak and higher levels of depression, tension, and panic.⁵

Therefore, panic and anxiety might be included in the emotional responses, fear and distorted concepts of risk often drive negative social actions,⁶ especially in special groups, such as students, recent college graduates, medical staff, older persons, pregnant women, children, and the general public. Therefore, we need to demonstrate solicitude for the mental health of these different populations.

Impact on specific populations

The main impact of COVID-19 outbreak on the mental health of different populations is shown in [Table 1](#).

Table 1. The mental impact of COVID-19 on specific populations

Specific populations	Mental manifestation
Students	Nervous, anxious, stressful, relatively fragile and fear
Recent college graduates	Affected negatively long-term, anxious
Healthcare workers	Dejection, restlessness, sleeplessness, discomfort, heavy depression, disquiet and tribulation
Older persons	Anxiety, loneliness and no social support
Pregnant women	Fragility, depression and anxiety
Children and adolescents	Fear, inattention, depression, and anxiety
General public	Sympathy, grief, loneliness and psychological endurance is poor.

Students

To control the COVID-19 epidemic, the Chinese government took emergency measures to close all schools across the country to curb the spread of infection. Therefore, almost all the students were trapped at home and unable to go to school. Therefore, they had less physical activity, spent more time on the screen, slept more irregularly, and ate less healthy diets, which often led to weight gain and loss of cardiorespiratory fitness. Some students faced the pressure of entering high school or college entrance examinations, and they were nervous and anxious. Their parents were even more anxious. Then, China's Ministry of Education and China's Ministry of Industry and Information Technology (2020) recommend "suspending courses without suspending learning". Therefore, since mid-February 2020, there have been >100 million students gaining knowledge using different learning methods in China, which included online learning platforms based on various methods to achieve their goals.^{7,8}

By living a simple life at home every day, many students' normal social interactions have been forced to stop. The stress that comes from the COVID-19 might be overwhelming. Therefore, managing psychological impact is essential to ensure a long and healthy lifestyle. Campus life and study are critical to the psychological well-being development of college students, and it has been assumed that problems related to family confinement have psychological effects on college students.⁸ In addition, the values and judgments of college students are at an important developmental age and are influenced by social media views and opinions. Therefore, their emotions were relatively fragile.⁸

To help students overcome the fear and anxiety caused by the epidemic, a health-conscious schedule, appropriate diet, physical exercise, good personal hygiene, and good sleeping habits were promoted actively by most schools, and some health improvement materials were included in the school curriculum.^{7,9}

Wang *et al.*⁸ concluded that after the outbreak of COVID-19, college students were more anxious than the general population, which suggested that COVID-19 had a negative impact on the anxiety of college students. During COVID-19, the degree of anxiety among college students was higher than SARS and H1N1.

In addition, Cao *et al.*¹⁰ sampled college students from one medical college in China using cluster sampling and highlighted that college students that suffered from anxiety due to the COVID-19 epidemic accounted for 24.9%. To reduce the spread of COVID-19, the majority of students were forced to stay at home, and most of them were relatively lax and did not take part in proper exercise and social lives.

However, the statistics indicated that some of the students were experiencing stress, dread, or anxiety and were influenced

by the unknown effects of COVID-19. All these factors should be considered when teachers conduct online teaching.⁸ Compared with SARS in 2003 (when college students underwent the same isolation), the internet now plays an important role in rapid information dissemination, open online discussion, and emotional expression. Frequent use of social and electronic media results in exposure to COVID-19 related information. This increased exposure has been shown to increase anxiety and depression. Following the feedback from different types of psychological counseling hotlines for COVID-19 that have been established across China, one of the primary characteristics of student callers is anxiety.⁸ Therefore, the mental health of students needs to be accounted for.

Recent college graduates

The careers of recent college graduates this year might be significantly influenced by the COVID-19 outbreak. The students were severely interrupted in the final stages of their studies and their assessments experienced major interruptions. They might graduate at the start of a severe global recession. Research has indicated that poor market conditions have meant that workers have accepted low-paying jobs, and the careers of numerous recent college graduates could be affected negatively long-term.¹¹

The lives of recent college graduates have been disrupted by the COVID-19 pandemic in various ways. Their learning level and learning processes have been affected and their learning goals have been affected. Students that are about to move from one stage of education to another, such as those transitioning from school to higher education, or from higher education to employment, face special challenges.¹²

Students that have completed half of the assessment from their course might feel anxious until they have a clear understanding of how to resume courses and assessment programs following the crisis. Compared with college students that enter studies normally, a significant number of recent college graduates that have been affected by COVID-19 will be anxious about the long-term adverse effects when entering another level of learning or entering the labor market. Statements from colleges and universities that they will "compassionately" adopt admissions standards might not always be reassuring.¹²

Healthcare workers

Lai *et al.*¹³ conducted an epidemiological survey of 1,257 healthcare workers in 34 Grade A hospitals that had fever clinics or wards in various regions of China, and those who treated treating

COVID-19 patients had a high prevalence of negative psychological well-being symptoms. In addition, it attracted the attention of the mental health of healthcare workers who were busy with the COVID-19 pandemic. They found that among all participants, 50.4%, 44.6%, 34.0%, and 71.5% reported feelings of dejection, restlessness, sleeplessness, and discomfort, respectively. Most of the participants were female employees, nurses, and were aged between 26 and 40 years. Those working in different hospitals in Wuhan reported more serious psychological well-being difficulties. The research further showed that women who had a mid-level technical title experienced heavy depression, disquiet, and tribulation. Frontline work is an independent hazard factor that leads to the deterioration of psychological well-being.¹³

When faced with the pandemic of infectious diseases, the psychological response of medical staff is complex. Emotional fragility or emotionally out-of-control, overwhelming workload, and worrying about their health, family and others, being infected with the virus, job changing, and isolation were the main sources of suffering.⁴

COVID-19 is highly contagious and can be fatal.^{3,14,15} This might increase the awareness of personal danger. In addition, the predicted supply shortages and the influx of numerous suspected and actual COVID-19 cases were exacerbated by the pressure and concerns of health care workers.⁴ Exposure to COVID-19 cases in the hospital, isolation due to COVID-19, death or illness of relatives or friends, and a high degree of self-perception of risk due to the lethality of the virus might have a negative influence on the psychological well-being of medical staff.¹⁶

Medical professionals in countries such as China, which is severely infected with COVID-19, are under tremendous work pressure. Due to the increase in workload that has led to overwork, insufficient protection against contamination, and frustration at the inability to provide adequate patient care, and isolation, an increased number of psychiatric consequences have been caused.¹⁷ Different types of events on vicarious traumatization that is related to psychological stress among nursing staff have been reported successively.¹⁸

Facing the frustration, noncooperation, phobia, and stigmatized patients of COVID-19 that the Chinese medical teams have already experienced, these might exact indifference and dispiritedness among clinicians. A lot of healthcare workers that have been in direct contact with confirmed or suspected COVID-19 patients were kept under observation and isolation, and separation from their families might generate huge emotional losses to them.¹⁷ Those who are working in the hospital and commuting home every day become more anxious, they are concerned about spreading the disease to their family members, especially elderly people with chronic diseases who are at increased risk of serious adverse outcomes.^{4,19}

Older people

The elderly are extremely vulnerable to the risk of infection from COVID-19, in particular, those suffering from chronic diseases (*e.g.*, diabetes, cardiovascular disease, and hypertension). China has the largest aging population in the world. In 2017, there were 241 million elderly people (>60 years old) in the country, which accounted for 17.3% of the total population. Approximately half of them were empty nesters (*e.g.*, no children or their children worked away from home), with almost no social support.²⁰

There are >30 million people >80 years old. Due to disabilities, there were >40 million people who needed to be cared about for a long time. Psychological well-being problems are universal

among the Chinese elderly (≥ 55 years old). According to reports, the prevalence of anxiety symptoms in this population is 23.6%.²⁰

The COVID-19 pandemic has presented a huge challenge for the psychological well-being service to the elderly in the community. During the crisis, a psychology service was established in China; however, there remains a lack of attention to these disadvantaged groups. To acquire timely and efficient crisis psychology services for the elderly that live in the community, related policymakers should strengthen cooperation to overcome obstacles.²⁰

Therefore, older people are struggling with increased health risks and a poorer ability to support themselves independently in isolation. To prevent the spread of disease, social isolation is necessary, but if improperly implemented, such measures might cause older people to increase social distancing when they might need help the most.²¹

Pregnant women

During the COVID-19 outbreak, a particularly vulnerable group might be pregnant women. Mental health disorders commonly occur during pregnancy. Approximately 12% of women feel depressed and as many as 22% of women in the third trimester will feel anxious. In addition, due to increased concerns about fetal vertical transmission, pregnant women might be more prone to anxiety.²²

Yan *et al.*²³ found that the incidence of depressive symptoms in pregnant women assessed after the declaration of the COVID-19 epidemic was significantly higher than that of women assessed before the epidemic declaration (26.0% versus 29.6%, $p = 0.02$). The former were more probable to self-harm ($p = 0.005$). The depression rates were positively correlated with the number of newly confirmed cases of COVID-19 ($p = 0.003$), suspected infections ($p = 0.004$), and deaths per day ($p = 0.001$). Pregnant women that were primiparous, underweight before pregnancy, <35 years old, in the middle-income category, employed full-time, and had adequate living space, had increased risk of anxiety and depressive symptoms during the outbreak. Therefore, strategies for maternal stress and isolation, which includes effective risk communication and psychological first aid measures, might be of significant help to prevent adverse consequences for women and their fetuses.

Children and adolescents

It has been confirmed in the literature that children, in particular, adolescents, are prone to experience psychological well-being problems, and most mental disorders occur in this age group.²⁴ In addition, findings indicate that COVID-19 influences youth psychological well-being and is especially related to anxiety and depression in adolescent cohorts.²⁵ Moreover, Jiao *et al.*²⁶ showed that younger children (3–6 years old) were more prone to appear clingy and to express fear that family members could be infected with COVID-19 and older children (6–18 years old) were more susceptible to inattention (to a small extent) and continuous inquiry. Similarly, in a sample of teenagers (12–18 years old), older teenagers (senior high school) were more probable to report higher symptoms of depression and anxiety than younger teenagers (junior high school).²⁷

Children who face unexpected and unknown events, as in other emergencies and COVID-19, usually show various stress responses. If appropriately supported by healthcare professionals, families, and other social relationships (including the school environ-

Table 2. The mechanism of loneliness and its manifestations

The mechanism of loneliness	Manifestations
Loneliness model	Over-vigilance of social threats in the environment
Gene effects	Changes in sensitivity to social isolation
Sleep	Loneliness and sleep disturbance affect each other
Health behaviors	A decline in the capacity of self-regulation
Immune functioning	Have lower immunity and more inflammation

ment), children and adolescents could properly overcome pain and become emotionally and physiologically stable.²⁶

General public

The psychological stress faced by the general public, especially vicarious traumatization caused by the COVID-19 pandemic, should not be ignored. The vicarious traumatization initially referred to the phenomenon where professional psychotherapists were involuntarily affected by the bidirectional interactions of the relationship between consultation and interview due to long-term contact with patients with mental diseases.²⁸ There were no differences in the scores of vicarious traumatization between ordinary public people and nonfirst-line nurses; however, the severity of vicarious traumatization for ordinary citizens was higher than that of first-line nurses. This discovery might be related to the timely and effective quarantine policy adopted by China in response to the epidemic. Therefore, to minimize the virus transmission as much as possible, the public was called on to reduce face-to-face communication.¹⁸

During the COVID-19 pandemic, a significant number of the general public were forced to stay at home and be quarantined. Therefore, they had time on the internet and social media to acquire information about the epidemics and lives of others (especially COVID-19 patients).¹⁸ The public sympathizes with COVID-19 patients and care about healthcare workers. For public health issues, their psychological endurance is poor.¹⁸ This conception implies that reasonable and effective publicity strategies should be organized to prevent and control the COVID-19 virus transmission.¹⁸

Experiencing the death of relatives or loved ones is one of the most difficult experiences for mankind; however, the coronavirus pandemic meant that it has been more difficult for many people to grieve those they have lost. Because many COVID-19 patients have been forced to quarantine, their family members could not take care of them before they died, or even visit them for the last time. Therefore, even in the company of others, people might feel lonely. Loneliness might be caused by interference in a person's social circle, and sometimes can be accompanied by homesickness, which is caused when people leave for work or to receive an education.^{29,30}

Short-term loneliness usually has little effect on the body. However, long-term loneliness is a harmful condition. This is because prolonged social isolation can increase vigilance for threat and heighten feelings of vulnerability. Increased vigilance might be an evolutionary resilience for people who have been unnoticed for a long time, but it might lead to excessive cynicism and suspicion of others, which might be detrimental to interpersonal relationships. Therefore, without intervention, chronic loneliness increases.³¹ Therefore, attention should be paid to the factors that affect loneliness.

Factors that contribute to loneliness

Loneliness is often described as the absence of any company or isolation from the community or society. It is a dark and painful feeling and is a risk factor for many mental disorders (*e.g.*, anxiety, depression, adjustment disorders, insomnia, chronic stress, and even late-life dementia).³² In addition, loneliness is affected by a great number of factors, which include employment status, socio-economic status, age, and sex.³³ The mechanisms of loneliness are given in Table 2.

The loneliness model

The loneliness model that was hypothesized by Hawkley and Cacioppo recognizes that social quarantine is similar to feeling insecure,³¹ which triggers an implicit over-vigilance of (other) social threats in the environment. Cognitive bias stems from unconscious monitoring of social threats. Compared with nonlonely individuals, a lonely individual usually views the social world as a more harmful place, look for more negative social communications, and retain more negative social information in their memory.³¹ Loneliness occurs when there is a major mismatch between a person's actual social relationships and the social relationships that they need or expect.³⁴

Gene effects

Loneliness has an inherited element. The genetic components are thought to include changes in sensitivity to social isolation, which might cause individuals to feel more or less lonely in similar situations. The nongenetic components include individual differences, which mean loneliness is a long-term social cognitive variation.³⁵

Sleep

Loneliness and sleep disturbance affect each other. Loneliness heightens the feelings of unconscious vigilance and vulnerability against social threats, an implicit cognition that is the opposite of relaxation and sound sleep.³⁶ In contrast, lack of sleep causes social regression and loneliness.²⁹ The relationship between loneliness and poor quality social relationships is related to daytime dysfunction (*e.g.*, hunger, fatigue) and self-described bad sleep quality, but not to sleep time.^{26,37–39} Therefore, in convenience samples with cross-sectional design, the daily functions of lonely people are more impaired than nonlonely people.³⁹

The impact of long-term sleep disruption due to COVID-19 on mental and physical health has been confirmed by research, which indicated that when people are isolated at home, it might be difficult to adapt to the new daily schedule or lack of a schedule. Therefore, they have more irregular sleep patterns, which might be worse for

those who have a relative one who is ill or has passed away from COVID-19. The feelings of loneliness and depression could be more pronounced, and physiologically they become more uncoordinated.⁴⁰

Health behaviors

A decline in the capacity of self-regulation is the consequences of loneliness and veiled alertness against social threats. The feeling of isolation from society weakens an individual's ability to self-regulate.³¹ Loneliness is involved in the probability of health risk behaviors. In addition to direct effects, loneliness might indirectly affect health risk behaviors through stress.^{41,42}

During COVID-19, similar trends of increases in loneliness and isolation were identified in first responders and quarantined people in Wuhan, China. This increased the prevalence of anxiety, depression, post-traumatic stress disorders, and insomnia in the population. In addition, it caused fatigue and reduced the performance of healthcare workers. Therefore, we need to be sensitive to the personalized needs of quarantined people and cater to them.⁴³

Immune functioning

In 2015, Cole *et al.*⁴⁴ conducted a study on the impact of loneliness on overall health. The results found that gene expressions of leukocytes impacted the immune system's ability to respond to infection. The leukocytes of lone participants (humans and macaques) indicated an increased expression of genes associated with inflammation and decreased expression of genes related to antiviral responses.⁴⁴ Loneliness appears to cause long-term fight-or-flight stress signals, which negatively affect the function of the immune system. In summary, people who feel lonely have lower immunity and more inflammation.⁴⁵

Studies found that when it enters a host cell, SARS-CoV-2 is detected by macrophages. Macrophages regulate the production of a pro-inflammatory microenvironment, which inhibits virus replication, stimulates adaptive immunity, and recruits other immune cells to the site of infection. Therefore, helping to enhance antibody production.⁴⁶ Therefore, maintenance of a reasonable diet, proper exercise, and the company of family members could help reduce loneliness and enhance resistance.

Future research directions

More studies are required to explore the pathogenesis of negative mental health problems, such as anxiety and depression. In addition, the appropriate preventive measures must be taken to curb the spread of COVID-19 and its negative psychological impact. First, we should recognize the manifestations of the poor mental states, diagnose them as soon as possible, and take active measures, such as distraction, listening, companionship, reasonable rest, and appropriate exercise to reduce the accumulation of negative emotions. Second, positive energy should be spread using internet communication, stories, and movies to help to identify ways to release emotions to meet the psychological needs of the specific groups of people; therefore, avoiding or reducing the spread of negative emotions.

Conclusions

Major life-threatening public health events, such as COVID-19,

might increase the risk of mental illness among students, recent college graduates, medical staff, older people, pregnant women, children, and the general public. They include anxiety, depression, and thoughts of self-harm. These groups have all suffered psychological shocks to different degrees during COVID-19. COVID-19 has negatively impacted their study, work, and life, and to a small section has caused tragedies. Some key groups were at increased risk, and therefore, it is necessary to pay attention to the mental health of these key groups.

Because of the significant prevalence of moderate to severe psychological symptoms and the subsequent risk for negative social interactions, the pressure that COVID-19 brings to these groups of people might be overwhelming. Being trapped at home and unable to go to school, some students face the added pressure of entering high school or college entrance examinations, which means that they are nervous and anxious. Recent college graduates had the final stages of their studies severely interrupted and the careers of them will be affected negatively long-term. For healthcare workers, frontline work is an independent hazard factor that leads to the deterioration of psychological well-being. Suffering from chronic diseases or if they are empty nesters with almost not no social support, psychological well-being problems are universal among the Chinese elderly. Mental health disorders commonly occur during pregnancy, which is due to increased concerns about fetal vertical transmission; therefore, pregnant women might be more prone to anxiety. Similar to emergencies, such as COVID-19, children who have faced unexpected and unknown events usually show various stress responses. For public health issues, the general public's psychological endurance is extremely poor, because they are prone to loneliness due to being quarantined.

Therefore, a series of psychological intervention measures should be adopted by relevant departments to monitor the psychological state of the key groups. During a crisis, decision makers, students, recent college graduates, medical staff, the public, the elderly and other groups might face a series of psychological pressures. The risks to these vulnerable groups should be considered in advance, and the necessary preventive measures should be taken to control the spread of COVID-19 and its negative psychological impact.⁴⁷

Acknowledgments

None.

Funding

This study was funded by the Key Public Welfare Projects of Huzhou City (No.2020GZT01).

Conflict of interest

The authors declare no conflicts of interest regarding the publication of this manuscript.

Author contributions

Drafting the manuscript (CHY, TY, SB, ZQQ, LXF, ZXS), searching the databases and extracting the data (ZJF, WHW, TZW, CXF,

ZLQ, XX), critically revising the manuscript (CHY, XX). All authors contributed to the final version of the manuscript.

References

- [1] Xu X, Yu C, Qu J, Zhang L, Jiang S, Huang D, *et al.* Imaging and clinical features of patients with 2019 novel coronavirus SARS-CoV-2. *Eur J Nucl Med Mol Imaging* 2020;47(5):1275–1280. doi:10.1007/s00259-020-04735-9.
- [2] Report of the WHO–China Joint Mission on Coronavirus Disease 2019 (COVID-19). Updated on February 28, 2020. Available from: [https://www.who.int/publications/i/item/report-of-the-who-china-joint-mission-on-coronavirus-disease-2019-\(covid-19\)](https://www.who.int/publications/i/item/report-of-the-who-china-joint-mission-on-coronavirus-disease-2019-(covid-19)).
- [3] UN Committee for the Coordination of Statistical Activities. How COVID-19 is changing the world: a statistical perspective. September 2020. Available from: <https://openknowledge.worldbank.org/handle/10986/33773>.
- [4] Dubey S, Biswas P, Ghosh R, Chatterjee S, Dubey MJ, Chatterjee, *et al.* Psychosocial impact of COVID-19. *Diabetes Metab Syndr* 2020;14(5):779–788. doi:10.1016/j.dsx.2020.05.035.
- [5] Wang C, Pan R, Wan X, Tan Y, Xu L, Ho CS, *et al.* Immediate psychological responses and associated factors during the initial stage of the 2019 coronavirus disease (COVID-19) epidemic among the general population in China. *Int J Environ Res Public Health* 2020;17(5):1729. doi:10.3390/ijerph17051729.
- [6] Ćosić K, Popović S, Šarlija M, Kesedžić I. Impact of human disasters and COVID-19 pandemic on mental health: potential of digital psychiatry. *Psychiatr Danub* 2020;32(1):25–31. doi:10.24869/psyd.2020.25.
- [7] Brazendale K, Beets MW, Weaver RG, Pate RR, Turner-McGrievy GM, Kaczynski AT, *et al.* Understanding differences between summer vs. school obesogenic behaviors of children: the structured days hypothesis. *Int J Behav Nutr Phys Act* 2017;14(1):100. doi:10.1186/s12966-017-0555-2.
- [8] Wang C, Zhao H. The impact of COVID-19 on anxiety in Chinese university students. *Front Psychol* 2020;11:1168. doi:10.3389/fpsyg.2020.01168.
- [9] Briguglio M, Vitale JA, Galentino R, Banfi G, Dina CZ, Bona A, *et al.* Healthy eating, physical activity, and sleep hygiene (HEPAS) as the winning triad for sustaining physical and mental health in patients at risk for or with neuropsychiatric disorders: considerations for clinical practice. *Neuropsychiatr Dis Treat* 2020;16:55–70. doi:10.2147/NDT.S229206.
- [10] Cao W, Fang Z, Hou G, Han M, Xu X, Dong J, *et al.* The psychological impact of the COVID-19 epidemic on college students in China. *Psychiatry Res* 2020;287:112934. doi:10.1016/j.psychres.2020.112934.
- [11] d’Orville H. COVID-19 causes unprecedented educational disruption: Is there a road towards a new normal? *Prospects (Paris)* 2020;49:11–15. doi:10.1007/s11125-020-09475-0.
- [12] Daniel SJ. Education and the COVID-19 pandemic. *Prospects (Paris)* 2020;49:91–96. doi:10.1007/s11125-020-09464-3.
- [13] Lai J, Ma S, Wang Y, Cai Z, Hu J, Wei N, *et al.* Factors associated with mental health outcomes among health care workers exposed to coronavirus disease 2019. *JAMA Netw Open* 2020;3(3):e203976. doi:10.1001/jamanetworkopen.2020.3976.
- [14] Lai CC, Shih TP, Ko WC, Tang HJ, Hsueh PR. Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and coronavirus disease-2019 (COVID-19): The epidemic and the challenges. *Int J Antimicrob Agents* 2020;55(3):105924. doi:10.1016/j.ijantimicag.2020.105924.
- [15] Habibzadeh P, Stoneman EK. The novel coronavirus: A bird’s eye view. *Int J Occup Environ Med* 2020;11(2):65–71. doi:10.15171/ijomem.2020.1921.
- [16] Greenberg N, Docherty M, Gnanapragasam S, Wessely S. Managing mental health challenges faced by healthcare workers during covid-19 pandemic. *BMJ* 2020;368:m1211. doi:10.1136/bmj.m1211.
- [17] Kang L, Li Y, Hu S, Chen M, Yang C, Yang BX, Wang Y, *et al.* The mental health of medical workers in Wuhan, China dealing with the 2019 novel coronavirus. *Lancet Psychiatry* 2020;7(3):e14. doi:10.1016/S2215-0366(20)30047-X.
- [18] Li Z, Ge J, Yang M, Feng J, Qiao M, Jiang R, *et al.* Vicarious traumatization in the general public, members, and non-members of medical teams aiding in COVID-19 control. *Brain Behav Immun* 2020;88:916–919. doi:10.1016/j.bbi.2020.03.007.
- [19] Chen Q, Liang M, Li Y, Guo J, Fei D, Wang L, *et al.* Mental health care for medical staff in China during the COVID-19 outbreak. *Lancet Psychiatry* 2020;7(4):e15–e16. doi:10.1016/S2215-0366(20)30078-X.
- [20] Yang Y, Li W, Zhang Q, Zhang L, Cheung T, Xiang YT. Mental health services for older adults in China during the COVID-19 outbreak. *Lancet Psychiatry* 2020;7(4):e19. doi:10.1016/S2215-0366(20)30079-1.
- [21] Schröder I. COVID-19: a risk assessment perspective. *ACS Chem Health Saf* 2020;27(3):160–169. doi:10.1021/acs.chas.0c00035.
- [22] Woody CA, Ferrari AJ, Siskind DJ, Whiteford HA, Harris MG. A systematic review and meta-regression of the prevalence and incidence of perinatal depression. *J Affect Disord* 2017;219:86–92. doi:10.1016/j.jad.2017.05.003.
- [23] Wu Y, Zhang C, Liu H, Duan C, Li C, Fan J, *et al.* Perinatal depressive and anxiety symptoms of pregnant women during the coronavirus disease 2019 outbreak in China. *Am J Obstet Gynecol* 2020;223(2):240.e1–240.e9. doi:10.1016/j.ajog.2020.05.009.
- [24] Paus T, Keshavan M, Giedd JN. Why do many psychiatric disorders emerge during adolescence? *Nat Rev Neurosci* 2008;9(12):947–957. doi:10.1038/nrn2513.
- [25] Nearchou F, Flinn C, Niland R, Subramaniam SS, Hennessy E. Exploring the impact of COVID-19 on mental health outcomes in children and adolescents: a systematic review. *Int J Environ Res Public Health* 2020;17(22):8479. doi:10.3390/ijerph17228479.
- [26] Jiao WY, Wang LN, Liu J, Fang SF, Jiao FY, Pettoello-Mantovani M, *et al.* Behavioral and emotional disorders in children during the COVID-19 epidemic. *J Pediatr* 2020;221:264–266.e1. doi:10.1016/j.jpeds.2020.03.013.
- [27] Zhou SJ, Zhang LG, Wang LL, Guo ZC, Wang JQ, Chen JC, *et al.* Prevalence and socio-demographic correlates of psychological health problems in Chinese adolescents during the outbreak of COVID-19. *Eur Child Adolesc Psychiatry* 2020;29(6):749–758. doi:10.1007/s00787-020-01541-4.
- [28] Patel-Kerai G, Harcourt D, Rumsey N, Naqvi H, White P. The psychosocial experiences of breast cancer amongst Black South Asian and White survivors do differences exist between ethnic groups. *Psychooncology* 2017;26(4):515–522. doi:10.1002/pon.4187.
- [29] Benson H, Casey A, editors. *Stress Management*, Harvard Medical School Special Health Report. Harvard Medical School; 2011.
- [30] World Health Organization. COVID-19 strategy update, 14 April 2020. Available from: <https://www.who.int/publications/i/item/covid-19-strategy-update---14-april-2020>.
- [31] Hawkey LC, Cacioppo JT. Loneliness matters: a theoretical and empirical review of consequences and mechanisms. *Ann Behav Med* 2010;40(2):218–227. doi:10.1007/s12160-010-9210-8.
- [32] Wilson RS, Krueger KR, Arnold SE, Schneider JA, Kelly JF, Barnes LL, *et al.* Loneliness and risk of Alzheimer disease. *Arch Gen Psychiatry* 2007;64(2):234–240. doi:10.1001/archpsyc.64.2.234.
- [33] Ben Simon E, Walker MP. Sleep loss causes social withdrawal and loneliness. *Nat Commun* 2018;9(1):3146. doi:10.1038/s41467-018-05377-0.
- [34] Yasmin S, Firdous S, Saqib S, Khatoun T. Fear of negative evaluation, loneliness and life orientation of never married men and women. *Journal of Health, Medicine and Nursing* 2020;71:26–51. doi:10.7176/JHMN/71-05.
- [35] Sieber WJ. Listening to the body understanding the language of stress-related symptoms. 2020.
- [36] Chung J. Social support, social strain, sleep quality, and actigraphic sleep characteristics: evidence from a national survey of US adults. *Sleep Health* 2017;3(1):22–27. doi:10.1016/j.sleh.2016.10.003.
- [37] Friedman EM, Hayney MS, Love GD, Urry HL, Rosenkranz MA, Davidson RJ, *et al.* Social relationships, sleep quality, and interleukin-6 in aging women. *Proc Natl Acad Sci U S A* 2005;102(51):18757–18762. doi:10.1073/pnas.0509281102.
- [38] Jung FU, Luck-Sikorski C. Overweight and lonely? A representative study on loneliness in obese people and its determinants. *Obes Facts* 2019;12(4):440–447. doi:10.1159/000500095.
- [39] Hawkey LC, Preacher KJ, Cacioppo JT. Loneliness impairs daytime functioning but not sleep duration. *Health Psychol* 2010;29(2):124–

129. doi:10.1037/a0018646.
- [40] Leung TYM, Chan AYL, Chan EW, Chan VKY, Chui CSL, Cowling BJ, *et al*. Short-and potential long-term adverse health outcomes of COVID-19: a rapid review. *Emerg Microbes Infect* 2020;9(1):2190–2199. doi:10.1080/22221751.2020.1825914.
- [41] Algren MH, Ekholm O, Nielsen L, Ersbøll AK, Bak CK, Andersen PT. Social isolation, loneliness, socioeconomic status, and health-risk behaviour in deprived neighbourhoods in Denmark: A cross-sectional study. *SSM Popul Health* 2020;10:100546. doi:10.1016/j.ssmph.2020.100546.
- [42] Hämmig O. Health risks associated with social isolation in general and in young, middle and old age. *PLoS One* 2019;14(7):e0219663. doi:10.1371/journal.pone.0219663.
- [43] Torales J, O'Higgins M, Castaldelli-Maia JM, Ventriglio A. The outbreak of COVID-19 coronavirus and its impact on global mental health. *Int J Soc Psychiatry* 2020;66(4):317–320. doi:10.1177/0020764020915212.
- [44] Cole SW, Capitanio JP, Chun K, Arevalo JMG, Ma J, Cacioppo JT. Myeloid differentiation architecture of leukocyte transcriptome dynamics in perceived social isolation. *Proc Natl Acad Sci U S A* 2015;112(49):15142–15147. doi:10.1073/pnas.1514249112.
- [45] Bao Y, Sun Y, Meng S, Shi J, Lu L. 2019-nCoV epidemic: address mental healthcare to empower society. *Lancet* 2020;395(10224):e37–e38. doi:10.1016/S0140-6736(20)30309-3.
- [46] Cunha LL, PerazzioSF, Azzi J, Cravedi P, Riella LV. Remodeling of the immune response with aging: immunosenescence and its potential impact on COVID-19 immune response. *Front Immunol* 2020;11:1748. doi:10.3389/fimmu.2020.01748.
- [47] Koinis A, Giannou V, Drantaki V, Angelaina S, Stratou E, Saridi M. The impact of healthcare workers job environment on their mental-emotional health. Coping strategies: the case of a local general hospital. *Health Psychol Res* 2015;3(1):1984. doi:10.4081/hpr.2015.1984.