Biopsychosocial Processes of Health and Disease During the COVID-19 Pandemic

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ABSTRACT

The biopsychosocial model provides a useful perspective for understanding the development and characteristics of the COVID-19 pandemic and its anticipated long-term consequences for society as well as individuals. This article provides a biopsychosocial perspective on the COVID pandemic and an editorial comment on the articles in this Special Issue of Psychosomatic Medicine. Based on analysis of the PubMed database, it is shown that the attention to psychological and social factors is 74% higher in COVID-19-related articles compared to all other health-related scientific articles published during the same time-period (between 1/1/2020 and 4/18/2021). Specifically, 18.6% of the ≈123,500 articles addressing COVID-19-related topics also included psychological or social factors in their content vs. 10.7% of articles that did not address COVID-19. The biopsychosocial model is relevant to understanding the interrelationships among risk factors and the multidimensional clinical and psychosocial COVID-19 outcomes. Clinical outcomes directly related to COVID-19 range from severe but rare events (mortality and intensive care treatment) to less severe common outcomes such as positive screening tests for COVID-19 with or without symptoms. In addition, psychosocial outcomes range in severity from frequently observed reduced psychological wellbeing to less common clinical mood and anxiety disorders and, in rare cases, suicidality. The COVID-19 pandemic is characterized by an unusually strong and short-term link between social factors and biological aspects of the disease, without mediating psychological factors. After a review of the articles presented in this Special Issue, this editorial concludes with suggestions for biopsychosocial models in research on COVID-19 and other large-scale health threats.

Key words: biopsychosocial, COVID-19, psychology, social factors, behavior, risk factors, corona virus, review.

The COVID-19 pandemic is characterized by strong interactions among biological, psychological and social processes. The biopsychosocial model (1) is therefore critically important to the understanding of health risks and disease consequences of the COVID-19 pandemic. Biopsychosocial approaches are also useful to optimize preventive strategies targeting exposure and vulnerability to COVID-19 as well as the development and improvement of immediate and long-term interventions. These contributions can take place at the population level and also in the treatment of individuals infected with the virus. In this editorial, a perspective is presented on: (1) the exponential growth in the published scientific literature addressing the COVID-19 pandemic and its social and psychological aspects; (2) the social, psychological, and biological components of the biopsychosocial model as related to COVID-19; and (3) a summary of the articles that appear in this Special Issue of Psychosomatic Medicine on COVID-19.

The scientific literature addressing COVID-19-related issues has grown exponentially since the emergence of the virus at the end of 2019. The social and behavioral sciences have added significantly to this literature, including work from experts in psychosomatic medicine, health psychology, and behavioral medicine. To illustrate the magnitude of the scientific contributions in this area, the PubMed database was searched on the terms “(corona OR covid)”, which revealed a total of approximately 123,500 articles for the period from January 1, 2020, through April 18, 2021, indicating that circa 7% of all ≈1,900,000 biomedical scientific publications in that period have in some way addressed the COVID-19 pandemic. Limiting this search to articles that also address social or psychological factors (i.e., adding “AND (psychol* OR social*)” to the search terms) resulted in a total of 22,944 remaining articles, suggesting that more than 1 in 6 (18.6%) articles about COVID-19 also included psychological or sociological content. This is substantially higher (i.e., 74%) than the number of papers with a focus on social or psychological factors included in the PubMed database that did not address COVID-19-related issues (about 1 in 10) in the same time period (212,219/(1,900,000–123500) = 10.7%). However, specific mention of the biopsychosocial perspective was relatively rare, with only 81 articles mentioning the term in the title or abstract and 16 in the title (e.g., (2,3)), which can be used as an overall index of how central the topic was in the article. These numbers, although not reflecting a formal literature search, indicate that the behavioral and social sciences have added substantially...
to the scientific literature on the COVID-19 pandemic and that a biopsychosocial perspective might add important insights into the prevention and treatment of the short-term disease complications and its long-term consequences.

Figure 1 presents a conceptual model based on biopsychosocial research over the past 50 years since the term was coined by Dr. George L. Engel in 1977 (1) and incorporating recent work on the social and psychological factors that play a role in the COVID-19 pandemic. The biopsychosocial factors displayed in the left part of the figure result in exposure and vulnerability factors for adverse COVID-19 outcomes. The clinical COVID-19 outcomes (middle part) range from relatively rare severe disease manifestations such as mortality and intensive care treatment, to more common and less severe outcomes (e.g., a positive screening test for COVID-19 with or without signs or symptoms of infection). The psychosocial outcomes also range in severity from relatively rare events (e.g., suicidality (4)) to clinical psychological outcomes such as mood and anxiety disorders (5), poor sleep (6), burnout and exhaustion (particularly among health care workers) (7), to very common but less severe outcomes (e.g., high levels of perceived stress and reduced psychological well-being) (see also articles in this issue of the journal). Psychological outcomes of COVID-19 can further increase the risk or severity of its clinical manifestations. The COVID-19 pandemic is not limited to short-term consequences; it is increasingly clear that adverse long-term effects can be expected (right part of the figure), which also have biological, psychological and social aspects. These include adverse economic consequences at the societal and individual level, including increased socioeconomic disparities, reduced education (8) and employment opportunities (9), post stress-related psychological disorders and symptoms (10) and, importantly, post-viral infection symptoms (11,12) (e.g., fatigue, poor sleep, respiratory problems, cognitive problems such as poor concentration, memory, and sustained attention).

Social factors are associated with adverse COVID-19 outcomes (13,14). The effects of these social factors on the likelihood of contracting COVID-19 infection and worse clinical outcomes are unusually strong and short-term, in contrast to most other contexts in which the link between social factors and the manifestation of disease outcomes typically takes years to decades. Large-scale (macro) social factors (e.g., laws and regulations) have direct consequences for the biological aspects of the infectious disease, including virus exposure, individual exposure and access to optimal medical care. National and local governments play essential roles in preventive strategies, vaccination programs, and resource allocations to hospitals and other health care facilities (see Figure 1). There is an increasing need for international collaboration in areas such as travel, trade, production and access to vaccines, information exchange, and other areas to reduce the threats associated with the COVID-19 pandemic. In addition, the standard application of the biopsychosocial model focuses on the “per level” approach linking the various levels of the model, for example, factors at the social level are assumed to influence factors at the individual psychological and behavioral level and these individual factors in turn influence the individual’s biological processes. However, the COVID-19 pandemic is characterized by unusually strong and short-term links between societal factors to biological factors relevant to disease vulnerability, thereby partly ‘skipping’ the step of mediation via individual psychological factors. The role of behavioral factors (e.g., physical or social distancing and

![Biopsychosocial Factors and COVID-19 Outcomes](https://example.com/biopsychosocial-diagram.png)

**FIGURE 1.** The biopsychosocial model as related to clinical and psychosocial outcomes of COVID-19. The left part shows the social, psychological and biological components of the biopsychosocial model, the middle part displays the COVID-19 clinical and psychological outcomes, with rare events at the top of the triangles and more common events at the base. The right part displays the long-term outcomes after the acute phase of COVID-19 has passed (see text for additional details).
other COVID-19 protective behaviors) in this context is critically important and is related to social, cultural, and individual personality factors (see Hall et al. in this issue of *Psychosomatic Medicine* (15)).

Psychological factors are part of the individual “person” level of the biopsychosocial model (1), including experiences (e.g., affect and cognitions) and behaviors. The COVID-19 pandemic is associated with perceived threat, experiences of loss, loneliness/social isolation and lack of control. These individual psychological experiences can lead to outcomes ranging from elevated levels of general psychological distress and reduced well-being to severe psychopathology and suicidality (4). These psychological outcomes can be a reaction to having COVID-19 (Figure 1, middle part), but more often result from the multiple macro-social consequences of COVID-19 which have had a substantial impact on smaller social groups (i.e., schools, universities, religious groups, professional and non-professional associations, etc.), families and groups of close friends (i.e., the link between biopsychosocial factors with COVID-19 outcomes in Figure 1). For example, government-based interventions to curtail the COVID-19 pandemic involve major changes to societal processes, including restrictions on social behavior, “lockdowns”, curfews, closing of businesses, reduction of public transportation and (international) travel. These government-based interventions can result in psychological distress because of their direct consequences on daily life and also because they are sometimes not consistent with the legal rights or usual customs of individuals and groups and enforced by short-term laws and regulations that might not have gone through the usual evaluation processes. Adverse COVID-19-related psychosocial outcomes can additionally be exacerbated by individual psychological vulnerability factors such as personality, early life adversity, and genetic factors. The long-term consequences of social isolation following government-initiated regulations (e.g., lack of visitors in nursing homes, restriction to the home in families where violence is a problem), and job loss are difficult to quantify at this stage, but are likely to resonate for a long time. The psychological outcomes of the COVID-19 pandemic also include non-social factors, such as perceived threat related to fear of becoming infected, distress associated with actually contracting the disease, and worries about long-term post-COVID-19 disease-related factors such as fatigue or other persisting symptoms and cognitive problems (i.e., post-viral syndromes).

Behavioral factors play an important role in COVID-19, at the individual “person level” as well as “higher” levels of the biopsychosocial model (i.e., the behaviors of family members, friends, and larger groups; for a review see (15)). Two behavioral domains are particularly relevant to COVID-19. In the first place, behaviors specific to COVID-19 including social distancing, minimizing travel, adhering to protective measures such as wearing masks and hand washing, staying home and/or getting tested when symptomatic, and getting vaccinated. These behaviors are critically important in pandemics as they influence exposure to and spreading of the virus. Individual differences in these behaviors depend on social, cultural and psychological factors. A second domain of COVID-19-relevant behaviors includes health-related behaviors such as smoking, poor dietary habits and suboptimal weight management, and overuse of alcohol and/or other substances. Evidence also suggests that behaviors such as physical activity and adequate sleep can reduce the risk of COVID-19 as they have beneficial effects on the biology of the disease.

The biological processes involved in COVID-19 are complex and described in more detail elsewhere (15). In brief, the virus responsible for the COVID-19 pandemic, the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), is unusually contagious and can result in severe and life-threatening conditions, primarily affecting the respiratory system. However, the occurrence of clinically severe outcomes is relatively rare compared to other high-risk viral epidemics, and the main threat is the spread of the disease and the lack of sufficient hospital capacity to treat the number of patients that end up developing life-threatening conditions. High-risk groups for adverse COVID-19 progression include individuals with low socioeconomic resources, minority groups, individuals with chronic medical conditions, including diabetes mellitus, individuals with obesity, among others. In addition to these general risk factors, psychoneuroimmunology research has shown that high levels of psychological distress are associated with impaired functioning of the immune system (16) and autonomic nervous system dysregulation (5). Systematic laboratory research by Cohen and colleagues found that, when young adults are exposed to a cold or influenza virus that typically causes respiratory complaints, those with high levels of psychological distress, current smokers, and individuals with suboptimal intake of vitamin C, experienced more respiratory problems when monitored in quarantine (in groups of participants) for up to 6 days (17). In contrast, usual physical activity levels, adequate and efficient sleep, moderate alcohol intake, social integration, and perceived social support were associated with a lower risk of respiratory problems (17). Of particular relevance to COVID-19 is the reduced anti-viral response among individuals with depression or other psychological conditions associated with high levels of distress (18). Furthermore, evidence has shown that psychological distress may adversely affect the response to vaccines (19,20), but current evidence supporting benefits of psychological interventions to enhance the antibody response to vaccination is limited (21). The role of genetic factors and gene-environment interactions in this context still needs systematic investigation.

In this special issue of *Psychosomatic Medicine*, a series of articles is presented in which biopsychosocial risk factors and outcomes of COVID-19 play a central role. Hall and colleagues (15) provide a comprehensive review of the biological characteristics of COVID-19 and discuss critical behavioral aspects of exposure and vulnerability to adverse clinical outcomes. The authors summarize critical evidence supporting the association of affective, cognitive, behavioral, and socioeconomic factors with the spread of infection, response precautions, and outcomes of government-based “mitigation measures.” Individuals living with severe mental illness and/or chronic medical diseases are at high risk of adverse outcomes, and the authors show that technological innovations might prove useful in improving outcomes and reducing COVID-19-related risks. In a cross-sectional study by Wang and colleagues (22) the affective consequences of COVID-19 are documented in Wuhan, China, where the first major adverse consequences of the COVID-19 pandemic occurred. This team, being at the core of the early phases of the pandemic, documented that participants from Wuhan had a higher prevalence of mental health problems compared to participants from other parts of China (46.6% vs. 32.2%; covariate-adjusted odds ratio (OR) = 1.89, 95% confidence
interval (CI) = 1.65–2.17), with the highest risk for anxiety (15.2% vs. 6.2%; OR = 2.65, 95%CI = 2.14–3.29) and depression (18.3% vs. 9.7%; OR = 2.11, 95%CI = 1.74–2.54). The prevalence of suicidal ideation during the COVID-19 epidemic in Wuhan was 10.5%. Only 7.1% of participants reported seeking help for mental health issues and 3.5% received treatment. Results from the UK revealed consistent findings, as shown by Pieh and colleagues (23), with more mental health problems in individuals younger than 35 years, women, people with no work, and people with low income. During COVID-19, several groups are at high risk of mental health problems, and Bo and colleagues (24) showed that pregnancy was associated with high levels of depression, particularly among women who experienced delays in prenatal care as a consequence of COVID-19-related limitations in prenatal care resources. Jowett et al. (25) found that of the post-traumatic symptom clusters that develop in response to COVID-19, a sense of threat was most strongly related to somatic complaints. The association between post-traumatic stress disorder (PTSD) and psychophysiological risk factors is addressed in a study by Ginty and colleagues (26). This intriguing study found that heart rate reactivity to a mental challenge task predicted subsequent PTSD symptoms of intrusion and hyperarousal, but not avoidance, whereas no associations with blood pressure reactivity were found. Bourassa et al. (27) used novel technologies (large-scale GPS tracking) to determine the effects of government-issued stay-at-home orders on physical movement (i.e., remaining within 1 mile of home and overall vehicle miles driven per day). It was found that these orders resulted in corresponding changes in mobility, but the magnitude of these changes was relatively minor. Willrot et al. (28) showed that the personality factor agreeableness was associated with compliance to government-issued behavioral guidelines.

The studies in this Special Issue mentioned so far focused on individuals in the general population. When examining patients admitted for clinically severe COVID-19 in Wuhan, Li et al. (29) found high levels of anxiety (56.3%) and depression (39.3%), with female sex, widowhood, and COVID-19 disease duration as potential risk factor for both conditions. In addition to patients with COVID-19, health care workers who take care of severely ill patients also experience reduced psychological well-being and a higher prevalence of psychological disorders, possibly resulting from high levels of psychological strain. Wang et al. (30) found that acute stress disorder is common (38.3%) among health professionals in Wuhan. Acute stress disorder was also associated with physical symptoms (30). High levels of psychological distress were also reported in primary care physicians during the peak of the COVID-19 epidemic in Chengdu city, province of Sichuan, China as shown by Zeng et al. (31). High levels of distress were related to perceived low preparedness and high levels of work and personal life impact. A systematic review of 35 articles by Yan et al. (32) covering data from 25,343 health care professionals indicated that fear-related symptoms (67%) and high levels of perceived stress (56%) were the most commonly reported psychological problems, followed by anxiety symptoms (41%), insomnia (41%), post-traumatic stress disorder symptoms (38%), depressive symptoms (27%), and somatic symptoms (16%). In aggregate, the findings reported in this Special Issue of Psychosomatic Medicine indicate a high prevalence of mental health and other psychosocial problems during the COVID-19 pandemic, particularly among young adults and individuals with low socioeconomic resources in the general population, patients hospitalized with COVID-19 symptoms, and (frontline) health care professionals. Anxiety and a sense of COVID-19 related threat may increase the risk of developing somatic symptoms in general, and possibly corona virus infection-related symptoms. Elevated autonomic nervous system responsiveness to mental stressors may further increase the risk of developing mental health problems. Individuals who experience mental health problems during the COVID-19 pandemic may also have an increased risk of developing long-term post-COVID-19 adverse mental and physical health outcomes and future studies are needed to evaluate whether these high-risk groups could benefit from early intervention programs.

This selective review highlights the importance of the biopsychosocial model in optimizing the response to the COVID-19 pandemic. Although this model has been criticized as being too vague, insufficiently specific on how the three main factors of the model interact, and inadequately considering an individual's subjective/personal experiences (e.g., (33)), the biopsychosocial model remains a valuable alternative to the biomedical model it intended to expand upon (34). In addition, models focusing on social and structural determinants of health (e.g., as proposed by the World Health Organization) could be considered as additional perspectives on the COVID-19 pandemic because they are more explicit about macro-social factors. However, the biopsychosocial model also specifically addresses these “higher order” socioeconomic and cultural levels in addition to the biological, psychological and social factors mentioned in this article. For example, it is possible that collectivist cultures and also countries with a relative totalitarian government structure are better equipped than individualistic cultures and democratically organized countries to efficiently respond to the social challenges related to a large-scale infectious epidemic such as COVID-19. At the biosphere level—i.e., the “top level” of the biopsychosocial model—it has been found that air pollution was reduced at the peak of lockdown and travel restriction (35). The COVID-19 pandemic has created enormous suffering worldwide, causing high levels of distress, substantial societal, and individual disease burden, and already over 3 million deaths in the 15 months after the report of the first cases in December 2019. Despite the clearly devastating effects, there have also been a few positive points related to the COVID-19 pandemic (36), including the increased use of the internet for social communication and connectedness (37) and major advances in the application and progress of telecommunication, telemedicine, and telemonitoring (for example, (38)). These positive aspects also have biopsychosocial underpinnings and are essential in promoting resilience at the societal and individual level. Research methods other than cross-sectional designs are needed to unravel the role of biopsychosocial processes in large-scale public health threats. The behavioral subcomponent of the biopsychosocial model is of particular importance in infectious disease pandemics (see Figure 1). The negative consequences of the COVID-19 pandemic far outweigh the positive ones and the major effects of psychosocial factors, such as social isolation, on health make it clear that the biomedical model is not sufficient to fully understand patterns of health and well-being, illness and disease risks. Social and psychological determinants of health are increasingly incorporated in the diagnosis and treatment of diseases in clinical care settings.
and the COVID-19 pandemic will likely accelerate the attention paid to biopsychosocial factors in routine health care. It is likely that the COVID-19 pandemic will have long-term adverse outcomes and not be the last infectious large-scale health challenge that requires an integrated global response. The present experiences and scientific findings emphasizing the importance of biopsychosocial factors in COVID-19 should help preparedness and effective responsiveness to future large-scale health threats.

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