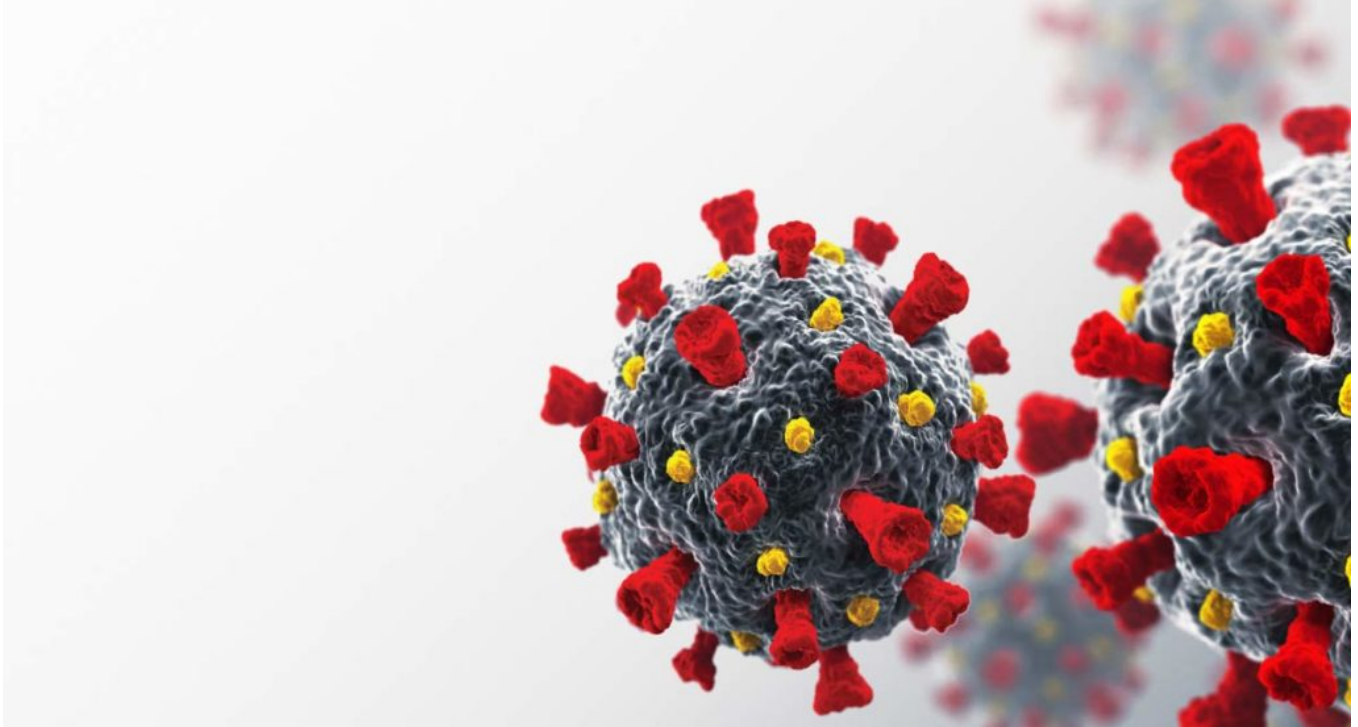


Psychology Meets Biology in COVID-19: Past, Present, and the Road to Recovery

April 29, 2022



Psychological scientists have long known that psychological and social factors can affect our responses to viral infections and vaccinations, but that critical connection seems to have eluded many of the public health officials and others charged with leading the global response to the COVID-19 pandemic in its early days. That costly disconnect, along with hope that broader understanding of psychobiological factors could shape the road to recovery, weighed heavily on the attendees of a January 21 webinar exploring the intersection of psychology and biology in COVID-19. Produced by the [APS Global Collaboration on COVID-19](#), the live webinar featured presentations from 11 leading scientists and attracted hundreds of participants from around the world.

Speakers presented an overview of what was known before the COVID-19 pandemic about the importance of psychosocial factors for health and physiology, what research conducted during the pandemic has revealed about those factors' interconnections and implications, and how those factors may shape the road to recovery by influencing people's response to vaccines and the long-term effects of inflammation (e.g., long COVID).

The APS Global Collaboration on COVID-19 convenes psychological scientists and other behavioral science experts to assess how the field has contributed to combating the COVID-19 pandemic and to identify gaps in understanding that should be addressed through new research. Learn more about the initiative, and view a recording of this and a December 9 webinar on mental health in a global pandemic, at psychologicalscience.org/covid-initiative.

Sarah Pressman (University of California, Irvine) moderated the 2-hour webinar, which also included a lively audience discussion. The event was co-organized by Kavita Vedhara and Kieran Ayling (University of Nottingham), Pressman and Cameron Wiley (University of California, Irvine), and Anna Marsland and Emily Jones (University of Pittsburgh).

Presenters

Keely A. Muscatell (University of North Carolina at Chapel Hill) is a social neuroscientist and psychoneuroimmunologist studying how social experiences influence the brain and the immune system. Her research examines how stress, economic deprivation, racial discrimination, and social support are represented in the brain and lead to physiological changes that influence health and well-being.

Anna L. Marsland (University of Pittsburgh) focuses on pathways linking psychosocial, demographic, and environmental factors to immune function and immune-related health. In particular, she has contributed to current understanding of the impact of psychological stress on immune function and on magnitude of response to vaccination.

Rodlescia S. Sneed (Michigan State University) is a social and health psychologist whose work focuses on community-engaged research in marginalized communities. She is interested in evaluating and improving successful aging among minority and economically vulnerable older adults and in understanding and potentially modifying social and psychological factors that contribute to health inequities.

Adam Geraghty (University of Southampton) is an academic psychologist working in primary care medicine who is interested in the nature of stress, its relation to depression and impacts in primary care medicine; the development and evaluation of behavioral interventions for long-term symptoms and of preventative interventions; and the psychological impacts of COVID-19.

Kavita Vedhara (University of Nottingham) is a behavioral scientist whose research focuses on whether emotional health affects physical health and whether psychological interventions can improve disease and treatment outcomes. During the pandemic, Vedhara and her colleagues have designed studies to look at how the pandemic has affected mental health in the United Kingdom and New Zealand, whether mental health influences stress biology and likelihood of contracting COVID-19, and psychological and behavioral influences on how well COVID-19 vaccines work. They also developed a website to support people in making decisions about getting a COVID-19 vaccine (www.covidvaxfacts.info).

Hannah M. C. Schreier (The Pennsylvania State University) is a health psychologist by training who is interested in how experiences, such as growing up in low-socioeconomic-status environments or experiencing child maltreatment, influence chronic-disease risk among children and adolescents. To this end, she focuses primarily on inflammatory and metabolic outcomes.

Julianne Holt-Lunstad (Brigham Young University) is interested in understanding long-term health effects, biological mechanisms, and effective risk-mitigation and protective strategies associated with social connection. Her work has been seminal in the recognition of social isolation and loneliness as risk factors for early mortality. She serves as a scientific advisor and consults regularly for organizations

across sectors aimed at bridging evidence and application.

Judith T Moskowitz (Northwestern University Feinberg School of Medicine) trained as a social psychologist and has studied behavioral and psychosocial factors in the context of stressful life experiences. Her current research is focused on the adaptive role of positive emotion regulation in supporting beneficial health behaviors (e.g., engagement in care) and preventing maladaptive health behaviors (e.g., substance abuse).

Julienne Bower (University of California, Los Angeles) focuses broadly on bidirectional interactions between psychological states and the immune system among individuals facing stressful life events. One line of her work examines how stress influences immune function and health and investigates resilience factors that may buffer against the negative effects of stress exposure.

Neetu Abad (CDC) is a senior behavioral scientist and lead of the CDC's Demand for Immunization team in the Global Immunization Division. She also co-led the U.S.-based Vaccine Confidence and Demand Team in the CDC's COVID-19 Vaccine Task Force. Her work focuses on assessing and intervening on the behavioral and social drivers of undervaccination.

Aric A. Prather (University of California, San Francisco) is a clinical-health psychologist with training in psychoneuroimmunology. His research focuses on the causes and consequences of insufficient sleep, with particular interest in how sleep regulates the immune system.

Discussion Panel

Roxane Cohen Silver (University of California, Irvine) is an international expert in the field of stress and coping. She has spent over four decades studying acute and long-term psychological and physical reactions to stressful life experiences, including personal traumas such as loss, physical disability, and childhood sexual victimization as well as larger collective events such as terrorist attacks, infectious disease outbreaks, and natural disasters across the world (e.g., in Chile, Indonesia, Israel, and the United States).

David Robson is a freelance science writer (BBC, the *Observer*, *New Scientist*). In 2021, Robson received awards from the Association of British Science Writers and the UK Medical Journalists' Association for his writing on misinformation and risk communication during the COVID pandemic.

Amy Greer (University of Guelph) is an infectious disease epidemiologist and mathematical modeler. Her research program explores the introduction, spread, dynamics, and control of infectious diseases in populations to support evidence-based policy decisions.

What did we know before the pandemic that can be applied to this and future pandemics?

- 1. Biological mechanisms can inform the connection between psychological processes and infectious diseases.**

Keely A. Muscatell (University of North Carolina at Chapel Hill) cited research indicating that factors including social connection, purpose in life, positive emotions, and giving to others are associated with lower inflammation and more effective responses from the adaptive immune system, thereby providing protections for the immune system.

In contrast, preexisting psychosocial risks (e.g., discrimination, stress) combined with pandemic-induced psychosocial risks (e.g., unemployment, loneliness) can weaken the immune response to COVID-19 and lead to worse symptoms and outcomes.

To these points, Muscatell identified actions that may enhance individuals' immune-system responses broadly, including strengthening social safety nets to reduce the impact of poverty, unemployment, and systemic racism on the immune system; developing strategies to mitigate the impact of public health policies on psychological processes that affect immunity (e.g., the impact of social distancing on loneliness); recognizing the impact of mental health issues on physical health and providing affordable mental health care to those who need it; and bolstering psychosocial protections by enhancing social connection and providing opportunities to contribute meaningfully to one's community.

2. Psychological and social factors can predict susceptibility to infection.

Marsland cited research by Sheldon Cohen (a researcher from the University of Carnegie Mellon who has focused on the roles of stress, affect, and social support systems in health and well-being) on the factors that predict susceptibility to respiratory infections (e.g., colds, SARS-CoV). He found that the psychological and social risks identified above, especially interpersonal and work-related stress, can predict who is more likely to get infected and to develop symptoms. Chronic stress appears to weaken resistance to infection via an increased inflammatory response.

3. Racial and ethnic disparities are mirrored in disparate infection and disease outcomes.

Racial and ethnic minorities are disproportionately affected by infectious diseases. These disparities might be explained by their disparate exposures to infections, health behaviors, and psychosocial factors, said Rodlescia S. Sneed (Michigan State University). For example, studies have shown that in the United States, tuberculosis and influenza are more likely to affect Black, Hispanic, and Asian individuals than Whites. The most affected individuals tend to live in more crowded houses, work in close proximity to others, and have more frequent exposure to infections. They also experience more susceptibility because of discrimination, chronic stress, and certain health behaviors that have been linked to less efficient immune responses (e.g., inadequate sleep). Occupational risk and overcrowding limit opportunities for social distancing; preexisting skepticism about health care contributes to low vaccine confidence; and stress, exacerbated during the pandemic, affects immune responses and maladaptive health behaviors.

What have we learned from the pandemic?

1. Anxiety and depression increased across the globe.

In 2015, the World Health Organization estimated the global prevalence of depression and anxiety disorders at 4.4% and 3.6%, respectively. Both proportions increased dramatically during the pandemic.

Adam Geraghty (University of Southampton) reported that six systematic reviews published in 2021 measured the global prevalence of depression and anxiety at about 30% on average. These increases were affected by prepandemic factors. For instance, the more hospital beds available in a country, the lower its levels of depression and anxiety, and the higher the human development index of a country, the lower its prevalence of depression and anxiety.

2. Mental health affects physical health.

Prepandemic studies had shown that psychological distress can affect physical health by influencing vulnerability to infection and severity of disease, stated Vedhara—and the pandemic heightened psychological distress. In the United Kingdom, people with a history of psychiatric disorder were 1.5 to 2 times more likely to be diagnosed with COVID-19, be hospitalized, and die than people without a psychiatric disorder. Among the general U.K. population, people who reported the greatest distress at the start of the pandemic were much more likely to report COVID-19 infection and more severe symptoms 8 to 9 months later. Studies with health care workers have suggested that the mechanisms involved in this relationship may be increased cortisol levels due to pandemic-imposed distress. Early data, still under peer review, indicate that during the pandemic, the U.K. population experienced a mean cortisol increase of 23%.

This evidence suggests the need to treat psychological distress as a risk factor for physical health, particularly during a pandemic, and, consequently, the need to monitor the population and not only the virus.

3. Early life stress may influence how disease develops.

Chronic stress impacts youths' health. For example, children raised in poverty are more likely to experience asthma and develop diseases such as coronary heart disease later in life, as Hannah M. C. Schreier (The Pennsylvania State University) reported. These risks persist even if these individuals become more affluent later in life. Because children have spent more time at home during the pandemic, they have become more exposed to their caregivers' increased levels of distress. Similarly, children who were already in distressing or dangerous situations were less likely to be removed from these situations.

How can we shape the factors that may contribute to youth's chronic stress and increase the protective factors that contribute to their resilience? Data from two interventions indicate that improving relationships with family members and peers might reduce risk markers for chronic disease in youth from lower socioeconomic groups. These data underscore the value of turning to psychosocial interventions to lower disease risk, rather than relying exclusively on medical interventions.

4. Loneliness may increase physical illness.

Social isolation has been associated with greater incidence of psychological and physical illness (e.g., depression, anxiety, addiction, cardiovascular disease, stroke, dementia) and lower perceived well-being and quality of life, explained Julianne Holt-Lunstad (Brigham Young University). It has also been associated with increased risk of premature mortality, with effects comparable to or greater than those of other risk factors (e.g., smoking, obesity). The prevalence and severity of loneliness appear to have increased during the pandemic, which may have increased disease.

Although some research has been done, there are still many gaps to address, Holt-Lunstad said. Research must systematically measure populations' loneliness levels (along with other health factors), address the time course of loneliness effects, and explore the potential effectiveness of remote means of connection in lieu of in-person contact. Actionable steps to mitigate potential effects of loneliness during the pandemic include raising awareness about the relevance of social connection, reducing stigma, and activating (and rigorously evaluating) programs to address loneliness.

5. Positive emotions may improve well-being during a pandemic.

To study how developing positive emotions may improve quality of life during a pandemic, Judith T. Moskowitz (Northwestern University Feinberg School of Medicine) and colleagues created a self-guided online program that taught individuals to notice positive events; capitalize on savoring, gratitude, mindfulness, and positive reappraisal; and focus on personal strengths, attainable goals, and self-compassion. Results of a 5-week training program indicated that the intervention increased participants' positive affect and sense of meaning and purpose while reducing their anxiety, depression, and social isolation, even 12 weeks after the intervention.

How can biology and psychology enhance the response to the effects of this and future pandemics?

1. We must further explore how psychological factors play a role in long COVID—the lingering symptoms many individuals experience after recovery from COVID-19.

Neuropsychiatric symptoms such as fatigue, mood disturbances, and cognitive disturbances ("brain fog") are common among people with COVID-19 and can persist for months after infection, including mild infections. Julianne Bower (University of California, Los Angeles) cited limited studies suggesting that inflammation may be a key factor in signaling the central nervous system and leading to "sickness behavior." As noted, psychological factors such as stress can modulate inflammation and its effects on the brain.

Biopsychosocial models of other diseases (e.g., cancer) may help researchers understand long COVID. These models include psychological factors (e.g., early life stress, history of depression, catastrophizing coping style) as strong predictors of recovery as well as symptom persistence. For example, stress may increase inflammation along with sensitivity to inflammation-related symptoms. Understanding the role of psychological factors may help identify vulnerable patients and intervention targets and approaches. Just as targeting inflammation with anti-inflammatory medicines is important, targeting catastrophizing coping styles with cognitive-behavioral therapy may also help patients with long-COVID symptoms.

2. We must mobilize communities to increase vaccine uptake.

To increase individuals' vaccine acceptance, researchers and policymakers must consider behavioral and social drivers of motivation to get vaccines, such as social and thinking processes (e.g., risk perceptions, trust in vaccines, social norms), said Neetu Abad (U.S. Centers for Disease Control and Prevention [CDC]). Practical issues such as vaccine availability, affordability, ease of access, and service quality may also affect uptake.

Tracking, understanding, and responding to concerns, rumors, information voids, and misinformation play a fundamental role in building vaccine trust. The CDC built a [strategy to reinforce confidence in COVID-19 vaccines](#) that takes into account these diverse factors. The strategy includes:

- building trust by sharing accurate, clear, and complete information about the vaccines;
- boosting health care personnel's confidence in their own decisions to get vaccinated and empowering them to recommend vaccinations to patients; and
- engaging communities and individuals to listen, build trust, and increase collaboration (e.g., by working with community leaders and other trusted messengers to tailor and share culturally relevant messages with diverse communities).

Overall, greater vaccine acceptance hinges on vaccines being perceived as accessible and convenient, beneficial (i.e., their health benefits must outweigh their risks), desirable, normative (i.e., a social default), and necessary (i.e., indispensable for a return to normal life and activities). The complexity of these goals underscores the need for public health investments in behavioral science, Abad warned.

3. Research must address how psychosocial factors can improve vaccine response.

Psychological factors may influence how much protection a vaccine provides and for how long, reported Aric A. Prather (University of California, San Francisco). Chronic stress and loneliness, for instance, appear to predict a poor response to the influenza vaccine, whereas positive affect and mood appear to boost the vaccine's efficacy. These effects appear to be related to the influence of psychological factors on the immune system and on health behaviors (e.g., sleep duration, diet, substance use). Thus, Prather suggested, more research on how psychosocial interventions may enhance vaccine response could help to improve vaccine response in the future.

4. The future: Communication and policy must become higher priorities.

The greatest remaining challenges of COVID-19 involve helping the public understand the relationship between psychosocial and physiological factors and influencing policy to reflect what science has shown.

In a lively discussion, led by Amy Greer, David Robson, and Roxane Cohen Silver, webinar presenters focused on the importance of transmitting clear and accurate messages to policymakers and to the public. Improving communication and combating misinformation may lead policymakers to take into account the role of psychological and social factors in responses to and outcomes of COVID-19 and other diseases and influence the public to make better-informed decisions about health behaviors, including vaccination and other measures that can effectively fight infectious diseases.

View a recording of this webinar, including references to much of the research cited, at <https://www.psychologicalscience.org/psychology-biology-covid-19>.

Get the latest updates on the [APS Global Collaboration on COVID-19](#).

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