Psychological Resilience to Trauma and Risk of COVID-19 Infection and Somatic Symptoms Across 2 Years

Kristen Nishimi, PhD, MPH, Jeri Tan, BS, Arielle Scoglio, PhD, Karmel W. Choi, PhD, Dennis Parker Kelley, PhD, Thomas C. Neylan, MD, and Aoife O'Donovan, PhD

ABSTRACT

Objective: Exposure to trauma increases the risk of somatic symptoms, as well as acute and chronic physical diseases. However, many individuals display psychological resilience, showing positive psychological adaptation despite trauma exposure. Resilience to prior trauma may be a protective factor for physical health during subsequent stressors, including the COVID-19 pandemic.

Methods: Using data from 528 US adults in a longitudinal cohort study, we examined psychological resilience to lifetime potentially traumatic events early in the pandemic and the risk of COVID-19 infection and somatic symptoms across 2 years of follow-up. Resilience was defined as level of psychological functioning relative to lifetime trauma burden, assessed in August 2020. Outcomes included COVID-19 infection and symptom severity, long COVID, and somatic symptoms assessed every 6 months for 24 months. Using regression models, we examined associations between resilience and each outcome adjusting for covariates.

Results: Higher psychological resilience to trauma was associated with a lower likelihood of COVID-19 infection over time, with one standard deviation higher resilience score associated with a 31% lower likelihood of COVID-19 infection, adjusting for sociodemographics and vaccination status. Furthermore, higher resilience was associated with lower levels of somatic symptoms during the pandemic, adjusting for COVID-19 infection and long COVID status. In contrast, resilience was not associated with COVID-19 disease severity or long COVID.

Conclusions: Psychological resilience to prior trauma is associated with lower risk of COVID-19 infection and lower somatic symptoms during the pandemic. Promoting psychological resilience to trauma may benefit not only mental but also physical health.

Key words: psychological resilience, COVID-19 infection, long COVID, somatic symptoms.

INTRODUCTION

Trauma exposure is among the strongest risk factors for the most common psychiatric disorders, including depression and anxiety, and it is a prerequisite for the diagnosis of posttraumatic stress disorder (PTSD) (1). Accumulating evidence from the past decade also links trauma exposure with an increased risk of physical diseases and somatic symptoms via its impact on psychological, behavioral, and biological pathways (2–4). However, a large portion of individuals who experience trauma do not experience prolonged psychiatric symptoms (5), a key potential pathway to poorer physical health outcomes (6–8). Indeed, because of a variety of structural and individual factors, many individuals show psychological resilience—positive psychological adaptation in the context of significant trauma exposure (9). In turn, emerging evidence has linked psychological resilience to trauma with better physical health outcomes over time (10). Effects of psychological resilience on physical health may be particularly salient in the face of chronic stressors that increase the risk of somatic symptoms and physical diseases, including infectious diseases (11,12). The COVID-19 pandemic has presented one such chronic stressor, involving ongoing economic, social, and health threats as well as high risk of contracting a potentially deadly infection. However, no studies have examined if psychological resilience is associated with COVID-19 infection or other physical health outcomes across time during the pandemic.

Psychological resilience has been conceptualized in multiple ways, including as an intrapersonal capacity and as a manifested outcome (13,14). Psychological resilience is commonly measured

CDC = Centers for Disease Control and Prevention, **CI** = confidence interval, **GEE** = generalized estimating equation, **PHQ-15** = Patient Health Questionnaire-15, **PTSD** = posttraumatic stress disorder, **RR** = relative risk, **THS** = Trauma History Screen

SDC Supplemental Digital Content

From the Mental Health Service (Nishimi, Tan, Kelley, Neylan, O'Donovan), San Francisco Veterans Affairs Health Care System; Department of Psychiatry and Behavioral Sciences (Nishimi, Tan, Kelley, Neylan, O'Donovan), University of California San Francisco, San Francisco, California; Department of Natural and Applied Sciences (Scoglio), Bentley University, Waltham; Department of Epidemiology (Scoglio), Harvard TH Chan School of Public Health, Boston, Massashusetts; and Center for Precision Psychiatry, Department of Psychiatry (Choi) and Psychiatric and Neurodevelopment Genetics Unit (Choi), Center for Genomic Medicine, Massachusetts General Hospital, Boston, Massashusetts.

Address correspondence to Kristen Nishimi, PhD, MPH, 4150 Clement St, San Francisco, CA 94121. E-mail: kristen.nishimi@ucsf.edu

ORCID IDs: 0000-0001-6189-830X (K.N.); 0000-0002-3680-9405 (A.S.); 0000-0001-8492-2704 (D.P.K.); 0000-0002-1572-2626 (T.C.N.); 0000-0003-2353-7217 (A.O.D.).

Received for publication December 7, 2022; revision received March 29, 2023.

Article Editor: Daryl O'Connor

DOI: 10.1097/PSY.0000000000001215

as a capacity or trait using self-report scales that assess one's perceived ability to cope with and recover from adversity. However, trait scales typically fail to incorporate actual experiences of adversity or indicators of psychological adaptation after exposure, instead capturing only perceived capacity independent of experiences. In contrast, psychological resilience as an outcome is the manifestation of positive psychological health despite the experience of significant adversity or trauma. Manifested psychological resilience can be assessed by measuring one's trauma burden and adaptive psychological health outcomes (e.g., low psychological distress, positive psychological well-being) after exposure. Although related, these different conceptual definitions capture distinct psychological experiences or processes (15,16). Moreover, perceived trait psychological resilience may be one, among several, important indicators of positive psychological functioning after adversity (i.e., high perceived trait psychological resilience after adversity may indicate manifested psychological resilience). We aimed to capture individuals' psychological resilience to lifetime trauma in the early phases of the COVID-19 pandemic, a time of heightened stress and uncertainty, which, in addition to prior trauma, can further pose a threat to psychological health. Most studies of manifested psychological resilience have focused on identifying what predicts or promotes resilience, whereas fewer have extended to assess the potential physical health benefits of demonstrating resilience to adversity (17). Indeed, if one has shown psychological resilience to prior trauma or adversity, he or she may be protected against a range of adverse health outcomes that may occur in the face of chronic stressors (11,18,19).

Psychosocial factors are important predictors of infectious disease risk (20). Individuals with PTSD and other forms of psychological distress are at elevated risk for infectious disease in general (21), COVID-19 specifically (22), and more severe disease when infected with COVID-19 (23). Moreover, elevated levels of perceived psychological stress predicted the risk of contracting the common cold in a landmark experimental study (20). In contrast, experimental work has suggested that positive psychosocial factors related to psychological resilience, like positive affect or social support, can buffer the negative effects of chronic stress on immune responses and susceptibility to the common cold (24–26). Psychological resilience may be another important, but understudied, psychosocial factor associated with risk of infection. Indeed, preclinical studies suggest that models of stress resilience are linked to better innate immune system functioning (27,28). Psychological resilience may also promote more adaptive or favorable health behaviors (e.g., physical activity, nonsmoking) (29) that enhance immune function or prevent infection. In addition to actual infectious disease risk, psychological resilience may also be linked to lower perceived susceptibility or health risk, with work suggesting that trait psychological resilience is associated with lower perceived severity of the threat of COVID-19 to one's health (30) and is associated with better perceived immune functioning (31). However, studies of manifested psychological resilience and risk of infectious disease are missing from the literature.

Somatic symptoms, including bodily pain, fatigue, or somatic complaints, increase in the face of chronic stressors (2), and psychological resilience may be associated with lower levels of these symptoms. Trauma exposure may increase the risk of somatic symptoms via alterations in stress-related hypothalamic-pituitary-adrenal and sympathoadrenal medullary axes, impacting the functioning of the central nervous, endocrine, and immune systems (32), and through adverse health or coping behaviors (33,34). In contrast, psychological resilience to trauma may protect against stress-related somatic symptoms by downregulating physiological stress responses through lower perceived threat to stress and/or more adaptive behavioral coping strategies (35). There is evidence for this protective association; higher trait psychological resilience was associated with lower levels of total somatic symptoms over time in one observational study of adults exposed to a natural disaster (36). Experimental evidence also indicates that promoting trait psychological resilience via brief video and training modules may decrease somatic symptoms (37). Early in the pandemic, one cross-sectional study suggested that higher trait psychological resilience was correlated with lower levels of fatigue (38), but no studies have examined manifested psychological resilience to trauma and associations with somatic symptoms more broadly during the COVID-19 pandemic.

In the current study, we examined if psychological resilience to lifetime trauma early in the pandemic was associated with COVID-19 outcomes and somatic symptoms across 2 subsequent years. Using data from a longitudinal community-based sample of mostly female individuals who had all experienced at least one potentially traumatic event, we hypothesized that higher psychological resilience would be associated with a lower likelihood and severity of COVID-19 infection, a lower risk of long COVID, and fewer somatic symptoms in general over time. We adjusted for multiple sociodemographic factors that could be confounders (e.g., age, gender, race/ethnicity, socioeconomic status), and COVID-19–related experiences and vulnerabilities that could also be related to psychological resilience and health outcomes (e.g., medical comorbidities, COVID-19 vaccination status). Multiple studies have documented the negative impact of the pandemic on psychiatric symptoms across populations (e.g., (39)). It is likely that individuals who show psychological resilience to prior trauma will maintain positive psychological health and avoid negative psychiatric effects, including depressive, anxiety, and posttraumatic stress symptoms, in the face of pandemic stress, as has been shown in some prior work (40). Therefore, we sought to both characterize psychiatric symptoms across 2 years of the pandemic in our sample and, as secondary analyses, to confirm this hypothesis that higher resilience at baseline would be linked with lower psychiatric symptoms over time. To our knowledge, this is the first study examining associations of manifested psychological resilience and health outcomes over time during the pandemic, which can provide insight into the potential protective effects of psychological resilience to physical health amid chronic stress.

MATERIALS AND METHODS

Study Sample

Participants included US adults 18 years and older who had completed a screening questionnaire for research related to trauma and posttraumatic stress in 2017 to 2018 and subsequent COVID-19–related questionnaires in 2020 to 2022 (41). All 3631 individuals who responded to or participated in the 2017 to 2018 trauma-related research were recontacted in August 2020 with an invitation to participate in surveys related to the COVID-19 pandemic (42). Of these, 831 individuals (22.9%) provided informed consent and completed the baseline 30-minute online COVID-19 Qualtrics survey in August to September 2020 (wave 1) that

assessed psychological experiences during the COVID-19 pandemic. Prior descriptive analyses in this sample indicate that nonresponders were younger and had higher PTSD symptoms relative to the COVID-19 survey study participants (43). After the baseline COVID-19 survey, all wave 1 participants were invited to participate in four subsequent surveys in February to March 2021 (wave 2, n = 442 [68.2%]), August to September 2021 (wave 3, n = 418 [64.5%]), January to February 2022 (wave 4, n = 405 [62.5%]), and July to August 2022 (wave 5, n = 345 [53.2%]). Individuals received a $5 Amazon e-gift card upon completing each full survey. Because we were interested in examining psychological resilience to trauma, we restricted the analytic sample to those who reported at least one lifetime potentially traumatic event at baseline (n = 666 [80.0%]). We further excluded those without at least one follow-up (n = 125) and individuals who had COVID-19 at wave 1 to determine new infections at follow-ups (n = 13), resulting in an analytic sample of 528. This study was approved and conducted in compliance with the Institutional Review Board at the University of California, San Francisco.

Measures

Psychological Resilience

Psychological resilience was assessed at wave 1 by determining lifetime exposure to potentially traumatic events and current psychological functioning. Lifetime exposure to potentially traumatic events was reported using a modified version of the Trauma History Screen (THS), a self-report tool assessing whether individuals ever experienced 14 potentially traumatic events (e.g., bad accident, natural disaster, sexual assault, sudden death of close family or friend) and one other trauma not specified (44). We modified the THS to include two additional events: experiencing a life-threatening illness, and serious injury, harm, or death you caused to someone else. We calculated trauma burden by summing the count of potentially traumatic event types experienced (potential range, 1–16). Psychological functioning was assessed based on wave 1 measures of both distress and positive resilience capacity, including self-reported past-month symptoms of posttraumatic stress in relation to one's worst event experienced from the THS (PTSD Checklist-5 (45)), depression (depression subscale of the 21-item Depression Anxiety Stress Scale (46)), and anxiety (anxiety subscale of the 21-item Depression Anxiety Stress Scale (46)), as well as perceived resilience capacity (2-item Connor-Davidson Resilience Scale (47), an abbreviated version of the widely used, original 25-item Connor-Davidson Resilience Scale (48)). Sum scores for each distress and positive domain (i.e., perceived resilience capacity) were calculated, each sum score was standardized (mean [standard deviation], or M [SD] = 0 [1]), the distress scores were inversed, and the inversed distress and perceived resilience capacity standardized scores summed together to create an overall psychological functioning score (e.g., (49)). Higher values on this score indicate lower distress and higher perceived resilience capacity.

To create the manifested psychological resilience measure, we outputted standardized residuals from a linear regression model with trauma burden predicting overall psychological functioning, whereby increased trauma burden was significantly associated with lower psychological functioning ($\beta = -0.38$, 95% confidence interval [CI] = −0.47 to −0.30, $p < .001$). Each individual's standardized residuals were used to define their manifested psychological resilience level, such that higher values indicate higher overall psychological functioning relative to level of trauma burden —that is, higher resilience (50,51). This derived continuous psychological resilience variable was the primary independent variable.

COVID-19 Infection, Severity, and Long COVID

At each wave, individuals reported whether they have had COVID-19, with response options of the following: "Yes, I was diagnosed with COVID-19 based on the results of a COVID-19 test"; "Probably yes, a clinician diagnosed me with COVID-19 without using a test"; "Maybe, I suspect I had COVID-19"; or "No, I do not think I have had COVID-19." We defined a binary variable of COVID-19 infection as reporting yes or probably yes (infected = 1) otherwise uninfected (infected = 0), as the prevalence for these indicators most closely tracked the broader US prevalence of COVID-19 infection reported by the US Centers for Disease Control and Prevention (CDC; Figure 1) (52). In sensitivity analyses, we examined COVID-19 infection as reporting yes, probably yes, or maybe, to incorporate individuals with suspected COVID-19 infection.

For those reporting yes, probably yes, or maybe, individuals reported the severity of their symptoms: none, mild, moderate, severe, and life-threatening. Severe COVID-19 was defined as indicating symptoms were moderate or more severe. Those reporting yes, probably yes, or maybe were also asked whether they had experienced COVID-19 symptoms or effects that lasted longer than 4 weeks (53); endorsement was considered as long COVID.

As additional secondary COVID-19–related outcomes, individuals reported their predicted likelihood of contracting COVID-19 in the next 12 months (0 = very unlikely to 4 = very likely) and predicted severity of COVID-19 disease if contracted (0 = asymptomatic to 4 = life-threatening) at baseline. These items were included to investigate whether psychological resilience was related to both one's perception of their risk, as well as their later actual risk of infection and severe disease, in exploratory analyses.

Somatic Symptoms

Somatic symptoms were self-reported at waves 3 to 5 using an adapted version of the Patient Health Questionnaire-15 (PHQ-15 (54)), a brief measure assessing the severity of 15 somatic symptoms rated from 0 (not bothered at all) to 2 (bothered a lot). Assessed symptoms included the complaints most frequently reported in outpatient settings and the most prevalent somatization disorder symptoms (54), including stomach pain, headaches, fainting spells, and nausea. At wave 3, the instructions specified how much individuals had been bothered by the following problems "since the pandemic began," to assess the frequency of somatic symptoms on average during the pandemic by August 2021. At waves 4 and 5, the instructions specified "in the past 6 months" to assess all the time since the previous wave. At each wave, we calculated a sum score across the 15 items (potential range, 0–30). As secondary measures at each wave, we calculated subscale sum scores for pain (i.e., back pain, joint pain, headaches), gastrointestinal symptoms (i.e., stomach pain, pain during sexual intercourse, constipation, nausea), cardiopulmonary symptoms (i.e., chest pain, dizziness, heart racing, shortness of breath), and fatigue (i.e., trouble sleeping, feeling tired), consistent with prior work identifying underlying PHQ-15 factors (55).

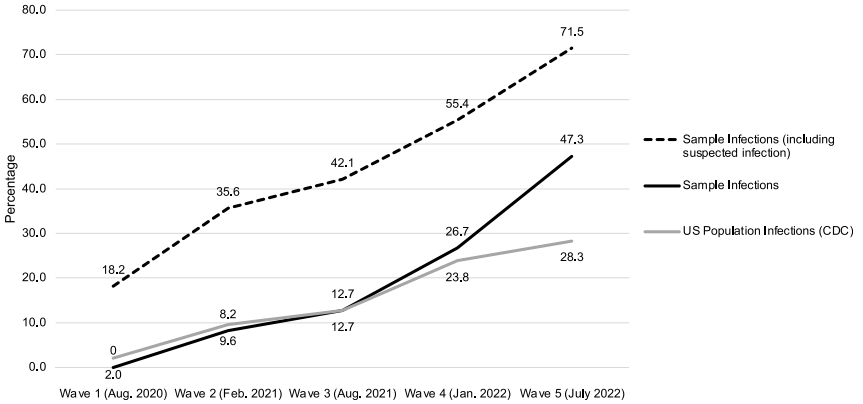

FIGURE 1. Cumulative prevalence of COVID-19 infection reported in the analytic sample compared with the broader US population. The sample infections are proportions of infections among respondents at each wave from the analytic sample (n = 528), which excluded those with infections at wave 1. Infections were defined as indicating yes or probably yes, whereas "suspected" infections were defined as indicating yes, probably yes, and maybe for COVID-19 infection at each wave. US population infections were derived from the CDC COVID-19 Data Tracker. CDC = Centers for Disease Control and Prevention.

Psychiatric Symptoms

To determine associations between psychological resilience and psychiatric symptoms over time as the pandemic unfolded, we examined psychiatric symptoms at waves 2 to 5. Psychiatric symptoms included the following: past month posttraumatic stress (PTSD Checklist-5 (45)), depression (depression subscale of the 21-item Depression Anxiety Stress Scale (46)), and anxiety (anxiety subscale of the 21-item Depression Anxiety Stress Scale (46)). Sum scores for each measure were derived at each follow-up wave.

Covariates

Sociodemographic covariates were all self-reported at wave 1 and chosen because they represent potential confounders. These included age (continuous age in years), gender (man, woman, nonbinary/transgender/other), sexual orientation (heterosexual, homosexual, bisexual/queer/pansexual/other), race/ethnicity (non-Hispanic White, Black, Asian, Latinx, other [including Native Hawaiian/Pacific Islander, American Indian or Alaska Native, Middle Eastern, or other race], or more than one race), annual household income (≤$50,000, $50,001–$100,000, $100,001–$150,000, >$150,000 per year), marital status (married, in a relationship, single, separated/divorced/widowed), and area of residence (urban, suburban, town, rural).

COVID-19–related experiences and vulnerabilities reported at wave 1 were also considered as covariates, including having any health conditions making one vulnerable to COVID-19 (yes/no; i.e., asthma; hypertension; kidney, lung, or liver disease; diabetes; blood or immune disorder; serious heart condition) and whether they provided COVID-19 care in employment (provide direct COVID-19 care, provide supportive COVID-19 care, does not provide COVID-19 care). Starting at wave 2, once COVID-19 vaccines were available as of December 2020, individuals reported whether they had been vaccinated against COVID-19 (yes/no; time updated at each wave starting at wave 2). At wave 1, participants reported past 30-day average frequency of engagement in 10 protective behaviors (e.g., wearing a mask, washing hands, isolating oneself) and 8 risky behaviors (e.g., going to indoor restaurants or bars, attending events with large crowds) for COVID-19 (42).

Statistical Analyses

Given attrition over time, we determined how baseline covariates and psychological resilience differed across those retained and those lost to follow-up. Differences suggested potential selection bias, with significant ($p < .10$) differences by age (younger individuals were more likely to be lost to follow-up), sexual orientation (those identifying as not heterosexual were more likely to be lost to follow-up), and household income (individuals with lower income were more likely to be lost to follow-up). However, loss to follow-up was unassociated with psychological resilience levels at baseline. To account for differences, we created inverse probability weights for differential loss to follow-up by modeling the odds of being lost to follow-up versus retained predicted by all baseline covariates and psychological resilience; the resulting weights were included in all analytic models (56). Our sample size was determined a priori based on data availability in the cohort. However, because related prior work has indicated that psychosocial risk factors (e.g., loneliness, perceived stress, worry, depressive symptoms) early in the pandemic were strongly associated with COVID-19 infection (adjusted relative risks [RRs] = 1.32–1.42) (22), we anticipated adequate power to identify associations between psychological resilience and COVID-19 infection (with n = 528, we have 87% power to detect associations at the magnitude of RR = 1.32). See Supplement Digital Content, http://links.lww.com/PSYMED/A932, for additional post-hoc power analyses.

We first examined distributions of psychological resilience and baseline covariates. Psychological resilience and all continuous variables were standardized (M [SD] = 0 [1]) before analyses, so associations are interpreted as effects per 1 SD change in resilience. For COVID-19 outcomes, we used repeated-measures Poisson regression with generalized estimating equations (GEE) to determine associations between psychological resilience and RR of each outcome over time. GEE models with repeated measures use quasi-likelihood estimation to determine marginal, population-level effects, account for correlated longitudinal data with robust variance estimates, and can handle unbalanced data (57). Time since baseline was included as a variable in models, and time by psychological resilience interactions were tested to determine whether the associations between resilience and outcomes

were stable or changed over time. Models were adjusted for all sociodemographic variables, COVID-19 vulnerabilities, providing COVID-19 care in employment, and time-updated COVID-19 vaccination status. Secondary analyses determined associations between psychological resilience and COVID-19 infection while adjusting for average level of protective and risky behaviors for COVID-19 infection at wave 1. Additional secondary analyses included adjusted linear regression examining cross-sectional associations between psychological resilience and perceived likelihood and severity of COVID-19 infection at baseline.

For somatic symptoms, we used repeated-measures linear regression with GEE to determine associations between psychological resilience and somatic symptoms across the three available waves. Because somatic symptoms were only reported beginning at wave 3, the analytic sample for these models was restricted to respondents by wave 3 (n = 470). Outcomes included repeated measures of total somatic symptoms and secondarily each symptom subscale. Models were adjusted for time, all sociodemographic covariates, COVID-19 vulnerabilities, COVID-19 infection, and long COVID; time by psychological resilience interactions were included to test for changes in resilience and somatic symptom associations over time.

For psychiatric symptoms, we used repeated-measures linear regression with GEE to determine associations between psychological resilience and symptom levels over time. Separate models were conducted for each psychiatric symptom measure, including time since baseline and time by psychological resilience interactions. Models were adjusted for all sociodemographic covariates. All models included inverse probability weights to account for differential attrition. All analyses were conducted in R, version 4.0.2. Data and analysis code are available upon request from the first author.

RESULTS

Baseline covariates are presented in Table 1. As of August to September 2020, the analytic sample was 37.8 years old on average, and most were women (80.5%), heterosexual (79.2%), and non-Hispanic White (59.8%). Among the sample, commonly reported potentially traumatic events included sudden death of a close family member or friend (63.1% prevalence) and other sudden event that made one feel very scared, helpless, or horrified (58.0% prevalence). Psychological resilience was associated with several sociodemographic covariates, with older individuals, those with higher household income, and married individuals having higher resilience.

Psychological Resilience and COVID-19 Outcomes

The proportion of COVID-19 infection among respondents increased across time, generally consistent with prevalence rates reported by the CDC (Figure 1) (52). Psychological resilience manifested early in the pandemic was associated with a significantly lower risk of COVID-19 infection across time, with 1 SD higher resilience conferring a 31% lower risk of infection (RR = 0.69, 95% CI = 0.49–0.99; Table 2). Time was significantly associated with elevated odds of COVID-19 infection (RR = 1.16, 95% CI = 1.08–1.24, $p < .001$), indicating infections increased across the four waves, which is consistent with the trajectory of the broader pandemic. There was a significant interaction between psychological resilience and time, suggesting that the protective effect of resilience against infection risk waned over time (time by psychological resilience: RR = 1.02, 95% CI = 1.00–1.03, p = .026). In sensitivity analyses, psychological resilience was marginally associated with a lower risk of COVID-19 infection when including those with suspected infection (RR = 0.85, 95% CI = 0.72–1.01, p = .059). Considering COVID-19–related behaviors, psychological resilience was not correlated with levels of protective behaviors (r = 0.02) or risky behaviors (r = −0.04). The association between psychological resilience and COVID-19 infection was attenuated but remained marginally significant (RR = 0.72, 95% CI = 0.50–1.04, p = .081) when additionally adjusting for averaged protective and risky COVID-19–related behaviors.

Across follow-up, 31.8% of the sample reported severe COVID-19 symptoms and 15.3% reported long COVID. Psychological resilience was not significantly associated with severity of COVID-19 once infected (RR = 1.00, 95% CI = 0.75–1.32) or with risk for reporting long COVID (RR = 0.79, 95% CI = 0.58–1.07). Psychological resilience was significantly associated with a lower perceived likelihood of contracting COVID-19 (β = −0.08, 95% CI = −0.15 to 0.00, p = .039) and lower perceived severity of COVID-19 symptoms if contracted (β = −0.08, 95% CI = −0.16 to −0.01, p = .030), as reported at study baseline.

Psychological Resilience and Somatic Symptoms

Somatic symptoms were relatively stable during the first 2 years of the pandemic (Supplemental Digital Content, Figure S1, http://links.lww.com/PSYMED/A932) and were highly correlated across time (r values = 0.69–0.76), and average levels were moderate ($M_{wave\ 3}$ [SD] = 10.0 [6.0], $M_{wave\ 4}$ [SD] = 10.0 [6.0], $M_{wave\ 5}$ [SD] = 9.7 [6.0]; PHQ-15 scores of 10–14 are considered "medium") (54). Psychological resilience was associated with significantly lower somatic symptoms over time, even when adjusting for the presence of COVID-19 vulnerabilities, COVID-19 infection, and long COVID (Table 2). There were no significant time by psychological resilience effects, indicating that associations between resilience and symptoms were stable across follow-up (e.g., time by psychological resilience for overall somatic symptoms β = 0.00, 95% CI = −0.01 to 0.01, p = .98). When examining somatic subscales, associations with fatigue were of higher magnitude relative to pain, cardiopulmonary, and gastrointestinal symptoms, but effect estimates were largely similar across subscales, indicating general rather than specific effects.

Psychological Resilience and Psychiatric Symptoms

PTSD and depressive symptoms slightly decreased on average across waves 2 through 5 (PTSD: $M_{wave\ 2}$ [SD] = 25.0 [20.5] versus $M_{wave\ 5}$ [SD] = 22.1 [19.6]; depression: $M_{wave\ 2}$ [SD] = 14.7 [12.1] versus $M_{wave\ 5}$ [SD] = 12.4 [11.6]), whereas anxiety seemed more stable ($M_{wave\ 2}$ [SD] = 10.6 [9.7] versus $M_{wave\ 5}$ [SD] = 9.8 [9.7]; Supplemental Digital Content, Figure S2, http://links.lww.com/PSYMED/A932). As anticipated, higher psychological resilience at wave 1 was significantly and strongly associated with lower levels of PTSD, depressive, and anxiety symptoms across follow-up waves (Table 2). We did not identify significant time by psychological resilience effects (time by psychological resilience for PTSD symptoms RR = 0.00, 95% CI = 0.00–0.01, p = .347; for depressive symptoms: RR = 0.00, 95% CI = 0.00–0.01, p = .138; for PTSD: RR = 0.00, 95% CI = −0.01 to

TABLE 1. Baseline Covariates Among the Analytic Sample and Level of Psychological Resilience Across Covariates (N = 528)

	Total		Psychological Resilience		
Covariate	*N*	%	M or *r*	SD	*p* Value
Age, mean (SD)	37.8	11.2	0.18	—	<.001
Gender					
Man	87	16.5	0.21	0.9	.060
Woman	425	80.5	−0.03	1.0	
Nonbinary, transgender, other	16	3.0	−0.31	1.0	
Sexual orientation					
Heterosexual	418	79.2	0.04	1.0	.079
Homosexual or other	110	20.8	−0.15	1.0	
Race/Ethnicity					
Non-Hispanic White	316	59.8	0.00	1.1	.651
Black	75	14.2	0.10	0.9	
Asian	36	6.8	0.01	0.9	
Latinx	52	9.8	−0.18	1.0	
Other[a] or more than one race	49	9.3	0.06	1.1	
Annual household income					
≤$50,000	219	41.5	−0.20	1.0	.001
$50,001–$100,000	212	40.2	0.14	1.0	
$100,001–$150,000	64	12.1	0.08	1.1	
>$150,000	33	6.2	0.32	0.9	
Marital status					
Married	175	33.1	0.17	0.9	.025
Single	302	57.2	−0.08	1.0	
Separated/divorced/widowed	51	9.7	−0.08	1.1	
Area of residence					
City/Urban	253	47.9	−0.05	1.0	.578
Suburban	187	35.4	0.05	1.0	
Town/Rural	88	16.7	0.04	1.0	
COVID-19 vulnerabilities					
Vulnerabilities	208	39.4	−0.07	1.1	.223
No vulnerabilities	320	60.6	0.05	1.0	
Provides COVID-19 care in employment					
Provides direct COVID-19 care	18	3.4	0.48	1.0	.127
Provides supportive COVID-19 care	34	6.4	0.01	1.1	
Does not provide COVID-19 care	476	90.2	−0.02	1.0	

M (SD) = mean (standard deviation).

p Values are for *t* tests or analyses of variance for mean levels of psychological resilience across categorical covariates, or for correlation between age and resilience.

[a] Other race includes Native Hawaiian/Pacific Islander, American Indian or Alaska Native, Middle Eastern, or other race.

0.01, p = .785), indicating that the association of resilience with reduced psychiatric symptoms was stable across follow-up.

DISCUSSION

In a community-based sample of majority female individuals who had all experienced at least one potentially traumatic event, psychological resilience early in the pandemic was associated with favorable physical health outcomes over time. Specifically, higher psychological resilience was associated with a lower risk of reporting a COVID-19 infection and fewer somatic symptoms across 2 years of the pandemic. We incorporated multiple dimensions of psychological distress and perceived individual capacity for resilience to index not only absence of distress but also positive psychological capacities in the face of trauma. Moreover, manifested psychological resilience was captured early in the COVID-19 pandemic, a time of stress, fear, and confusion that negatively impacted the mental health of many in the population, suggesting that those with high resilience in our sample show notably robust psychological health in the face of adversity. Our results identify manifested psychological resilience to trauma as an important psychosocial factor associated with physical health outcomes in the face of a chronic stressor.

TABLE 2. Associations Between Baseline Psychological Resilience and Health Outcomes Over Follow-up ($N = 528$)

Dependent Variable	Independent Variable: Psychological Resilience		
COVID-19 Outcomes[a]	RR	95% CI	*p*
COVID-19 infection	0.69	0.49 to 0.99	.042
COVID-19 severity	1.00	0.75 to 1.32	.98
Long COVID	0.79	0.58 to 1.07	.130
Somatic Symptoms[b]	*β*	95% CI	*p*
Overall somatic symptoms	−0.18	−0.26 to −0.10	<.001
Pain symptoms	−0.23	−0.32 to −0.15	<.001
Gastrointestinal symptoms	−0.25	−0.34 to −0.16	<.001
Cardiopulmonary symptoms	−0.27	−0.35 to −0.19	<.001
Fatigue symptoms	−0.37	−0.48 to −0.26	<.001
Psychiatric Symptoms[c]	*β*	95% CI	*p*
PTSD symptoms	−0.50	−0.58 to −0.42	<.001
Depressive symptoms	−0.53	−0.61 to −0.45	<.001
Anxiety symptoms	−0.44	−0.53 to −0.35	<.001

RR = relative risk; CI = confidence interval; PTSD = posttraumatic stress disorder.

Individual longitudinal repeated-measures regressions with generalized estimating equations were run separately for each outcome. All models are adjusted for inverse probability weighting for loss to follow-up. All continuous variables are standardized (M [standard deviation] = 0 [1]).

[a] Adjusted for time, time by psychological resilience, age, gender, sexual orientation, race/ethnicity, income, marital status, area type, COVID-19–related vulnerabilities, providing COVID-19 care in employment, and COVID-19 vaccination.

[b] Outcomes were somatic symptoms at waves 3 to 5 among $n = 470$. Adjusted for time, time by psychological resilience, age, gender, sexual orientation, race/ethnicity, income, marital status, area type, COVID-19–related vulnerabilities, COVID-19 infection, and long COVID.

[c] Adjusted for time, time by psychological resilience, age, gender, sexual orientation, race/ethnicity, income, marital status, and area type.

Psychological Resilience and COVID-19 Outcomes

Psychological resilience showed protective effects against contracting COVID-19 infection earlier in the pandemic with the strength of these effects waning over time. Specifically, higher psychological resilience levels were associated with a significantly lower risk of incident infection early in the pandemic, even after adjusting for sociodemographic variables, health conditions, and COVID-19 vaccination status. This association was more pronounced earlier in follow-up, which could indicate that manifested psychological resilience levels most close in time to any infection seemed most strongly associated with subsequent infection. It is also possible that manifested psychological resilience was most strongly associated with COVID-19 infections early in the course of the pandemic, when infections were relatively rare, or that resilience reduced the risk of earlier more than later variants of severe acute respiratory syndrome coronavirus 2. Further longitudinal analyses and studies on other infectious diseases could tease out the specific protective effects of psychological resilience.

There are several potential mechanisms underlying the link between psychological resilience and COVID-19 infection, including behavioral and physiological processes. Evidence during the pandemic indicates that psychological resilience is positively associated with adaptive coping behaviors (e.g., acceptance, active coping) and negatively associated with less-adaptive behaviors (e.g., behavioral disengagement, substance use) (58). Therefore, psychological resilience to trauma may promote more adaptive or healthy behavioral practices and may lessen risky behaviors for COVID-19 infection specifically. However, in contrast with our prior work on PTSD and COVID-19 behaviors (42,59), we did not observe strong associations of psychological resilience with COVID-19–related behaviors in our sample. As seen in secondary analyses adjusting for these behaviors, these COVID-19–related behaviors explain only a very small portion of the association between psychological resilience and infection risk. Psychological resilience may also promote healthier practices in general (e.g., greater physical activity (60), better diet quality, better sleep quality (61)), which may support immune health and protect against infection (62). With respect to physiological processes, resilience also may be associated with more effective immune function (18). Some evidence indicates that psychological distress, including major depression, schizophrenia, and insomnia, may be associated with impaired immune function (63) and attenuated immune response to vaccines (64). Moreover, evidence from observational studies of psychological well-being and emotional styles, as well as interventions to improve mental states, indicates that positive psychological factors are associated with better immune system functioning (65).

In contrast to our hypotheses, we did not identify associations between psychological resilience and risk of more severe COVID-19 infection or long COVID. Although no prior studies, to our knowledge, have examined these associations, some studies do suggest that PTSD is linked to more severe COVID-19 outcomes (23) and to an increased likelihood of long COVID (66) in large-scale health records data. However, in our current data, psychological resilience was related specifically to the likelihood of contracting infection, rather than with severity or long COVID outcomes once contracted. In addition, because psychological

resilience was associated with a lower likelihood of COVID-19 infection in our study, it is possible that resilience was less associated with severity or long COVID risk among the subset of individuals (who had lower average psychological resilience) who contracted COVID-19 over time. Moreover, relatively few individuals in our sample reported severe COVID-19 symptoms and particularly long COVID; thus, we may have been underpowered to identify significant associations.

Higher psychological resilience was associated with a lower perceived likelihood of COVID-19 infection, which was consistent with subsequent infection reports, but interestingly, with an optimistic bias with regard to the more subjective outcome of perceived symptom severity. The concordance of associations of psychological resilience with lower perceived likelihood and lower actual reports of contracting COVID-19 is consistent with prior work indicating that self-rated health is a strong predictor of objective health risks (67). Individuals with higher psychological resilience also predicted that they would have lower COVID-19 symptom severity, but resilience was not associated with COVID-19 severity ratings among those who contracted the disease. This finding is in contrast with one previous study that indicated that individuals' prior beliefs about their COVID-19 symptom severity are a strong predictor of subsequent true symptom severity (68). However, it is consistent with some evidence that higher depressive symptoms are associated with more accurate predictions about risk due to increased analytic rumination (69). Further research is needed to clarify how psychological resilience might influence the accuracy of health-related risk prediction, and the implications of these predictions for behaviors, emotional well-being, and disease outcomes.

Psychological Resilience and Somatic Symptoms

Higher psychological resilience was associated with lower levels of somatic symptoms over time, across pain, gastrointestinal, cardiopulmonary, and fatigue dimensions, even after accounting for presence of health conditions (e.g., asthma, heart conditions, diabetes) and for COVID-19 infection and long COVID. Thus, increased somatic symptoms associated with lower psychological resilience were not explained by associations of lower resilience with health conditions or COVID-19 infection. Protective associations of psychological resilience with lower somatization may be via positive coping behaviors, adaptive psychological or physiological responses to stress, or more positive bias in subjective perceptions of one's health. Indeed, several studies conducted before the COVID-19 pandemic have identified coping behaviors as mediators of associations between psychological resilience and somatic symptoms, with effects of higher resilience on lower somatic health mediated by more adaptive coping abilities, strategies, and support-seeking behavior (33,34). Therefore, those with higher psychological resilience to trauma may behave more adaptively and experience reduced psychological and biological responses to stress, resulting in fewer somatic symptoms.

Psychological Resilience and Psychiatric Symptoms

Consistent evidence has indicated the significant mental health toll of the COVID-19 pandemic across populations (70), and our sample with high levels of potentially traumatic event exposure showed relatively high burden of PTSD, depressive, and anxiety symptoms. As hypothesized, psychological resilience to lifetime trauma was strongly associated with lower psychiatric symptoms in the following 2 years as the pandemic unfolded. These findings are consistent with previous work, from before and during the COVID-19 pandemic, indicating that psychological resilience to prior trauma is predictive of better psychological health when facing later stress or adversity (40,71). However, these prior studies assessed psychological health at only a single time point and thus did not demonstrate associations with sustained mental health benefits. Our current findings indicate that the association between higher psychological resilience and lower psychiatric symptoms remained stable across follow-up, suggesting that despite the variability in psychiatric symptoms in our sample, those with high resilience consistently showed lower distress over time. Given the strong effects of psychological distress on physical health outcomes, this is an important intervention target for individuals who have demonstrated relatively low psychological resilience.

Our measure of psychological resilience was derived with a psychological functioning composite comprising PTSD, depressive, and anxiety symptoms and perceived resilience capacity, and thus weighted toward measures of distress. In sensitivity analyses included in Supplemental Digital Content (see Supplemental Table 1, http://links.lww.com/PSYMED/A932, for results), an alternative psychological resilience measure that equally weighted distress and positive domains showed weaker associations with COVID-19, somatic, and psychiatric outcomes. This may suggest that low levels of distress in response to trauma exposure are more important indicators of psychological resilience than positive psychological capacities, particularly in relation to later health outcomes. However, interpretation of this alternative weighted measure is cautioned, as the positive domain was derived from only two items (cf. 7–20 items for distress) and thus was a limited indicator for a broad, multidimensional construct of "positive psychological capacity."

Limitations

There are several limitations to the current study. All measures were from self-report items that may be subject to reporting biases. Self-reported COVID-19 infection may have been misreported or underreported because of asymptomatic cases or accessibility to COVID-19 testing or clinical care, especially early in the pandemic. However, the prevalence in our sample was similar to the US CDC data tracker prevalence over time (52) and even more similar to studies of seroprevalence of infection-induced antibodies (72), which more accurately captures cases that were not officially diagnosed or reported. In addition, we also explored reports of suspected infection in sensitivity analyses, which showed similar patterns of associations as the primary models. We examined associations between psychological resilience and COVID-19 infection adjusted for COVID-19 vaccination status, but it remains possible that resilience could be associated with more favorable vaccine responses, which may have contributed to our pattern of findings (73). However, the association between psychological resilience and COVID-19 infection risk was strongest earlier in follow-up when fewer people were vaccinated. There was substantial attrition in our sample over time, which may have resulted in selection biases because those who remained in the sample differed by several sociodemographic factors. Nevertheless, we applied inverse probability weighting for loss to follow-up to attempt to statistically account for this bias. Our findings may have limited

generalizability beyond our sample, which included mostly women, all of whom had experienced at least one lifetime potentially traumatic event; therefore, our findings may be most applicable for women exposed to lifetime trauma. Of note, women may be at higher risk for certain poor COVID-19 sequelae (e.g., psychiatric, musculoskeletal) and long COVID (74) and tend to show higher levels of somatic symptoms (75) and psychiatric symptoms during the pandemic (39). However, additional work should examine the nature of psychological resilience and implications on health outcomes in more diverse samples.

Conclusions

Psychological resilience to prior trauma may be protective against adverse physical health outcomes, particularly infection and somatic symptoms, in the midst of a chronic stressor. Our findings highlight that identifying levels of psychological resilience to trauma is informative for understanding the risk of physical health problems, helping to both target interventions or supports and to identify the characteristics or strategies of resilient individuals that can be used to inform such interventions. The benefits of promoting psychological resilience after trauma may extend to physical health.

Source of Funding and Conflicts of Interest: This work was supported by the UCSF Department of Psychiatry Rapid Award (A.O.D.), a UCSF Faculty Resource Fund Award (A.O.D.), and the National Institutes of Mental Health (AOD; K01MH109871), and K.N. is supported by the Department of Veterans Affairs Office of Academic Affiliations Advanced Fellowship Program in Mental Illness Research and Treatment, the Medical Research Service of the SFVAHCS, and the Department of Veterans Affairs Sierra-Pacific Mental Illness Research, Education, and Clinical Center. There are no conflicts of interest.

REFERENCES

1. Breslau N. Epidemiologic studies of trauma, posttraumatic stress disorder, and other psychiatric disorders. Can J Psychiatry 2002;47:923–9.
2. Afari N, Ahumada SM, Wright LJ, Mostoufi S, Golnari G, Reis V, et al. Psychological trauma and functional somatic syndromes: a systematic review and meta-analysis. Psychosom Med 2014;76:2–11.
3. Schnurr PP, Green BL. Understanding relationships among trauma, posttraumatic stress disorder, and health outcomes. Adv Mind Body Med 2004;20:18–29.
4. McEwen BS, Gray J, Nasca C. Recognizing resilience: learning from the effects of stress on the brain. Neurobiol Stress 2015:1–11.
5. Galatzer-Levy IR, Huang SH, Bonanno GA. Trajectories of resilience and dysfunction following potential trauma: a review and statistical evaluation. Clin Psychol Rev 2018;63:41–55.
6. Nishimi K, Neylan TC, Bertenthal D, Seal KH, O'Donovan A. Association of psychiatric disorders with Incidence of SARS-CoV-2 breakthrough infection among vaccinated adults. JAMA Netw Open 2022;5:e227287.
7. O'Donovan A, Cohen BE, Seal KH, Bertenthal D, Margaretten M, Nishimi K, et al. Elevated risk for autoimmune disorders in Iraq and Afghanistan veterans with posttraumatic stress disorder. Biol Psychiatry 2015;77:365–74.
8. Sumner JA, Kubzansky LD, Elkind MS, Roberts AL, Agnew-Blais J, Chen Q, et al. Trauma exposure and posttraumatic stress disorder symptoms predict onset of cardiovascular events in women. Circulation 2015;132:251–9.
9. Luthar SS, Cicchetti D, Becker B. The construct of resilience: a critical evaluation and guidelines for future work. Child Dev 2000;71:543–62.
10. Nishimi K, Koenen KC, Coull BA, Chen R, Kubzansky LD. Psychological resilience predicting cardiometabolic conditions in adulthood in the Midlife in the United States Study. Proc Natl Acad Sci 2021;118:e2102619118.
11. Cohen S, Janicki-Deverts D, Doyle WJ, Miller GE, Frank E, Rabin BS, et al. Chronic stress, glucocorticoid receptor resistance, inflammation, and disease risk. Proc Natl Acad Sci 2012;109:5995–9.
12. Kozlowska K. Stress, distress, and bodytalk: co-constructing formulations with patients who present with somatic symptoms. Harv Rev Psychiatry 2013;21:314–33.
13. Choi KW, Stein MB, Dunn EC, Koenen KC, Smoller JW. Genomics and psychological resilience: a research agenda. Mol Psychiatry 2019;24:1770–8.
14. Fletcher D, Sarkar M. Psychological resilience: a review and critique of definitions, concepts, and theory. Eur Psychol 2013;18:12–23.
15. Nishimi K, Choi KW, Cerutti J, Powers A, Bradley B, Dunn EC. Measures of adult psychological resilience following early-life adversity: how congruent are different measures? Psychol Med 2021;51:2637–46.
16. Sheerin CM, Stratton KJ, Amstadter AB, Education Clinical Center Mirecc Workgroup TVMMIR, , McDonald SD. Exploring resilience models in a sample of combat-exposed military service members and veterans: a comparison and commentary. Eur J Psychotraumatol 2018;9:1486121.
17. Bonanno GA, Romero SA, Klein SI. The temporal elements of psychological resilience: an integrative framework for the study of individuals, families, and communities. Psychol Inq 2015;26:139–69.
18. Dantzer R, Cohen S, Russo SJ, Dinan TG. Resilience and immunity. Brain Behav Immun 2018;74:28–42.
19. Kiecolt-Glaser JK, Bennett JM, Derry HM, Gillie BL, Fagundes CP. Resilience and immune function in older adults. Annu Rev Gerontol Geriatr 2012;32:29–47.
20. Cohen S, Tyrrell DAJ, Smith AP. Psychological stress and susceptibility to the common cold. N Engl J Med 1991;325:606–12.
21. Jiang T, Farkas DK, Ahern TP, Lash TL, Sørensen HT, Gradus JL. Posttraumatic stress disorder and incident infections: a nationwide cohort study. Epidemiology 2019;30:911–7.
22. Wang S, Quan L, Chavarro JE, Slopen N, Kubzansky LD, Koenen KC, et al. Associations of depression, anxiety, worry, perceived stress, and loneliness prior to infection with risk of post–COVID-19 conditions. JAMA Psychiatry 2022;79:1081–91.
23. Nishimi K, Neylan TC, Bertenthal D, Dolsen EA, Seal KH, O'Donovan A. Posttraumatic stress disorder and risk for hospitalization and death following COVID-19 infection. Transl Psychiatry 2022;12:1–8.
24. Cohen S, Pressman SD. Positive affect and health. Curr Dir Psychol Sci 2016;15:122–5.
25. Kiecolt-Glaser JK, Glaser R, Gravenstein S, Malarkey WB, Sheridan J. Chronic stress alters the immune response to influenza virus vaccine in older adults. Proc Natl Acad Sci 1996;93:3043–7.
26. Cohen S, Janicki-Deverts D, Turner RB, Doyle WJ. Does hugging provide stress-buffering social support? A study of susceptibility to upper respiratory infection and illness. Psychol Sci 2015;26:135–47.
27. Ambrée O, Ruland C, Scheu S, Arolt V, Alferink J. Alterations of the innate immune system in susceptibility and resilience after social defeat stress. Front Behav Neurosci 2018;12:141.
28. Gururajan A, van de Wouw M, Boehme M, Becker T, O'Connor R, Bastiaanssen TFS, et al. Resilience to chronic stress is associated with specific neurobiological, neuroendocrine and immune responses. Brain Behav Immun 2019;80:583–94.
29. Nishimi K, Koenen KC, Coull BA, Kubzansky LD. Association of psychological resilience with healthy lifestyle and body weight in young adulthood. J Adolesc Health 2022;70:258–66.
30. Cervera-Torres S, Ruiz-Fernández S, Godbersen H, Massó L, Martínez-Rubio D, Pintado-Cucarella S, et al. Influence of resilience and optimism on distress and intention to self-isolate: contrasting lower and higher COVID-19 illness risk samples from an extended health belief model. Front Psychol 2021;12:662395.
31. Van Schrojenstein Lantman M, Mackus M, Otten LS, de Kruijff D, van de Loo AJ, Kraneveld AD, et al. Mental resilience, perceived immune functioning, and health. J Multidiscip Healthc 2017;10:107–12.
32. Gupta MA. Review of somatic symptoms in post-traumatic stress disorder. Int Rev Psychiatry 2013;25:86–99.
33. Beutel ME, Tibubos AN, Klein EM, Schmutzer G, Reiner I, Kocalevent RD, et al. Childhood adversities and distress—the role of resilience in a representative sample. PloS One 2017;12:e0173826.
34. Fullerton DJ, Zhang LM, Kleitman S. An integrative process model of resilience in an academic context: resilience resources, coping strategies, and positive adaptation. PloS One 2021;16:e0246000.
35. Feder A, Nestler EJ, Charney DS. Psychobiology and molecular genetics of resilience. Nat Rev Neurosci 2009;10:446–57.
36. Osofsky HJ, Weems CF, Graham RA, Osofsky JD, Hansel TC, King LS. Perceptions of resilience and physical health symptom improvement following post disaster integrated health services. Disaster Med Public Health Prep 2019;13:223–9.
37. Smith B, Shatté A, Perlman A, Siers M, Lynch WD. Improvements in resilience, stress, and somatic symptoms following online resilience training: a dose-response effect. J Occup Environ Med 2018;60:1–5.
38. Ye B, Zhou X, Im H, Liu M, Wang XQ, Yang Q. Epidemic rumination and resilience on college students' depressive symptoms during the COVID-19 pandemic: the mediating role of fatigue. Front Public Health 2020;8:560983.
39. Dal Santo T, Sun Y, Wu Y, He C, Wang Y, Jiang X, et al. Systematic review of mental health symptom changes by sex or gender in early-COVID-19 compared to pre-pandemic. Sci Rep 2022;12:11417.
40. Choi KW, Nishimi K, Jha SC, Sampson L, Hahn J, Kang JH, et al. Pre-pandemic resilience to trauma and mental health outcomes during COVID-19. Soc Psychiatry Psychiatr Epidemiol 2022;58:453–65.
41. Niles AN, Woolley JD, Tripp P, Pesquita A, Vinogradov S, Neylan TC, et al. Randomized controlled trial testing mobile-based attention-bias modification for posttraumatic stress using personalized word stimuli. Clin Psychol Sci 2020;8:756–72.

42. Nishimi K, Borsari B, Marx BP, Tripp P, Woodward E, Rosen RC, et al. Posttraumatic stress disorder symptoms associated with protective and risky behaviors for coronavirus disease 2019. Health Psychol 2022;41:104–14.
43. Dolsen EA, Nishimi K, LeWinn KZ, Byers AL, Tripp P, Woodward E, et al. Identifying correlates of suicide ideation during the COVID-19 pandemic: a cross-sectional analysis of 148 sociodemographic and pandemic-specific factors. J Psychiatr Res 2022;156:186–93.
44. Carlson EB, Smith SR, Palmieri PA, Dalenberg C, Ruzek JI, Kimerling R, et al. Development and validation of a brief self-report measure of trauma exposure: the Trauma History Screen. Psychol Assess 2011;23:463–77.
45. Weathers FW, Litz BT, Keane TM, Palmieri PA, Marx BP, Schnurr PP. The PTSD Checklist for DSM-5 (PCL-5). 2013. Scale Available at National Center for PTSD. www.ptsd.va.gov. Accessed May 11, 2021.
46. Antony MM, Bieling PJ, Cox BJ, Enns MW, Swinson RP. Psychometric properties of the 42-item and 21-item versions of the Depression Anxiety Stress Scales in clinical groups and a community sample. Psychol Assess 1998;10:176–81.
47. Vaishnavi S, Connor K, Davidson JR. An abbreviated version of the Connor-Davidson Resilience Scale (CD-RISC), the CD-RISC2: psychometric properties and applications in psychopharmacological trials. Psychiatry Res 2007;152(2–3):293–7.
48. Connor KM, Davidson JR. Development of a new resilience scale: the Connor-Davidson Resilience Scale (CD-RISC). Depress Anxiety 2003;18:76–82.
49. Pimple P, Lima BB, Hammadah M, Wilmot K, Ramadan R, Levantsevych O, et al. Psychological distress and subsequent cardiovascular events in individuals with coronary artery disease. J Am Heart Assoc 2019;8:e011866.
50. Amstadter AB, Maes HH, Sheerin CM, Myers JM, Kendler KS. The relationship between genetic and environmental influences on resilience and on common internalizing and externalizing psychiatric disorders. Soc Psychiatry Psychiatr Epidemiol 2016;51:669–78.
51. Sheerin CM, Lind MJ, Brown EA, Gardner CO, Kendler KS, Amstadter AB. The impact of resilience and subsequent stressful life events on MDD and GAD. Depress Anxiety 2018;35:140–7.
52. CDC. COVID Data Tracker [Internet]. Centers for Disease Control and Prevention. 2020. Available at: https://covid.cdc.gov/covid-data-tracker. Accessed May 11, 2021.
53. Crook H, Raza S, Nowell J, Young M, Edison P. Long covid—mechanisms, risk factors, and management. BMJ 2021;26:n1648.
54. Kroenke K, Spitzer RL, Williams JBW. The PHQ-15: validity of a new measure for evaluating the severity of somatic symptoms. Psychosom Med 2002;64:258–66.
55. Witthöft M, Hiller W, Loch N, Jasper F. The latent structure of medically unexplained symptoms and its relation to functional somatic syndromes. Int J Behav Med 2013;20:172–83.
56. Howe CJ, Cole SR, Lau B, Napravnik S, Eron JJ. Selection bias due to loss to follow up in cohort studies. Epidemiology 2016;27:91–7.
57. Wang M. Generalized estimating equations in longitudinal data analysis: a review and recent developments. Adv Stat 2014;2014:1–11.
58. Vannini P, Gagliardi GP, Kuppe M, Dossett ML, Donovan NJ, Gatchel JR, et al. Stress, resilience, and coping strategies in a sample of community-dwelling older adults during COVID-19. J Psychiatr Res 2021;138:176–85.
59. Nishimi K, Borsari B, Marx BP, Rosen RC, Cohen BE, Woodward E, et al. Clusters of COVID-19 protective and risky behaviors and their associations with pandemic, socio-demographic, and mental health factors in the United States. Prev Med Rep 2022;25:25.
60. To QG, Vandelanotte C, Cope K, Khalesi S, Williams SL, Alley SJ, et al. BMC Public Health 2022;22:491.
61. Du C, Zan MCH, Cho MJ, Fenton JI, Hsiao PY, Hsiao R, et al. The effects of sleep quality and resilience on perceived stress, dietary sleep quality and resilience on perceived stress, dietary behaviors, and alcohol misuse: a mediation-moderation analysis of higher education students from Asia, Europe, and North America during the COVID-19 pandemic. Nutrients 2021;13:442.
62. Chastin SFM, Abaraogu U, Bourgois JG, Dall PM, Darnborough J, Duncan E, et al. Effects of regular physical activity on the immune system, vaccination and risk of community acquired infectious disease in the general population: systematic review and meta-analysis. Sports Med Auckl NZ 2021;51:1673–86.
63. Bennett FC, Molofsky AV. The immune system and psychiatric disease: a basic science perspective. Clin Exp Immunol 2019;197:294–307.
64. Xiao K, Gillissie ES, Lui LMW, Ceban F, Teopiz KM, Gill H, et al. Immune response to vaccination in adults with mental disorders: a systematic review. J Affect Disord 2022;304:66–77.
65. Huppert FA. Psychological well-being: evidence regarding its causes and consequences. Appl Psychol Health Well-Being 2009;1:137–64.
66. Kostev K, Smith L, Koyanagi A, Jacob L. Prevalence of and factors associated with post-coronavirus disease 2019 (COVID-19) condition in the 12 months after the diagnosis of COVID-19 in adults followed in general practices in Germany. Open Forum Infect Dis 2022;9:ofac333.
67. Wu S, Wang R, Zhao Y, Ma X, Wu M, Yan X, et al. The relationship between self-rated health and objective health status: a population-based study. BMC Public Health 2013;13:320.
68. Rozenkrantz L. How beliefs about coronavirus disease (COVID) influence COVID-like symptoms?—a longitudinal study. Health Psychol 2022;41:519–26.
69. Andrews PW, Thomson JA. The bright side of being blue: depression as an adaptation for analyzing complex problems. Psychol Rev 2009;116:620–54.
70. Robinson E, Sutin AR, Daly M, Jones A. A systematic review and meta-analysis of longitudinal cohort studies comparing mental health before versus during the COVID-19 pandemic in 2020. J Affect Disord 2022;296:567–76.
71. Fernandez CA, Choi KW, Marshall BD, Vicente B, Saldivia S, Kohn R, et al. Assessing the relationship between psychosocial stressors and psychiatric resilience among Chilean disaster survivors. Br J Psychiatry 2020;217:630–7.
72. Clarke KEN, Jones JM, Deng Y, et al. Seroprevalence of infection-induced SARS-CoV-2 antibodies—United States, September 2021–February 2022. MMWR Morb Mortal Wkly Rep 2022;71:606–8.
73. Dhabhar FS. Psychological stress and immunoprotection versus immunopathology in the skin. Clin Dermatol 2013;31:18–30.
74. Sylvester SV, Rusu R, Chan B, Bellows M, O'Keefe C, Nicholson S. Sex differences in sequelae from COVID-19 infection and in long COVID syndrome: a review. Curr Med Res Opin 2022;38:1391–9.
75. Silverstein B. Gender differences in the prevalence of somatic versus pure depression: a replication. Am J Psychiatry 2002;159:1051–2.