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Psychological Resilience to Trauma and Risk for COVID-19 Infection and Somatic Symptoms Over Two Years

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Abstract

Objective: Exposure to trauma increases risk for 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 risk for COVID-19 infection and somatic symptoms across two 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 six 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 lower likelihood of COVID-19 infection over time, with one standard deviation higher resilience score associated with 31% lower likelihood of COVID-19 infection, adjusting for socio-demographics 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 for COVID-19 infection and lower somatic symptoms during the pandemic. Promoting psychological resilience to trauma may benefit not only mental, but also physical, health.

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Keywords

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 increased risk for 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, due to 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 risk for 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 for 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 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 following 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) following 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 following adversity (i.e., high perceived trait psychological resilience following 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, while 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, they 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 risk for 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 for 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, non-smoking) (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 for 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 risk for somatic symptoms via alterations in stress-related hypothalamic-pituitary-adrenal (HPA) and sympatho-adrenal medullary axes, impacting the functioning of 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 two 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 lower likelihood and severity of COVID-19 infection, lower risk of long COVID, and fewer

somatic symptoms in general over time. We adjusted for multiple socio-demographic factors that could be confounders (e.g., age, gender, race/ethnicity, socio-economic 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 over two 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 aged 18 and older who had completed a screening questionnaire for research related to trauma and posttraumatic stress in 2017–2018 and subsequent COVID-19 related questionnaires in 2020–2022 (41). All 3,631 individuals who responded or participated in the 2017–2018 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 (22.9%) individuals provided informed consent and completed the baseline 30-minute online COVID-19 Qualtrics survey in August-September 2020 (Wave 1) that assessed psychological experiences during the COVID-19 pandemic. Prior descriptive analyses in this sample indicate that non-responders were younger and had higher PTSD symptoms relative to the COVID-19 survey study participants (43). Following the baseline COVID-19 survey, all Wave 1 participants were invited to participate in four subsequent surveys in February-March 2021 (Wave 2, $n = 442$, 68.2%), August-September 2021 (Wave 3, $n = 418$, 64.5%), January-February 2022 (Wave 4, $n = 405$, 62.5%), and July-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 CD-RISC (48)). Sum scores for each distress and positive domain (i.e., perceived resilience capacity) were calculated, each sum score was standardized ($M = 0$, $SD = 1$), 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%CI −0.47, −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: "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 who suspected COVID-19 infection.

For those reporting Yes, Probably yes, or Maybe, individuals reported the severity of their symptoms: none, mild, moderate, severe, 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 four 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 for infection and severe disease in exploratory analyses.

Somatic Symptoms—Somatic symptoms were self-reported at Waves 3–5 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).

Psychiatric Symptoms—To determine associations between psychological resilience and psychiatric symptoms over time as the pandemic unfolded, we examined psychiatric symptoms at Waves 2–5. Psychiatric symptoms included: 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—Socio-demographic covariates were all self-reported at Wave 1 and chosen as they represent potential confounders. These included age (continuous age in years), gender (man, woman, non-binary/ 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 ten protective behaviors (e.g., wearing a mask, washing hands, isolating oneself) and eight 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, as 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 [*RR*] = 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 the Supplement Digital Content for additional post-hoc power analyses.

We first examined distributions of psychological resilience and baseline covariates. Psychological resilience and all continuous variables were standardized ($M = 0$, $SD = 1$) prior to analyses, so associations are interpreted as effects per one standard deviation 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 relative risk (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*psychological resilience interactions were tested to determine whether the associations between resilience and outcomes were stable or changed over time. Models adjusted for all socio-demographic 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. As 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 socio-demographic covariates, COVID-19 vulnerabilities, COVID-19 infection, and long COVID; time*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*psychological resilience interactions. Models were adjusted for all socio-demographic 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 is available upon request from the first author.

Results

Baseline covariates are presented in Table 1. As of August-September 2020, the analytic sample was 37.8 years old on average, majority 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 significantly lower risk for COVID-19 infection across time, with one standard deviation higher resilience conferring 31% lower risk for 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*psychological resilience $RR = 1.02$, 95%CI 1.00, 1.03, $p = 0.026$). In sensitivity analyses, psychological resilience was marginally associated with lower risk for COVID-19 infection when including those with suspected infection ($RR = 0.85$, 95%CI 0.72, 1.01, $p = 0.059$). 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* = 0.081) 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), nor with risk for reporting long COVID (*RR* = 0.79, 95%CI 0.58, 1.07). Psychological resilience was significantly associated with lower perceived likelihood of contracting COVID-19 (β = −0.08, 95% CI −0.15, 0.00, *p* = 0.039) and lower perceived severity of COVID-19 symptoms if contracted (β = −0.08, 95% CI −0.16, −0.01, *p* = 0.030), as reported at study baseline.

Psychological Resilience and Somatic Symptoms

Somatic symptoms were relatively stable during the first two years of the pandemic (Supplemental Digital Content, Figure S1,), were highly correlated across time (*r*s = 0.69–0.76), and average levels were moderate ($M_{wave\ 3}$ = 10.0, *SD* = 6.0, $M_{wave\ 4}$ = 10.0, *SD* = 6.0, $M_{wave\ 5}$ = 9.7, *SD* = 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*psychological resilience effects, indicating associations between resilience and symptoms were stable across follow-up (e.g., time*psychological resilience for overall somatic symptoms β = 0.00, 95%CI −0.01, 0.01, *p* = 0.98). 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 $M_{Wave\ 2}$ = 25.0, *SD* = 20.5 vs $M_{Wave\ 5}$ = 22.1, *SD* = 19.6; depression $M_{Wave\ 2}$ = 14.7, *SD* = 12.1 vs $M_{Wave\ 5}$ = 12.4, *SD* = 11.6), while anxiety appeared more stable ($M_{Wave\ 2}$ = 10.6, SD = 9.7 vs $M_{Wave\ 5}$ = 9.8, SD = 9.7), see Supplemental Digital Content, Figure S2. 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*psychological resilience effects (time*psychological resilience for PTSD symptoms *RR* = 0.00, 95%CI 0.00, 0.01, *p* = 0.347; for depressive symptoms *RR* = 0.00, 95%CI 0.00, 0.01, *p* = 0.138; for PTSD *RR* = 0.00, 95%CI −0.01, 0.01, *p* = 0.785), 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 significantly associated with favorable physical health outcomes over time. Specifically,

higher psychological resilience was associated with lower risk of reporting a first COVID-19 infection and fewer somatic symptoms across two 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 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.

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 significantly lower risk for incident infection early in the pandemic, even after adjusting for socio-demographic 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 appeared 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 risk for earlier more than later variants of SARS-CoV-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) (60). 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 (42,61), 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 (62), better diet quality, better sleep quality (63)), which may support immune health and protect against infection (64). 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 (65) and attenuated immune response to vaccines (66). Moreover, evidence from observational studies of psychological well-being and emotional styles, as well as

interventions to improve mental states, indicate that positive psychological factors are associated with better immune system functioning (67).

In contrast to our hypotheses, we did not identify associations between psychological resilience and risk for more severe COVID-19 infection or long COVID. While 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 increased likelihood of long COVID (68) 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. Additionally, since psychological resilience was associated with 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 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 (69). Individuals with higher psychological resilience also predicted 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 (70). However, it is consistent with some evidence that higher depressive symptoms are associated with more accurate predictions about risk due to increased analytic rumination (71). 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 wellbeing, 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 symptomology associated with lower psychological resilience was 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 prior to the COVID-19 pandemic have identified coping behaviors as mediators of associations between

psychological resilience and somatic symptomology, 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 (72), 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 two years as the pandemic unfolded. These findings are consistent with previous work, from prior to 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 (40,73). However, these prior studies assessed psychological health at only a single time point, thus did not demonstrate associations with sustained mental health benefits. Our current findings indicate 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, thus weighted towards measures of distress. In sensitivity analyses included in the Supplement, 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), 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 due to 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 (74), which more accurately captures cases that were not officially diagnosed or reported. Additionally, 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 (75). 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 as those who remained in the sample differed by several socio-demographic 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 (58), and tend to show higher levels of somatic symptoms (59) and psychiatric symptomology 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 risk for 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 following trauma may extend to physical health.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Conflicts of Interest and Source of Funding:

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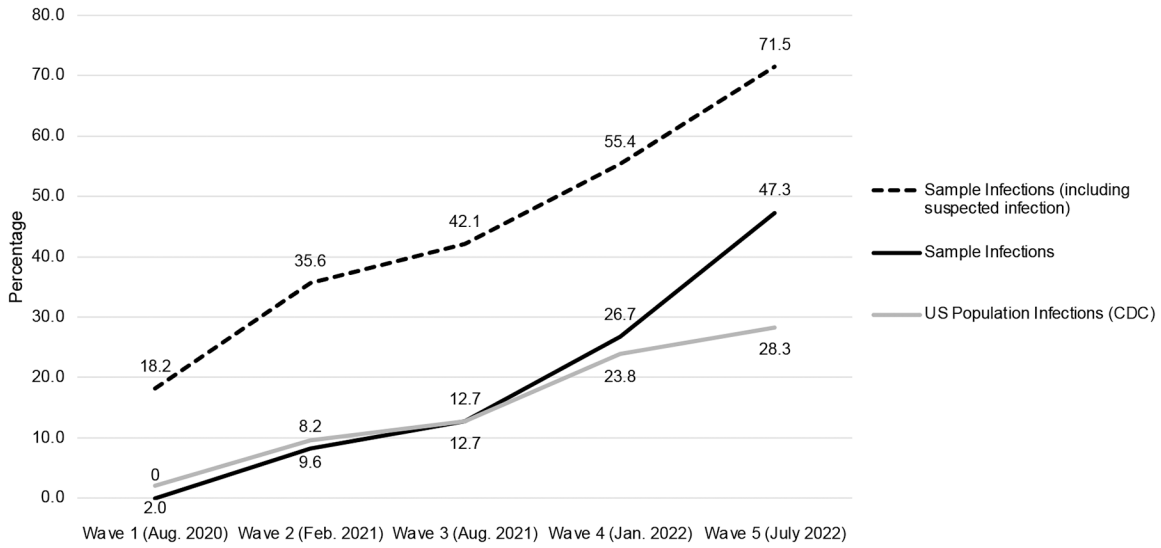

Figure 1.

Cumulative prevalence of COVID-19 infection reported in the analytic sample compared to the broader US population

Note. 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, while "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.

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***	***T-test, χ^2 or r p-value***
Age (*Mean (SD)*)		37.8	11.2	0.18	--	<.001
Gender	Man	87	16.5	0.21	0.9	0.060
	Woman	425	80.5	−0.03	1.0	
	Non-Binary, Transgender, Other	16	3.0	−0.31	1.0	
Sexual Orientation	Heterosexual	418	79.2	0.04	1.0	0.079
	Homosexual or Other	110	20.8	−0.15	1.0	
Race/Ethnicity	Non-Hispanic White	316	59.8	0.00	1.1	0.651
	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	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	0.025
	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	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	0.223
	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	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	

Note. P-values are for T-tests or ANOVAs for mean levels of psychological resilience across categorical covariates, or for correlation between age and resilience.

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-value*
COVID-19 Infection	0.69	0.49, 0.99	0.042
COVID-19 Severity	1.00	0.75, 1.32	0.98
Long COVID	0.79	0.58, 1.07	0.130
Somatic Symptoms [b]	*β*	*95% CI*	*p-value*
Overall Somatic Symptoms	−0.18	−0.26, −0.10	<.001
Pain Symptoms	−0.23	−0.32, −0.15	<.001
Gastrointestinal Symptoms	−0.25	−0.34, −0.16	<.001
Cardiopulmonary Symptoms	−0.27	−0.35, −0.19	<.001
Fatigue Symptoms	−0.37	−0.48, −0.26	<.001
Psychiatric Symptoms [c]	*β*	*95% CI*	*p-value*
PTSD Symptoms	−0.50	−0.58, −0.42	<.001
Depressive Symptoms	−0.53	−0.61, −0.45	<.001
Anxiety Symptoms	−0.44	−0.53, −0.35	<.001

Note. 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 ($M = 0$, $SD = 1$)

[a]Adjusted for time, time*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 3–5 among $n = 470$. Adjusted for time, time*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*psychological resilience, age, gender, sexual orientation, race/ethnicity, income, marital status, and area type.