Associations between social COVID-19 exposure and psychological functioning

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Abstract The negative consequences of the COVID-19 pandemic on mental health have been widely reported, but less is known about how the impact of COVID-19 on others in one’s social circle shapes these high distress levels. This study examines associations between social COVID-19 exposure—knowing someone who had a COVID-19 infection—and psychological functioning, as well as whether socio-demographic factors moderate these relationships. In June 2020, respondents (N = 343) from clinics in Tampa, Florida, U.S.A. reported whether they had social COVID-19 exposure, anxiety, depression, and stress, and other COVID-19-related concerns. Social COVID-19 exposure was associated with increased anxiety, stress, and concerns about a family member getting sick, and concerns about drinking and substance use. Several associations between exposure and psychological functioning were stronger in women, younger people, and people with lower income, implying these groups face elevated psychological risks due to the pandemic, and should be prioritized in mental health recovery efforts.

Keywords COVID-19 · Social factors · Psychological functioning · COVID-19 concerns · Exploratory factor analysis (EFA) · Moderation analyses

Introduction

The COVID-19 pandemic is an unprecedented public health challenge that has had devastating consequences for the United States, which reported the highest number of cases and COVID-19-related deaths in the world (World Health Organization [WHO], 2022). As COVID-19 spread throughout the nation, it not only increased morbidity and mortality rates, but also caused significant psychological distress, including steep increases in stress, anxiety, and depression (Panchal, 2021). For example, a representative survey conducted among adults aged ≥ 18 years across the
United States in June 20, 2020 showed that 41% of respondents reported at least one adverse mental health outcome, including symptoms of anxiety disorder or depressive disorder (31%), symptoms of a trauma-and stressor-related disorder attributable to the pandemic (27%; Czeisler et al., 2020). This translates into sharp deterioration in mental health during the pandemic compared to pre-COVID-19. For example, in 2020 the rates of anxiety and depression among the U.S. public increased by more than three and four times respectively, relative to 2019 (Czeisler et al., 2020).

According to the biopsychosocial model, physical and mental health are a produced by the dynamic interplay of social, psychological, and biological factors (Engel, 1977). In this study, we applied the biopsychosocial model to the study of mental health during the early months of the COVID-19 pandemic by asking how one key social factor—knowing someone who had COVID-19, or “social COVID-19 exposure”—may have shaped high distress levels in the U.S. population in the context of a novel and highly-contagious pathogen with unknown long-term health consequences. Because biopsychosocial formulations are beneficial for informing mitigative efforts targeting exposure and vulnerability to COVID-19 as well as developing and improving acute and long-term interventions (Kop, 2021), a study integrating biological, social, and psychological factors is critically important to the understanding of health risks and disease outcomes of the COVID-19 pandemic.

There are important insights to be gained about the dynamics between social exposure and psychological functioning during the early stage of a novel infectious outbreak. Specifically, because early in the pandemic there was great uncertainty about the epidemiology, transmission, and consequences of infection by the SARS-CoV-2 virus, the social impacts of COVID-19 may have been more severe in the early months of the pandemic (rather than in subsequent months when certainty about scientific knowledge was higher; Otu et al., 2020).

Being socially connected is generally linked to psychological benefits (Holt-Lunstad et al., 2017). However, in the context of an infectious disease pandemic where others can be the source of infection, the health status of one’s social circle may impact psychological outcomes. Specifically, when members of individuals’ social circles develop infections, those within those circles may experience more distress than when the infections occur outside those circles. There are two putative mechanisms implicated. First, knowing others who have been infected with COVID-19 could increase one’s own perceived vulnerability to infection—either directly as a source of personal viral exposure or indirectly by serving as easily accessible reminders of the disease’s presence (Butter et al., 2021; Pachur et al., 2012; Schulze et al., 2021; Tversky & Kahneman, 1973, 1974)—and lead to psychological distress. Second, worrying about the health and well-being of known others infected with the virus could more directly lead to psychological distress (Adams et al., 2021; Lightfoot et al., 2021).

Some segments of the population, including women and younger adults (Dragioti et al., 2021), those with less income (Hall et al., 2021), parents and children (Czeisler et al., 2021), and communities of color (Panchal, 2021) experienced more adverse psychological consequences due to the COVID-19 pandemic. Thus, these groups may be particularly susceptible to any negative psychological consequences of interpersonal factors such as social COVID-19 exposure. Investigating whether and how potential effects of social COVID-19 exposure on distress might vary by these sociodemographic factors could help identify individuals particularly likely to experience psychological adversities related to COVID-19 and future infectious disease outbreaks.

Consistent with the biopsychosocial model, we investigated how social COVID-19 exposure may be associated with psychological functioning, and whether select sociodemographic characteristics might moderate these associations. Accordingly, the first aim of this study was to examine whether social COVID-19 exposure is associated with our primary psychological outcomes: anxiety, depression, stress, and COVID-19 specific concerns, which included items describing areas of life vulnerable to potential complications due to the pandemic (e.g., personal and family health, work, finances).

We hypothesized that those with social COVID-19 exposure would have more negative psychological outcomes compared to people without social exposure. The second aim was to explore whether select socio-demographic variables moderate the relationships between social COVID-19 exposure and our primary psychological outcomes. Given the exploratory nature of this aim, no specific hypotheses were tested.

**Method**

Survey data were collected between June 8 and June 27, 2020 from participants who were enrolled onto one of two skin cancer prevention intervention studies, one conducted among non-Hispanic White participants and one conducted among Hispanic participants. Both studies predominately recruited participants from two non-specialty, academic clinic settings in Tampa, Florida, U.S.A. Details of these studies have been published elsewhere (Lacson et al., 2021, 2022). Trial participants who previously (i) consented to be re-contacted for future studies, (ii) provided an email address, (iii) completed the baseline study questionnaire for the intervention trial, (iv) indicated English as a language preference, and were (v) less than 89 years of age and (v) not under active trial follow up were sent an
email inviting them to participate in a COVID-19 research study. The email message contained an active link to a secured Research Electronic Data Capture (REDCap) application hosted at Moffitt Cancer Center that housed the COVID-19 survey. At the time of the emails, the trial conducted among non-Hispanic White participants was closed to follow up; the trial among Hispanic participants was closed to accrual, but under active follow up. A total of 1247 emails were sent, but 33 bounced back to the sender (3%). Of the 1214 emails (1015 to non-Hispanic White participants, 199 to Hispanic participants) that were received, a total of 343 (28%) participants completed the survey. Completion rates among non-Hispanic white (29%) and Hispanic (23%) participants were similar. This study was deemed exempt from human subjects consideration by Advarra (provider of institutional review board (IRB) services) and an alteration of HIPAA authorization per 45 CFR 164.512(i)(ii) was granted; informed consent was not obtained from participants completing the survey. Socio-demographic information reported by participants included age, sex, ethnicity, race, education, income, and household size and composition.

Measures

Social COVID-19 exposure

Social COVID-19 exposure was measured using the question “Has someone you know had or think they’ve had COVID-19?” The exposure group included participants who responded that they knew someone who was tested and confirmed to have COVID-19 and/or had symptoms but was not tested. The no-exposure group was comprised of those who reported not knowing anyone with COVID-19 or who responded “I don’t know” to the question.

COVID-19 concerns

A range of COVID-19 concerns were assessed using 23 statements generated by the study team describing potential complications associated with the pandemic. Participants indicated their level of concern using a 3-point response scale ranging from 1 (not concerned) to 3 (very concerned). Participants were also provided with a “not applicable” response option for each statement. We grouped the “not applicable” responses with “not concerned,” inferring that if a person saw a given complication as not relevant to them, then it likely posed no concerns for them. The items addressed included personal and family health, government response to the pandemic, work, finances, and lifestyle challenges.

Anxiety and depression

Anxiety and depression were measured using the Patient Health Questionnaire-4 (Kroenke et al., 2009) a 4-item, valid, reliable (α = 0.88), ultra-brief screener assessing depression (2 items) and anxiety (2 items) on a 4-point scale from 0 (not at all) to 3 (nearly every day). The total scores for anxiety and depression were obtained by summing the respective item responses, with the possible score range for either construct being 0 to 6. Higher scores denote more anxiety or depression, and scores of 3 or more on either subscale indicate clinically significant levels (Kroenke et al., 2009).

Stress

Stress was measured using the Perceived Stress Scale-4 (Cohen et al., 1983), a 4-item scale with adequate validity and reliability (α = 0.70) assessing perceived stress on a 5-point scale from 0 (never) to 4 (often). The stress score was computed as the sum of the 4 items; higher scores denote more stress. There is no cut-off score established for PSS-4 to determine clinically significant levels of stress.

Statistical approach

We examined the underlying structure of COVID-19 concerns using exploratory factor analysis (EFA). Given that the data were approximately normally distributed, we used maximum likelihood as the extraction method (Osborne, 2014) with oblique rotation (promax). One item, “Concerns about drinking more or using substances more,” did not meet the communality threshold of 0.2, and was subsequently removed from analyses. Three items (“Getting sick myself,” “A family member getting sick,” “Not being able to get tested if I develop symptoms”) cross-loaded on several factors and were included in subsequent analyses as individual items. The EFA with the remaining 19 items was re-run to determine the final factor structure. Factorability of the data was established using the Kaiser–Meyer–Olkin (KMO = 0.83) measure of sampling adequacy and deemed “meritorious” (Kaiser & Rice, 1974). Bartlett’s test of sphericity was statistically significant (χ2 (171) = 3711.59, p < 0.001). Items comprising each factor were averaged, and each factor was examined as an outcome in the subsequent analyses (see Table 2 for the EFA analyses). Associations between social COVID-19 exposure and items excluded from the EFA were examined individually.

To examine associations between social COVID-19 exposure (yes/no) and COVID-19 concerns, anxiety, depression, and stress (aim 1), we used independent sample t-tests. To test the moderating effects of select socio-demographic characteristics (i.e., sex, age, and income) on the relationships between social COVID-19 exposure with COVID-19
concerns, anxiety, depression, and stress (exploratory aim 2), we used the PROCESS macro for SPSS (Hayes, 2022). All analyses were conducted using IBM SPSS, v. 26. The statistical significance was set to $\alpha = 0.05$.

**Results**

**Participant characteristics**

Participants were on average 50.6 ($SD = 14.4$) years old, slightly more than half self-identified as female (55%), and most were non-Hispanic (87%) and White (95%) with at least a college degree (67%). See Table 1 for more details.

**Social COVID-19 exposure**

Two hundred and twenty-two participants (65% of the sample) reported “no exposure”. Of those, 197 reported they did not know anyone with a COVID-19 diagnosis, and 21 answered “I don’t know” about whether they knew someone diagnosed with COVID-19. Four participants selected both responses. There were no differences for the outcomes of interest ($p > 0.05$) between those who answered “No” and “I don’t know.” The remaining 115 participants (34%) reported knowing someone who was either diagnosed or was suspected to have had COVID-19. Data from six participants were excluded because of either true missingness ($n = 1$; 0.3% of the sample) or endorsement of mutually exclusive answers (e.g., endorsing both knowing someone with a diagnosis or suspicion of COVID-19, and endorsing not knowing anyone with a known or suspected COVID-19 diagnosis [$n = 5$; 1% of the sample]).

**Psychological functioning: descriptive findings**

The proportion of participants positively screening for clinically significant anxiety or depression was 14% and 13%, respectively. See Table 3 for more details.

Respondents were most concerned about a family member getting sick (55% indicated “very concerned”) and least concerned about Internet access (71% indicated “not concerned”) (Fig. 1). “Other concerns” received the highest proportion of “not applicable” responses (78% of respondents). Additional items that were endorsed as not applicable by most participants described parenting concerns.

**Exploratory factor analysis of COVID-19 concerns**

An initial analysis indicated that six factors had eigenvalues over the Kaiser criterion of 1 (Kaiser, 1960). These six factors explained 76.2% of the variance, which meets the recommended threshold of at least 50% of the total variance explained by the retained factors (Streiner, 1994). Items clustering on the same factor suggested that factor one represented work and financial concerns, factor two represented government protection concerns, factor three represented healthcare concerns, factor four represented lifestyle concerns, factor five represented social isolation concerns, and factor six represented parenting concerns (Table 2). All factors demonstrated good reliability assessed using Cronbach’s alpha ($\alpha$ range 0.73–0.94; see Table 2 for specific values).

**Associations between social COVID-19 exposure and psychological functioning**

Participants with social COVID-19 exposure reported statistically significantly more concern about a family member getting sick ($M = 2.58, SD = 0.51, p = 0.015$), and concern about drinking more and using substances more ($M = 1.24, SD = 0.64, p = 0.042$) compared to those without social exposure ($M = 2.42, SD = 0.68$ and $M = 0.99, SD = 0.66$, respectively). Those with and without exposure did not differ on the remaining factor-analyzed categories of concerns (all $p > 0.05$).

As hypothesized, participants with social COVID-19 exposure reported statistically significantly more anxiety ($M = 1.46, SD = 1.56, p = 0.018$) and stress ($M = 5.26, SD = 3.24, p = 0.018$), although not more depression ($M = 1.23, SD = 1.54, p > 0.05$) than those without social exposure ($M = 1.04, SD = 1.52; M = 4.40, SD = 3.14; M = 1.01, SD = 1.62$, respectively; Table 3).

**Moderation analyses**

Knowing someone who had COVID-19 had more impact on the concerns of women, younger people, and people with incomes less than $100,000 per year. Biological sex emerged as a statistically significant moderator of the relationship between social COVID-19 exposure and concerns regarding government protection ($b = 0.33, se = 0.16, p = 0.04$) and healthcare ($b = 0.32, se = 0.16, p = 0.05$) (Fig. 2). Simple slope tests showed that women but not men who had social COVID-19 exposure had greater concerns regarding government ($b = 0.27, se = 0.10, p = 0.01$) and healthcare ($b = 0.25, se = 0.11, p = 0.02$) compared to those without exposure. Biological sex interacted with the relationship between social COVID-19 exposure and lifestyle concerns ($b = 0.30, se = 0.12, p = 0.01$), but neither the simple slope tests for women ($b = 0.14, se = 0.08, p = 0.07$) nor men ($b = -0.16, se = 0.09, p = 0.09$) were statistically significant.

Age emerged as a statistically significant moderator of the relationships between social COVID-19 exposure and anxiety ($b = -0.04, se = 0.01, p = 0.002$), and social exposure and depression ($b = -0.03, se = 0.01, p = 0.007$). Participants younger than age 36 (i.e., those -1 SD on the
centered age variable [whereby $M = 50.6$ and $SD = 14.4$]) who had social COVID-19 exposure reported more anxiety ($b = 0.77$, $se = 0.23$, $p < 0.001$) and depression ($b = 0.59$, $se = 0.24$, $p = 0.02$) than participants without exposure. Among older participants, anxiety and depression did not vary based on social COVID-19 exposure ($ps > 0.05$). Income was a statistically significant moderator of the relationship between social exposure and work and financial

Table 1  Participant characteristics

| Variable                                    | Mean (SD), Range | n (%) |
|---------------------------------------------|------------------|------|
| Age                                         | 50.63 (14.36), 18–84 |      |
| Sex                                         |                  |      |
| Female                                      | 189 (55.1)       |      |
| Male                                        | 154 (44.9)       |      |
| Race                                        |                  |      |
| White                                       | 326 (95.0)       |      |
| Marginalized$^a$                            | 17 (5.0)         |      |
| Education                                   |                  |      |
| Less than 4-year college degree             | 108 (31.4)       |      |
| 4-year college degree or more               | 230 (67.1)       |      |
| Missing                                     | 5 (1.5)          |      |
| Ethnicity                                   |                  |      |
| Non-Hispanic                                | 297 (86.6)       |      |
| Hispanic                                    | 46 (13.4)        |      |
| Household size                              |                  |      |
| 1                                           | 66 (19.2)        |      |
| 2                                           | 153 (44.6)       |      |
| 3                                           | 53 (15.5)        |      |
| 4                                           | 38 (11.1)        |      |
| 5                                           | 19 (5.5)         |      |
| 6 or more                                   | 6 (1.8)          |      |
| Missing                                     | 8 (2.3)          |      |
| Children in the household                   |                  |      |
| 0                                           | 261 (76.1)       |      |
| 1                                           | 42 (12.2)        |      |
| 2                                           | 23 (6.7)         |      |
| 3 or more                                   | 9 (2.6)          |      |
| Missing                                     | 8 (2.3)          |      |
| Pre-tax income within the past year         |                  |      |
| $0 to $9999                                  | 3 (0.9)          |      |
| $10,000 to $14,999                          | 2 (0.6)          |      |
| $15,000 to $19,999                          | 4 (1.2)          |      |
| $20,000 to $34,999                          | 17 (5.0)         |      |
| $35,000 to $49,999                          | 28 (8.2)         |      |
| $50,000 to $74,999                          | 59 (17.2)        |      |
| $75,000 to $99,999                          | 56 (16.3)        |      |
| $100,000 to $199,999                        | 111 (32.4)       |      |
| $200,000 or more                            | 39 (11.4)        |      |
| Missing                                     | 24 (7.0)         |      |

$^a$11 respondents identified their racial identity as “Other,” 1 as “Black or African American,” 1 as “American Indian or Alaska Native,” 1 as “White & African American,” 1 as “White & African American & American Indian or Alaska Native,” 1 as “White & African American & Other,” 1 as “White & Asian.”
concerns ($b = -0.11$, $se = 0.04$, $p = 0.01$). Participants whose annual household income was less than $100,000 and had social COVID-19 exposure experienced more work and financial concerns ($b = 0.15$, $se = 0.07$, $p = 0.03$) than those without exposure. Among those with incomes of more than $100,000, the relationship between social COVID-19 exposure and work and financial concerns was not statistically significant ($p > 0.05$).

**Discussion**

Using a sample from Tampa, Florida collected during the first COVID-19 pandemic wave in mid-June 2020, and drawing from the biopsychosocial model, we investigated associations between social COVID-19 exposure and psychological functioning, and whether these relationships varied by socio-demographic factors. We found that those with social COVID-19 exposure reported more anxiety and stress compared to those without exposure. This suggests that the widely reported increases in symptoms of anxiety (Jia et al., 2021) and stress (American Psychological Association [APA], 2019; APA, 2020) during the early stages of the pandemic may have been influenced, at least in part, by knowing about suspected or diagnosed COVID-19 cases in one’s social circle.

Social COVID-19 exposure was associated with concerns about a family member getting sick, but not concerns about personal health, implying that anxiety and stress were driven more by thinking about the well-being of close others than one’s own vulnerability. This is consistent with research examining online COVID-19 narratives that identified worrying about close others as a substantial source of psychological distress (Hung et al., 2020). Those with social COVID-19 exposure were also more concerned about excessive alcohol consumption and substance use than those without exposure. This finding is in line with research linking personal COVID-19 experiences (e.g., having personally contracted the virus, knowing others in the community who had a case of, or died of, COVID-19) to the use of alcohol and substances in the general population (MacMillan et al., 2021), and could indicate that social exposure to COVID-19 is a risk factor for problematic use of alcohol and substances.

The bidirectional nature of the relationship between social COVID-19 exposure and mental health should be acknowledged. It is possible that just as social COVID-19 exposure may lead to worsened psychological functioning, deterioration in mental health can create additional risk factors, including risky behaviors such as neglect of safety...
measures and low adherence to mitigative strategies (Trojen & Caplan, 2021) that could increase the risk of exposure to those infected with the COVID-19 virus.

Research shows that certain segments of the U.S. population, including women (Kolakowsky-Hayner et al., 2021), younger people (Sojli et al., 2021), or persons with lower socioeconomic status (Lee & Singh, 2021) experienced more burdensome pandemic-induced mental health impacts compared to men, older people, and those with higher socioeconomic status, respectively. Our study suggests that this increased burden may translate to further adverse outcomes due to COVID-19 attributable social factors. Specifically, women who had social COVID-19 exposure reported greater government protection and healthcare concerns compared to women without exposure; younger people with exposure experienced more anxiety and depression than their counterparts without exposure; and those with less income who had social COVID-19 exposure experienced more work and financial concerns than those without. Women, younger adults, and lower income workers were also at a higher risk for losing employment and experiencing economic insecurity early in the pandemic (Office of Human Services Policy [HSP, 2021]). Thus, it is possible that knowing others who have been infected with COVID-19 increased the salience of perceived vulnerability within those groups, including to adverse financial sequelae of becoming ill with COVID-19, and the deterioration in psychological health. Additionally, it’s possible that women and younger people who knew others in their social circle with a COVID-19 infection stayed at home more to reduce their own chances for getting sick, and increased their exposure to environments that in some cases are detrimental to psychological well-being, for example, due to domestic violence (Huecker et al., 2022) or family tensions (Hall & Zygmunt, 2021).

Men, older individuals, and people with higher income did not experience detrimental effects of social COVID-19 exposure to the same degree. This mental health crisis should be recognized as a public health emergency, and

### Table 2 Results of exploratory factor analysis for COVID-19 related concerns (n = 343)

| Item                                                                 | Work and Financial | Government protection | Healthcare | Lifestyle | Social isolation | Parenting |
|----------------------------------------------------------------------|--------------------|-----------------------|------------|-----------|-----------------|-----------|
| Losing my job                                                        | 0.932              |                       |            |           |                 |           |
| Losing my health insurance                                           | 0.707              | 0.172                 |            |           |                 |           |
| Not being able to work                                               | 0.907              |                       |            |           |                 |           |
| Not being able to pay my bills                                      | 0.708              | 0.132                 |            |           |                 |           |
| Being able to afford my retirement                                  | 0.549              |                       |            |           |                 |           |
| Not being protected at work                                          | 0.441              | 0.158                 | – 0.126    | 0.129     |                 |           |
| My local government not doing enough to protect people               | 0.845              | 0.119                 |            |           |                 |           |
| My state government not doing enough to protect people               | 0.982              |                       |            |           |                 |           |
| US government not doing enough to protect people                     | 0.923              |                       |            |           |                 |           |
| Not being able to get healthcare if I get sick with Covid-19         |                    |                       |            |           | 0.836           |           |
| Not being able to get healthcare for other problems that I have     |                    |                       |            |           | 0.878           |           |
| Not being able to get healthcare for emergency situations            |                    |                       |            |           | 0.937           |           |
| Not being able to exercise regularly                                 |                    |                       |            |           | 0.754           |           |
| Not being able to eat healthy foods                                  |                    |                       |            |           | 0.803           |           |
| Having Internet access                                              | 0.171              | 0.468                 |            |           |                 |           |
| Being socially isolated                                              | 0.158              | 0.724                 |            |           |                 |           |
| My family members being socially isolated                            | – 0.101            | 0.909                 |            |           |                 |           |
| Providing supervision for my children                               |                    |                       |            |           | 0.789           |           |
| My children’s ability to complete school                             |                    |                       |            |           | 0.803           |           |
| Eigenvectors                                                         | 6.51               | 2.32                  | 1.84       | 1.48      | 1.18            | 1.15      |
| % of variance                                                        | 34.28              | 12.22                  | 9.77       | 7.78      | 6.20            | 6.05      |
| Cronbach’s Alphas                                                   | 0.87               | 0.94                   | 0.91       | 0.73      | 0.82            | 0.79      |

Bolded numbers within each column indicate items that loaded onto the same factor

**Extraction Method:** Maximum Likelihood

**Rotation Method:** Promax with Kaiser Normalization

Factor loadings below 0.10 were suppressed. The highest loading value for any given item that achieved at least 0.40 was the criterion for selection to represent the factor.
vulnerable individuals should be given priority in referrals to mental health services, such as those delivered digitally. Technology-based approaches have proved safe and effective models of mental health care delivery (Lecomte et al., 2020), and should be widely expanded to ensure that vulnerable populations receive the psychological services they need.

Limitations

Our study design was cross-sectional and represented associations between constructs at one time point during the pandemic. This precluded us from conducting mediational analyses and establishing what factors drive the associations between social COVID-19 exposure and psychological functioning. Longitudinal methods could offer a more comprehensive portrayal of how the extent to which members of one’s social networks contract an infectious disease impacts psychological functioning amidst a continually changing epidemiological situation, and what drives these effects. The question assessing social COVID-19 exposure, did not allow us to distinguish who in one’s social circle had a true COVID-19. COVID-19 diagnoses may have also led to vastly different health outcomes in those affected, from mild illness to death, and consequently varying levels of distress. Additionally, we grouped the “not applicable” responses together with the “not concerned” ones in the EFA, inferring that if a given complication was marked as not applicable by the respondent, then it likely posed no concerns for that person. However, the mechanism behind the “not applicable” responses may be different from what drives the “not concerned” answers, and by merging these together we potentially overlook qualitatively distinct experiences underlying these two types of answers. Further, most participants identified as White, which limits generalizability of the findings to other races and ethnicities, and precluded us from being able to examine whether or how the hypothesized associations between social COVID-19 exposure and psychological functioning might have varied by race and ethnicity.

Conclusions

Consistent with the biopsychosocial model, we found that a person’s psychological functioning can be associated with the health of their social circle, and that the consequences of social exposure for mental health outcomes are worse for socio-demographic groups that experience social and health inequities. Such populations are at heightened risk for negative mental health consequences due the pandemic and should be prioritized in mental health service delivery. The COVID-19 pandemic highlighted that health and disease outcomes are influenced by the dynamic interplay between biological, psychological and social factors. Increased incorporation of biopsychosocial approaches to clinical care, and public health should be a priority within the public health agenda.
Authors' contributions ML, JH, EW, HO, MK, PK, and JH were responsible for the conceptualization of the study; PK was responsible for financially supporting data collection; ML, JH, JH, and ES were responsible for the data analysis; ML, JH, and JH drafted the manuscript; all authors contributed to editing the manuscript.

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Availability of data and material Data are available upon request from the corresponding author.

Code availability Syntax are available upon request from the corresponding author.

Fig. 2 Sex, income, and age as moderators of the relationship between social COVID-19 exposure and primary outcomes

Declarations

Conflict of interest None of the authors have conflicts of interest that would impact the unbiased reporting of study results.

Consent to participate This study was deemed exempt from human subjects consideration by Advarra and an alteration of HIPAA authorization per 45 CFR 164.512(i)(ii) was granted; informed consent was not obtained from participants completing the survey.

Consent for publication All authors give consent for publication.
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