

Emotional distress and disease control in asthma during two phases of the pandemic

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Abstract

Background. This study aimed to examine aspects of emotional distress and their association with asthma control among individuals with asthma across two phases of the pandemic. Individuals with asthma report emotional distress at higher rates than healthy controls, an association thought to be exacerbated by the COVID-19 pandemic. Although early studies suggested elevated mental health vulnerability in asthma, changes throughout the pandemic and the role of asthma control remain unclear.

Methods. Data were collected via online surveys in an early phase in 2020 and a late phase in 2022. Participants (N=414; asthma n=180, controls n=234) completed measures of general anxiety and depression, COVID-19 related fear, emotional exhaustion/burnout, and asthma control. Analyses were conducted using multivariate multilevel models, adjusting for demographics and pandemic-specific adverse events.

Results. Those with asthma reported higher distress compared to controls, regardless of pandemic phase. Specifically, those with asthma reported higher COVID-19 fear, anxiety, and emotional exhaustion, but not depression. In both groups, there was reduction in distress from the early phase to the late phase of the pandemic, which was evident for depression, anxiety, COVID-19 fear, but not for emotional exhaustion. Lower asthma control was associated with higher distress among participants with asthma, which was significant on all 4 measures of distress.

Conclusion. Asthma was associated with psychological vulnerability throughout the pandemic. Integrated asthma care needs to address sustained emotional distress during times of a public health crisis.

Background

Individuals with asthma frequently experience compromised mental well-being, with anxiety and depression being a particularly prevalent concern [1, 2]. This heightened distress is often intertwined with the challenges inherent in managing a chronic respiratory condition, creating a bidirectional relationship in which distress can exacerbate asthma symptoms, and the experience of asthma can further fuel distress [3, 4]. Recognizing this comorbidity is crucial, as it can significantly impede overall well-being and effective disease management in this population [5–7]. Pre-pandemic studies have established that mental health symptoms, including anxiety and depression, are linked to poorer asthma management [3, 8]. As far as intervention goes, some have suggested interventions traditionally used in treatment of psychopathology (cognitive behavioral therapy, mindfulness-based interventions) may improve asthma control [9, 10].

The COVID-19 pandemic triggered a global surge in distress levels [11, 12]. This period presented unique stressors, contributing to emotional distress, including anxiety and a specific fear of contracting the virus. For vulnerable populations, including individuals with pre-existing conditions like asthma, distress is often amplified by factors such as social isolation, reduced access to medical care resources, and the

potential for respiratory infections to trigger asthma exacerbations [13–15]. Fear of COVID-19 itself became a significant predictor of anxiety symptoms, disproportionately affecting those with underlying health issues [16]. Uncontrolled asthma during lockdown was also associated with anxiety and depression [17, 18]. Consistent with this, our initial findings from a survey early during the pandemic [15] demonstrated elevated psychological distress in those with asthma. Emotional exhaustion, an aspect of burnout, was particularly elevated in participants with asthma compared to healthy controls, and asthma symptoms mediated this group difference. Interestingly, burnout has rarely been studied in the context of asthma, as most studies have focused on anxiety and depression. Burnout can be characterized by symptoms of emotional exhaustion, negative attitudes or low empathy in interpersonal relations, and feelings of professional failure. In the context of the initial phase of the pandemic, it was the emotional exhaustion component of burnout that stood out in our earlier findings [15], thought to be in part due to the stress of managing asthma symptoms during a pandemic. Surprisingly, COVID-19-related fear was not significantly elevated in asthma over healthy controls at that time.

The current study followed up on this survey with a second wave of data collection in a later phase of the pandemic, during which vaccines had become available. This second wave included data from about half of the participants in the first wave, plus new participants. The aim was to investigate differences in distress, including reports of general anxiety, depression, COVID-19 fear, and emotional exhaustion, between an asthma sample and healthy controls, and whether these associations differed between the two phases of the pandemic. Given the protective potential of vaccines, we expected lower levels of distress to be reported in the second phase. However, in line with an extensive literature showing higher distress in asthma, we expected higher levels of distress in the asthma sample across phases. We also expected that, for those with asthma, the perceived vulnerability of lower asthma control would be associated with more distress across pandemic phases specifically for COVID-19 fear and for the emotional exhaustion component of burnout. The latter of which has been shown to distinguish individuals with asthma from healthy controls, and which was related to asthma symptoms early in the pandemic in our previous report [15].

Methods

Participants

This investigation used two primary samples from a COVID-19 Experience Survey collected through the RedCap survey platform. The surveys explored lifestyle changes experienced by adults during the pandemic. Adult participants with and without asthma were recruited both through social media advertisements and from a research participant database. The majority of participants were located in the North Texas. The early phase survey was completed from July to November of 2020 [15], and the later phase from January to May of 2022. In the later phase, we included all participants who responded to our recruiting efforts, comprised of a subgroup of the participants who participated in the early phase ($n = 96$ out of the original $n = 219$) plus others who had not participated in the early phase survey. As an incentive, participants of both surveys were offered an option of entering email addresses not linked to

their survey into a raffle for 10 \$50 online retailer gift cards. The protocol for this study was approved by the Southern Methodist University Institutional Review Board (Protocol #H20-103-RITT). Participants provided written consent to participate in the survey.

Measures

Fear of COVID-19

The Fear of COVID-19 Scale (FCV-19S) was used to assess specific fears and concerns related to COVID-19 [19]. The FCV-19S is a questionnaire with seven items rated on a 5-point bipolar rating scale (1 = Strongly Disagree, 5 = Strongly Agree), with possible total scores ranging from 7 to 35. Example items include, “My heart races or palpitates when I think about getting Coronavirus Disease-19” and “I am afraid of losing my life because of coronavirus-19”. A higher score is indicative of a higher fear of COVID-19. The scale had acceptable reliability at development ($\alpha = .82$, ICC = .72) [19].

General Anxiety and Depression

The Patient Health Questionnaire for Depression and Anxiety (PHQ-4) was used to assess levels of general anxiety and depression [20]. This brief measure contains 2 items relevant to cognitive aspects of anxiety and worry, and two items relevant to depression. Items were rated on a 4-point scale (0 = Not at all, 3 = Nearly every day), with subscale scores ranging from 0 to 6. Higher scores indicated more anxiety or depression symptomology. The subscales have been shown to have acceptable internal consistency for anxiety ($\alpha = .78$) and depression ($\alpha = .75$) [21].

Asthma Control

The Asthma Control Test (ACT) was used to assess participants’ self-report of asthma control [22]. It is a 5-item questionnaire in which each item is rated on a 5-point scale. The ACT scores range from 5 to 25, with higher scores indicating better asthma control. The ACT has been shown to have an acceptable internal consistency ($\alpha = .84$) [23].

Emotional Exhaustion

The Maslach Burnout Inventory-General Survey (MBI-GS) [24] was used to assess levels of emotional exhaustion. The MBI-GS was administered with modified instructions to expand the scope from feelings towards job and work to feelings towards “jobs, volunteer work, studies, and/or daily routine”. The MBI-GS Emotional Exhaustion scale assesses feeling overextended and drained of one’s emotional resources and consists of 5 items rated on a 7-point rating scale of frequency (0 = Never, 6 = Everyday). Higher scores indicate more emotional exhaustion. The MBI-GS Emotional exhaustion has been shown to have an excellent internal consistency ($\alpha = .91-.92$) [25, 26].

Pandemic-specific adverse events

To account for experiences unique to the pandemic that could lead to heightened distress, we assessed the experience of pandemic-specific adverse events identified in literature to be particularly stressful [27]. In the early pandemic survey, 30 events were assessed, such as job loss, housing insecurity, and the death of a close friend or family member due to COVID-19. Given that many of these events were not relevant anymore in the late phase of the pandemic after vaccine availability and termination of lockdowns, only four events were assessed in the late phase, including testing positive for COVID-19, experiencing complications from COVID-19, being hospitalized for COVID-19, and experiencing the death of a close friend or family member from COVID-19. Two of these events overlapped between surveys in both phases: being hospitalized for COVID-19 and death of a close friend or family member. Reports of being hospitalized for COVID-19 were rare in both phases (< 2.6%), compared to over 10% of the sample endorsing the death of the loved one from COVID-19. Therefore, only the latter item is included in the analyses.

Data Analysis

All statistical analyses were performed using mixed effects multilevel models in SPSS version 28. Participants missing > 50% of their data were excluded (12.7%). Data were screened for outliers and skewness. Differences between groups of participants (phase one only, phase two only, and both phases) on key demographic variables were tested using Chi-square test of independence, Fisher-Freeman-Halton exact tests, or one-way ANOVAs as appropriate given the variable type and expected cell count. Phase one pandemic data (collected in 2020) has been previously published [15] but was included in the present analyses as part of a larger sample combining data from early in the pandemic (2020) with data from late in the pandemic (2022). The multivariate, repeated measures, analytical approach in the current study was also very different from the univariate, non-repeated measures approach employed in the previous paper.

Multivariate multilevel mixed models (MMLMs) were used to investigate effects of asthma and asthma control on distress (for details see the Supplement). The multivariate distress outcome was comprised of 4 measures: anxiety (PHQ-4 Anxiety subscale), depression (PHQ-4 Depression subscale), COVID-19 Fear (FCV-19s), and emotional exhaustion (MBI-GS). Participants who provided data for the early phase of the pandemic were invited to provide data at the late phase assessment. N = 96 of the total n = 219 participants in the early phase provided data for the late phase assessment. An additional 195 individuals who did not participate in the early phase provided data at the late phase. Since MLM models are intent-to-treat and include all participants who completed at least one outcome at one timepoint, our models included participants who took part in either survey phase as well as those who participated in both phases (total N = 414). For participants with only one assessment (either early or late phase), the data at the missing assessment was coded as missing (as opposed to eliminating those participants with only one assessment).

In our first set of analyses (model 1), the focal predictors were group (asthma vs. control), phase (early phase vs. late phase) and their interaction. In the second set of analyses (model 2), the focal predictors were asthma control (ACT total score), phase, and their interaction. Since asthma control only relates to individuals with asthma, these analyses just included participants with asthma. Follow-up univariate analyses for each individual outcome measure were performed to examine each significant multivariate result in detail. All analyses included the following covariates: age, sex, minority race/ethnicity, and whether the participant experienced the loss of a loved one due to COVID-19.

Sensitivity analyses were performed to assess the missing at random assumption of the MMLMs [28] (for details see the Supplement) These models tested whether any of the effects from the primary analyses differed between those who participated in both phases (no missing data) vs. those who participated in one phase (with missing data).

All analyses controlled for age, sex, race, ethnicity, and death of a close friend or family member from COVID-19. Further, all models were calculated using an unstructured covariance matrix and maximum likelihood estimation. Random intercepts were estimated for individuals.

Results

A total of 414 participants were included in the analyses (219 in early phase, 291 in late phase, 96 of which had participated in both phases; 180 with asthma, 234 without asthma). No outliers (defined as > 3 SD from the mean) were identified. Skewness was $\leq |1|$ for all measures. The sample was predominantly White (78.7%), female (82.9%), and middle-aged (mean = 56.2 years, SD = 9.4, range = 30–83). Participants with asthma represented all levels of asthma control with intermittent and persistent severity levels. 62.8% of patients' scores on the ACT indicating "well controlled" asthma (score of 20 or greater) and 70.2% meeting criteria for persistent asthma according to self-reported symptoms and medications [29] (Table 1). Individuals who participated only in phase one, only in phase two, or in both phases did not differ on the key demographic variables of age, sex, race, ethnicity, asthma status, and years of education. These three groups did differ on reports of death of a loved one ($\chi^2(2) = 10.74, p=.005$). Not surprisingly, individuals who participated only in phase two were more likely to report having a loved one die from COVID-19, compared to those who participated in phase one only ($\chi^2(1) = 7.04, p=.008$). Similarly, those who participated in both phases were more likely to report COVID-19 related deaths compared to those who participated in phase one only ($\chi^2(1) = 10.6, p=.001$). Reports did not significantly differ between the phase two group and the group who participated in both phases ($p=.323$).

Table 1

Basic descriptives and questionnaire scores for participants in two pandemic phases (2020 and 2022).

Categorical Variables, n (%)	Full Sample (n = 414)
Asthma Status	
Healthy Control	234 (56.5)
Asthma	180 (43.5)
Sex	
Female	343 (82.9)
Male	71 (17.1)
Race	
White	343 (82.9)
Black/ African American	35 (8.5)
Asian	8 (1.9)
Pacific Islander	1 (0.2)
Native American	7 (1.7)
Mixed race	14 (3.4)
Other	6 (1.4)
Ethnicity	
Hispanic	45 (10.9)
Non-Hispanic	367 (88.6)
Other	2 (0.5)
Pandemic-specific adverse events	
death of a loved one from COVID	62 (15.0)
COVID-19 Vaccination Status	
Vaccinated or partially vaccinated	256 (88.0)
Continuous Variables, M (SD)	
Age- Years	56.2 (9.4)
Education - Years	15.9 (3.0)
<i>Note.</i> Abbreviations: ACT, asthma control test; FCV-19s, fear of COVID-19 scale; M, mean; SD, standard deviation; MBI, Maslach burnout inventory; PHQ, patient health questionnaire	

Categorical Variables, n (%)	Full Sample (n = 414)
Asthma Control (ACT)	19.1 (5.0)
General Anxiety (PHQ)	2.3 (1.9)
Depression (PHQ)	1.9 (1.8)
COVID-19 Fear (FCV-19S)	16.0 (6.3)
Emotional Exhaustion (MBI)	3.1 (1.9)
Note. Abbreviations: ACT, asthma control test; FCV-19s, fear of COVID-19 scale; M, mean; SD, standard deviation; MBI, Maslach burnout inventory; PHQ, patient health questionnaire	

Associations between both Asthma and Phase with distress (Model 1)

The analysis of the multivariate outcome showed that participants with asthma reported higher multivariate distress than control participants (main effect of group: $b = 0.27, t(419) = 3.73, p < .001$, Table 2).

Table 2
Parameter estimates demonstrating the associations of asthma group and pandemic phase with multivariate distress

Predictor	<i>B</i>	95% CI	<i>df</i>	<i>t</i>	<i>p</i>
Group	0.27	(0.13, 0.41)	419	3.73	< .001
Phase	-0.21	(-0.30, -0.12)	201	-4.40	< .001
Group by Phase	0.04	(-0.15, 0.23)	196	0.40	.691
Death of a loved one	0.22	(0.05, 0.38)	378	2.63	.009
Age	-0.01	(-0.02, -0.01)	414	-3.68	< .001
Race	0.04	(-0.14, 0.21)	415	0.41	.681
Sex	-0.17	(-0.35, 0.01)	413	-1.81	.071
Note. Abbreviations, CI, confidence interval; df, degrees of freedom Coding: Group, asthma = 1, control = 0; Phase, early phase = 1, late phase = 2; Death of a loved one, experienced = 1, not experienced = 0. Race, non-Hispanic White = 0, any other racial or ethnic non-Hispanic group = 1; Sex, male = 1, female = 0. The group and phase variables are centered at their means.					

Follow-up univariate analyses of the individual components of multivariate distress showed that participants with asthma reported significantly more COVID-19 fear ($p = .024$), anxiety ($p < .001$), and emotional exhaustion ($p < .001$) than control participants (Table 3). The group difference in emotional exhaustion was significantly greater than the group difference in depression and COVID-19 fear ($p < .001$).

and $p=.032$, respectively), while the group difference in anxiety was greater than that in depression ($p=.023$) (Table 3).

Table 3

Models showing the univariate effects of Group and Phase on each outcome separately, and how these effects differ between the referenced outcome and the other outcomes.

Predictor	<i>B</i>	95% CI	<i>df</i>	<i>t</i>	<i>p</i>
Interpretation					
Reference Outcome: COVID-19 Fear					
Group	0.21	(0.03, 0.38)	510	2.26	.024
<i>Association of asthma group with COVID-19 fear</i>					
Phase	-0.39	(-0.53, -0.24)	318	-5.27	< .001
<i>Association of phase with COVID-19 fear</i>					
Anxiety	-0.01	(-0.10, 0.09)	513	-0.11	.912
<i>Association of anxiety with COVID-19 fear</i>					
Group by Anxiety	0.11	(-0.08, 0.29)	513	1.14	.253
<i>Difference in group effect between anxiety and COVID-19 fear</i>					
Phase by Anxiety	0.11	(-0.08, 0.29)	513	1.11	.267
<i>Difference in phase effect between anxiety and COVID-19 fear</i>					
Depression	-0.01	(-0.11, 0.09)	514	-0.18	.860
<i>Association of depression with COVID-19 fear</i>					
Group by Depression	-0.05	(-0.26, 0.16)	514	-0.47	.636
<i>Difference in group effect between depression and COVID-19 fear</i>					
Phase by Depression	0.23	(0.03, 0.44)	514	2.21	.027
<i>Difference in phase effect between depression and COVID-19 fear</i>					
Emotional Exhaustion	-0.03	(-0.13, 0.07)	512	-0.62	.538
<i>Association of emotional exhaustion with COVID-19 fear</i>					
Group by Emotional Exhaustion	0.21	(0.02, 0.41)	512	2.16	.032
<i>Difference in group effect between emotional exhaustion and COVID-19 fear</i>					
Phase by Emotional Exhaustion	0.44	(0.25, 0.64)	512	4.44	< .001

Predictor	<i>B</i>	95% CI	<i>df</i>	<i>t</i>	<i>p</i>
Interpretation					
<i>Difference in phase effect between emotional exhaustion and COVID-19 fear</i>					
Reference Outcome: Anxiety					
Group <i>Association of asthma group with anxiety</i>	0.31	(0.14, 0.49)	530	3.50	< .001
Phase <i>Association of phase with anxiety</i>	-0.28	(-0.42, -0.14)	304	-3.93	< .001
COVID-19 Fear <i>Association of COVID-19 fear with anxiety</i>	0.01	(-0.09, 0.10)	513	0.11	.912
Group by COVID-19 Fear <i>Difference in group effect between COVID-19 fear and anxiety</i>	-0.11	(-0.29, 0.08)	513	-1.14	.253
Phase by COVID-19 Fear <i>Difference in phase effect between COVID-19 fear and anxiety</i>	-0.11	(-0.29, 0.08)	513	-1.11	.267
Depression <i>Association of depression with anxiety</i>	-0.00	(-0.07, 0.06)	514	-0.12	.907
Group by Depression <i>Difference in group effect between depression and anxiety</i>	-0.16	(-0.30, -0.02)	514	-2.27	.023
Phase by Depression <i>Difference in phase effect between depression and anxiety</i>	0.13	(-0.01, 0.27)	514	1.83	.068
Emotional Exhaustion <i>Association of emotional exhaustion with anxiety</i>	-0.03	(-0.10, 0.05)	514	-0.63	.531
Group by Emotional Exhaustion <i>Difference in group effect between emotional exhaustion and anxiety</i>	0.10	(-0.05, 0.26)	514	1.30	.194
Phase by Emotional Exhaustion <i>Difference in phase effect between emotional exhaustion and anxiety</i>	0.33	(0.18, 0.49)	514	4.14	< .001

Predictor	<i>B</i>	95% CI	<i>df</i>	<i>t</i>	<i>p</i>
Interpretation					
Reference Outcome: Depression					
Group <i>Association of asthma group with depression</i>	0.16	(-0.03, 0.34)	536	1.66	.097
Phase <i>Association of phase with depression</i>	-0.15	(-0.31, 0.00)	342	-2.02	.044
COVID-19 Fear <i>Association of COVID-19 fear with depression</i>	0.01	(-0.09, 0.11)	514	0.18	.860
Group by COVID-19 Fear <i>Difference in group effect between COVID-19 fear and depression</i>	0.05	(-0.16, 0.26)	514	0.47	.636
Phase by COVID-19 Fear <i>Difference in phase effect between COVID-19 fear and depression</i>	-0.23	(-0.44, -0.03)	514	-2.21	.027
Anxiety <i>Association of anxiety with depression</i>	0.00	(-0.06, 0.07)	514	0.12	.907
Group by Anxiety <i>Difference in group effect between anxiety and depression</i>	0.16	(0.02, 0.30)	514	2.27	.023
Phase by Anxiety <i>Difference in phase effect between anxiety and depression</i>	-0.13	(-0.27, 0.01)	514	-1.83	.068
Emotional Exhaustion <i>Association of emotional exhaustion with depression</i>	-0.02	(-0.10, 0.06)	514	-0.55	.586
Group by Emotional Exhaustion <i>Difference in group effect between emotional exhaustion and depression</i>	0.26	(0.11, 0.42)	513	3.39	< .001
Phase by Emotional Exhaustion <i>Difference in phase effect between emotional exhaustion and depression</i>	0.21	(0.05, 0.36)	513	2.65	.008

Predictor	<i>B</i>	95% CI	<i>df</i>	<i>t</i>	<i>p</i>
Interpretation					
Reference Outcome: Emotional Exhaustion					
Group <i>Association of asthma group with emotional exhaustion</i>	0.42	(0.24, 0.59)	523	4.70	< .001
Phase <i>Association of phase with emotional exhaustion</i>	0.05	(-0.09, 0.19)	294	0.72	.470
COVID-19 Fear <i>Association of COVID-19 fear with emotional exhaustion</i>	0.03	(-0.07, 0.13)	512	0.62	.538
Group by COVID-19 Fear <i>Difference in group effect between COVID-19 fear and emotional exhaustion</i>	-0.21	(-0.41, -0.02)	512	-2.16	.032
Phase by COVID-19 Fear <i>Difference in phase effect between COVID-19 fear and emotional exhaustion</i>	-0.44	(-0.64, -0.25)	512	-4.44	< .001
Depression <i>Association of depression with emotional exhaustion</i>	0.02	(-0.06, 0.10)	514	0.55	.586
Group by Depression <i>Difference in group effect between depression and emotional exhaustion</i>	-0.26	(-0.42, -0.11)	513	-3.39	< .001
Phase by Depression <i>Difference in phase effect between depression and emotional exhaustion</i>	-0.21	(-0.36, -0.05)	513	-2.65	.008
Anxiety <i>Association of anxiety with emotional exhaustion</i>	0.03	(-0.05, 0.10)	514	0.63	.531
Group by Anxiety <i>Difference in group effect between anxiety and emotional exhaustion</i>	-0.10	(-0.26, 0.05)	514	-1.30	.194
Phase by Anxiety	-0.33	(-0.49, -0.18)	514	-4.14	< .001

Predictor	<i>B</i>	95% CI	<i>df</i>	<i>t</i>	<i>p</i>
Interpretation					
<i>Difference in phase effect between anxiety and emotional exhaustion</i>					
<i>Note.</i> For each referenced outcome, there are main effects for group, phase, and dummy variables of each of the other outcomes. The main effects for group and phase are the univariate effects for that outcome. The interactions between the dummy variables for each other outcome and each effect (Group and Phase) tests the difference between that effect on the referenced outcome and that effect on the dummy coded alternative outcome. For example, the Group x Emotional Exhaustion effect under the COVID-19 Fear outcome tests whether the group effect was different for Emotional Exhaustion than for COVID-19 fear. Abbreviations, see Table 2. Coding: Anxiety Dummy, Anxiety outcome = 1, COVID-19 Fear, Depression, and Emotional Exhaustion outcomes = 0; Depression, Depression outcome = 1, Anxiety, COVID-19 Fear, and Emotional Exhaustion outcomes = 0; Emotional Exhaustion, Emotional Exhaustion outcome = 1, COVID-19 Fear, Depression, and Anxiety outcomes = 0, see Table 2. Group and phase are centered at their means. For simplicity, the covariates that were included in each analysis (age, sex, minority race/ethnicity, loss of a loved one from COVID-19, are not included this table.					

The MMLM also showed that multivariate distress was higher in the early phase of the pandemic than in the late phase (main effect of time: $b=-0.21, t(201)=-4.40, p<.001$). Follow-up univariate analyses showed that in the late phase, participants reported lower COVID-19 fear ($p<.001$), anxiety ($p<.001$), and depression ($p=.044$), but not lower emotional exhaustion ($p=.470$), compared to the early phase. Comparing the effect of pandemic phase on the individual measures of distress, emotional exhaustion retained its level of distress more in the second phase than did COVID-19 fear, anxiety, and depression ($p<.001, p<.001, \text{ and } p=.008$, respectively; Table 3). Also, although both depression and COVID-19 fear decreased from early to late pandemic, depression decreased significantly less than COVID-19 fear from the early to the late phase ($p=.027$) (Table 3).

[insert Table 3, submitted separately]

Additionally, the MMLM showed that the effect of group on distress did not vary by phase ($p=.691$ for the Group x Phase interaction). Because the multivariate analysis showed that this effect was not significant, no follow-up univariate analyses were conducted.

Finally, the MMLM showed that the covariates age ($b=-0.01, t(414)=-3.68, p<.001$) and Death of a loved one from COVID-19 ($b = 0.22, t(378) = 2.63, p=.009$) were significantly associated with multivariate distress.

Association of asthma control with distress

The analyses of the effects of asthma control on multivariate distress necessarily only included the participants with asthma ($n = 180$). These MMLMs showed that lower asthma control was associated with greater multivariate distress (main effect of baseline ACT: $b=-0.05, t(191) = -4.74, p<.001$) (Table 4).

Table 4

Parameter estimates demonstrating the associations of baseline asthma control and pandemic phase with multivariate distress

Parameter	<i>B</i>	95% CI	<i>df</i>	<i>t</i>	<i>p</i>
ACT baseline	-0.05	(-0.07, -0.03)	191	-4.74	< .001
Phase	-0.20	(-0.32, -0.07)	93	-3.15	.002
ACT by Phase	0.00	(-0.03, 0.03)	97	-0.10	.920
Death of a loved one	0.38	(0.18, 0.58)	181	3.74	< .001
Age	-0.01	(-0.02, 0.00)	185	-1.14	.254
Race	-0.21	(-0.44, 0.02)	190	-1.84	.067
Sex	-0.19	(-0.46, 0.09)	183	-1.34	.184
<i>Note.</i> Abbreviations, see Table 2. Coding, see Table 2. ACT Baseline it centered at its mean value.					

Follow-up univariate analyses showed that better asthma control was associated with lower COVID-19 fear ($p<.001$), lower anxiety ($p=.014$), lower depression ($p=.013$), and lower emotional exhaustion ($p<.001$). While none of these associations were significantly different from one another, the association of asthma control with emotional exhaustion was marginally stronger than its association with depression ($p=.085$) (Table 5).

Table 5

Models showing the univariate effects of Group and Phase on each outcome separately, and how these effects differ between the referenced outcome and the other outcomes.

Predictor	<i>B</i>	95% CI	<i>df</i>	<i>t</i>	<i>p</i>
Interpretation					
Reference Outcome: COVID-19 Fear					
ACT	-0.05	(-0.08, -0.02)	242	-3.40	< .001
<i>Association of ACT with COVID-19 fear</i>					
Phase	-0.37	(-0.58, -0.15)	150	-3.30	.001
<i>Association of phase with COVID-19 fear</i>					
Anxiety	0.06	(-0.08, 0.20)	236	0.83	.408
<i>Association of anxiety with COVID-19 fear</i>					
ACT by Anxiety	0.01	(-0.02, 0.04)	236	0.83	.409
<i>Difference in ACT effect between anxiety and COVID-19 fear</i>					
Phase by Anxiety	0.03	(-0.25, 0.31)	236	0.21	.835
<i>Difference in phase effect between anxiety and COVID-19 fear</i>					
Depression	-0.01	(-0.17, 0.15)	236	-0.14	.888
<i>Association of depression with COVID-19 fear</i>					
ACT by Depression	0.01	(-0.02, 0.05)	236	0.70	.488
<i>Difference in ACT effect between depression and COVID-19 fear</i>					
Phase by Depression	0.24	(-0.08, 0.56)	236	1.50	.136
<i>Difference in phase effect between depression and COVID-19 fear</i>					
Emotional Exhaustion	0.10	(-0.05, 0.24)	235	1.29	.198
<i>Association of emotional exhaustion with COVID-19 fear</i>					
ACT by Emotional Exhaustion	-0.01	(-0.04, 0.02)	236	-0.56	.575
<i>Difference in ACT effect between emotional exhaustion and COVID-19 fear</i>					
Note. See the notes for Tables 2 and 3. ACT and phase were centered at their means					

Predictor	<i>B</i>	95% CI	<i>df</i>	<i>t</i>	<i>p</i>
Interpretation					
Phase by Emotional Exhaustion <i>Difference in phase effect between emotional exhaustion and COVID-19 fear</i>	0.30	(0.00, 0.59)	236	1.99	.048
Reference Outcome: Anxiety					
ACT <i>Association of ACT with anxiety</i>	-0.04	(-0.07, -0.01)	239	-2.47	.014
Phase <i>Association of phase with anxiety</i>	-0.34	(-0.56, -0.11)	166	-2.95	.004
COVID-19 Fear <i>Association of COVID-19 fear with anxiety</i>	-0.06	(-0.20, 0.08)	236	-0.83	.408
ACT by COVID-19 Fear <i>Difference in ACT effect between COVID-19 fear and anxiety</i>	-0.01	(-0.04, 0.02)	236	-0.83	.409
Phase by COVID-19 Fear <i>Difference in phase effect between COVID-19 fear and anxiety</i>	-0.03	(-0.31, 0.25)	236	-0.21	.835
Depression <i>Association of depression with anxiety</i>	-0.07	(-0.18, 0.04)	236	-1.26	.210
ACT by Depression <i>Difference in ACT effect between depression and anxiety</i>	0.00	(-0.02, 0.02)	236	-0.05	.957
Phase by Depression <i>Difference in phase effect between depression and anxiety</i>	0.21	(-0.01, 0.43)	236	1.89	.060
Emotional Exhaustion <i>Association of emotional exhaustion with anxiety</i>	0.04	(-0.08, 0.16)	236	0.60	.549
ACT by Emotional Exhaustion <i>Difference in ACT effect between emotional exhaustion and anxiety</i>	-0.02	(-0.05, 0.00)	236	-1.62	.106
Note. See the notes for Tables 2 and 3. ACT and phase were centered at their means					

Predictor	<i>B</i>	95% CI	<i>df</i>	<i>t</i>	<i>p</i>
Interpretation					
Phase by Emotional Exhaustion <i>Difference in phase effect between emotional exhaustion and anxiety</i>	0.27	(0.02, 0.51)	236	2.14	.033
Reference Outcome: Depression					
ACT <i>Association of ACT with depression</i>	-0.04	(-0.07, -0.01)	243	-2.50	.013
Phase <i>Association of phase with depression</i>	-0.12	(-0.35, 0.10)	180	-1.09	.278
COVID-19 Fear <i>Association of COVID-19 fear with depression</i>	-0.06	(-0.20, 0.08)	236	-0.83	.408
ACT by COVID-19 Fear <i>Difference in ACT effect between COVID-19 fear and depression</i>	-0.01	(-0.04, 0.02)	236	-0.83	.409
Phase by COVID-19 Fear <i>Difference in phase effect between COVID-19 fear and depression</i>	-0.03	(-0.31, 0.25)	236	-0.21	.835
Anxiety <i>Association of anxiety with depression</i>	-0.07	(-0.18, 0.04)	236	-1.26	.210
ACT by Anxiety <i>Difference in ACT effect between anxiety and depression</i>	0.00	(-0.02, 0.02)	236	-0.05	.957
Phase by Anxiety <i>Difference in phase effect between anxiety and depression</i>	0.21	(-0.01, 0.43)	236	1.89	.060
Emotional Exhaustion <i>Association of emotional exhaustion with depression</i>	0.04	(-0.08, 0.16)	236	0.60	.549
ACT by Emotional Exhaustion <i>Difference in ACT effect between emotional exhaustion and depression</i>	-0.02	(-0.05, 0.00)	236	-1.73	.085
Note. See the notes for Tables 2 and 3. ACT and phase were centered at their means					

Predictor	<i>B</i>	95% CI	<i>df</i>	<i>t</i>	<i>p</i>
Interpretation					
Phase by Emotional Exhaustion <i>Difference in phase effect between emotional exhaustion and depression</i>	0.06	(-0.17, 0.28)	236	0.49	.623
Reference Outcome: Emotional Exhaustion					
ACT <i>Association of ACT with emotional exhaustion</i>	-0.06	(-0.08, -0.03)	230	-4.62	< .001
Phase <i>Association of phase with emotional exhaustion</i>	-0.07	(-0.25, 0.11)	118	-0.78	.440
COVID-19 Fear <i>Association of COVID-19 fear with emotional exhaustion</i>	-0.10	(-0.24, 0.05)	235	-1.29	.198
ACT by COVID-19 Fear <i>Difference in ACT effect between COVID-19 fear and emotional exhaustion</i>	0.01	(-0.02, 0.04)	236	0.56	.575
Phase by COVID-19 Fear <i>Difference in phase effect between COVID-19 fear and emotional exhaustion</i>	-0.30	(-0.59, 0.00)	236	-1.99	.048
Anxiety <i>Association of anxiety with emotional exhaustion</i>	-0.04	(-0.16, 0.08)	236	-0.60	.549
ACT by Anxiety <i>Difference in ACT effect between anxiety and emotional exhaustion</i>	0.02	(0.00, 0.05)	236	1.62	.106
Phase by Anxiety <i>Difference in phase effect between anxiety and emotional exhaustion</i>	-0.27	(-0.51, -0.02)	236	-2.14	.033
Depression <i>Association of depression with emotional exhaustion</i>	-0.11	(-0.22, 0.00)	236	-1.90	.058
ACT by Depression <i>Difference in ACT effect between depression and emotional exhaustion</i>	0.02	(0.00, 0.05)	236	1.73	.085
Note. See the notes for Tables 2 and 3. ACT and phase were centered at their means					

Predictor	<i>B</i>	95% CI	<i>df</i>	<i>t</i>	<i>p</i>
Interpretation					
Phase by Depression	-0.06	(-0.28, 0.17)	236	-0.49	.623
<i>Difference in phase effect between depression and emotional exhaustion</i>					
Note. See the notes for Tables 2 and 3. ACT and phase were centered at their means					

This MMLM also showed that multivariate distress was significantly higher in phase one compared to phase two for this subsample of the full sample that had asthma ($p=.002$) (Table 4). Follow-up univariate analyses showed that this effect of phase was significant for COVID-19 fear ($p=.001$) and for anxiety ($p=.004$) (Table 5) in this subsample.

[insert Table 5, submitted separately]

Finally, the MMLM showed that the effect of asthma control on multivariate distress did not vary by phase ($p=.920$ for the asthma control x phase interaction, Table 4). Because the multivariate analysis showed that this effect was not significant, no follow-up univariate analyses were conducted. In this model, Death of a loved one from COVID-19 ($b = 0.38$, $t(181) = 3.74$, $p<.001$) was significantly associated with multivariate distress.

Sensitivity analyses

The sensitivity analyses examined whether the effects of group, time, and their interaction were different between those who had missing data (i.e., those who completed one survey phase) from those who had no missing data (i.e., completed both survey phases). This analysis served two purposes. First, it can show whether the missing data is consistent with the missing at random assumption of MLM. Second, it can show if results for participants who completed only one survey were different from the results for participants who completed both surveys. In model 1, no significant differences between those with missing data and those without missing data were found ($ps=.127$ to $.847$; see Supplemental Table 1). Similarly, the same sensitivity analysis for the effects of asthma control, phase, and their interaction (model 2) found that none of the results were significantly different between those who had missing data and those who did not ($ps=.438$ to $.790$; Supplemental Tables 2).

Discussion

The current study sought to examine the effect of asthma on distress during the COVID-19 pandemic. We also examined how these aspects of distress were related to asthma disease control. Those with asthma reported higher distress compared to controls, an association that did not differ between early and late phases of the pandemic. This greater distress among those with asthma was evident on 3 of the 4 measures of distress (COVID-19 fear, anxiety, and emotional exhaustion, but not depression) and was stronger for emotional exhaustion than for depression and COVID-19 fear. We also found that there

was a significant reduction in distress from the early to the late phase of the pandemic, which was evident for depression, anxiety, COVID-19 fear, but not for emotional exhaustion, which notably did not decrease significantly from early to late pandemic. Finally, lower asthma control was associated with higher distress among participants with asthma, which was significant on all 4 measures of distress.

These results are consistent with previous work that highlights the psychological burden of disease management [3, 4, 10]. They reinforce the importance of mental health care as a part of asthma management during periods of health crises. Further the association with asthma control and distress aligns with previous research suggesting a link between poorer asthma management and increased distress [3, 17]. Addressing both distress and asthma control is likely to reduce the emotional and health care burden of asthma, as their relation is likely to be reciprocal.

We observed that one aspect of distress, emotional exhaustion, was the only measure of distress that did not decrease from early to late pandemic. This finding was evident in the analysis of the full sample as well as in the analysis that included only participants with asthma. This questionnaire measures psychological burnout and exhaustion related to daily activities and it may be that this measure reflected the worry, concern, and drastic changes in daily life that continued, at least in part, into the late phase of the pandemic (e.g. mask wearing, social distancing). Our findings extend the evidence for the specific role that emotional exhaustion had shown in our previous analysis of the early pandemic phase, where it was selectively elevated in asthma and associated with the experience of asthma symptoms [15]. Interestingly, the current study showed that the greater distress suffered by participants with asthma over controls was significantly stronger for emotional exhaustion than for depression and COVID-19 fear. The metacognitive theory of dyshomeostasis [30] suggests that in chronic dyshomeostasis, such as a chronic disease like asthma, a metacognitive monitor updates beliefs regarding the ability to successfully regulate bodily states (allostatic self-efficacy). With the repeated experience of a lack of control over the disease, self-efficacy of the person would be negatively affected resulting in a stable condition of burnout. While low asthma control itself can thus lead to dyshomeostasis that manifests as exhaustion and burnout, the condition is further aggravated when combined with the specific challenges a pandemic can pose to symptoms control. Thus, this aspect of distress deserves particular attention in both disease management and mental health care of patients with asthma in times of pandemic crises.

Two of covariates also showed associations with pandemic distress. Experiencing the death of a close friend or family member to COVID-19 was associated with higher distress highlighting the profound impact of personal loss. Also, older adults showed lower distress in the full sample. However, age was not significantly associated with distress in the asthma sample alone when accounting for asthma control, which may indicate that the variance in distress accounted for by age in model one is subsumed when more specific aspects of health and symptom experience are included. Although this is surprising, given the possible elevated risk from COVID-19 infection in older adults, it aligns with the general literature that indicates higher levels of emotional well-being, including lower reports of anxiety, depression, and stress in older adults [31, 32], as well as with findings from pandemic studies, in which

younger adults report more distress [33, 34]. Better adaptive coping and resilience buffering against distress [31, 34, 35] may account for these differences.

Like many survey studies not based on strict sampling according to population characteristics, our study was limited regarding representativeness of the sample. Our sample was predominantly composed of white and female participants, which reduces its generalizability to more diverse populations. Participants were also predominately located in specific regions of the American south, with North Texas being most represented in these samples, which may further limit generalizability to residents of other states who may have faced different pandemic-related policies or restrictions. As a survey, reliance on self-report measures can also introduce bias towards the patients' experience of their disease state when medical assessments are not included in conjunction. Even though asthma control was assessed, the survey format prohibited a detailed assessment of severity and clinical presentation of asthma, including lung function, and adherence to prescribed medication, which may have provided further insight into the relationship between asthma and psychological outcomes. While our analytical design (i.e., multivariate, multilevel models) allows the inclusion of the full sample (both those who participated in only one of phases and those who participated in both phases), the sample of those who took part in both surveys was relatively small, which may limit longitudinal conclusions. However, results of the sensitivity analyses showed that our findings were not different between those who completed one or both surveys. Additionally, the demographic characteristics were not statistically different between those who completed phase one, phase two, or both phase. Nevertheless, this study provides valuable insights into the experiences of distress during the COVID-19 pandemic, and how adults with asthma and low disease control may have been particularly susceptible to distress.

Conclusions

Our findings highlight the persistent vulnerability of individuals with asthma to elevated distress, across multivariate components of general anxiety, depression, emotional exhaustion, and COVID-19 fear. This greater vulnerability over those without asthma is quite stable and unaffected even by more drastic changes in daily life as observed during the pandemic. Emotional exhaustion appears to be a particularly problematic aspect of distress, in that we found it to be stable across early and late pandemic, and that it was particularly elevated in asthma, as well as consistently associated with low asthma control. Thus, this study reemphasizes that effective asthma care should include promoting better psychological well-being. It indicates a need for integrated approaches that address both the physical and mental health needs of individuals with asthma, which also extends to public health emergencies.

Declarations

Ethics approval and consent to participate.

This research was performed in accordance with the Declaration of Helsinki and was approved by the Southern Methodist University Institutional Review Board (Protocol #H20-103-RITT). Participants provided written informed consent to participate in the survey.

Consent for publication.

Not applicable.

Competing Interests.

None.

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None.

Author Contribution

W.H. and T.R. wrote the manuscript main text. M.S. collected and prepared all data for analysis. T.R. and M.S. designed the project. D.R. assisted with formal data analysis, writing of the manuscript, and preparation of tables. All authors reviewed the manuscript.

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None.

Data Availability

The datasets analyzed during the current study are not publicly available due to privacy protection for study participants. Deidentified data can be obtained from the authors upon reasonable request.

References

1. Goodwin RD, Scheckner B, Pena L, Feldman JM, Taha F, Lipsitz JD. A 10-year prospective study of respiratory disease and depression and anxiety in adulthood. *Ann Allergy Asthma Immunol.* 2014;113(5):565–70. 10.1016/j.anai.2014.08.003.
2. Meuret AE, Kroll J, Ritz T. Panic Disorder Comorbidity with Medical Conditions and Treatment Implications. *Annu Rev Clin Psychol.* 2017;13:209–40. 10.1146/annurev-clinpsy-021815-093044.

3. Marco FD, Verga M, Santus P, Giovannelli F, Busatto P, Neri M, et al. Close correlation between anxiety, depression, and asthma control. *Respir Med.* 2010;104(1):22–8. 10.1016/j.rmed.2009.08.005.
4. Ye G, Baldwin DS, Hou R. Anxiety in asthma: a systematic review and meta-analysis. *Psychol Med.* 2021;51(1):11–20. 10.1017/S0033291720005097.
5. Stanescu S, Kirby SE, Thomas M, Yardley L, Ainsworth B. A systematic review of psychological, physical health factors, and quality of life in adult asthma. *npj Prim Care Respir Med.* 2019;29(1):37. 10.1038/s41533-019-0149-3.
6. Fong WCG, Rafiq I, Harvey M, Stanescu S, Ainsworth B, Varkonyi-Sepp J, et al. The Detrimental Clinical Associations of Anxiety and Depression with Difficult Asthma Outcomes. *J Personalized Med.* 2022;12(5). 10.3390/jpm12050686.
7. Stubbs MA, Clark VL, Gibson PG, Yorke J, McDonald VM. Associations of symptoms of anxiety and depression with health-status, asthma control, dyspnoea, dysfunction breathing and obesity in people with severe asthma. *Respir Res.* 2022;23(1):341. 10.1186/s12931-022-02266-5.
8. Pilipenko N, Karekla M, Georgiou A, Feldman J. Impact of psychiatric illness upon asthma patients' health care utilization and illness control. Are all psychiatric comorbidities created equal? *Psychol Health Med.* 2016;21(7):787–99. 10.1080/13548506.2015.1131995.
9. Kew KM, Nashed M, Dulay V, Yorke J. Cognitive behavioural therapy (CBT) for adults and adolescents with asthma - Kew, KM – 2016 | Cochrane Library. Accessed February 6, 2026. <https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD011818.pub2/full>
10. Higgins ET, Davidson RJ, Busse WW, Klaus DR, Bednarek GT, Goldman RI, Brain, Behavior, et al. *Immun - Health.* 2022;25:100509. 10.1016/j.bbih.2022.100509.
11. Salari N, Hosseini-Far A, Jalali R, Vaisi-Raygani A, Rasoulopoor S, Mohammadi M, et al. Prevalence of stress, anxiety, depression among the general population during the COVID-19 pandemic: a systematic review and meta-analysis. *Global Health.* 2020;16(1):57. 10.1186/s12992-020-00589-w.
12. Santabábara J, Lasheras I, Lipnicki DM, Bueno-Notivol J, Pérez-Moreno M, López-Antón R, et al. Prevalence of anxiety in the COVID-19 pandemic: An updated meta-analysis of community-based studies. *Prog Neuropsychopharmacol Biol Psychiatry.* 2021;109:110207. 10.1016/j.pnpbp.2020.110207.
13. de Boer GM, Houweling L, Hendriks RW, Vercoulen JH, Tramper-Stranders GA, Braunstahl GJ. Asthma patients experience increased symptoms of anxiety, depression and fear during the COVID-19 pandemic. *Chron Respir Dis.* 2021;18:14799731211029658. 10.1177/14799731211029658.
14. 20, Smith BA, Ricotta EE, Kwan JL, Evans NG. COVID-19 risk perception and vaccine acceptance in individuals with self-reported chronic respiratory or autoimmune conditions. *Allergy Asthma Clin Immunol.* 2023;19(1):37. 10.1186/s13223-023-00791-6.
15. Salsman ML, Nordberg HO, Howell J, Berthet-Miron MM, Rosenfield D, Ritz T. Psychological distress and symptom-related burnout in asthma during the COVID-19 pandemic. *J Behav Med.* 2023;46(6):960–72. 10.1007/s10865-023-00412-y.

16. Alimoradi Z, Ohayon MM, Griffiths MD, Lin CY, Pakpour AH. Fear of COVID-19 and its association with mental health-related factors: systematic review and meta-analysis. *BJPsych Open*. 2022;8(2):e73. 10.1192/bjo.2022.26.
17. Lacwik P, Szydłowska D, Kupczyk M, Pałczyński C, Kuna P. High levels of anxiety during the COVID-19 pandemic as a risk factor of clinical worsening in patients with severe asthma. *J Allergy Clin Immunology: Pract*. 2021;9(3):1381–3. 10.1016/j.jaip.2020.12.060.
18. Eldeirawi KM, Nyenhuis SM, Huntington-Moskos L, Polivka BJ. Coronavirus disease 2019–related anxiety is associated with uncontrolled asthma in adults. *Ann Allergy Asthma Immunol*. 2022;129(1):109–11. 10.1016/j.anai.2022.04.011.
19. Ahorsu DK, Lin CY, Imani V, Saffari M, Griffiths MD, Pakpour AH. The Fear of COVID-19 Scale: Development and Initial Validation. *Int J Ment Health Addict*. 2022;20(3):1537–45. 10.1007/s11469-020-00270-8.
20. Kroenke K, Spitzer RL, Williams JBW, Löwe B. An ultra-brief screening scale for anxiety and depression: the PHQ-4. *Psychosomatics*. 2009;50(6):613–21. 10.1176/appi.psy.50.6.613.
21. Löwe B, Wahl I, Rose M, Spitzer C, Glaesmer H, Wingenfeld K, et al. A 4-item measure of depression and anxiety: validation and standardization of the Patient Health Questionnaire-4 (PHQ-4) in the general population. *J Affect Disord*. 2010;122(1–2):86–95. 10.1016/j.jad.2009.06.019.
22. Nathan RA, Sorkness CA, Kosinski M, Schatz M, Li JT, Marcus P, et al. Development of the asthma control test: a survey for assessing asthma control. *J Allergy Clin Immunol*. 2004;113(1):59–65. 10.1016/j.jaci.2003.09.008.
23. Przybyszowski M, Stachura T, Szafraniec K, Sladek K, Bochenek G. The influence of self-assessment of asthma control on the Asthma Control Test outcome. *J Asthma*. 2021;58(4):537–46. 10.1080/02770903.2019.1708098.
24. Maslach C, Jackson SE, Leiter MP. Maslach Burnout Inventory: Third edition. In: *Evaluating Stress: A Book of Resources*. Scarecrow Education; 1997:191–218.
25. Golonka K, Gawłowska M, Mojsa-Kaja J, Marek T. Psychophysiological Characteristics of Burnout Syndrome: Resting-State EEG Analysis. *Biomed Res Int*. 2019;2019(1):3764354. 10.1155/2019/3764354.
26. Haghighinejad H, Jafari P, Rezaie M, Farrokhi M, Jafari M, Ramzi M. Burnout Comparison between Clinical and Basic Sciences Faculty of a Medical School and Evaluation of Related Factors. *Iran J Psychiatry*. 2021;16(4):399–408. 10.18502/ijps.v16i4.7227.
27. Mousavi SAM, Hooshyari Z, Ahmadi A. The Most Stressful Events during the COVID-19 Epidemic. *Iran J Psychiatry*. 2020;15(3):220–7. 10.18502/ijps.v15i3.3814.
28. Hedeker D, Gibbons RD. *Longitudinal Data Analysis*. Hoboken, N.J.: Wiley; 2006.
29. 2020 Focused Updates to the Asthma Management Guidelines | NHLBI, NIH, Published, December 3, 2020. Accessed June 16, 2025. <https://www.nhlbi.nih.gov/health-topics/asthma-management-guidelines-2020-updates>

30. Stephan KE, Manjaly ZM, Mathys CD, Weber LAE, Paliwal S, Gard T, et al. Allostatic Self-efficacy: A Metacognitive Theory of Dyshomeostasis-Induced Fatigue and Depression. *Front Hum Neurosci*. 2016;10:550. 10.3389/fnhum.2016.00550.
31. Butterworth JW, Finley AJ, Baldwin CL, Kelley NJ. Self-control mediates age-related differences in psychological distress. *Pers Indiv Differ*. 2022;184:111137. 10.1016/j.paid.2021.111137.
32. Charles ST, Rush J, Piazza JR, Cerino ES, Mogle J, Almeida DM. Growing old and being old: Emotional well-being across adulthood. *J Personal Soc Psychol*. 2023;125(2):455–69. 10.1037/pspp0000453.
33. Wang Y, Kala MP, Jafar TH. Factors associated with psychological distress during the coronavirus disease 2019 (COVID-19) pandemic on the predominantly general population: A systematic review and meta-analysis. *PLoS ONE*. 2020;15(12):e0244630. 10.1371/journal.pone.0244630.
34. Best R, Strough J, Bruine de Bruin W. Age differences in psychological distress during the COVID-19 pandemic: March 2020 – June 2021. *Front Psychol*. 2023;14. 10.3389/fpsyg.2023.1101353.
35. Blanchard-Fields F, Stein R, Watson TL. Age differences in emotion-regulation strategies in handling everyday problems. *J Gerontol B Psychol Sci Soc Sci*. 2004;59(6):P261–269. 10.1093/geronb/59.6.p261.
36. Hox JJ, Van de Moerbeek M. *Multilevel Analysis: Techniques and Applications*. New York, NY: Routledge; 2018.

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