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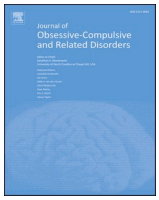

COVID-19 and obsessive-compulsive symptoms in a large multi-site college sample

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ABSTRACT

The COVID-19 pandemic poses unique risks to college students' mental health, and specifically to symptoms of obsessive-compulsive disorder (OCD). To better understand the relationship between COVID-19 impact and OC symptoms in this population, six colleges from across the US administered a battery of questionnaires and an emotion differentiation paradigm to eligible students ($N = 841$). We examined whether degree of pandemic-related disruption was associated with OC severity, and if so, whether this relationship was explained by trait (poor emotion regulation and differentiation) and state risk factors (poor sleep quality, less exercise frequency, less social support, thwarted sense of belongingness, and greater loneliness). Results indicated that the positive relationship between COVID-19 impact and OC severity was mediated by trait emotion-related processes (e.g., emotion regulation and differentiation), but no state risk factors emerged as significant mediators. Our findings contribute to the literature demonstrating a significant relationship between COVID-19 impact and OC severity, and highlight that emotion regulation difficulties may help explain this association. Our findings can inform evidence-based interventions on college campuses; however, the cross-sectional design precludes causal inferences. Future research should evaluate these relationships longitudinally and incorporate other psychosocial factors that may operate as mechanisms.

1. COVID-19 and obsessive-compulsive symptoms in a large multi-site college sample

The COVID-19 pandemic has had a devastating impact on mental health, and our understanding of its diverse effects on well-being is only in its infancy. Sadly, college students may be uniquely vulnerable to COVID-19-related psychological difficulties because the pandemic intersected with a critical phase of their development (e.g., Zhang et al., 2021). Pandemic-related restrictions on their social activities, living arrangements, and academic opportunities were especially detrimental (e.g., Hamza, Ewing, Heath, & Goldstein, 2021), as they interfered with students' navigation of age-appropriate milestones, such as forming adult-like social relationships and working toward a greater sense of autonomy and self-concept (e.g., Arnett, Zukauskiene, & Sugimura, 2014). Cross-sectional data indicate that college students, relative to population norms, reported higher levels of somatization, obsessive-compulsive disorder (OCD) symptoms, and anxiety, among other negative psychological effects during the pandemic (Huang & Zhao, 2020; Jiang, 2020). These findings align with prospective data that college students experienced an increase in depression and anxiety symptoms in the months after the pandemic's peak (Li, Zhao, et al., 2021), and that prior psychological health (i.e., having no previous mental health diagnoses) was not protective against negative psychological outcomes (Hamza et al., 2021).

When considering the relationship between COVID-19 and psychopathology, it is of the utmost importance to examine its association with

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OC symptoms (Grant et al., 2022). OCD is a relatively common psychological disorder characterized by frequent, intrusive obsessions (e.g., what if I become ill from using the public bathroom?) and repetitive compulsions (e.g., excessive handwashing and sanitizing). A common theme for obsessions and compulsions centers around the fear of being contaminated, as well as fears of harm coming to oneself or others (Abramowitz et al., 2010). Public health guidelines may have incidentally exacerbated OC-like symptoms during the pandemic, as the World Health Organization and Centers for Disease Control and Prevention actively promoted repeated handwashing, sanitization procedures, and physical distancing (i.e., symptoms of the contamination dimension of OCD). While the recommendations were proportionate to the disease threat (e.g., washing hands for 20–30 seconds when coming home; wearing a mask in enclosed places with other people), clinically significant OC symptoms would be evidenced by feeling compelled to go above and beyond the guidelines (e.g., washing hands for >10 min, avoiding coming within 10 feet of other people, even while wearing masks). Although the thematic overlap of cleansing behaviors makes the relationship between COVID-19 and the contamination dimension of OCD the most salient, other OC symptoms could be related to COVID-19. Indeed, the pandemic may be associated with: morality obsessions about causing harm to loved ones, taboo images of loved ones dying from COVID, repetitive checking or reassurance-seeking regarding one's distance from others, or re-positioning one's mask until it is perfectly symmetrical or feels "just right."

Not surprisingly, researchers have examined the relationship between COVID-19 and OC symptoms, yielding mixed results. While some work suggests that those with OCD did not experience substantial worsening in the early stages of the pandemic (e.g., Chakraborty & Karmakar, 2020; Matsunaga, Mukai, & Yamanishi, 2020; Sharma et al., 2021), others found an increase in contamination obsessions and washing compulsions during the pandemic among child, adolescent, and adult outpatients with OCD (e.g., Benatti et al., 2020; Davide et al., 2020; Tanir et al., 2020; Wheaton, Ward, Silber, McIngvale, & Björgvinsson, 2021). Pre-pandemic contamination symptoms were also associated with OC symptom worsening during the lockdown (Davide et al., 2020), which is consistent with data from the 2009 H1N1 swine flu pandemic, during which contamination fears emerged as one of the strongest predictors of pandemic-related anxiety in college students (Wheaton, Abramowitz, Berman, Fabricant, & Olatunji, 2012). Despite growing interest in the relationship between COVID-19 and OC symptoms, only a few studies have addressed this link among college students (e.g., Dixon, Witcraft, & Schadegg, 2021; Ji et al., 2020; Jiang, 2020; Zhang et al., 2021) and no studies have examined this link across multiple universities in the U.S. Given the variability in COVID-19 responses from local and state governments, research must elucidate how COVID-19 relates to OC symptoms beyond a single university. In this vulnerable population, the relationship between COVID-19 impact and OC symptoms must be clarified, and the psychological risk factors associated with OC symptom severity should be identified. Fittingly, leaders in the field (Grant et al., 2022) have called for cross-sectional studies that use general population samples (where most do not have OCD, but some might) to provide insight into the dimensional mechanisms (e.g., emotion dysregulation) by which the pandemic may relate to OC symptoms. Such knowledge can serve as the foundation for future research on university-based prevention and intervention programs that work to minimize or prevent adverse psychological outcomes due to the ongoing pandemic.

Toward this end, our broad objective was to examine psychological trait and state risk factors associated with OC symptoms in college students during the COVID-19 pandemic. In terms of trait risk factors, we expected that emotional processing difficulties, specifically poor emotion regulation and emotion differentiation would be associated with more severe OC symptoms. Our hypothesis rests upon empirical evidence that difficulties in multiple aspects of emotion regulation (e.g., accepting emotions, engaging in goal-directed behavior, controlling impulses) are significantly greater in those with OCD compared to healthy controls (Yazici & Yazici, 2019), even after controlling for depression and anxiety (Berman, Shaw, & Wilhelm, 2018; Yap et al., 2018). Poor emotion differentiation, which refers to difficulties distinguishing between emotional experiences (e.g., sadness vs anger), has also been linked to negative mental health outcomes and internalizing psychopathology in adolescents and young adults (Erbas, Ceulemans, Lee Pe, Koval, & Kuppens, 2014; Nook, 2021; Nook, Sasse, Lambert, McLaughlin, & Somerville, 2018). Emotion regulation and differentiation deficits may help explain why some college students struggle with OC symptoms during COVID-19. For instance, a student who is bombarded by messaging about the dangers of COVID-19 may be unable to differentiate the resultant emotional experience (e.g., cannot disentangle the *sadness* caused by her isolation, from the *guilt* of potentially infecting her loved ones, from the *fear* of contracting the illness herself, from the *anger* at her peers who are ignoring mandated safety measures). If she cannot disentangle her internal experience, then she would not be able to implement emotion-specific skills that effectively delay impulsive urges or facilitate acceptance of unwanted emotional experiences. Consequently, she may rely on ritualistic behaviors, like excessive handwashing, to regulate her emotional arousal.

In terms of state risk factors, we expected that five psychological constructs would be positively associated with OC symptom severity, based on the unique challenges that the pandemic imposed on college students' lives. Maladaptive health behaviors, such as poor sleep and lack of physical exercise, are considered general risk factors for mental health in college students (Ghrouz et al., 2019). Findings suggest that these health behaviors are also relevant risk factors during the COVID-19 pandemic, as: (a) individuals who experienced worsening OC symptoms reported greater sleep disturbances, when compared to those who did not experience worsening (Benatti et al., 2020), (b) pre-pandemic insomnia symptoms predicted OC symptoms after the onset of the pandemic (Cox & Olatunji, 2021), and (c) longer sleep onset latency increased the risk of OCD during the early phase of the pandemic (Zheng, Xiao, Xie, Wang, & Wang, 2020). Furthermore, less exercise was associated with an increased risk, whereas frequent exercise was associated with reduced risk, of mental health problems in large college samples (Li, Zhao, et al., 2021; Zhang et al., 2021). In addition to maladaptive health behaviors, social state-based risk factors, such as lack of social support, lack of belongingness, and loneliness, have also been associated with poor health outcomes (Leigh-Hunt et al., 2017; Palgi et al., 2020) and may be important risk factors for OC severity. Accordingly, a lack of perceived social support and being single has been linked to an increased risk of OCD during the pandemic (Alonso et al., 2021; Zheng et al., 2020). Recent research also suggests that thwarted belongingness (e.g., fundamental need for connectedness is not being met; Cacioppo & Patrick, 2008) and loneliness may underlie suicide risk during COVID-19 (Gratz et al., 2020; Raj, Ghosh, Singh, Verma, & Arya, 2021).

Based upon the extant literature, our team of investigators generated two hypotheses regarding the relationship between COVID-19 and OC symptoms. First, we hypothesized that greater impact from COVID-19 (operationalized as higher scores on our COVID-19 Impact Measure) would be positively associated with OC symptom severity in college students from across the country. Second, we hypothesized that the positive association between COVID-19 impact and OC symptom severity would be explained by trait (poor emotion regulation and differentiation) and state risk factors (poor sleep quality, less exercise frequency, less social support, thwarted sense of belongingness, and greater loneliness). We addressed past limitations by adopting a multimodal approach (i.e., questionnaires and paradigms), and recruiting participants across six academic institutions in the United States (US) during the pandemic.

2. Methods

2.1. Participants

Data collection occurred at six higher education institutions (four liberal arts colleges and two universities) in the US. Participants were recruited from the Introduction to Psychology course at each institution and inclusion criteria were broad - at least 18 years of age, fluent in English, and willing to provide informed consent. In total, 841 students participated in the current study. Larger samples were recruited from the two universities (n's = 147 and 235) than the four liberal arts colleges (range of n's = 73 to 176; site-specific demographic information can be found in Table 1). Students were allowed to enroll in the research study throughout the entire fall semester, with data collection occurring between October 2 to December 16, 2020.

2.2. Measures

To assess risk factors, as well as OC symptoms, we administered a battery of psychometrically valid and reliable self-report questionnaires and paradigms. Additionally, we designed a measure assessing the impact of COVID-19 on participants' psychological health.

2.2.1. Demographic questionnaire

To characterize the sample, we assessed the following characteristics: age, biological sex, gender identity, race, ethnicity, sexual orientation, and academic year (i.e., first-year, second-year, etc.). We also assessed where students resided for Fall 2020, who they lived with, and their ideal academic arrangement for the term (e.g., complete virtual learning; a hybrid approach). We used the single-item MacArthur Scale of Subjective Social Status – Adult Version (Adler, Epel, Castellazzo, & Ickovics, 2000) to assess subjective social status, a validated alternative to more objective indices, such as education or income. Participants marked their perceived social status on a ladder with 10 rungs, with the highest rung representing individuals who are "the best off, those who have the most money, most education, and best jobs," and the bottom rung representing the "people who are the worst off." Answers were recoded into three categories: low (rungs 1–4), medium (rungs 5–7), and high (rungs 8–10).

2.2.2. COVID-19 Impact Measure

This 14-item self-report measure assesses the impact of the COVID-19 pandemic on psychological health. We modified a previous version of this questionnaire (Fang, Berman, Hoeppner, Wolfe, & Wilhelm, 2021) to be relevant for college students. Respondents rated the impact of COVID-19 on their everyday lives (e.g., "I found it hard to concentrate on work and/or leisure activities because I was preoccupied with thoughts about COVID-19") on a Likert scale from 1 ("Strongly Disagree") to 5 ("Strongly Agree"), with higher scores reflecting greater impact. The factor structure of the COVID-19 Impact Measure, and additional psychometrics, are reported in the *Data Preparation* section. In addition to the 14 quantitative ratings, participants also reported their degree of personal exposure (e.g., tested positive; hospitalized) to COVID-19 since January 2020, as well as that of their roommates and close friends/family.

2.2.3. Dimensional Obsessive Compulsive scale (DOCS;Abramowitz et al., 2010)

This 20-item self-report measure assesses four dimensions of OCD: contamination, responsibility for harm, unacceptable thoughts, and symmetry/"just right" phenomena. For each dimension, respondents rate: (a) time occupied by obsessions and rituals, (b) avoidance behavior, (c) distress, (d) functional interference, and (e) difficulty disregarding obsessions and resisting compulsions. In both clinical and college student samples, the DOCS has shown strong internal consistency, test-retest reliability, convergent validity, divergent validity, sensitivity to treatment, and diagnostic sensitivity (total score ≥18 differentiates individuals with OCD from students; Abramowitz et al., 2010; Thibodeau, Leonard, Abramowitz, & Riemann, 2015). Cronbach's α (for the total score) in the current sample was 0.93. Thirty-four participants (4.0%) had >20% missing data for this measure.

2.2.4. Difficulties in Emotion Regulation Short Form (DERS-SF; Kaufman et al., 2016)

This 18-item, self-report measure assesses four dimensions of trait emotion regulation abilities: awareness of emotions, acceptance of emotions, ability to engage in goal-directed behavior and refrain from impulsive behavior when experiencing negative emotions, and access to emotion regulation strategies perceived as effective. Each item (e.g., "I'm confused about how I feel") is rated from 1 ("Almost Never) to 5 ("Almost Always"). For the analyses, we used DERS-SF total scores, where higher scores reflect greater emotion dysregulation. This measure has demonstrated good internal consistency, convergent, and divergent validity in both adolescent and college student samples (Kaufman et al., 2016). Cronbach's α in the current sample was 0.89. Thirty-five participants (4.2%) had >20% missing data for this measure.

2.2.5. Exercise frequency (Marshall, Smith, Bauman, & Kaur, 2005)

To assess respondent's exercise behaviors, participants were asked: "[Since the beginning of the academic term], about how many times a week, have you done 30 min (or more) of moderate physical activity that makes you breathe harder than normal? (for example, jogging, heavy lifting, aerobics, or fast bicycling)." Participants then chose from the following: 0 ("None"), 1 ("1–2 times/week"), 2 ("3–4 times/week"), or 3 ("5 times/week or more"). This tool has good reliability and convergent validity with accelerometer measurements of physical activity (Marshall et al., 2005). It has been widely used in clinical and college student samples (e.g., Zimmermann, Bledsoe, & Papa, 2021). Thirty-eight participants (4.5%) had missing data for this item.

2.2.6. Interpersonal needs questionnaire (Van Orden, Cukrowicz, Witte, & Joiner, 2012)

This 15-item questionnaire assesses thwarted belongingness and perceived burdensomeness; however, only the 9-item belongingness sub-scale was used in this study. Each sub-scale item (e.g., "These days, I rarely interact with people who care about me") is rated from 1 ("Not at all true for me") to 7 ("Very true for me"), with higher scores reflecting greater thwarted belongingness. The belongingness sub-scale has demonstrated adequate internal consistency, convergent, and divergent validity with college student samples (e.g., Van Orden et al., 2012) and Cronbach's α in the current sample was 0.90. Thirty-six participants (4.3%) had >20% missing data for this measure.

2.2.7. Multidimensional Scale of Perceived Social Support (MSPSS;Zimet, Dahlem, Zimet, & Farley, 1988)

The MSPSS is a 12-item self-report scale measuring support from family, friends, and significant others. Each item (e.g., "I get the emotional help and support I need from my family") is rated on a 7-item Likert scale from 1 ("Very Strongly Disagree") to 7 ("Very Strongly Agree"). The total score (sum of all items) was used in analyses. The MSPSS has sufficient construct validity, test-retest reliability, and internal consistency (Zimet et al., 1988) and is widely used in college samples (e.g., López-Castro, Brandt, Anthonipillai, Espinosa, & Melara, 2021). Cronbach's α in the current sample was 0.92. Thirty-seven participants (4.4%) had >20% missing data for this measure.

Table 1
Demographic characteristics, risk and resilience factors, COVID-19 impact, and OC symptom severity by site.

	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Total	Site differences
	(n = 176)	(n = 89)	(n = 121)	(n = 235)	(n = 73)	(n = 147)	(n = 841)	p
Demographics								
Age, years, M(SD)	19.2(2.6)	18.8(1.0)	18.6(0.7)	18.8(1.2)	18.9(1.2)	18.7(1.0)	18.8(1.5)	0.0339
First-year student, % (n)	59.4(95)	75.3(67)	67.5(81)	62.1(146)	57.5(42)	66.4(97)	64.2(528)	0.1049
Female, % (n)	91.1(144)	54.6(48)	73.3(88)	63.4(149)	39.7(29)	66.2(96)	67.6(554)	<.0001
Heterosexual, % (n)	71.8(112)	70.8(63)	90.0(108)	89.8(211)	69.4(50)	88.4(129)	82.3(673)	<.0001
Hispanic ethnicity, % (n)	19.2(30)	8.0(7)	13.6(15)	27.7(65)	16.4(12)	4.3(6)	16.9(135)	<.0001
Race, % (n)								<.0001
White	49.0(74)	63.6(56)	79.3(92)	72.3(170)	38.6(27)	26.2(38)	56.8(457)	
Black	4.6(7)	9.1(8)	8.6(10)	11.9(28)	12.9(9)	2.1(3)	8.1 (65)	
Asian	35.8(54)	18.2(16)	6.9(8)	9.4(22)	37.1(26)	64.1(93)	27.2(219)	
Other	10.6(16)	9.1(8)	5.2(6)	6.4(15)	11.4(8)	7.6(11)	8.0(64)	
Perceived socio-economic status (SES), % (n)								<.0001
Low	14.4(23)	12.5(11)	13.3(16)	4.7(11)	26.0(19)	10.3(15)	11.6(95)	
Medium	45.0(72)	50.0(44)	60.8(73)	55.3(130)	41.1(30)	63.0(92)	53.7(441)	
High	40.6(65)	37.5(33)	25.8(31)	40.0(94)	32.9(24)	26.7(39)	34.8(286)	
Campus experience								
Hoped college/university would re-open as usual with safety measures, % (n)	10.2(16)	31.8(28)	24.4(29)	37.6(88)	33.3(24)	10.4(15)	24.6(200)	<.0001
Lived away from campus, % (n)	75.2(118)	22.7(20)	83.2(99)	28.3(66)	36.1(26)	71.5(103)	53.1(432)	<.0001
Risk Factors								
Thwarted belongingness, M(SD)	30.1(10.8)	27.1(12.0)	27.2(11.3)	26.2(11.2)	30.2(12.2)	27.3(10.7)	27.8(11.3)	0.0092
UCLA-LS-3 total, M(SD)	6.2(1.6)	6.1(1.9)	5.8(1.9)	5.4(1.9)	6.3(1.9)	5.8(1.8)	5.8(1.8)	0.0002
MSPSS total, M(SD)	57.7(12.7)	61.1(12.3)	59.0(11.4)	58.8(12.9)	57.0(15.7)	59.5(12.6)	58.8(12.8)	0.3521
DERS-SF total, M(SD)	47.9(11.5)	45.1(11.7)	45.6(12.9)	43.6(13.3)	45.8(13.4)	43.3(12.8)	45.0(12.7)	0.0141
Emotion Diff., M(SD)	0.5(0.2)	0.5(0.2)	0.5(0.2)	0.5(0.3)	0.5(0.2)	0.5(0.2)	0.5(0.2)	0.7228
Sleep Quality, M(SD)	2.0(1.0)	2.4(0.8)	2.1(1.0)	2.2(1.0)	2.0(0.9)	2.3(0.9)	2.2(0.9)	0.0057
Exercise Frequency, M(SD)	1.3(1.0)	1.8(1.0)	1.6(1.1)	1.6(1.1)	1.7(1.1)	1.2(0.9)	1.5(1.1)	<.0001
Impact of COVID-19								
COVID-19 Impact, apprehension sub-scale, M(SD)	3.7(0.7)	3.4(0.6)	3.5(0.6)	3.3(0.7)	3.1(0.7)	3.1(0.7)	3.4(0.7)	<.0001
COVID-19 Impact, social distress sub-scale, M(SD)	3.8(0.7)	3.8(0.7)	3.8(0.7)	3.6(0.8)	3.6(0.9)	3.4(0.8)	3.6(0.8)	<.0001
Most serious personal exposure, % (n)								<.0001
No known exposure	70.5(124)	55.1(49)	56.2(68)	27.7(65)	60.3(44)	62.6(92)	52.6(442)	
Suspected exposure, no infection	13.1(23)	27.0(24)	22.3(27)	41.3(97)	21.9(16)	21.1(31)	25.9(218)	
Symptoms, not tested positive	13.6(24)	14.6(13)	14.1(17)	16.2(38)	12.3(9)	15.0(22)	14.6(123)	
Tested positive or hospitalized	2.8(5)	3.4(3)	7.4(9)	14.9(35)	5.5(4)	1.4(2)	6.9(58)	
Someone close tested positive or worse, % (n)	43.8(77)	42.7(38)	53.7(65)	70.6(166)	32.9(24)	29.3(43)	49.1(413)	<.0001
Family or friend(s) were hospitalized or died, % (n)	23.3(41)	12.4(11)	14.9(18)	20.4(48)	6.9(5)	9.5(14)	16.3(137)	0.0012
OCD Symptoms								
DOCS total score, M(SD)	24.6(13.7)	20.2(12.5)	20.0(11.7)	18.2(11.9)	20.9(13.5)	20.7(12.5)	20.6(12.7)	0.0002
DOCS sub-scale: contamination, M(SD)	7.0(3.5)	5.4(3.7)	6.1(3.5)	5.7(3.6)	6.4(4.1)	6.2(3.3)	6.1(3.6)	0.0055
DOCS sub-scale: responsibility for harm, M(SD)	6.3(4.2)	5.1(4.0)	4.8(3.7)	4.5(4.0)	5.4(4.1)	5.1(3.9)	5.1(4.0)	0.0019
DOCS sub-scale: unacceptable thoughts, M(SD)	6.5(4.7)	5.2(4.3)	5.2(4.5)	4.6(4.1)	5.8(4.8)	5.1(4.4)	5.3(4.5)	0.0024
DOCS sub-scale: symmetry, M(SD)	4.9(4.6)	4.4(4.2)	3.9(3.8)	3.4(3.9)	3.4(4.1)	4.3(3.9)	4.0(4.1)	0.0097

Note. To calculate the proportion of respondents with a specific demographic factor (e.g., % female), the available data from each site is used as the denominator, and this may differ from the total sample listed.
Abbreviations. UCLA-LS-3 = UCLA – Loneliness Scale – 3 Items; MSPSS = Multidimensional Scale of Perceived Social Support; DERS-SF = Difficulties in Emotion Regulation Short Form; DOCS = Dimensional Obsessive-Compulsive Scale.

2.2.8. Negative emotion differentiation

To assess participants' ability to differentiate their own negative emotion states, we used a paradigm that parallels Boden, Thompson, Dizén, Berenbaum, and Baker (2013), Erbas et al. (2014), and Nook et al. (2018). Participants were shown 10 images from the International Affective Picture System (IAPS;Lang, Bradley, & Cuthbert, 1995) and before each image appeared, participants saw a fixation cross in the center of the screen for two seconds. Each of the 10 images then appeared on the screen for six seconds and participants were told to "look directly at the picture." The order of the images was randomized to minimize potential order effects. Following each image, participants rated the intensity of the following emotions: fear, worried, lonely, sad, guilty, ashamed, jealous, embarrassed, angry, disgusted on a scale from 1 ("Not at all felt") to 6 ("Extremely felt"). A negative emotion differentiation index was then calculated using the average intraclass correlation (ICC (3,k); Shrout & Fleiss, 1979) to assess consistency across the negative emotion terms and across pictures, for each participant (e.g., Erbas et al., 2014). In this context, a high ICC would indicate that ratings for different emotions across pictures were strongly correlated and without notable distinctions (i.e., low emotion differentiation). Thus, paralleling past research, we reverse-scored the ICC values (i.e., 1 – ICC), so that larger values correspond to greater emotion differentiation among negative emotions. For this measure, we excluded observations from participants with more than 20% missing picture ratings ($n = 41$; 4.9%), participants with no variance between any emotion ratings ($n = 2$; 0.2%), and participants who had negative ICC scores ($n = 187$; 22.1%), because negative scores are beyond the theoretical lower limit for the ICC.

2.2.9. Sleep quality (Snyder, Cai, DeMuro, Morrison, & Ball, 2018)

Based upon the single-item sleep quality scale (Snyder et al., 2018), participants were asked to "rate the quality of [your] sleep" on a scale of: 0 ("Very Poor"), 1 ("Poor"), 2 ("Fair"), 3 ("Good"), and 4 ("Very Good"). The SQS has demonstrated adequate test-retest reliability, convergent and divergent validity, and responsivity to treatment (Snyder et al., 2018). Thirty-eight participants (4.5%) had missing data for this item.

2.2.10. UCLA loneliness short scale (Hughes, Waite, Hawkley, & Cacioppo, 2004)

This 3-item self-report scale assesses respondents' degree of loneliness. Each item (e.g., "How often do you feel isolated from others?") is rated from 1 ("Hardly Ever") to 3 ("Often"), with higher scores reflecting greater loneliness. This shortened version is unidimensional, possesses adequate internal consistency, convergent, and divergent validity, was developed specifically for large scale surveys (Hughes et al., 2004), and has been widely used in clinical, community, and college student samples (e.g., Vaterlaus, 2022). Cronbach's α in the current sample was 0.82. Thirty-six participants (4.3%) had missing data for this measure.

2.3. Procedure

Individuals at all six sites were enrolled in Introduction to Psychology and were given the opportunity to participate in our study examining the relationship between COVID-19 and psychological difficulties. Interested participants were sent a unique link to a Qualtrics survey. The same online questionnaire battery was administered to participants at all sites and was approximately 45-min in duration. At study completion, participants were given a debriefing form and compensated for their time. Each institution and/or instructor of Introduction to Psychology used a different approach for research compensation (e.g., lowest quiz dropped, extra credit), so compensation differed site to site. All measures and procedures were reviewed and approved by each site's local institutional review board (IRB).

3. Data Preparation and analytic strategy

3.1. COVID-19 Impact Measure

To explore the factorial structure of our COVID-19 Impact Measure, we subjected all 14 items of the instrument to an exploratory factor analysis with oblique rotation (promax). Eight hundred and sixteen participants had complete data for all scale items and were used in this analysis. The Kaiser-Meyer-Olkin measure verified the sampling adequacy for the analysis, KMO = 0.84. Bartlett's test of sphericity X^2 (df = 91) = 4801.29, $p < .0001$, indicated that the correlation structure was adequate for factor analyses. Velicer's MAP analysis (O'Connor, 2000; Velicer, Eaton, & Fava, 2000) indicated that a two-factor solution was the best fit for the data. Initial eigenvalues indicated that the first two factors explained 77.84% and 17.37% of the common variance, respectively. The two factors were: (a) COVID-19 apprehension (fear, anxiety, and uncertainty) with 7 items; and (b) pandemic social distress (loneliness, stress, mental health) with 5 items. Two items (8 and 9) had no clear factor loadings on either factor (Supplementary Table S1) and were excluded from the final factor scores. The inter-factor correlation was moderate ($r = 0.53$). The results of the rotated factor solution are presented in Supplementary Table S1. Both factors 1 (α = 0.80) and 2 (α = 0.72) possessed acceptable internal consistency.

3.2. Missing data

For all questionnaires, we calculated scale scores using within-person mean replacement (Downey & King, 1998; Shrive, Stuart, Quan, & Ghali, 2006) if no more than 20% of the scale items were missing; for scales with existing sub-scales, we imputed scale scores at the sub-scale level before totaling them into total scores. In most cases of missing data in questionnaires, scale items were completely missing and less than 1% of the scores used mean-item replacement.

3.3. Analyses

To test whether COVID-19 impact scores (COVID-19 apprehension sub-scale and social distress sub-scale) were associated with DOCS scores, we used generalized linear mixed models with COVID-19 impact scores as the independent variables (fixed effect) in separate models. Both models included site as a random effect and DOCS total scores as the outcome. We used a z-score transformation of the COVID-19 impact scores in both models, so that the model coefficients could be interpreted as the expected change in raw DOCS scores with an increase of one standard deviation in the COVID-19 impact sub-scale scores.

To investigate which risk factors mediated the association between either of the two COVID-19 impact sub-scales and DOCS scores, we used a multiple mediation model using ordinary least squares path analysis with either of the COVID-19 impact sub-scale scores as the independent variable (in separate models), our hypothesized risk factors (i.e., thwarted belongingness, loneliness, perceived social support, difficulties with emotion regulation, negative emotion differentiation, sleep quality, and exercise frequency) as the mediators, and DOCS total score as the outcome. Preliminary review revealed, however, that our measure of negative emotion differentiation had substantially less useable data than our other hypothesized risk factors, due to the number of negative ICC values that needed to be excluded (i.e., only $n = 610$ possessed complete data). Because the mediational model only uses scales with no missing data, including this variable in the full model would have substantially reduced the available data for every other risk factor, thereby limiting our power. Therefore, we conducted two parallel mediational models. The first model ($n = 800$) included six of our seven hypothesized risk factors as mediators (i.e., thwarted belongingness, loneliness, perceived social support, difficulties with emotion regulation, sleep quality, and exercise frequency; Fig. 1) and the second model ($n = 610$) included only negative emotion differentiation as a mediator (Fig. 2). We then

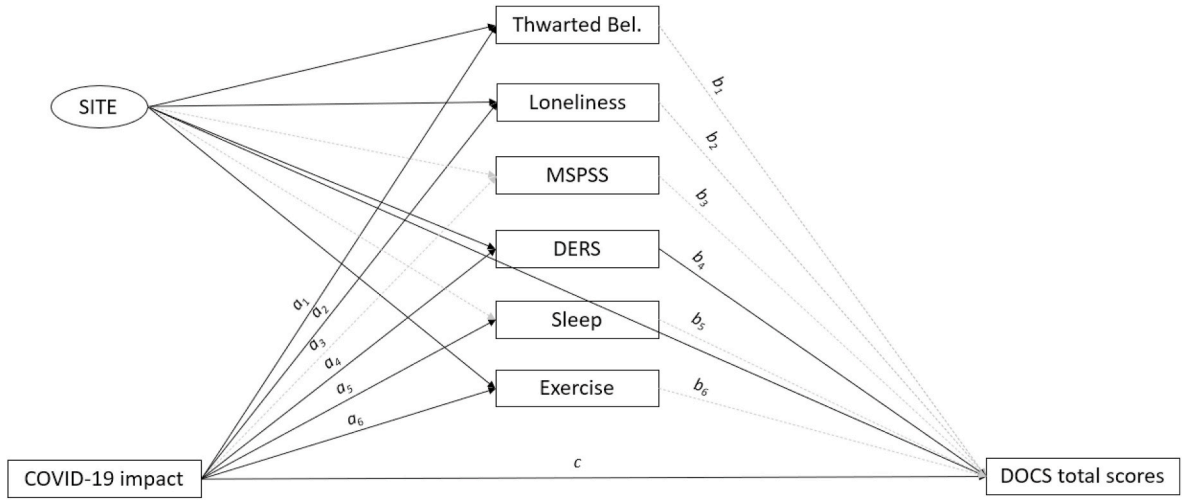

Fig. 1. Cross-sectional multiple mediation model examining the association between the COVID-19 Impact apprehension and social distress sub-scales and overall OC symptom severity (DOCS total scores), mediated by six potential mechanisms: thwarted belongingness, loneliness, perceived social support, difficulties in emotion regulation, sleep quality, and exercise frequency.
Notes: Solid lines represent significant associations, dotted lines represent non-significant associations in the two multiple mediation models that use different COVID-19 Impact sub-scale scores as predictors. For the site effect, solid lines indicate that at least one site has a significantly different effect ($p < .05$) compared to the largest site (#4). Path estimates for specific models are presented in Table 2.
Abbreviations: MSPSS = Multidimensional Scale of Perceived Social Support; DERS = Difficulties in Emotion Regulation Short Form; DOCS = Dimensional Obsessive-Compulsive Scale.

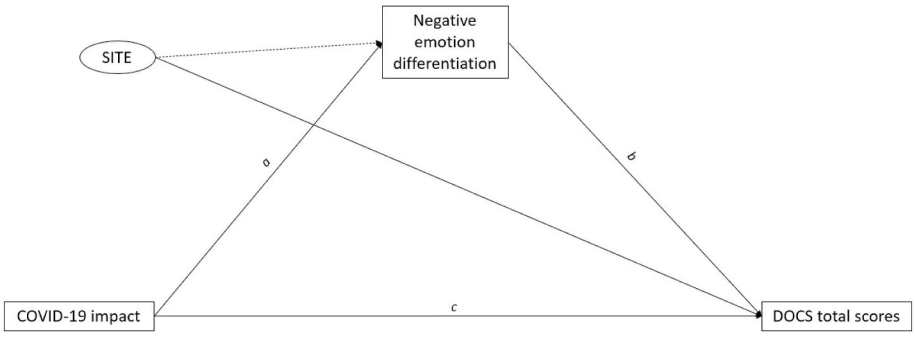

Fig. 2. Cross-sectional mediation model examining the association between the COVID-19 Impact apprehension or social distress sub-scales and overall OC symptom severity (DOCS total scores), mediated by negative emotion differentiation in the sub-sample with valid negative emotion differentiation scores ($n = 610$).
Notes: Solid lines represent significant associations in at least one mediation model, dotted lines represent non-significant associations in both mediation models. For the site effect, solid lines indicate that at least one site has a significantly different effect ($p < .05$) compared to site 4 in at least one mediation model. Specific path estimates for each model are presented in Table 2.
Abbreviation: DOCS = Dimensional Obsessive-Compulsive Scale.

repeated the mediation models with each of the DOCS sub-scales. We intended these additional mediation models to be hypothesis-generating explorations of the different OCD symptom dimensions and did not adjust them for family-wise error. In all mediation models, site was a covariate, and the significance of indirect effects was evaluated through percentile confidence intervals based on 10,000 bootstrap samples. All variables in the mediation models were also standardized using a z-score transformation to aid in the interpretation of path coefficients. The mediation analysis was performed using the PROCESS macro (Hayes, 2013) in SAS 9.4 for Windows. Results were interpreted as statistically significant when $p < .05$ or bootstrap confidence intervals of effect estimates excluded zero.

4. Results

4.1. Sample characteristics

Table 1 provides a full description of participant characteristics split by site. Participants were predominantly first-year college students (64.2%), female (67.6%), non-Hispanic (83.1%), white (56.8%), and heterosexual (82.3%), and were on average 18.80 (SD = 1.5) years old. Only about a quarter of participants hoped that their school would re-open in Fall 2020 as usual (with safety measures in place; $n = 200$, 24.6%). Most students hoped that their school would transition to a hybrid learning model ($n = 399$, 49.0%), while less hoped for a complete transition to virtual learning ($n = 212$, 26.0%), and a few wanted their institution to "do something else" ($n = 3$, 0.4%). Roughly half of participants lived away from campus ($n = 432$, 53.1%), though this percentage varied widely between schools (Table 1). The majority of those who lived away from campus reported living with their parents or primary caregivers ($n = 402$, 93.3%). The majority of students perceived themselves to be of medium (53.7%) or high (34.8%) social standing, with only 11.6% reporting comparatively low social standing. Given the geographic variability, composition of each school, and type of higher education (university vs. liberal arts), we expectedly observed demographic differences between sites, as well as site differences in mean DOCS scores, COVID-19 impact, and various risk and resilience factors reported by students (Table 1).

The majority of students did not report being personally infected with the COVID-19 virus; only 56 participants (6.7%) reported testing

positive for COVID-19 since January 2020 and only 2 (0.2%) had been hospitalized. However, 413 participants (49.1%) knew of at least one person they lived with, or a close friend or family member they did not live with, who tested positive, needed hospitalization, or died of COVID-19 (Table 1). Of note, the average DOCS total score at all six sites exceeded 18, which is the cut-off score for differentiating OCD from student samples (Abramowitz et al., 2010).

4.2. Association between COVID-19 impact and DOCS total scores

There were significant associations between the two COVID-19 impact sub-scales and DOCS total scores. The association was stronger for the COVID-19 apprehension sub-scale than for the social distress sub-scale. A one standard deviation increase in COVID-19 apprehension sub-scale scores was associated with a 4.9-point increase in DOCS total scores (95% CI: [4.0, 5.7]; $p < .0001$). A one standard deviation increase in pandemic social distress sub-scale scores was associated with a 3.5-point increase in DOCS total scores (95% CI: [2.7, 4.4]; $p < .0001$).

4.3. Mediation models

As shown in Table 2, higher COVID-19 apprehension sub-scale scores and social distress sub-scale scores were significantly associated ($p \leq .004$) with worse outcomes for all but one of the hypothesized mediators (perceived social support), but only one mediator had a significant association with DOCS total scores. Specifically, only the DERS-SF had a significant association with DOCS total scores, such that a one standard deviation increase in DERS-SF total scores was associated with one third of a standard deviation higher DOCS total score in either COVID-19 impact sub-scale model (Table 2). The multiple mediation model with COVID-19 apprehension sub-scale scores as the predictor accounted for about 35% of the variation in DOCS total scores, and the direct association between the COVID-19 apprehension sub-scale on DOCS total scores was greater than that of the only significant mediation pathway (82.9% vs. 14.5%). The multiple mediation model with the social distress sub-scale scores as the predictor accounted for about 27% of the variation in DOCS total scores, and the direct association between the social distress sub-scale on DOCS total scores was only slightly greater than that of the only significant mediation pathway (48.3% vs. 39.3%). In the simple mediation model, negative emotion differentiation emerged as a significant mediator only between the COVID-19 apprehension sub-scale and DOCS total scores, with the whole model explaining about 17% of the variation in DOCS total scores. In this model, higher COVID-19 apprehension was associated with decreased negative emotion differentiation (a-path; $p = .0029$), while higher (i.e., more successful) negative emotion differentiation was associated with a lower severity of DOCS total scores (b-path; $p = .0158$). The net (indirect) effect of this mediation pathway was that the association of COVID-19 apprehension with negative emotion differentiation accounted for approximately 3.1% of the total association between COVID-19 apprehension and DOCS total scores (Table 2). We were unable to detect an association between the COVID-19 social distress sub-scale and negative emotion differentiation ($p = .1169$).

These mediation models were repeated with each DOCS sub-scale as an individual outcome, and the results were very similar to the DOCS total score model (Supplementary Tables S2–S5). This is not surprising since the correlations of the individual DOCS sub-scales with the total score were expectedly high (ranging from 0.73 [contamination sub-scale] to 0.85 [responsibility for harm sub-scale]). In these exploratory models, DERS-SF was the only consistent mediator of both COVID-19 impact sub-scales, though negative emotion differentiation, exercise frequency and loneliness sporadically emerged as weaker secondary mediators in models. Overall, the models with the COVID-19 apprehension sub-scale as the predictor explained greater variation in DOCS scales than models using the COVID-19 social distress sub-scale as the predictor. We were unable to detect any direct effects of thwarted belongingness, perceived social support, or sleep quality on any DOCS outcomes in any model.

5. Discussion

In this study, researchers at six higher education institutions (two large public universities and four liberal arts colleges) investigated the association between COVID-19 impact and OC symptom severity. As expected, college students who reported greater COVID-19-related apprehension and social distress (i.e., greater pandemic-related disruption) also reported more OC symptoms. This finding was relatively large in magnitude and remained significant after accounting for site effects. Our pattern of results aligns with research demonstrating a positive relationship between pandemic fears and OC symptoms (e.g., Wheaton et al., 2012), as well as with research on the relationship between COVID-19 and OC symptomology in some clinical samples (e.g., Benatti et al., 2020; Wheaton et al., 2021) and college students at specific universities (Dixon et al., 2021; Ji et al., 2020; Jiang, 2020; Zhang et al., 2021). Thus, using a heterogenous sample of American college students from across the country, the present results add to our field's understanding of the relationship between the COVID-19 pandemic and OC symptoms in a uniquely vulnerable population (Arnett et al., 2014).

Supporting our first hypothesis, positive associations emerged between OC symptom severity and both the apprehension and social distress sub-scales of the COVID-19 Impact Measure. However, the relationship between the COVID-19 apprehension sub-scale and OC outcomes was stronger than the observed relationships between the social distress sub-scale and OC symptom severity. This pattern aligns with recent research demonstrating that pandemic-related stress and fear (i.e., the foundation of our apprehension sub-scale) is associated with elevated OC symptoms in the general population (Albertella et al., 2021; Fontenelle et al., 2021; Seçer & Ulaş, 2020). Moreover, past research has consistently linked elevated stress levels to heightened OC symptoms (e.g., Coles, Pietrefesa, Schofield, & Cook, 2008; Vidal-Ribas et al., 2015). The resultant stress due to COVID-19 may help explain why both sub-scales (apprehension and social distress) were positively associated with overall OC symptom severity, as well as with most OC dimensions (contamination, responsibility for harm, unacceptable thoughts, and symmetry/"just right" concerns). Although the COVID-19 social distress sub-scale possessed significant associations with OC outcomes, we anticipate that this sub-scale would be more strongly associated with depressive symptoms. Aligning with the loss of reinforcement theory (Lewinsohn, 1974), the items assessing pandemic-related social distress (e.g., isolation; missed important social opportunities, like a wedding) reflect a reduction in response-contingent positive reinforcement, which could ultimately increase dysphoria and depressive symptomology.

Aligning with predictions, there were significant associations between COVID-19 impact and nearly all of the individual vulnerability factors. Indeed, individuals who reported greater COVID-19 apprehension and social distress also reported worse sleep quality, getting less exercise, more loneliness and thwarted belongingness, and worse emotion regulation (e.g., Alonso et al., 2021; Ghrouz et al., 2019; Leigh-Hunt et al., 2017; Palgi et al., 2020; Zheng et al., 2020). Somewhat surprisingly, neither COVID-19 apprehension nor social distress was significantly associated with perceived social support. One interpretation for this non-significant finding is that our measure of this construct (MSPSS;Zimet et al., 1988) did not assess social support via social media

Table 2
Path and effect estimates for the multiple ($n = 800$) and simple mediation ($n = 610$) models examining the direct and indirect associations between COVID-19 Impact and OCD symptom severity.

	Relationship between COVID-19 Impact and mediator (*a* paths)				Relationship between mediator and DOCS total symptom severity (*b* paths)				Paths (*ab, c*) from COVID-19 Impact to DOCS total symptom severity			% of total effect
Mediator	Path	Std. est.	95% CI	*p*	Path	Std. est.	95% CI	*p*	Path	Std. est.	95% CI[a]	
COVID-19 impact, apprehension sub-scale												
					Multiple mediation model ($R^2 = 0.35$, $p < .0001$)							
Thwarted belongingness	a_1	**0.110**	**[0.038,0.181]**	**.0027**	b_1	0.068	[−0.021,0.156]	.1332	a_1b_1	0.007	[−0.003,0.021]	1.9
UCLA-LS-3 total	a_2	**0.147**	**[0.076,0.218]**	**.0001**	b_2	0.065	[−0.016,0.147]	.1171	a_2b_2	0.010	[−0.002,0.024]	2.5
MSPSS total	a_3	0.024	[−0.049,0.096]	.5181	b_3	−0.044	[−0.114,0.026]	.2166	a_3b_3	−0.001	[−0.008,0.003]	−0.3
DERS-SF total	a_4	**0.165**	**[0.094,0.236]**	**<.0001**	b_4	**0.344**	**[0.278,0.410]**	**<.0001**	a_4b_4	**0.057**	**[0.031,0.085]**	**14.5**
Sleep quality	a_5	**−0.119**	**[−0.191,−0.048]**	**.0011**	b_5	−0.006	[−0.067,0.056]	.8605	a_5b_5	0.001	[−0.008,0.009]	0.2
Exercise frequency	a_6	**−0.159**	**[−0.229,−0.088]**	**<.0001**	b_6	0.041	[−0.020,0.103]	.1853	a_6b_6	−0.007	[−0.018,0.003]	−1.7
COVID-19 Impact	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	*c*	**0.325**	**[0.264,0.386]**	**82.9**
					Single mediator model ($R^2 = 0.17$, $p < .0001$)							
Emotion Differentiation	*a*	**−0.126**	**[−0.208,−0.043]**	**.0029**	*b*	**−0.091**	**[−0.164,−0.017]**	**.0158**	*ab*	**0.011**	**[0.001,0.026]**	**3.1**
COVID-19 Impact	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	*c*	**0.354**	**[0.277,0.430]**	**96.9**
COVID-19 impact, social distress sub-scale												
					Multiple mediation model ($R^2 = 0.27$, $p < .0001$)							
Thwarted belongingness	a_1	**0.186**	**[0.117,0.255]**	**<.0001**	b_1	0.089	[−0.004,0.182]	.0619	a_1b_1	0.017	[−0.002,0.038]	5.9
UCLA-LS-3 total	a_2	**0.328**	**[0.263,0.394]**	**<.0001**	b_2	0.050	[−0.039,0.138]	.2721	a_2b_2	0.016	[−0.013,0.045]	5.8
MSPSS total	a_3	−0.048	[−0.119,0.022]	.1780	b_3	−0.013	[−0.086,0.061]	.7395	a_3b_3	0.001	[−0.004,0.007]	0.2
DERS-SF total	a_4	**0.314**	**[0.248,0.381]**	**<.0001**	b_4	**0.350**	**[0.279,0.422]**	**<.0001**	a_4b_4	**0.110**	**[0.078,0.146]**	**39.3**
Sleep quality	a_5	**−0.105**	**[−0.175,−0.036]**	**.0031**	b_5	−0.024	[−0.089,0.041]	.4753	a_5b_5	0.003	[−0.005,0.011]	0.9
Exercise frequency	a_6	**−0.115**	**[−0.183,−0.046]**	**.0011**	b_6	0.009	[−0.055,0.073]	.7826	a_6b_6	−0.001	[−0.009,0.007]	−0.4
COVID-19 Impact	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	*c*	**0.135**	**[0.069,0.202]**	**48.3**
					Single mediator model ($R^2 = 0.11$, $p < .0001$)							
Emotion Differentiation	*a*	−0.065	[−0.146,0.016]	.1169	*b*	**−0.117**	**[−0.193,−0.041]**	**.0026**	*ab*	0.008	[−0.002,0.021]	3.1
COVID-19 Impact	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	*c*	**0.240**	**[0.163,0.317]**	**96.9**

Note: [a] Confidence intervals based on 10,000 percentile bootstrap samples were used for indirect effects (*ab* paths); **Bolded** areas reflect statistically significant effects. *Abbreviations*: Std. est. = standardized effect estimates; UCLA-LS-3 = UCLA – Loneliness Scale – 3 Items; MSPSS = Multidimensional Scale of Perceived Social Support; DERS-SF = Difficulties in Emotion Regulation Short Form; DOCS = Dimensional Obsessive-Compulsive Scale.

or networking sites, which was a predominant source of communication among college students during the pandemic (Zhen, Nan, & Pham, 2021). As a result, we may not have tapped into the true relationship between COVID-19 impact and social support.

The present study also highlighted meaningful relationships between our examined vulnerability factors and OC symptom severity. Of the indices investigated, impaired emotion regulation was the only factor that consistently related to overall OC symptom severity (and all four OCD dimensions in our exploratory analyses). These findings parallel past research demonstrating that individuals with deficits in emotional awareness and affect regulation also report greater OC symptom severity (Berman et al., 2018; Khosravani, Ardestani, Bastan, & Kamali, 2017; Roh, Kim, & Kim, 2011; Yap et al., 2018; Yazici & Yazici, 2019). Partially supporting our second hypothesis, the mediational models indicated that both of our emotion-related vulnerability factors (emotion dysregulation and negative emotion differentiation) accounted for a significant portion of the direct effect between COVID-19 apprehension and overall OC symptom severity. It may be that students who had difficulty differentiating the negative emotions provoked by pandemic-related apprehension (e.g., feeling *frightened* of becoming sick) may have relied upon maladaptive emotion regulation strategies (e.g., ritualistic behaviors) to regulate their undifferentiated emotional distress. Interpreted in the other direction, individuals who successfully identified their emotion states (e.g., guilt), and could then implement emotion-specific regulatory strategies (e.g., affect labeling; opposite action; problem-solving; Linehan, 2014), may have been less likely to turn toward maladaptive short-term regulatory behaviors that were ritualistic in nature (e.g., compulsive washing routines). Further mechanistic research is needed to test out these effects; however, the current findings do align with evidence that emotional intelligence mediated the relationship between pandemic exposure and the severity of psychological disorders in college students (Li, Li, & Fan, 2021). In further support of this effect, Hong, Zhu, and Yu (2022) reported that a poor understanding of one's affective experience (i.e., limited emotion differentiation abilities), non-acceptance of one's emotions, and trying to control impulses in the face of high affect (i.e., emotion dysregulation) helped explain the relationship between health-related concerns during the pandemic and the severity of OC symptoms.

The present results may have important clinical implications. Emerging work clearly suggests that the pandemic is having deleterious mental health effects on college students, including on their OC symptom severity. Fortunately, effective treatments exist for OCD, including both serotonin reuptake inhibitor (SRI) medications and cognitive-behavioral therapy (Koran, Hanna, Hollander, Nestadt, & Simpson, 2007). Therefore, it is important that these treatments are available to students experiencing clinically significant OC symptoms as a result of the pandemic. Our findings also suggest that interventions aimed at improving emotion regulation (e.g., Affect Regulation Training [ART]; Berking, 2010; Berking et al., 2008) may weaken the association between COVID-19 impact and pathological outcomes. Accordingly, Sacchi and Dan-Glauser (2021)recently demonstrated that using adaptive coping strategies during the pandemic, specifically future-oriented planning (e.g., identify the necessary next steps to manage difficult events; Carver, Scheier, & Weintraub, 1989) may interrupt the emotion emergence process, and decrease both emotion regulation difficulties and internalizing symptoms.

The present findings should be interpreted in light of several important study limitations. First, although the current study included a geographically diverse set of schools from across the country, the present sample may not generalize to all college students. The participating schools were not randomly selected, and all students were selected from psychology classes at academically rigorous four-year institutions. Further study is needed to generalize to other college settings (e.g., community colleges). Moreover, given the disproportionate mental health impact of COVID-19 on communities of color, future research should examine whether the reported associations between COVID-19 impact and OC symptom severity persist in a more representative, diverse sample of U.S. college students.

Second, data were collected at a single time point in a cross-sectional design. A longitudinal framework would be needed to establish that participants' OC symptoms increased following the emergence of COVID-19 (as some participants' OC symptoms may have preceded the pandemic). Moreover, a longitudinal design would help elucidate the progression and course of college students' OC symptoms over time. As previously described, participants' self-reported OC symptom severity exceeded the threshold that distinguishes past student samples from those with clinically significant OCD. Notably, this pattern aligns with recent research demonstrating that a year into the pandemic, individuals considered to be "healthy controls" reported more severe internalizing symptoms compared to their pre-pandemic levels (Kok et al., 2022). A longitudinal design would identify whether this elevation reflects (a) a temporary (and potentially adaptive) increase in obsessive pre-occupation and ritualizing that dissipates as restrictions and pandemic-fears subside (Grant et al., 2022) or (b) a more enduring pattern of elevated OC symptoms in college students that may not naturalistically remit as the pandemic recedes (bringing implications for large-scale interventions at the community-level).

A third limitation relates to the emotion differentiation paradigm. Given the number of negative ICC scores on this paradigm, including this variable in the multiple mediation model would have substantially reduced the available data. Therefore, we ran a separate simple mediation model to test whether emotion differentiation explained the relationship between COVID-19 impact and OC symptom severity. Despite the fact that emotion differentiation was not in competition with other risk factors, this model does highlight that this trait risk factor significantly explains the relationship between some pandemic-related disruption and OC symptom severity. That being said, we encourage researchers to further investigate this paradigm to determine "best practices" for managing negative ICC scores, and whether online administrations (i.e., without supervision) can yield valid and reliable outcomes. A fourth limitation is that our mediation models only explained part of the variance between COVID-19 impact and OC symptom severity, highlighting the need to identify other explanatory variables (e.g., cultural orientation; identity factors) in future research.

Limitations notwithstanding, our study is the largest to date assessing OC symptoms in American college students during the COVID-19 pandemic. Our findings confirm those of previous studies showing worsened mental health outcomes, including OC symptoms, during the pandemic, and suggest that college students with OC symptoms are a particularly vulnerable group warranting further research attention on emotion-related mechanisms underlying risk.

CRediT author statement

Noah Chase Berman: Conceptualization, methodology, project administration, formal analysis, data curation, writing (original draft; review and editing). **Angela Fang:** Conceptualization, methodology, project administration, writing (original draft; review and editing). **Susanne Hoeppner:** Formal analysis, writing (original draft; review and editing). **Jed Siev:** Conceptualization, methodology, project administration, writing (review and editing). **Hannah Reese:** Conceptualization, methodology, project administration, writing (review and editing). **Kiara Timpano:** Conceptualization, methodology, project administration, writing (review and editing). **Michael Wheaton:** Conceptualization, methodology, project administration, writing (original draft; review and editing)

Declaration of competing interest

Given their role as an Editorial Board Member for the *Journal of Obsessive Compulsive and Related Disorders*, Drs. Berman, Siev, Timpano, and Wheaton had no involvement in the peer-review of this article and had no access to information regarding its peer-review.

The remaining authors (Drs. Fang, Hoeppner, and Reese) declare no conflicts of interest.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jocrd.2022.100727.

References

Abramowitz, J. S., Deacon, B. J., Olatunji, B. O., Wheaton, M. G., Berman, N. C., Losardo, D., et al. (2010). Assessment of obsessive-compulsive symptom dimensions: Development and evaluation of the dimensional obsessive-compulsive scale. *Psychological Assessment, 22*(1), 180–198.

Adler, E., Epel, E., Castellazzo, G., & Ickovics, J. (2000). Relationship of subjective and objective social status with psychological and physiological functioning: Preliminary data in healthy white women. *Health Psychology, 19*(6), 586–592.

Albertella, L., Rotaru, K., Christensen, E., Lowe, A., Brierley, M. E., Richardson, K., et al. (2021). The influence of trait compulsivity and impulsivity on addictive and compulsive behaviors during COVID-19. *Frontiers in Psychiatry, 12*, Article 634583.

Alonso, P., Bertolín, S., Segalàs, J., Tubío-Fungueiriño, M., Real, E., Mar-Barrutia, L., et al. (2021). How is COVID-19 affecting patients with obsessive-compulsive disorder? A longitudinal study on the initial phase of the pandemic in a Spanish cohort. *European Psychiatry, 64*(1), 1–9.

Arnett, J., Zukauskiene, R., & Sugimura, K. (2014). The new life stage of emerging adulthood at ages 18-29 years: Implications for mental health. *The Lancet Psychiatry, 1*, 569–576.

Benatti, B., Albert, U., Maina, G., Fiorillo, A., Celebre, L., Girone, N., et al. (2020). What happened to patients with obsessive compulsive disorder during the COVID-19 pandemic? A multicentre report from tertiary clinics in northern Italy. *Frontiers in Psychiatry, 11*, 720.

Berking, M. (2010). *The affect regulation training*. Springer.

Berking, M., Wupperman, P., Reichardt, A., Pejic, T., Dippel, A., & Znoj, H. (2008). Emotion-regulation skills as a treatment target in psychotherapy. *Behavior Research and Therapy, 46*(11), 1230–1237.

Berman, N. C., Shaw, A., & Wilhelm, S. (2018). Emotion regulation in patients with obsessive compulsive disorder: Unique effects for those with "taboo thoughts. *Cognitive Therapy and Research, 42*, 674–685.

Boden, M. T., Thompson, R. J., Dizén, M., Berenbaum, H., & Baker, J. P. (2013). Are emotional clarity and emotion differentiation related? *Cognition & Emotion, 27*, 961–978.

Cacioppo, J. T., & Patrick, W. (2008). *Loneliness: Human nature and the need for social connection*. W. W. Norton & Company.

Carver, C. S., Scheier, M. F., & Weintraub, J. K. (1989). Assessing coping strategies: A theoretically based approach. *Journal of Personality and Social Psychology, 56*(2), 267–283. https://doi.org/10.1037/0022-3514 .56.2.267

Chakraborty, A., & Karmakar, S. (2020). Impact of COVID-19 on obsessive-compulsive disorder (OCD). *Iranian Journal of Psychiatry, 15*(3), 256–259.

Coles, M. E., Pietrefesa, A. S., Schofield, C. A., & Cook, L. M. (2008). Predicting changes in obsessive compulsive symptoms over a six-month follow-up: A prospective test of cognitive models of obsessive compulsive disorder. *Cognitive Therapy and Research, 32*(5), 657–675.

Cox, R. C., & Olatunji, B. O. (2021). Linking insomnia and OCD symptoms during the coronavirus pandemic: Examination of prospective associations. *Journal of Anxiety Disorders, 77*, Article 102341.

Davide, P., Andrea, P., Martina, O., Andrea, E., Davide, D., & Mario, A. (2020). The impact of the COVID-19 pandemic on patients with OCD: Effects of contamination symptoms and remission state before the quarantine in a preliminary naturalistic study. *Psychiatry Research, 291*, Article 113213.

Dixon, L. J., Witcraft, S. M., & Schadegg, M. J. (2021). COVID-19 anxiety and mental health among university students during the early phases of the U.S. pandemic. *Journal of American College Health. Advanced online publication*.

Downey, R. G., & King, C. (1998). Missing data in likert ratings: A comparison of replacement methods. *The Journal of General Psychology, 125*(2), 175–191. https://doi.org/10.1080/00221309809595542

Erbas, Y., Ceulemans, E., Lee Pe, M., Koval, P., & Kuppens, P. (2014). Negative emotion differentiation: Its personality and well-being correlates and a comparison of different assessment methods. *Cognition & Emotion, 28*, 1196–1213.

Fang, A., Berman, N. C., Hoeppner, S., Wolfe, E., & Wilhelm, S. (2021). State and trait risk and resilience factors associated with COVID-19 impact and obsessive-compulsive symptom trajectories. *International Journal of Cognitive Therapy. Advanced Online Publication*.

Fontenelle, L., Albertella, L., Brierley, M. E., Thompson, E. M., Destrée, L., Chamberlain, S. R., et al. (2021). Correlates of obsessive-compulsive and related disorders symptom severity during the COVID-19 pandemic. *Journal of Psychiatric Research, 143*, 471–480.

Ghrouz, A. K., Noohu, M. M., Manzar, M. D., Spence, D. W., BaHammam, A. S., & Pandi-Perumal, S. R. (2019). Physical activity and sleep quality in relation to mental health among college students. *Sleep and Breathing, 23*, 627–634.

Grant, J., Drummond, L., Nicholson, T., Fagan, H., Baldwin, D., Fineberg, N., et al. (2022). Obsessive-compulsive symptoms and the COVID-19 pandemic: A rapid scoping review. *Neuroscience & Biobehavioral Reviews, 132*, 1086–1098.

Gratz, K. L., Tull, M. T., Richmond, J. R., Edmonds, K. A., Scamaldo, K. M., & Rose, J. P. (2020). Thwarted belongingness and perceived burdensomeness explain the associations of COVID-19 social and economic consequences to suicide risk. *Suicide and Life-Threatening Behavior, 50*, 1140–1148.

Hamza, C. A., Ewing, L., Heath, N. L., & Goldstein, A. L. (2021). When social isolation is nothing new: A longitudinal study on psychological distress during COVID-19 among university students with and without preexisting mental health concerns. *Canadian Psychology/Psychologie Canadienne, 62*(1), 20–30.

Hayes, A. F. (2013). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. The Guilford Press.

Hong, D., Zhu, Y., & Yu, M. (2022). How health anxiety affected obsessive-compulsive symptoms during the COVID-19 pandemic in China: The mediation of difficulties in emotion regulation and the moderation of pathological personality traits. *Personality and Individual Differences, 185*, Article 111254.

Huang, Y., & Zhao, N. (2020). Generalized anxiety disorder, depressive symptoms and sleep quality during COVID-19 outbreak in China: A web-based cross-sectional survey. *Psychiatry Research, 288*, Article 112954.

Hughes, M., Waite, L., Hawkley, L., & Cacioppo, J. (2004). A short scale for measuring loneliness in large surveys. *Research on Aging, 26*(6), 655–672.

Jiang, R. (2020). Knowledge, attitudes and mental health of university students during the COVID-19 pandemic in China. *Children and Youth Services Review, 119*, Article 105494.

Ji, G., Wei, W., Yue, K., Li, H., Shi, L., Ma, J., et al. (2020). Effects of the COVID-19 pandemic on obsessive-compulsive symptoms among university students: Prospective cohort survey study. *Journal of Medical Internet Research, 22*(9), Article e21915.

Kaufman, E. A., Xia, M., Fosco, G., Yaptangco, M., Skidmore, C. R., & Crowell, S. E. (2016). The difficulties in emotion regulation scale short form (DERS-SF): Validation and replication in adolescent and adult samples. *Journal of Psychopathology and Behavioral Assessment, 38*(3), 443–455.

Khosravani, V., Ardestani, M. S., Bastan, F. S., & Kamali, Z. (2017). The relationship between alexithymia and symptom dimensions in patients with obsessive-compulsive disorder. *Journal of Obsessive-Compulsive and Related Disorders, 14*, 127–133.

Kok, A., Pan, K., Rius-Ottenheim, N., Jorg, F., Eikelenboom, M., Horsfall, M., et al. (2022). Mental health and perceived impact during the first Covid-19 pandemic year: A longitudinal study in Dutch case-control cohorts of persons with and without depressive, anxiety, and obsessive-compulsive disorders. *Journal of Affective Disorders, 305*, 85–93.

Koran, L. M., Hanna, G. L., Hollander, E., Nestadt, G., & Simpson, H. B. (2007). Practice guideline for the treatment of patients with obsessive-compulsive disorder. *American Journal of Psychiatry, 164*(7 Suppl), 5–53.

Lang, P. J., Bradley, M. M., & Cuthbert, B. N. (1995). *International affective pictures System (IAPS): Technical manual and affective ratings (tech. Rep. A-4)*. Gainesville: University of Florida. Center for Research in Psychophysiology.

Leigh-Hunt, N., Bagguley, D., Bash, K., Turner, V., Turnbull, S., Valtorta, N., et al. (2017). An overview of systematic reviews on the public health consequences of social isolation and loneliness. *Public Health, 152*, 157–171.

Lewinsohn, P. M. (1974). A behavioral approach to depression. In R. J. Friedman, & M. M. Katz (Eds.), *The psychology of depression: Contemporary theory and research* (pp. 157–178). John Wiley & Sons.

Linehan, M. (2014). *DBT training manual*. The Guilford Press.

López-Castro, T., Brandt, L., Anthonipillai, N. J., Espinosa, A., & Melara, R. (2021). Experiences, impacts and mental health functioning during a COVID-19 outbreak and lockdown: Data from a diverse New York City sample of college students. *PLoS One, 16*(4). https://doi.org/10.1371/journal.pone.0249768

Marshall, A., Smith, B., Bauman, A., & Kaur, S. (2005). Reliability and validity of a brief physical activity assessment for use by family doctors. *British Journal of Sports Medicine, 39*, 294–297.

Matsunaga, H., Mukai, K., & Yamanishi, K. (2020). Acute impact of COVID-19 pandemic on phenomenological features in fully or partially remitted patients with obsessive–compulsive disorder. *Psychiatry and Clinical Neurosciences, 74*(10), 565–566.

Nook, E. C. (2021). Emotion differentiation and youth mental health: Current understanding and open questions. *Frontiers in Psychology, 12*, Article 700298.

Nook, E. C., Sasse, S. F., Lambert, H. K., McLaughlin, K. A., & Somerville, L. H. (2018). The nonlinear development of emotion differentiation: Granular emotional experience is low in adolescence. *Psychological Science, 29*(8), 1346–1357.

O'Connor, B. P. (2000). SPSS and SAS programs for determining the number of components using parallel analysis and Velicer's MAP test. *Behavior Research Methods, Instruments, and Computers, 32*, 396–402.

Palgi, Y., Shrira, A., Ring, L., Bodner, E., Avidor, S., Bergman, Y., et al. (2020). The loneliness pandemic: Loneliness and other concomitants of depression, anxiety and their comorbidity during the COVID-19 outbreak. *Journal of Affective Disorders, 275*, 109–111.

Raj, S., Ghosh, D., Singh, T., Verma, S. K., & Arya, Y. K. (2021). Theoretical mapping of suicidal risk factors during the COVID-19 pandemic: A mini-review. *Frontiers in Psychiatry, 11*, Article 589614.

Roh, D. Y., Kim, W. J., & Kim, C. H. (2011). Alexithymia in obsessive–compulsive disorder: Clinical correlates and symptom dimensions. *The Journal of Nervous and Mental Disease, 199*, 690–695.

Sacchi, L., & Dan-Glauser, E. (2021). Never too late to plan: "Refocus on planning" as an effective way to lower symptoms and difficulties during the COVID-19 first lockdown. *Emotion, 21*(7), 1483–1498.

Seçer, I., & Ulaş, S. (2020). An investigation of the effect of COVID-19 on OCD in youth in the context of emotional reactivity, experiential avoidance, depression and anxiety. *International Journal of Mental Health and Addiction, 19*(6), 2306–2319.

Sharma, L., Balachander, S., Thamby, A., Bhattacharya, M., Kishore, C., Shanbhag, V., et al. (2021). Impact of the COVID-19 pandemic on the short-term course of obsessive-compulsive disorder. *The Journal of Nervous and Mental Disease, 209*(4), 256–264.

Shrive, F. M., Stuart, H., Quan, H., & Ghali, W. A. (2006). Dealing with missing data in a multi-question depression scale: A comparison of imputation methods. *BMC Medical Research Methodology, 6*(1), 57. https://doi.org/10.1186/1471-2288-6-57

Shrout, P. E., & Fleiss, J. L. (1979). Intraclass correlations: Uses in assessing rater reliability. *Psychological Bulletin, 86*, 420–428.

Snyder, E., Cai, B., DeMuro, C., Morrison, M., & Ball, W. (2018). A new single-item sleep quality scale: Results of psychometric evaluation in patients with chronic primary insomnia and depression. *Journal of Clinical Sleep Medicine, 14*(11), 1849–1857.

Tanir, Y., Karayagmurlu, A., Kaya, İ., Kaynar, T. B., Türkmen, G., Dambasan, B. N., et al. (2020). Exacerbation of obsessive compulsive disorder symptoms in children and adolescents during COVID-19 pandemic. *Psychiatry Research, 293*, Article 113363.

Thibodeau, M. A., Leonard, R. C., Abramowitz, J. S., & Riemann, B. C. (2015). Secondary psychometric examination of the dimensional obsessive-compulsive scale: Classical testing, item response theory, and differential item functioning. *Assessment, 22*(6), 681–689. https://doi.org/10.1177/1073191114559123

Van Orden, K. A., Cukrowicz, K. C., Witte, T. K., & Joiner, T. E. (2012). Thwarted belongingness and perceived burdensomeness: Construct validity and psychometric properties of the Interpersonal Needs Questionnaire. *Psychological Assessment, 24*(1), 197–215.

Vaterlaus, J. M. (2022). College student loneliness and the reopening of campuses during the covid-19 pandemic. *Family and Consumer Sciences Research Journal. Advanced Online Publication*. https://doi.org/10.1111/fcsr.12427

Velicer, W. F., Eaton, C. A., & Fava, J. L. (2000). Construct explication through factor or component analysis: A review and evaluation of alternative procedures for determining the number of factors or components. In R. D. Goffin, & E. Helmes (Eds.), *Problems and solutions in human assessment* (pp. 41–71). Kluwer.

Vidal-Ribas, P., Stringaris, A., Rück, C., Serlachius, E., Lichtenstein, P., & Mataix-Cols, D. (2015). Are stressful life events causally related to the severity of obsessive-compulsive symptoms? A monozygotic twin difference study. *European Psychiatry, 30*(2), 309–316.

Wheaton, M. G., Abramowitz, J. S., Berman, N. C., Fabricant, L. E., & Olatunji, B. O. (2012). Psychological predictors of anxiety in response to the H1N1 (swine flu) pandemic. *Cognitive Therapy and Research, 36*, 210–218.

Wheaton, M. G., Ward, H. E., Silber, A., McIngvale, E., & Björgvinsson, T. (2021). How is the COVID-19 pandemic affecting individuals with obsessive-compulsive disorder (OCD) symptoms? *Journal of Anxiety Disorders, 81*, Article 102410.

Yap, K., Mogan, C., Moriarty, A., Dowling, N., Blair-West, S., Gelgec, C., et al. (2018). Emotion regulation difficulties in obsessive-compulsive disorder. *Journal of Clinical Psychology, 74*, 695–709.

Yazici, K. U., & Yazici, I. P. (2019). Decreased theory of mind skills, increased emotion dysregulation and insight levels in adolescents diagnosed with obsessive compulsive disorder. *Nordic Journal of Psychiatry, 74*(7), 462–469.

Zhang, X., Shi, X., Wang, Y., Jing, H., Zhai, Q., Li, K., et al. (2021). Risk factors of psychological responses of Chinese university students during the COVID-19 outbreak: Cross-sectional web-based survey data. *Journal of Medical Internet Research, 23*, Article e29312.

Zheng, Y., Xiao, L., Xie, Y., Wang, H., & Wang, G. (2020). Prevalence and characteristics of obsessive-compulsive disorder among urban residents in Wuhan during the stage of regular control of coronavirus disease-12 epidemic. *Frontiers in Psychiatry, 11*, Article 594167.

Zhen, L., Nan, Y., & Pham, B. (2021). College students coping with COVID-19: Stress-buffering effects of self-disclosure on social media and parental support. *Communication Research Reports, 38*(1), 23–31.

Zimet, G. D., Dahlem, N. W., Zimet, S. G., & Farley, G. K. (1988). The multidimensional scale of perceived social support. *Journal of Personality Assessment, 52*, 30–41.

Zimmermann, M., Bledsoe, C., & Papa, A. (2021). Initial impact of the COVID-19 pandemic on college student mental health: A longitudinal examination of risk and protective factors. *Psychiatry Research, 305*, Article 114254.

Further reading

Li, N., Li, S., & Fan, L. (2021a). Risk factors of psychological disorders after the COVID-19 outbreak: The mediating role of social support and emotional intelligence. *Journal of Adolescent Health, 69*, 696–704.

Li, Y., Zhao, J., Ma, Z., McReynolds, L. S., Lin, D., Chen, Z., et al. (2021b). Mental health among college students during the COVID-19 pandemic in China: A 2-wave longitudinal study. *Journal of Affective Disorders, 281*, 597–604.