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Routine Disruption Predicts Stress During the 2020 COVID-19 Lockdowns in the U.S.

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Abstract

In early 2020, governments around the world imposed various non-pharmaceutical interventions (NPIs) to slow the spread of COVID-19. NPIs like stay-at-home (or "lockdown") orders were especially effective in mitigating virus transmission but could also significantly disrupt people's usual activities. Given the hypothesized relationship between routine disruption and stress (e.g., Hou, Lai, Ben-Ezra, & Goodwin, 2020), we predicted that the amount of daily-life disruption people experienced during lockdowns would significantly predict their stress levels. To test this hypothesis, we collected data from over 300 adults living across the United States via an online survey. Analyses revealed that lockdowns did disrupt participants' daily routines, that most participants experienced several stress symptoms during lockdowns, and that overall life disruption strongly correlated with stress scores (r = .50). Subsequent multiple linear regression analyses revealed that changes in just 4-5 activities were driving this relationship—exercising, relaxing, using social media, eating, and volunteering—and that disruptions to these behavioral routines predicted between 24-32% of the variance in participants' stress symptoms. Overall, our results showed that many disruptions in daily routines correlated with stress during lockdowns but that some activity changes were more strongly related to stress than others.

Keywords: stress, life disruption, daily activity, COVID-19 pandemic, lockdowns.

Introduction The COVID-19 pandemic and the attempts to contain it spurred unprecedented societal changes around the world. Before the development of effective vaccines, the best defenses against the spread of COVID-19 were "non-pharmaceutical interventions," (NPIs)—public health measures designed to suppress and mitigate virus transmissibility (Ferguson et al. 2020). Informally known as "lockdown" measures, NPIs often utilize methods which significantly alter daily routines and activities. These measures include restricting travel, limiting the size of social gatherings, "shelter-in-place" orders, isolating the infected, quarantining the exposed, social distancing, and the wearing of face masks (e.g., Askitas, Tatsiramos, & Verheyden, 2021). While many NPIs are effective in reducing COVID-19 infections (see Perra, 2021), the most effective ones (e.g., limiting gatherings and closing schools; Askitas et al., 2021; Brauner et al., 2021; Haug et al., 2020) can be highly disruptive to people's daily lives, requiring significant adaptation to new situations or routines.

In the United States, a National Emergency was declared on March 13th, 2020, in response to COVID-19 (Federal Register), and sweeping changes soon followed. Most states issued stay-at-home orders, closed non-essential businesses and schools, prohibited dine-in eating or drinking, and limited in-person gatherings for at least part of the initial wave of infections (Alexander et al., 2021). In the weeks following the National Emergency declaration, approximately 20 million employees in the U.S. were either fired or laid off (Coibion et al., 2020), 35% of the remaining labor force transitioned to remote working (Brynjolfsson et al., 2020), and 50 million children and teens were affected by public school closures (EducationWeek). Other life-structuring services and settings like childcare and places of worship were also adversely impacted, leaving few realms of life untouched by the pandemic.

The psychological impacts of the pandemic were immediate and significant. Compared to pre-pandemic levels, for example, researchers observed greater levels of depression (Holman et al., 2020), anxiety (Santabárbara et al., 2021), acute and post-traumatic stress (Cooke et al., 2020), loneliness (Killgore et al., 2020), substance use and suicidal ideation (Czeisler et al., 2020), and sleep disruptions (Jahrami et al., 2021). Though many variables likely contributed to these mental health declines, one possible explanation is that the disruption of daily life by NPIs like lockdowns significantly contributed to these conditions (e.g., Hou et al., 2020; Kornilaki, 2021; Murray, Gottlieb, & Swartz, 2021; Robinson & Daly, 2021; Yang et al., 2021; Zhu et al., 2020). In support of this, leading health authorities such as the World Health Organization (2020) Centers for Disease Control and Prevention (2020) have recommended that people continue their regular routines as much as possible (or create new ones) during the pandemic for mental health purposes.

One possible reason for the link between NPIs and negative mental health outcomes is that the disruption of daily life caused by NPIs significantly increases stress, which itself is a factor associated with many negative physical and mental health conditions (Chrousos, 2009). It is therefore worth investigating the relationship between types of daily-life disruption during lockdowns and symptoms of stress during the COVID-19 pandemic to see which routine changes contribute to, protect against, or are unrelated to reported stress symptoms. If relationships exist between certain routine changes and stress, this knowledge could help inform the public about best practices for future NPI implementation(s).

To explore the potentially important relationships between daily routine disruption and stress, we asked adults from across the United States to retrospectively report on their daily activities and stress symptoms during the initial lockdown periods of COVID-19 in Spring 2020. Our primary hypothesis was that the disruption of daily life (or routines) during stay-at-home orders would predict individuals' reported stress symptoms. Furthermore, we explored which activities associated with daily life disruption most strongly contributed to stress during lockdowns.

Materials and Methods

All materials and procedures in this study were approved by the Institutional Review Board at Widener University.

Participants

Participants were recruited through advertisements on two social media platforms in March and April of 2021. The ad's headline read, "Tell us about your COVID-19 experiences," and the subsequent text informed readers that the aim of the university-affiliated, anonymous survey was to understand how stay-at-home orders impacted the health and well-being of adults (18 years and older) living in the United States during the 2020 lockdowns. The posting further outlined that the survey would take about 30 minutes to complete, and that participants could enter to win one of twenty $25.00 gift cards to a large online retailer. All data were collected online using Qualtrics (Version 3.21) and analyzed using IBM SPSS (Version 27).

In total, 309 people met the inclusion criteria and voluntarily completed the survey in full. Participants ranged in age from 19 to 87 years old (M = 43.95, SD = 18.76) and represented 44 of the 48 continental United States. About two-thirds of the sample identified as women (68.9%, n = 213), 86 identified as men (27.8%), and the remaining 10 participants (3.2%) identified as non-binary or agender (n = 9) or preferred not to say (n = 1). Over three-quarters identified as White / Caucasian (79.6%, n = 246) and the next largest racial / ethnic group had only 16 people (5.2%). Due to their small ns, we created a "non-White" group for the 55 (17.5%) participants who identified as (groups listed in order of decreasing sizes) Asian / Pacific Islander, Hispanic / Latinx, Black, Jewish, Native American, Indian / Pakistani, or biracial / mixed race. Eight participants (2.6%) declined to specify their race or ethnicity. Just over one-third had completed high school / some college (36.6%, n = 113) or had a bachelor's degree (35.0%, n = 108), and just under one-third had a graduate degree (28.2%, n = 87).

Measures

In the first section of the survey, we asked participants to report on their life experiences during stay-at-home orders. The 63 items in this section covered domains like their living situation, employment, health and safety, finances, and daily activities. Responses to most of these items were made via one of two 5-point rating scales. In the current study, we focused on changes to daily activities and reported stress symptoms during lockdowns.

To measure changes in participants' daily activities (behaviors, habits, rhythms, etc.) during stay-at-home orders, we asked them to rate the extent to which lockdowns changed their engagement in 14 common behavioral routines (e.g., "I slept…"; "I exercised…") using the following 5-point rating scale: *Much less than usual*, *Less than usual*, *Just as much as usual*, *More than usual*, and *Much more than usual*. The 14 activities were assessed with one item each and covered sleeping, exercising, leaving the house, eating, drinking alcohol, using marijuana (or its products), working, volunteering, relaxing, watching TV or movies, using social media, doing hobbies, watching the news, and doing home improvements. Responses to these 14 items were scaled from -2 to +2, with negative numbers reflecting *Much less* (-2) or *Less* (-1) engagement than usual in that activity, zeros indicating *Usual* engagement (i.e., no change), and positive numbers reflecting *More* (+1) or *Much more* (+2) engagement in that activity during stay-at-home orders. Going forward, we refer to this 5-point (-2 to +2) response scale as measuring *relative* life disruption, as the sign of the nonzero responses indicates the direction of the change *relative to* one's usual level of engagement in that activity.

Next, we assessed participants' stress via an English translation of the Lipp Stress Symptoms Inventory for Adults (LSSI; Lipp, 2000; see the Appendix of Lipp & Lipp, 2019, for a similar translation). Unlike measures of subjective stress (e.g., the Perceived Stress Scale; Cohen, 1983), the LSSI is a checklist of objective somatic and psychological symptoms of stress. Psychometrically, the 53-item LSSI exhibits high internal consistency (K-R 20 = .91; Lipp, 2009) and its theoretical structure is supported by confirmatory factor and item response theory analyses (Lipp & Lipp, 2019). As a full scale (K-R 20 = .95 in the current study) it yields scores from 0 to 53, with each one-point increase representing the presence of a new stress symptom or a more severe manifestation of a previously measured symptom.[1] We adapted this scale by asking participants to select "Yes" or "No" to indicate whether they experienced the listed stress symptom(s) during the stay-at-home orders.

Data Analyses

The first analysis we performed was creating a routine disruption scale to estimate the total impact that stay-at-home orders had on participants' daily lives. We did this by summing their responses to the 14 daily

activity items (recall that these responses ranged from -2 to +2, with 0 indicating no change). As the summation of positively and negatively scored responses would have underestimated total change, we used the absolute values of participants' responses. Taking the absolute values of the 5-point (-2 to +2) *relative* change responses yielded a new, 3-point (0 to +2) scale in which 0s (still) represented *No change* from usual in an activity during lockdowns, but 1s now represented both *Less* (-1) *and More* (+1) engagement than usual, and 2s now represented both *Much more* (+2) *and Much less* (-2) engagement than usual. Going forward, we refer to this 3-point (0 to +2) response scale as measuring *absolute* life disruption (from taking the absolute values of the 5-point *relative* scale responses), with 0 representing *No change*, +1 representing *Minor change*, and +2 representing *Major change* in an activity during lockdowns. The summation of all 14 *absolute* changes in daily activities yielded a *total* life disruption scale (α = .82) with scores that ranged from 0 (representing *No change* in any measured daily activity) to 28 (representing *Major change* in all 14 activities).

Next, we ran a series of bivariate correlations to explore the relationships between the measures of life disruption and stress symptoms. If *total* life disruption was correlated with reported stress symptoms, we would proceed with analyzing the relationships between *relative* and *absolute* changes in the 14 individual daily activities and stress. Specifically, if *relative* or *absolute* changes in an individual daily activity significantly correlated with stress, we would consider it for entrance as a predictor into one of two multiple linear regression models, one with *relative* daily changes predicting stress symptoms and the other with *absolute* daily changes predicting stress symptoms. Due to the number of inferential statistical tests performed, we used an alpha of $p \leq .01$ to mitigate Type I errors.

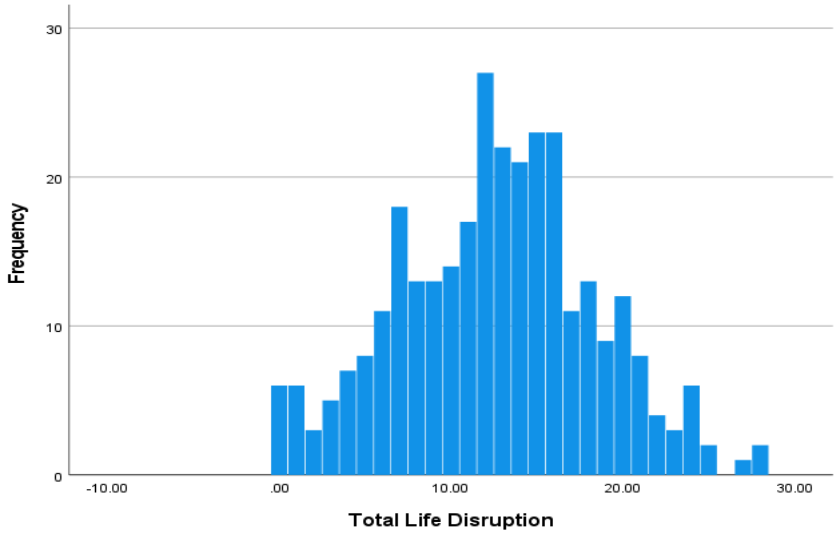
Results and Discussion

Life Disruption During COVID-19 Lockdowns

Frequencies and descriptive statistics for the 14 individual activities are displayed in Table 1, with *relative* disruption displayed on the left panel and *absolute* disruption on the right. As can be seen in the left panel of Table 1, the *relative* extent to which participants' daily routines changed during lockdowns varied greatly. Although *No change* was the modal response for half of the 14 measured activities, other daily routines were greatly impacted by stay-at-home orders. For example, most participants left the house (88.0%, *n* = 271) or volunteered (62.6%, *n* = 189) either *Less* or *Much less* than usual during lockdowns, and the majority reported watching TV / movies (69.6%, *n* = 213), using social media (74.7%, *n* = 230), or doing hobbies (51.0%, *n* = 157) either *More* or *Much more* than usual.

The right panel of Table 1 displays the 3-point *absolute* disruption results. The absolute values of the 5-point *relative* scale revealed that the frequencies of *No change* (*n* = 1556) and *Minor change* (*n* = 1558) responses were almost identical, with each accounting for 36.4% of the total responses. Over a quarter (27.2%) of the *absolute* scale responses represented *Major changes* among the 14 the measured behavioral routines. Taken together, nearly two-thirds (63.6%) of participants' *absolute* responses to the 14 daily activities represented *Minor* or *Major changes* compared to their "usual" (i.e., pre-lockdown) routines. At the 14-item scale level, participants' *total* life disruption scores during stay-at-home orders were relatively normally distributed (see Figure 1), with a mean score of 12.62 "change units" (*Mdn* = 13, *Mode* = 12, *SD* = 5.78) out of a possible 28, with higher scores representing greater life disruption.

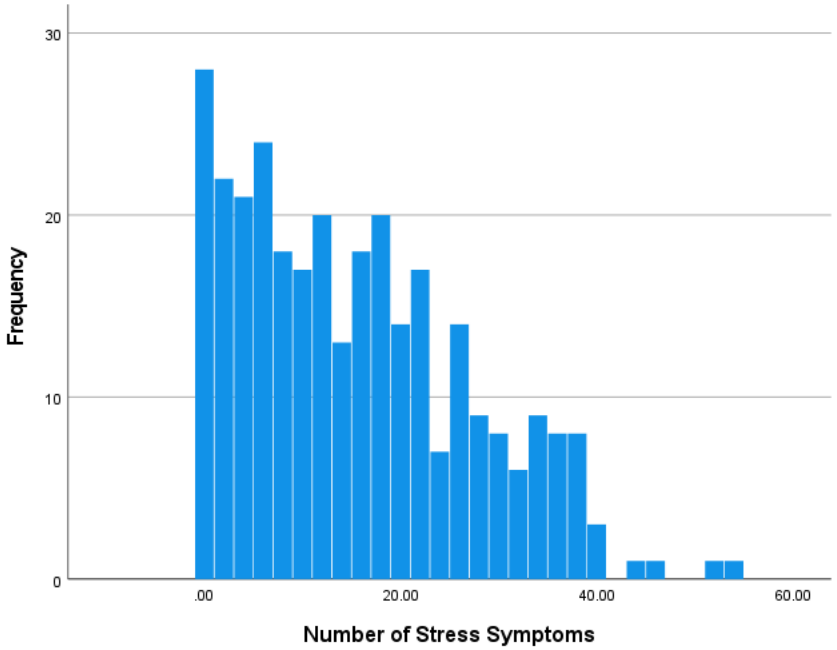
Figure 1: *Histogram of Total Life Disruption Scores Imposed by Lockdowns*



Stress Symptoms During COVID-19 Lockdowns

Whereas the distribution of *total* life disruption scores followed a near-normal distribution, reported stress symptoms during stay-at-home orders (as measured by the 53-item LSSI) were strongly and positively skewed (.63), with nearly one in 10 participants (9.4%, n = 29) reporting no stress symptoms (the mode was 0). A Kolmogorov-Smirnov test of normality further verified that stress scores were not normally distributed, $D(309) = .101$, $p < .001$. Hence, a sizable portion of our sample reported relatively few to no stress symptoms. Nevertheless, the median number of stress symptoms reported was 13 (M = 14.88, SD = 11.64) and a few participants reported 40 or more symptoms; one participant even endorsed all 53 stress symptoms. See Figure 2 for a depiction of this data.

Figure 2: *Histogram of Psychophysiological Stress Symptom Counts*



The Relationship Between Life Disruption and Stress Symptoms

Given that participants' lives were fairly disrupted on average during lockdown (see Table 1) and that most (though not all) participants reported experiencing several stress symptoms (Figure 1), we next explored the relationships between these two variables. A Pearson's correlation between *total* life disruption and stress symptoms during lockdowns revealed a moderately large, positive relationship, $r(307) = .50$, $p < .001$, such that individuals who reported more changes in their usual daily activities (i.e., more life disruption) during lockdowns tended to report a greater number of stress symptoms (and vice versa). With this relationship established at the scale level, we proceeded to analyze the associations between the 14 individual daily activities and stress symptoms to explore whether any specific routine changes were driving this relationship.

Table 2 displays the bivariate correlations between participants' reported stress symptoms, and their *relative* (5-point, -2 to +2) and *absolute* (3-point, 0 to +2) changes in the 14 daily activities. Of note in the *relative* column is that reported changes in five of the 14 activities (35.7%) were significantly correlated with stress symptoms, four negatively (exercising, leaving home, volunteering, and relaxing) and one positively (using social media); *relative* changes in the remaining nine daily activities were unrelated to reported stress symptoms. When measuring *absolute* life disruption, however, reported changes to all 14 of the daily routines were significantly and positively correlated with stress symptoms. Though the "positive" aspect of the correlations was expected (due to the nature of the *absolute* scale, negative correlations with stress were unlikely) the large proportion of significant correlations was not. Five of the significant correlations with stress replicated across both *relative* and *absolute* measures of change (changes in exercising, leaving home, volunteering, relaxing, and using social media), but the remaining nine activity change × stress correlations only emerged when measuring *absolute* change.

The correlations in Table 2 also served as a basis for building two multiple linear regression models for our next set of analyses, with the five significant *relative* changes in daily activities serving as candidate independent variable predictors in one model, the 14 significant *absolute* changes in daily activities serving as candidate independent variable predictors in the other model, and stress symptoms serving as the dependent variable in

both models. Due to concerns about the existence of multicollinearity among our predictor variables and overfitting the regression models, we attempted to remove all redundant predictors from both models by comparing the results of three multiple regression model-building methods (Enter, Forward, and Backward) and retaining only the predictors that were significant across all three.[2] In the final models, we also requested variance inflation factor (VIF) values to test for multicollinearity.

Table 3 displays the predictors (from Table 2) that were retained across the three model-building methods. As can be seen, the methods were remarkably consistent in terms of which predictors they retained; the only discrepancy was that *absolute* changes to sleep was retained in the Backward but not Enter or Forward methods. Table 3 also shows that four predictors were retained in each model and that changes in three of the four daily activities during lockdown (exercising, relaxing, and using social media) were significantly predictive of stress in both models. With two parsimonious models constructed, we ran a final set of multiple linear regression analyses (one for each model) using the Enter Method with the predictors listed in the rightmost column of Table 3.

The results of our final regression analyses are displayed in Table 4. The upper panel of Table 4 contains each model's summary statistics, and the lower panel contains the standardized beta weights and VIF values of each predictor. At the broadest level, Table 4 shows that both models were significant, with changes in four daily activities each during lockdown predicting 24% (Relative Change model) and 32% (Absolute Change model) of the variance in participants' reported stress symptoms when using the adjusted R^2 values. These findings supported our hypothesis that the psychophysiological impact of lockdowns is related to their disruptiveness to one's daily routines. At the predictor level, the Relative Change model results showed that changes in three activities (relaxing, volunteering, and exercising) were negative predictors and using social media was a positive predictor of stress symptoms. In the Absolute Change model, three familiar predictors (relaxing, exercising, and using social media) were joined by eating, all as positive predictors of stress (again, due to the nature of the *absolute* change scale, negative relationships with stress were unlikely). Finally, the VIF values—all less than 1.5—were far below the commonly used thresholds of 10 and 4 (see O'Brien, 2007), so the likelihood of multicollinearity inflating the adjusted R^2 estimates was low.

Table 1: *Frequencies of Relative and Absolute Changes in Daily Activities During Lockdowns*

	Relative Change							Absolute Change				
Activity	*Much less* (-2)	*Less than* (-1)	*As much* (0)	*More than* (+1)	*Much more* (+2)	*M*	*SD*	*No change* (0)	*Minor change* (+1)	*Major change* (+2)	*M*	*SD*
I slept	13	41	**143**	94	17	.20	.89	**143**	135	30	.63	.66
I exercised	70	81	**91**	52	14	-.46	1.15	91	**133**	84	.98	.76
I left home	**193**	78	29	2	6	-1.46	.84	29	80	**199**	1.55	.66
I ate	10	27	**169**	92	8	.20	.77	**169**	119	18	.51	.61
I drank alcohol	39	32	**173**	43	18	-.10	.99	**173**	75	57	.62	.78
I used marijuana	69	7	**190**	20	7	-.38	1.00	**190**	27	76	.61	.87
I worked	75	65	**90**	48	24	-.39	1.24	90	**113**	99	1.03	.79
I volunteered	**132**	57	96	11	6	-.99	1.04	96	68	**138**	1.14	.87
I relaxed	36	61	89	**97**	25	.05	1.14	89	**158**	61	.91	.69
I watched TV	12	9	72	**137**	76	.84	.97	72	**146**	88	1.05	.72
I used soc. med. [a]	5	5	68	**124**	106	1.04	.88	68	**129**	111	1.14	.75
I did hobbies	20	35	96	**115**	42	.40	1.07	96	**150**	62	.89	.71
I watched news	29	21	100	**102**	56	.44	1.15	100	**123**	85	.95	.78
I did home imp. [b]	31	21	**150**	81	25	.16	1.02	**150**	102	56	.70	.76
Totals	734	540	**1556**	1018	430	4278		1556	**1558**	1164	12.62	5.78
Proportions	17.2	12.6	34.6	23.8	10.1	100.0		36.4	36.4	27.2	100.0	

Note. Modal responses are shown in bold. The *As much* (0) and *No change* (0) columns are identical except for their labels. Values in the three Absolute Change columns—*No change*, *Minor change*, and *Major change*—were derived from taking the absolute value of the scoring scale for the five Relative Change columns—*Much less* (-2), *Less than* (-1), *As much* (0), *More than* (+1), and *Much more* (+2). Put differently, we scored both the *Less than* (-1) *and More than* (+1) responses as 1s when measuring *absolute* change. Hence, the *Minor change* column values are the sums of the *Less than* (-1) *and More than* (+1) column values, and represent one unit change *in either direction* from participants' "usual" / pre-lockdown behaviors. Similarly, we scored both the *Much less* (-2) *and Much more* (+2) responses as +2s when measuring *absolute* change. Values in the *Major change* column, therefore, are the sums of the *Much less* (-2) *and Much more* (+2) column values. [a] I used social media. [b] I did home improvements

Table 2: *Correlations between Changes in Daily Activities and Stress Symptoms During Lockdowns*

Activity	Relative Change	Absolute Change
Sleeping	.012	.367**
Exercising	-.260**	.348**
Leaving home	-.248**	.192*
Eating	-.011	.424**
Drinking alcohol	.073	.226**
Using marijuana	.001	.196*
Working	-.071	.223**
Volunteering	-.230**	.220**
Relaxing	-.283**	.416**
Watching TV / movies	.074	.260**
Using social media	.291**	.399**
Doing hobbies	-.015	.182*
Watching the news	.139	.221**
Doing home improvements	-.107	.234**

* $p < .01$, ** $p < .001$

Table 3: *Candidate Predictors across Linear Regression Model-Building Methods*

Candidate Predictors	Retained in Final Model?			
	Enter	Forw [a]	Back [b]	Final
Relative Change				
Exercising	Y	Y	Y	Y
Leaving house	-	-	-	-
Volunteering	Y	Y	Y	Y
Relaxing	Y	Y	Y	Y
Using social media	Y	Y	Y	Y
Absolute Change				
Sleeping	-	-	Y	-
Exercising	Y	Y	Y	Y
Leaving house	-	-	-	-
Eating	Y	Y	Y	Y
Drinking alcohol	-	-	-	-

Using marijuana	-	-	-	-
Working	-	-	-	-
Volunteering	-	-	-	-
Relaxing	Y	Y	Y	Y
Watching TV	-	-	-	-
Using social media	Y	Y	Y	Y
Doing hobbies	-	-	-	-
Watching news	-	-	-	-
Doing home improvements	-	-	-	-

Note: Y = Yes and - = No (to whether that predictor was retained in that model-building method).

[a] Forward. [b] Backward.

Table 4: *Multiple Linear Regression Models of Relative and Absolute Activity Changes Predicting Stress*

	Summary Statistics					
	R^2	R^2_{adj}	*SE*	*F*	*df*s	*p*
Relative Change	.25	.24	10.15	24.43	4, 297	< .001
Absolute Change	.33	.32	9.55	37.18	4, 301	< .001
	Model Coefficients and Diagnostics					
	Relative Change				Absolute Change			
Daily Activity	β	*t*	*p*	VIF [b]	β	*t*	*p*	VIF
Exercising	-.16	-3.01	.003	1.06	.17	3.36	.001	1.18
Volunteering	-.18	-3.46	.001	1.05	-	-	-	-
Relaxing	-.31	-6.02	< .001	1.03	.23	4.16	< .001	1.32
Using soc. media [a]	.28	5.38	< .001	1.04	.17	.308	.002	1.38
Eating	-	-	-	-	.26	4.98	< .001	1.19

Conclusions

The purpose of this study was to examine the relationship between daily-life disruption and stress symptoms in adults during the initial COVID-19 lockdowns in the United States. To this end, we recruited participants nationwide via social media advertisements to complete an online survey that included measures of their *relative* engagement in 14 common behavioral routines (e.g., eating, sleeping, and working) and the psychophysiological stress symptoms they experienced during stay-at-home orders. Our findings were threefold. First, people's lives were disrupted by lockdowns, with nearly two-thirds (63.6%) of participants' responses indicating either *Minor* or *Major* changes in 14 the daily activities we measured. Second, even though the modal number of stress symptoms reported was zero, a large proportion of participants experienced over 10 somatic or psychological stress symptoms during lockdowns. Third, and mostly importantly, measures of life disruption and stress symptoms were related at multiple levels, which supported our primary hypothesis. We will discuss each of these findings in turn.

In terms of the overall impact of stay-at-home orders on participants' daily activities, *total* life disruption scores had a mean of 12.6 "change units" out of a possible 28 (*Mdn* = 13; *Mode* = 12). Our interpretation of this result is that is that stay-at-home orders had significant impacts on most people's behavioral routines. That said, there was notable variability in our measures of life disruption, both within the *total* disruption scores and among the 14 individual daily activities. For example, just as lockdowns impacted some participants' daily routines more than others' (*SD* = 5.78; see Figure 1), they also impacted some behavioral routines (e.g., leaving home) more than others (e.g., eating); the disparate impact of lockdowns on certain routines (see Table 1) is consistent with their intended purpose—to mitigate virus transmissibility. Our results also revealed *relative* increases in indoor leisure activities during lockdowns, like watching TV and movies, using social media, and doing hobbies—a finding which

aligns with the increased time participants spent "staying-at-home" during the lockdown. Overall, these results supported our predictions and replicated previous research that suggested NPIs like lockdowns can lead to widespread changes in daily routines (Murray et al., 2021; Robinson & Daly, 2020; Yang et al., 2021; Zhu et al., 2020).

An additional aim of this study was to examine the levels of stress experienced during the lockdowns. To do this, we used an adapted form of the LSSI to measure the somatic and psychological symptoms of stress in our participants. The results revealed that more than half of our sample experienced a dozen or more stress symptoms (*M* = 14.9, *Mdn* = 13; *SD* = 11.63). Common symptoms included muscle tension (48.6%), insomnia (58.4%), avoidance behaviors (54.5%), obsessional thinking (41.6%), appetite change (46.1%), fear and anxiety (42.9%), fatigue (54.2%), and self-doubt (47.4%). While we cannot assume that lockdowns were the sole cause of these stress symptoms, we can assert that a large proportion of our participants experienced significant stress during the lockdown period. However, it is important to note that the distribution of stress scores was positively skewed (*Mode* = 0; see Figure 2), indicating that many participants reported few to no stress symptoms.

For our primary hypothesis, we expected that the changes in participants' daily routines imposed by stay-at-home orders would significantly predict the number of stress symptoms they experienced. While the results of our analyses largely supported this hypothesis, they also showed that not all routine changes necessarily correlate with stress. Of the 14 daily activities we measured, our multiple regression models revealed that changes in just 4-5 of them—relaxing, exercising, using social media, eating, and volunteering—were driving this relationship. Changes to these 4-5 daily routines predicted nearly one-quarter (24%) to one-third (32%) of the variance in reported stress symptoms during lockdowns.

Interestingly, the amount of variance that life disruption predicted in stress symptoms depended on how we measured "change" (i.e., using the *relative* or *absolute* measure). This was an unexpected finding, and one that warrants further review. In short, we began our data analyses by attempting to create a *total* life disruption scale that consisted of participants' responses to the 14 items measuring changes in daily activities. Because these responses were originally scaled from -2 to +2 (see the left panel of Table 1 for details), summing them would have underestimated the actual impact of lockdowns on one's usual routines. For example, if a participant engaged in one activity *Much more* than usual (coded as a +2) and another *Much less* than usual (coded as a -2), their sum (0) would erroneously imply that lockdowns had no impact on their daily routines. We corrected for this by taking the absolute values of the 5-point, -2 to +2 responses before summing them. (Using the previous example, the *total* disruption score would have been +4, not 0.) This yielded two ways of measuring life disruption—one that measured *relative* changes and the other that measured *absolute* changes in participants' daily activities.

These measures differ in that the *relative* change measure tracks both the direction of the change (e.g., whether one engaged in an activity *Less* or *More* than usual) *and* the degree of the change (e.g., whether one engaged in an activity *More* or *Much more* than usual), whereas the 3-point, 0 to +2 *absolute* change measure tracks *only the degree* of the change (i.e., whether there was *No change*, a *Minor change*, or a *Major change* in an activity; see the Table 1 caption for more information). Due to its properties, the *relative* change measure allows for the possibility that life changes relate to reduced or increased stress. The *absolute* change measure, on the other hand, essentially treats any changes from one's usual routine as the same, regardless of the direction or nature of that change.

We then used these models as tests of two contrasting viewpoints (or "traditions") in stress research, the *psychological* stress tradition, and the *epidemiological* stress tradition (see Cohen, Gianaros, & Manuck, 2016). In brief, an assumption of the *psychological* stress tradition is that stress only occurs when one perceives that the demands of an event exceeds one's resources to effectively cope with it (e.g., see Lazarus & Folkman, 1984). According to this tradition, life changes aren't inherently stressful and may even be adaptive (e.g., exercising more could lower stress). Our *relative* change measure accommodates the assumptions of the psychological stress tradition (i.e., that life changes can either increase, decrease, or have no effect on stress) and therefore served as a test of this perspective. Conversely, an assumption the *epidemiological* stress tradition is that all life changes—even desirable or temporary ones like going on vacation—require adaptation and are thus inherently stressful (e.g., see Holmes & Rahe, 1967). According to the epidemiological stress tradition, any life changes should result in more stress, regardless of the direction or perceived benefit of the change. The *absolute* change measurement parallels the assumptions of the epidemiological stress tradition (i.e., that any change is stressful) and therefore served as a test of this perspective.

When compared directly, our results more strongly supported the epidemiological stress tradition's assumption that any departure from one's routines is stressful. This can be seen both by the greater number of significant correlations between *absolute* (as compared to *relative*) changes in daily activities and stress symptoms in Table 2, and by the fact that the *absolute* measure predicted more variance in stress symptoms (32%) compared to the *relative* change measure (24%; see Table 4). The stronger relationship between the *absolute* change scale and

stress symptoms was especially notable, as the restricted range from collapsing the 5-point *relative* scale to the 3-point *absolute* scale likely attenuated the true strength of those relationships.

Interestingly, our results also supported the psychological stress tradition's assumption that not all life changes are inherently stressful. For example, many activity changes didn't correlate with stress (see Table 2) or emerge as a unique predictor of it (see Table 3). Further, changes in the *relative* amounts of relaxing, exercising, and volunteering were *negative* predictors of stress. That is, participants who relaxed, exercised, and volunteered *more* during lockdowns experienced *fewer* stress symptoms on average (and vice versa). Overall, aspects of both the epidemiological and psychological stress traditions are represented by our data set. Our *absolute* change measurement supports the idea advocated by epidemiological stress model, which predicts that overall routine disruption is stressful. Meanwhile, the *relative* change measurement supports the assertion of the psychological model, which is that some changes in activity can also *reduce* stress or are unrelated to it.

On a more practical note, the implications of our results provide some clear findings about individuals' experiences during the lockdowns: Stay-at-home orders disrupted most aspects of participants lives (Table 1) and many of those individual changes were correlated with stress symptoms (Table 2); changes in 4-5 daily activities (exercising, relaxing, using social media, eating, and volunteering) emerged as unique predictors of stress levels (Table 4), and the remaining changes in daily activities were ultimately non-significant or redundant predictors of stress in our regression models. Our results therefore suggest that in the future, individuals should change as little as possible when it comes to these 4-5 routines, as *any* reported changes in participants' exercise, relaxation, social media use, and eating behaviors were predictive of stress symptoms (see the Absolute Change panel in Table 4). If participants *are* to change any of these routines, our results suggest that they attempt to *increase* their engagement in exercise, relaxation, and volunteering, and *decrease* their social media use (see the Relative Change panel in Table 4).

Strengths, Limitations, & Future Directions

Strengths of the current study included our comprehensive measure of objective psychophysiological stress symptoms via the 53-item LSSI (Lipp, 2001), geographically diverse sample of U.S. adults (44 of the 48 continental U.S. states represented), and novel measures of life disruption / changes to daily activities. Our study, however, was not without its limitations, and these included its correlational nature (the causal direction of the stress by life disruption relationship remains unclear), reliance on retrospective reporting (data were collected approximately 10 months after the initial U.S. lockdowns), and a sample that skewed White, female, educated, and from the Northeast. Future studies should replicate and extend these findings, perhaps by adding a subjective / perceived measure of stress, measuring additional routines that may have been changed during lockdowns (e.g., interacting with pets or attending religious services), and gathering a more representative sample that also included children and teenagers. If similar lockdowns are implemented again, an experimental design in which participants were randomly assigned to specific conditions (e.g., exercise more, less, or the same as usual) would also help elucidate whether it was life changes that influenced stress, stress that influenced life changes, or some third variable(s) that influenced both.

In conclusion, our results indicated that reported changes in just 4-5 daily activities were able to predict between 24-32% of the variance in stress symptoms. Changes in relaxation, exercise, and social media use emerged as significant predictors in both regression models, suggesting that these three activities were especially relevant to stress symptoms during lockdowns; changes in eating habits and volunteering each also emerged in one of our two regression models. The ability of these few daily routine changes to predict nearly one-third of participants' stress during lockdowns is especially noteworthy given the many other relevant variables that also could have impacted their psychophysiological stress symptoms during that time (e.g., personality traits, existing mental health diagnoses, perceived risk of infection, employment status, financial situation, etc.). If similar lockdowns are implemented in the U.S. again, our results suggest that we should stick as closely as possible to our usual daily routines to mitigate stress, as changes in either direction can be stressful. A secondary finding is that spending more time relaxing, exercising, and volunteering, and spending less time on social media can also help mitigate stress, but these effects were less pronounced.

Footnotes

[1] The LSSI has subscales to separately measure its 34 somatic and 19 psychological stress symptoms, but the scale scores correlated so strongly and positively—$r(307) = .75$, $p < .001$—that we used the full scale scores for the remaining analyses.

[2] With the Enter Method, all predictors are entered simultaneously in a single step; only the predictors that significantly contribute unique variance to the model are retained. The Forward Method iteratively adds the largest significant predictor to the model (one per step) and stops when none of the remaining predictors contributes additional variance to the model. The Backward Method starts with all predictors and iteratively removes the smallest non-significant predictor (one per step) until all remaining predictors contribute unique variance to the model.

Data Availability

Data can be obtained by contacting the corresponding author (lwayers@widener.edu).

References

Alexander, M., Unruh, L., Koval, A., & Belanger, W. (2022). United States response to the COVID-19 pandemic, January–November 2020. *Health Economics, Policy and Law*, *17*(1), 62-75. https://doi.org/10.1017/S1744133121000116

Askitas, N., Tatsiramos, K., & Verheyden, B. (2021). Estimating worldwide effects of non-pharmaceutical interventions on COVID-19 incidence and population mobility patterns using a multiple-event study. *Scientific Reports*, *11*(1), 1-13. https://doi.org/10.1038/s41598-021-81442-x

Brauner, J. M., Mindermann, S., Sharma, M., Johnston, D., Salvatier, J., Gavenčiak, T., ... & Kulveit, J. (2021). Inferring the effectiveness of government interventions against COVID-19. *Science*, *371*(6531), eabd9338. https://doi.org/10.1126/science.abd9338

Brynjolfsson, E., Horton, J. J., Ozimek, A., Rock, D., Sharma, G., & TuYe, H. Y. (2020). *COVID-19 and remote work: An early look at US data* (No. w27344). National Bureau of Economic Research. https://doi.org/10.3386/w27344

Centers for Disease Control and Prevention (2021, December 13). *COVID-19 parental resources kit*. https://www.cdc.gov/mentalhealth/stress-coping/parental-resources/index.html

Chrousos, G. P. (2009). Stress and disorders of the stress system. *Nature Reviews Endocrinology*, *5*(7), 374-381. https://doi.org/10.1038/nrendo.2009.106

Cohen, S., Gianaros, P. J., & Manuck, S. B. (2016). A stage model of stress and disease. *Perspectives on Psychological Science*, *11*(4), 456-463. https://doi.org/10.1177%2F1745691616646305

Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior*, *24*(4), 385-396. https://doi.org/10.2307/2136404

Coibion, O., Gorodnichenko, Y., & Weber, M. (2020). *Labor markets during the COVID-19 crisis: A preliminary view* (No. w27017). National Bureau of Economic Research. https://doi.org/10.3386/w27017

Cooke, J. E., Eirich, R., Racine, N., & Madigan, S. (2020). Prevalence of posttraumatic and general psychological stress during COVID-19: A rapid review and meta-analysis. *Psychiatry Research*, *292*, 113347. https://doi.org/10.1016/j.psychres.2020.113347

Czeisler, M. É., Lane, R. I., Petrosky, E., Wiley, J. F., Christensen, A., Njai, R., ... & Rajaratnam, S. M. (2020). Mental health, substance use, and suicidal ideation during the COVID-19 pandemic—United States, June 24–30, 2020. *Morbidity and Mortality Weekly Report*, *69*(32), 1049-1057. https://doi.org/10.15585/mmwr.mm6932a1

EducationWeek. (2020, July 1). *The Coronavirus Spring: The Historic Closing of U.S. Schools (A Timeline).* https://www.edweek.org/leadership/the-coronavirus-spring-the-historic-closing-of-u-s-schools-a-timeline/2020/07

Executive Office of the President (2020, March 13). *Declaring a national emergency concerning the novel coronavirus disease (COVID-19) outbreak*. Federal Register. https://www.federalregister.gov/documents/2020/03/18/2020-05794/declaring-a-national-emergency-concerning-the-novel-coronavirus-disease-covid-19-outbreak

Ferguson, N. M., Laydon, D., Nedjati-Gilani, G., Imai, N., Ainslie, K., Baguelin, M., ... & Ghani, A. C. (2020, March 16). *Impact of non-pharmaceutical interventions (NPIs) to reduce COVID-19 mortality and healthcare demand* (Report 9). Imperial College London. https://doi.org/10.25561/77482

Haug, N., Geyrhofer, L., Londei, A., Dervic, E., Desvars-Larrive, A., Loreto, V., ... & Klimek, P. (2020). Ranking the effectiveness of worldwide COVID-19 government interventions. *Nature Human Behaviour*, *4*(12), 1303-1312. https://doi.org/10.1038/s41562-020-01009-0

Holman, E. A., Thompson, R. R., Garfin, D. R., & Silver, R. C. (2020). The unfolding COVID-19 pandemic: A probability-based, nationally representative study of mental health in the United States. *Science Advances*, *6*(42), eabd5390. https://doi.org/10.1126/sciadv.abd5390

Holmes, T. H., & Rahe, R. H. (1967). The social readjustment rating scale. *Journal of Psychosomatic Research*, *11*(2), 213-218. https://doi.org/10.1016/0022-3999(67)90010-4

Hou, W. K., Lai, F. T., Ben-Ezra, M., & Goodwin, R. (2020). Regularizing daily routines for mental health during and after the COVID-19 pandemic. *Journal of Global Health*, *10*(2), 1-3. https://doi.org/10.7189%2Fjogh.10.020315

Jahrami, H., BaHammam, A. S., Bragazzi, N. L., Saif, Z., Faris, M., & Vitiello, M. V. (2021). Sleep problems during the COVID-19 pandemic by population: a systematic review and meta-analysis. *Journal of Clinical Sleep Medicine*, *17*(2), 299-313. https://doi.org/10.5664/jcsm.8930

Killgore, W. D., Cloonan, S. A., Taylor, E. C., & Dailey, N. S. (2020). Loneliness: A signature mental health concern in the era of COVID-19. *Psychiatry Research*, *290*, 113117. https://doi.org/10.1016/j.psychres.2020.113117

Kornilaki, E. N. (2022). The psychological effect of COVID-19 quarantine on Greek young adults: Risk factors and the protective role of daily routine and altruism. *International Journal of Psychology*, *57*(1), 33-42. https://doi.org/10.1002/ijop.12767

Lazarus, R. S., & Folkman, S. (1984). *Stress, appraisal, and coping*. Springer.

Lipp, M. N. (2000). *Manual do inventário de sintomas de stress para adultos de Lipp* [Lipp's adult stress symptom inventory handbook]. São Paulo: Casa do Psicólogo.

Lipp, M. N., & Lipp, L. M. N. (2019). Proposal for a four-phase stress model. *Psychology*, *10*(11), 1435-1443. https://doi.org/10.4236/psych.2019.1011094

Murray, G., Gottlieb, J., & Swartz, H. A. (2021). Maintaining daily routines to stabilize mood: theory, data, and potential intervention for circadian consequences of COVID-19. *The Canadian Journal of Psychiatry*, *66*(1), 9-13. https://doi.org/10.1177%2F0706743720957825

Perra, N. (2021). Non-pharmaceutical interventions during the COVID-19 pandemic: A review. *Physics Reports*, *913*, 1-52. https://doi.org/10.1016/j.physrep.2021.02.001

Robinson, E., & Daly, M. (2021). Explaining the rise and fall of psychological distress during the COVID-19 crisis in the United States: Longitudinal evidence from the Understanding America Study. *British Journal of Health Psychology*, *26*(2), 570-587. https://doi.org/10.1111/bjhp.12493

Santabárbara, J., Lasheras, I., Lipnicki, D. M., Bueno-Notivol, J., Pérez-Moreno, M., López-Antón, R., ... & Gracia-García, P. (2021). Prevalence of anxiety in the COVID-19 pandemic: An updated meta-analysis of community-based studies. *Progress in Neuro-Psychopharmacology and Biological Psychiatry*, *109*, 110207. https://doi.org/10.1016/j.pnpbp.2020.110207

World Health Organization (2020, March 18). *Mental health and psychosocial considerations during the COVID-19 outbreak.* https://www.who.int/publications/i/item/WHO-2019-nCoV-MentalHealth-2020.1

Yang, M., He, P., Xu, X., Li, D., Wang, J., Wang, Y., ... & Chen, D. (2021). Disrupted rhythms of life, work and entertainment and their associations with psychological impacts under the stress of the COVID-19 pandemic: a survey in 5854 Chinese people with different sociodemographic backgrounds. *PLOS One*, *16*(5), e0250770. https://doi.org/10.1371/journal.pone.0250770

Zhu, S., Wu, Y., Zhu, C. Y., Hong, W. C., Yu, Z. X., Chen, Z. K., ... & Wang, Y. G. (2020). The immediate mental health impacts of the COVID-19 pandemic among people with or without quarantine managements. *Brain, Behavior, and Immunity*, 87, 56-58. https://doi.org/10.1016/j.bbi.2020.04.045

Conflicts of Interest

The authors have no conflicts of interest to disclose.

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