finding

Fear & anxiety in the time of COVID-19: How they influence behavior

Christina K. Zigler, Nicole Lucas, Debra M. Henke, & Ilona Fridman

Methods & Analysis

Methods

The team at Duke created the survey (see Materials section below) using established and novel survey items. The protocol was submitted to Duke University's institutional review board, which determined the study to be exempt. The study and analysis plan were preregistered at Open Science Framework (https://osf.io/mv92c).

The survey was administered by Qualtrics, which soft launched the survey on April 10 to obtain 200 responses for the study team to review. After this step, the study team implemented screening logic to exclude individuals who were less than 18 years old and that took less than six minutes to complete the entire survey. Qualtrics collected the rest of the responses April 13–14, 2020, with a target goal of 1,000 complete surveys.

During this time, individuals received an email invitation to respond to the online survey if they participated in an active Qualtrics panel (meaning they completed a Qualtrics baseline survey in advance and confirmed their interest to receive emails inviting them to participate in online research). The study team did not offer remuneration or payment for completion of the survey, but Qualtrics internally offers incentives to participants for completing surveys they are eligible to complete. Incentives offered by the company are typically points that can be redeemed for game rewards, gift cards, charity miles, and the like.

Recruitment was stratified proportionally to the population living in the United States by the following regions: New England, Mid-Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central, Mountain, and Pacific. Frequencies used for stratification are reported in Table S1 and were predetermined by the study team on the basis of U.S. census data (2018). Qualtrics used survey quotas to ensure that the sample was representative of the U.S. population by location, meaning that each cohort (for example, New England) would be closed to enrollment once the frequency target was met. Final proportions of location, gender, age, race or ethnicity, and income were verified before analysis to determine alignment with the U.S. Census data.

Materials

In addition to relevant demographics, the survey collected detailed information about individuals' employment, income, location, health status, and COVID status (that is, if participants had a confirmed or suspected COVID-19 infection). The survey was part of a larger project intending to measure the relationship between adherence to social distancing behaviors, emotional distress, social support, accurate knowledge regarding COVID-19, and trust in news sources. We report in this Supplemental Material variables that were part of the preregistered research questions and discussed in the main article.

Anxiety. To measure anxiety, we used the Patient-Reported Outcomes Measurement Information System (PROMIS®) Emotional Distress Anxiety Short Form 4a (Schalet et al., 2016). Participants reported how frequently they experienced negative feelings in the last seven days on a 5-point scale that ranged from 1 = *Never* to 5 = *Always*. The survey items described the experiences suggested by previous comprehensive mixed-method research (Cella et al., 2010; DeWalt, Rothrock, Yount, & Stone, 2007; Pilkonis et al., 2011) and included fear ("I felt fearful"), anxious misery ("My worries overwhelmed me"), hyperarousal ("I found it hard to focus on anything other than my anxiety"), and somatic symptoms related to arousal ("I felt uneasy"). Responses to all four items were summed and the raw scores converted to *T* scores (M = 50, SD = 10) using the PROMIS conversion tables (Pilkonis et al., 2011). A score of 50 is the average for the U.S. general population, allowing for easy comparison of our results with reference samples.

Risk Perception. To evaluate the extent of individual risk perceptions, we had participants answer the question "How serious of a health concern is the coronavirus?" in relation to themselves, the world, and their immediate family. These items were adapted from the survey included in Prue et al.'s 2019 article that looked at factors influencing adherence to postarrival monitoring during the Ebola crisis. The response options were on a 4-point scale and ranged between 1 = *Not serious at all* to 4 = *Very serious*.

Adherence. The major outcome of interest was adherence to behaviors recommended to reduce the spread of COVID-19. At the time of survey development, the U.S. Centers for Disease Control and Prevention (CDC) guidelines suggested a number of behaviors to slow the spread of coronavirus. The behaviors could be categorized within four domains: cleanliness, social distancing, staying at home, and use of personal protective equipment. These behaviors were compiled by the study team and turned into de novo self-report items using frequency response scales. Draft items were reviewed by the study team and measurement experts and updated iteratively on the basis of relevant feedback before survey finalization.

Domain 1: Cleanliness. Four items were included to measure cleanliness behaviors: (a) washing hands after being in a public place, (b) washing hands before eating, (c) washing hands for at least 20 seconds, and (d) wiping down frequently touched surfaces (doorknobs, light switches, countertops, phones, etc.). Participants were asked to report the frequency of handwashing on a 5-point response scale ranging from 1 - *Never* to 5 = *Always*. For cleaning surfaces, the 5-point scale ranged between 1 = *Not at all* to 5 = *Several times a day*. We considered participants adherent to all cleanliness behaviors

if they reported *Usually* or *Always* to all three handwashing items and at least *Daily* to wiping down frequently touched surfaces.

Domain 2: Social Distancing. Six items represented recommended social distancing behavior. Participants were asked how frequently (1 = *Not at all* to 5 = *Several times a day*) they (a) hugged or touched someone who does not live with them, (b) stood or walked close (within arm's length) to someone who does not live with them, (c) met face-to-face with people who do not live with them, (d) went to a gathering with five or more people, (e) went inside someone else's house, and (f) had friends or family over to visit. We considered participants to be adherent to all social distancing behaviors if they responded *Not at all* to all questions. We also asked participants to report how many people had entered their home in the past week (not counting the people who lived with them), and individuals who had left their house at least once were asked how often they stayed 6 feet away from other people. Both of these items were analyzed separately.

Domain 3: Staying at Home. We asked participants how many times they left their house in the last seven days (*0 times*, *1–4 times*, *4–6 times*, *7–9 times*, *10–12 times*, *13–15 times*, *15–17 times*, *18–20 times*, or *more than 20 times*). They also were asked to report reasons for leaving their home from a prepopulated list (data not shown). This list of common reasons to leave the home was created by the study team. Included reasons were positive or neutral reasons (would likely increase risk but were unavoidable for most) like going to work, going to the doctor, buying food, and exercising outside, and negative or avoidable reasons like bringing children to a playdate, going to a party, or going to a friend's house. Participants could also report other reasons using an open-ended response option.

Domain 4: Use of Personal Protective Equipment. Participants were asked about the frequency of wearing a mask or gloves while inside their home. Additionally, those individuals who reported leaving the house at least once in the past week were also asked about wearing masks or gloves while outside their home. Responses were on a 5-point Likert-type scale that ranged between 1 = *Never* and 5 = *Always*. We were most interested in how frequently masks were worn outside of the home, as this was an updated recommendation by the CDC the week before the survey was administered.

Data Analysis

Initial Data Quality Checks. Any individual who did not confirm their age or reported their age as being less than 18 years old were excluded from analysis (n = 9). To confirm the representativeness of our sample of the general U.S. population, prior to analysis, we compared the demographics in the survey with national census data from 2018. For those variables that the study team evaluated as being closely associated with COVID-19 outcomes, proportions were closely aligned (location, low income, race, and age greater than or equal to 60 years). On the basis of this conclusion, we did not incorporate a representative weighting scheme during analysis. Table 1 summarizes demographics of the survey and the demographics extracted from the 2018 census for a side-by-side comparison.

Descriptive Statistics. All demographic items were reported using frequencies or percentages for categorical or ordinal variables or means or medians and standard deviations or interquartile ranges for continuous variables, as appropriate. The three major variables of interest (anxiety, risk perception, and adherence) were explored in detail. Central tendency, distributions, and spread were evaluated for anxiety t scores, and frequencies were reported for risk perception. Adherence was explored at the item level for each domain and also using the calculated binary adherence variables (yes/no) as described above.

Inferential Statistics. Mean anxiety levels between adherence groups for the cleanliness and social distancing domains were compared using independent samples t tests. Spearman's correlations were used to estimate relationships between anxiety and adherence variables (the number of times someone left their house and the number of people who entered their

home). Spearman's correlations were also used to explore relationships between anxiety and the frequency of wearing personal protective equipment inside and outside the home. The standard $p < .05$ criterion as the cutoff for statistical significance was used for all analyses. However, the size of the correlation coefficient is more helpful in interpretation, and thus more focus was placed on the estimated coefficient and subsequent confidence interval.

To explore mediation between anxiety (predictor) and adherence (outcome) by perceived risk to self (mediator), we fit three models to the data. Model 1 was a binary logistic regression model predicting adherence by anxiety, Model 2 was a linear regression model predicting anxiety by perceived risk, and Model 3 was a binary logistic regression model predicting adherence by both anxiety and perceived risk simultaneously. As logistic regression models were used in our mediation model, indirect effects and bootstrap results were calculated using the process macro (version 3.4) by Hayes (2017). We expected to repeat this process for adherence to both cleanliness and social distancing behaviors, but anxiety was not related to social distancing behavior, so mediation was not further pursued. However, we did evaluate the relationship between adherence to social distancing and being under a mandatory stay-at-home order using a chi-square test (to evaluate independence).

Results

In this section, we include additional demographics and more details regarding results reported in the article.

Descriptive Statistics

About one third of the sample indicated they were working from home, and 35% indicated their work hours were reduced because of the outbreak (see Table S2). Household size ranged from one to eight people (*Mdn* = 3), with 61% of households reporting no children. Twenty-one percent of participants had at least one person 65 years of age or older living in their household, and 13% of participants reported that they considered themselves a caretaker for someone outside of their home. Thirty-six percent indicated they had at least one child home with them during the day.

Forty-percent of participants reported that they had a health condition that put them at particular risk for the coronavirus (heart disease, diabetes, chronic lung disease, immune-compromised, pregnant, kidney disease, asthma, or other chronic condition), with 36% saying that someone in their home had one of these health conditions.

Adherence to individual behaviors in the domains of cleanliness, personal protective equipment, and social distancing are reported in Table S3.

Inferential Statistics

Table S4 includes model specifics for the mediation analysis reported in the article that estimates the relationship between anxiety (predictor) and adherence (outcome) mediated by perceived risk to self (mediator). We found partial mediation, meaning the relationship between anxiety and adherence was reduced by the inclusion of perceived risk, but it did not become nonsignificant.

For adherence to social distancing behavior, anxiety was not related to adherence when fitting a binary logistic regression to the data ($B = -.009$, $SE = .006$, $p = .115$). However, perceived risk was a statistically significant predictor of adherence in a binary logistic regression model ($B = .146$, $SE = .058$, $p = .012$), yet the effect was so small, prediction did not improve even by one participant (the model predicted all participants as being nonadherent, identical to null model).[1] We also explored the relationship between adherence to all social distancing behaviors and being under a mandatory stay-at-home order (Table S5), which was found to not be significant ($\chi^2 = 4.42$, $p = .110$). This suggests that social distancing behavior was similar for those who were and were not under a mandatory stay-at-home order.

Table S1. Representativeness of the sample to United States general population (as per the 2018 census)

Category	Subcategory	In our sample %	2018 US Census %
Location	New England: CT, MA, ME.NH, RI, VT	4.6	4.5
	Mid-Atlantic: NJ, NY, PA	13.8	12.6
	East North Central: IL, IN, MI, OH, WI	13.5	14.3
	West North Central IA, KS, MN, MO, NE, ND, SD	6.4	6.5
	South Atlantic: DE, FL, GA, MD, NC, SC, VA, DC, WV	17.1	20.0
	East South Central: AL, KY, MS, TN	6.0	5.8
	West South Central: AR, LA, OK, TX	12.1	12.3
	Mountain: AZ, CO, ID, MT, NV, NM, UT, WY	7.3	7.5
	Pacific: AK, CA, HI, OR, WA	15.6	16.3
Age (in years)	20–40	50	38
	40–60	29	36
	60–80	21	26
	Median	40.5	38.2
Gender	Male	47	49
Race and ethnicity	White	68.8	72.2
	African American	12.3	12.7
	American Indian and Alaska Native	0.9	0.9
	Asian	6.8	5.6
	Native Hawaiian and other Pacific Islander	0.4	0.2
	Hispanic	18.3	7.1
Income	Less than $14,999	15.5	10.1
	$15,000–$74,999	45.6	47.7
	$75,000–$99,999	15.0	12.6
	$100,000–$149,999	8.9	15.0
	More than $150,000	6.5	14.2

Table S2. Impact of coronavirus on employment

Variable	*n* (%)
Are you currently working from home?	
Yes	422 (33.9)
No	292 (23.5)
Essential worker	
Yes	343 (27.6)
No	346 (27.8)
Work hours reduced by the coronavirus	
Yes	438 (35.2)
No	276 (22.2)
Lost job or furloughed because of the coronavirus	
Yes	88 (7.1)
No	370 (29.7)

Note. Survey logic resulted in questions being asked only of appropriate participants (for example, only individuals who were employed were asked about working from home), but for ease of comparison, percentages are out of the entire sample.

Table S3. Reported frequency of CDC-recommended behaviors designed to reduce the spread of COVID-19 in the past seven days

Domain	Behavior	Never *n* (%)	Rarely n (%)	Sometimes *n (%)*	Usually *n* (%)	Always *n* (%)
Cleanliness	Washing hands after being in a public place	37 (3.0)	31 (.5)	79 (6.4)	153 (12.4)	934 (75.7)
	Washing hands before eating	23 (1.9)	32 (2.6)	115 (9.3)	231 (18.7)	833 (67.5)
	Washing hands for at least 20 seconds	21 (1.7)	29 (2.4)	114 (9.2)	272 (22.0)	798 (64.7)
PPE	Wore a mask *inside* my house	740 (60.0)	151 (12.2)	129 (10.5)	86 (7.0)	128 (10.4)
	Wore gloves *inside* my house	710 (57.5)	174 (14.1)	147 (11.9)	82 (6.6)	121 (9.8)
	Wore a mask *outside* my house[a]	341 (31.4)	85 (7.8)	151 (13.9)	167 (15.4)	342 (31.5)
	Wore gloves *outside* my house[a]	428 (39.4)	114 (10.5)	176 (16.2)	140 (12.9)	228 (21.0)
		Not at all *n* (%)	Once a week *n* (%)	Several times a week *n* (%)	Daily *n* (%)	Several times a day *n* (%)
Social distancing	Stay 6 feet away from other people when *outside* my house*	26 (2.4)	24 (2.2)	103 (9.5)	285 (26.2)	648 (59.7)
	Hugged or touched someone who does not live with you	904 (73.3)	102 (8.3)	86 (7.0)	96 (7.8)	46 (3.7)
	Stood or walked close (within arm's length) to someone who does not live with you	673 (54.5)	229 (18.6)	165 (13.4)	97 (7.9)	70 (5.7)
	Met face-to-face with people who don't live with you	669 (54.2)	225 (18.2)	168 (13.6)	114 (9.2)	58 (4.7)
	Went to a gathering with five or more people	913 (74.0)	109 (8.8)	81 (6.6)	71 (5.8)	60 (4.9)
	Went inside someone else's house	849 (68.8)	151 (12.2)	101 (8.2)	84 (6.8)	49 (4.0)
	Had friends or family over to visit	836 (67.7)	156 (12.6)	100 (8.1)	88 (7.1)	54 (4.4)
Cleanliness	Wiped down frequently touched surfaces	123 (10.0)	147 (11.9)	283 (22.9)	364 (29.5)	317 (25.7)

Note. CDC = U.S. Centers for Disease Control and Prevention; PPE = personal protective equipment.

a. Percentages for these questions were calculated using only participants who reported leaving their house at least once in the past seven days (*n* = 1,086).

Table S4. Results of the mediation analysis of anxiety, perceived risk to self, & adherence to all cleanliness behaviors

Model	*B*	*SE*	Bootstrap 95% CI	R^{2}[a]	Predicted correct (%)
Model 1: Adherence (yes/no; binary logistic regression)				.05	59.7[b]
Constant	–2.81**	0.37			
Anxiety	0.05**	0.01			
Model 2: Perceived risk (linear regression)				.12	
Constant	0.37*	0.16			
Anxiety	0.04**	0.003			
Model 3: Adherence (yes/no: binary logistic regression)				.08	62.8[b]
Constant	–3.06**	0.38			
Anxiety	0.03**	0.01			
Perceived risk	0.43**	0.06			
Indirect effect	0.02**	0.003	[0.012, 0.023]		

Note. CI = confidence interval.

a. For logistic regression models, R^2 is the version proposed by Cox and Snell.

b. Null prediction for adherence to all cleanliness behaviors was 51%.

*$p \leq .05$. **$p \leq .001$.

Table S5. Relationship of being under a mandatory stay-at-home order & adherence to all recommended social distancing behaviors

Are you currently under a mandatory stay-at-home order?	Not adhering *n* (%)	Adhering *n* (%)	Total
Yes	592 (60.8)	382 (39.2)	188
No	129 (68.6)	59 (31.4)	974
I'm not sure	47 (65.3)	25 (34.7)	72

Note. Calculated percentages are out of row totals shown in column 3.

endnote

1. The relationship between risk and adherence was mirrored when looking at risk to immediate family and risk to the world. Both predictors were significant when placed in univariate binary logistic regression models, but the effect was extremely small and the overall prediction of adherence versus nonadherence was the same as the null model.

references

Cella, D., Riley, W., Stone, A., Rothrock, N., Reeve, B., Yount, S., . . . PROMIS Cooperative Group. (2010). The Patient-Reported Outcomes Measurement Information System (PROMIS) developed and tested its first wave of adult self-reported health outcome item banks: 2005–2008. *Journal of Clinical Epidemiology, 63,* 1179–1194.

Cox, D. R., & Snell, E.J. (1989.) *The Analysis of Binary Data* (2nd ed.). Chapman and Hall.

DeWalt, D. A., Rothrock, N., Yount, S., & Stone, A. A. (2007). Evaluation of item candidates: The PROMIS qualitative item review. *Medical Care, 45*(5, Suppl. 1), S12–S21. https://doi.org/10.1097/01.mlr.0000254567.79743.e2

Hayes, A. F. (2017). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach* (2nd ed.). New York, NY: Guilford Press.

Prue, C. E., Williams, P. N., Joseph, H. A., Johnson, M., Wojno, A. E., Zulkiewicz, B. A., . . . Southwell, B. G. (2019). Factors that mattered in helping travelers from countries with Ebola outbreaks participate in post-arrival monitoring during the 2014–2016 Ebola epidemic. *INQUIRY: The Journal of Health Care Organization, Provision, and Financing, 56*. https://doi.org/10.1177/0046958019894795

Pilkonis, P. A., Choi, S. W., Reise, S. P., Stover, A. M., Riley, W. T., Cella, D., & PROMIS Cooperative Group. (2011). Item banks for measuring emotional distress from the Patient-Reported Outcomes Measurement Information System (PROMIS®): Depression, anxiety, and anger. *Assessment, 18,* 263–283. https://doi.org/10.1177/1073191111411667

Schalet, B. D., Pilkonis, P. A., Yu, L., Dodds, N., Johnston, K. L., Yount, S., . . . Cella, D. (2016). Clinical validity of PROMIS Depression, Anxiety, and Anger across diverse clinical samples. *Journal of Clinical Epidemiology, 73,* 119–127.