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How an Epidemic Outbreak Impacts Happiness: Factors that Worsen (vs. Protect) Emotional Well-being during the Coronavirus Pandemic

Haiyang Yang[a], Jingjing Ma[b,*]

[a] Johns Hopkins University, Baltimore, Maryland, USA
[b] Peking University, Beijing, China

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ABSTRACT

What are the factors that worsen (vs. protect) emotional well-being during a pandemic outbreak such as COVID-19? Through two large-scale nationwide surveys (N_1 = 11,131; N_2 = 3,000) conducted in China immediately before versus during the coronavirus outbreak, we found that the onset of the coronavirus epidemic led to a 74% drop in overall emotional well-being. Factors associated with the likelihood of contracting the disease (e.g., residing near the epicenter), extent of potential harm (e.g., being an elderly), and relational issues (e.g., those within a marriage) exacerbated the detrimental effect of the outbreak on emotional well-being. Further, individuals' perception of their knowledge about coronavirus infection was another factor. Regardless of the actual amount of knowledge they possessed, those perceiving themselves as more knowledgeable, were able to experience more happiness during the outbreak. Higher perceived knowledge was associated with a stronger sense of control, which mediated the differences in emotional well-being. These patterns persisted even after controlling for a host of demographic and economic variables. In conclusion, public policies and mental health interventions aimed at boosting/protecting psychological well-being during epidemics should take account of these factors.

1. Introduction

From COVID-19, MERS and SARS to H1N1, Zika and Ebola, people around the world have been facing rampant waves of infectious diseases. New pandemics are anticipated to occur at an increasing frequency (Wolfe, 2011). Yet the current understanding of how an outbreak influences people's psychological well-being is incomplete. Much prior research has focused on well-being differences across, for example, gender (Wood, Rhodes, and Whelan, 1989), age (Steptoe, Deaton, and Stone, 2015), degrees of social connectedness (Myers, 1999), income levels (Kahneman and Deaton, 2010), individual dispositions (Diener and Seligman, 2002), and consumption patterns (Dunn, Aknin, and Norton, 2008). However, relatively little is known about how an increasingly common phenomenon—epidemic outbreak—impacts emotional well-being (Lu et al., 2020; Zhang et al., 2020). Even less is known about the factors that may worsen or protect emotional well-being during an outbreak. Identifying these factors is critically important, as they inform policies and interventions aimed at protecting people's psychological well-being in the age of pandemics.

We sought to add to this understanding through two large-scale nationwide surveys conducted in China immediately before versus during the coronavirus outbreak. We found that the onset of the epidemic in China led to a 74% decline in overall emotional well-being. Individuals who were residing near the epicenter of the outbreak, of an older age, or married, experienced a steeper decline in emotional well-being. This suggests that factors associated with, respectively, the likelihood of contracting the disease, extent of potential harm, and relational issues are moderators of well-being deterioration during an epidemic. Perhaps more importantly, we found that, during the coronavirus outbreak, individuals' *perceived* level of knowledge about coronavirus infection was a stronger "protector" of their emotional well-being than the actual amount of knowledge they possessed. We propose that this is because a higher level of perceived knowledge can lead to a stronger sense of control, which in turn protects emotional well-being during an outbreak. This proposition was supported by the results of our analyses: sense of control was a mediator of the impact of perceived knowledge on emotional well-being (even after controlling for actual knowledge as well as demographic and economic variables). The finding thus suggests that factors boosting sense of control can alleviate the detrimental effect of an epidemic outbreak on emotional well-being.

* Corresponding author: National School of Development, 5 Yiheyuan Road, Beijing, China 100871.
E-mail address: jingjingma@nsd.pku.edu.cn (J. Ma).

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2. Methods

Our data came from two nationally representative surveys of individuals living in China before versus during the coronavirus outbreak. Both surveys were administered by the Data Intelligence and National Development Lab of Peking University using the same nationwide participant panel.

The first survey (N = 11,131; from 32 provincial regions; 48% women; average age of 37.78; 66% married) was administered at the end of December 2019 (immediately before the coronavirus outbreak was publically reported in China). The second survey (N = 3,000; from 30 provincial regions; 50% women; average age of 34.7; 69% married) was conducted in mid-February 2020 (during the outbreak). Participants in both surveys completed an established measure of emotional well-being (Kahneman and Deaton, 2010). Specifically, they indicated whether they smiled or laughed a lot yesterday, and whether they experienced a lot of enjoyment/happiness/anger/sadness/stress/worry yesterday (1 = yes, 0 = no). Participants in both surveys also responded to demographic measures: age, sex, marital status, monthly household income, and residence region.

Participants in the second survey responded to additional measures pertaining to perceived knowledge about coronavirus infection. They indicated how much knowledge they had about how the coronavirus spreads from person to person, as well as how much knowledge they had about preventing coronavirus infection (1 = very little, 5 = very much). They also completed measures regarding their sense of control during the coronavirus outbreak. They indicated the extent to which they had control over the circumstances they were facing (1 = very much lack control, 5 = very much have control) and the extent to which they were confident that they could manage not to be infected by the coronavirus (1 = not confident at all, 5 = very confident). Finally, they completed five multiple-choice questions (adapted from the information officially released by China's CDC) that assessed their actual level of knowledge regarding preventing coronavirus infection. These questions covered effective handwashing, disinfectant usage, mask usage, avoidance of mouth/eye/nose touching, and prevention of droplet spread.

Following an established approach (Diener et al., 2010), we constructed an index of emotional well-being by subtracting the average of the negative affect measures (anger, sadness, stress, and worry; α = .769) from the average of the positive affect measures (smile/laugh, enjoyment, and happiness; α = .691). This overall index served as the dependent variable in our analyses. We coded whether participants were residing in Hubei Province, the epicenter of the coronavirus outbreak. Because the monthly household income measures used in the two surveys differed in the number of income brackets offered, we transformed them for use in our analyses. Specifically, due to the ordinal nature of the scale items (e.g., 5,000-7,999 RMB; 8,000-11,999 RMB; … 50,000 RMB or higher), we, following an established approach (Hout, 2004), recoded each response by taking the midpoint (e.g., 6,499 RMB) of the respective income interval when a fixed-range scale item was selected (e.g., 5,000-7,999 RMB). When an open-range item was chosen (e.g., 50,000 RMB or higher), we recoded the response using the lower bound (e.g., 50,000 RMB). We then linearly transformed the value by dividing it by 1,000 so that the monthly household income is measured in units of 1,000 RMB. Furthermore, we averaged the items for perceived knowledge (r = .595) and sense of control (r = .579), respectively, into a single measure. We also counted the number of objective knowledge questions each participant answered correctly, which served as a measure of actual knowledge.

3. Results

We first compared the data collected before versus during the coronavirus outbreak. We found that the outbreak significantly degraded emotional well-being (M_{before} = .437, SD_{before} = .568; M_{after} = .114, SD_{after} = .626; $F(1, 14129) = 728.808$, $p < .001$)—a 74% decline. We ran a series of regressions with emotional well-being as the dependent variable, and the coronavirus outbreak (1 = during, 0 = before), whether the individual resided in Hubei (1 = yes, 0 = no), age, sex (1 = female, 0 = male), marital status (1 = married, 0 = not married), household income, and each of their interaction term with the outbreak as predictors (see Table 1). The analyses not only established a consistent, significant negative effect of the outbreak on emotional well-being, but also revealed a set of significant interactions: (i) Individuals residing in Hubei, the epicenter of the outbreak, experienced a larger decline in emotional well-being. Because the overwhelming majority of Chinese coronavirus patients resided in that region (Dong, Du, and Gardner, 2020), this result suggests that a higher likelihood of contracting the disease accentuates the detrimental effect of an epidemic outbreak on emotional well-being. (ii) Those of an older age also experienced a larger reduction of emotional well-being during the outbreak. Because the coronavirus tends to cause more harm to the elderly than people of a younger age (CDC, 2020), this pattern suggests that the extent to which an individual might suffer from contracting the disease moderates the effect of an epidemic on the person's emotional well-being. (iii) Individuals who were married also experienced a greater decline in emotional well-being, suggesting that enduring an outbreak (e.g., being in a confined space for extended periods of lockdown) can potentially exacerbate relational issues that worsen emotional well-being. This pattern is consistent with the increase in marriage problems after the COVID-19 outbreak in China (Financial Times, 2020). Neither income or gender had a significant interaction effect with the outbreak.

We also examined the main effects of the demographic and economic variables on emotional well-being. Marriage and income were the only two variables that had a consistent, significant effect on emotional well-being. Specifically, married people enjoyed a higher level of emotional well-being than unmarried ones and a higher income was associated with a higher level of emotional well-being. These results are consistent with psychological well-being patterns in other countries examined in prior research (Lucas and Schimmack, 2009; Wood et al., 1989;).

Next, we analyzed the data collected during the outbreak. We ran a series of regressions with emotional well-being as the dependent variable, perceived knowledge, actual knowledge, whether the individual resided in Hubei, age, sex, marital status, income, and the interaction terms between the demographic variables and perceived knowledge as predictors (see Table 2). Across all regression models, participants' perceived knowledge about coronavirus infection was a consistent, significant predictor of their emotional well-being. However, their actual knowledge was not a consistent predictor. In other words, people's perceived level of knowledge about coronavirus infection served as a stronger protector of their emotional well-being during the outbreak than the actual amount of knowledge they possessed.

We tested whether sense of control mediated the effect of perceived knowledge on emotional well-being. We ran a mediation analysis using a bootstrapping technique with 10,000 resamples (Model 4, Hayes, 2013). This analysis indicated that perceived knowledge had a significant positive effect on sense of control (a = .37, SE = .02, t = 20.49, $p < .001$) and that sense of control had a significant positive effect on emotional well-being (b = .23, SE = .02, t = 12.49, $p <$

Table 1
The impact of coronavirus outbreak on emotional well-being

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14	Model 15	Model 16	Model 17
Outbreak	-.323****	-.322****	-.316****	-.317****	-.322****	-.318****	-.315****	-.311****	-.149***	-.145****	-.327****	-.323****	-.241****	-.241****	-.301****	-.294****	-.146***
	(.012)	(.012)	(.012)	(.012)	(.012)	(.012)	(.012)	(.012)	(.044)	(.044)	(.017)	(.017)	(.021)	(.021)	(.022)	(.022)	(.048)
Hubei		.023	.024	.024	.023	.026	.054*	.057*		.026		.026		.024		.025	.056*
		(.023)	(.023)	(.023)	(.023)	(.023)	(.025)	(.025)		(.023)		(.023)		(.023)		(.023)	(.025)
Age			.002****	.002****	.001	.001		.001	.002***	.001**		.001		.0004		.001	.001
			(.0004)	(.0004)	(.0005)	(.0005)		(.0005)	(.0004)	(.001)		(.005)		(.0005)		(.0005)	(.001)
Sex				.008 (.01)	.006 (.01)	.006 (.01)		.006 (.01)		.005 (.01)	.005	.004		.005 (.01)		.006 (.01)	.003
											(.011)	(.011)					(.011)
Married					.052****	.04***		.039***		.041***		.04***	.089****	.07****		.041***	.061****
					(.013)	(.013)		(.013)		(.013)		(.013)	(.012)	(.015)		(.014)	(.016)
Income						.002****		.002****		.002****		.002****		.002****	.002****	.002****	.002****
						(.0003)		(.0003)		(.0003)		(.0003)		(.0003)	(.0004)	(.0004)	(.0004)
Outbreak × Hubei							-.183***	-.179***									-.183***
							(.06)	(.06)									(.06)
Outbreak × Age									-.005****	-.005****							-.003*
									(.001)	(.001)							(.001)
Outbreak × Sex											.008	.01 (.024)					.006
											(.024)						(.024)
Outbreak × Married													-.121****	-.115****			-.079**
													(.026)	(.026)			(.031)
Outbreak × Income															-.001	-.001	-.001
															(.001)	(.001)	(.001)
Constant	.437****	.436****	.365****	.361****	.372****	.347****	.434****	.346****	.346****	.327****	.434****	.348****	.378****	.341****	.403****	.344****	.328****
	(.006)	(.006)	(.015)	(.016)	(.016)	(.017)	(.006)	(.017)	(.016)	(.018)	(.008)	(.018)	(.009)	(.017)	(.009)	(.018)	(.018)

Notes:
* $p \leq .05$;
** $p \leq .01$;
*** $p \leq .005$;
**** $p \leq .001$
Standard errors are shown in parentheses below coefficient estimates.

Table 2
Perceived knowledge helped protect emotional well-being during the coronavirus epidemic

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14	Model 15	Model 16	Model 17
Perceived Knowledge	.067****	.068****	.067****	.067****	.07****	.069****	.072****	.073****	.188**	.193**	.08***	.084***	.099***	.098***	.094***	.096***	.227***
	(.019)	(.019)	(.019)	(.019)	(.019)	(.02)	(.019)	(.02)	(.073)	(.073)	(.026)	(.027)	(.033)	(.033)	(.033)	(.033)	(.08)
Actual Knowledge	.019 (.011)	.020 (.011)	.022*	.021*	.022*	.022*	.020 (.011)	.022*	.021*	.022*	.019	.022*	.02 (.011)	.021*	.019	.021*	.021*
			(.011)	(.011)	(.011)	(.011)		(.011)	(.011)	(.011)	(.011)	(.011)		(.011)	(.011)	(.011)	(.011)
Hubei		-.137*	-.138*	-.137*	-.139*	-.138*	.295 (.4)	.275		-.137*		-.14*		-.137*		-.137*	.271
		(.059)	(.059)	(.059)	(.059)	(.059)		(.401)		(.059)		(.059)		(.059)		(.059)	(.402)
Age			-.003*	-.003*	-.002	-.002		-.002	.011	.012		-.002		-.002		-.002	.012 (.01)
			(.001)	(.001)	(.001)	(.001)		(.001)	(.008)	(.008)		(.001)		(.001)		(.001)	
Sex				.006 (.023)	.007	.006		.005		.008	.123	.125		.007		.006	.138
					(.023)	(.023)		(.023)		(.023)	(.154)	(.154)		(.023)		(.023)	(.155)
Married					-.03	-.031		-.031		-.034		-.031	.123	.141		-.031	-.029
					(.029)	(.029)		(.029)		(.029)		(.029)	(.161)	(.162)		(.029)	(.192)
Income						.0003		.0003		.0003		.0003		.0003	.007	.007	.006
						(.001)		(.001)		(.001)		(.001)		(.001)	(.007)	(.007)	(.007)
PK × Hubei							-.106	-.102									-.101
							(.098)	(.098)									(.098)
PK × Age									-.004	-.004							-.003
									(.002)	(.002)							(.002)
PK × Sex											-.028	-.03					-.033
											(.038)	(.038)					(.038)
PK × Married													-.043	-.044			-.001
													(.04)	(.04)			(.048)
PK × Income															-.002	-.002	-.001
															(.002)	(.002)	(.002)
Constant	-.211**	-.212**	-.127	-.131	-.149	-.148	-.228**	-.164	-.608*	-.639*	-.269*	-.206	-.31*	-.258	-.319*	-.253	-.776*
	(.083)	(.083)	(.092)	(.093)	(.094)	(.094)	(.084)	(.096)	(.293)	(.295)	(.111)	(.12)	(.132)	(.139)	(.134)	(.14)	(.322)

Notes:
* $p \leq .05$;
** $p \leq .01$;
*** $p \leq .005$;
**** $p \leq .001$
Standard errors are shown in parentheses below coefficient estimates.

.001). Moreover, the otherwise significant direct effect of perceived knowledge on emotional well-being (c = .07, SE = .02, t = 3.55, p < .001) became non-significant (c' = -.02, SE = .02, t = -.97, p = .33) after the indirect effect through sense of control was taken into account. The 95% bias corrected confidence interval for the indirect effect did not include 0 (95% CI = [.07, .10]), indicating a significant mediation. That is, sense of control mediated the relationship between perceived knowledge and emotional well-being.

As robustness checks, we reran the mediation analysis with emotional well-being as the dependent variable, perceived knowledge as the independent variable, actual knowledge as a covariate, and sense of control as the mediator. This analysis also yielded a significant indirect effect of perceived knowledge on emotional well-being through sense of control (95% CI [.07, .10]). We also reran the mediation analysis with actual knowledge, the demographic and economic variables and their interaction terms with perceived knowledge as covariates. This again yielded a significant indirect effect of perceived knowledge on emotional well-being through sense of control (95% CI [.02, .11]).

These mediation results provide evidence for our proposed psychological mechanism. That is, participants' perceived knowledge about coronavirus infection was associated with a higher sense of control, which in turn protected their emotional well-being during the outbreak.

4. Discussion

Overall, this research contributes to the literature on emotional well-being by exploring how an increasingly common phenomenon—epidemic outbreak—influences emotional well-being and by identifying a number of factors that can worsen (vs. protect) emotional well-being during an outbreak. Specifically, our results suggest that factors associated with the likelihood of contracting a disease (e.g., living close to the epicenter of an outbreak), extent of potential harm (e.g., being an elderly), and relational issues (e.g., those within a marriage) can exacerbate the detrimental effect of an epidemic outbreak on emotional well-being. Further, individuals' *perception* of their knowledge about an epidemic is another important factor: Regardless of their *actual* level of knowledge, those perceiving themselves as more knowledgeable, can better shield their emotional well-being from declining during an outbreak. This occurs because a higher level of perceived knowledge can lead to a stronger sense of control, protecting emotional well-being. In other words, approaches that boost sense of control, can attenuate the detrimental effect of an outbreak on happiness. These findings inform future research, and offer insights for policies and interventions aimed at caring for people's psychological well-being during epidemics.

Declaration of Competing Interest

The authors declare that there are no conflicts of interest.

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