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# Stratified changes in emotional distress during the COVID-19 pandemic: Evidence from a longitudinal survey of residents in Hubei province, China

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## ABSTRACT

**Background:** The COVID-19 pandemic has had a significant impact on individuals' emotional wellbeing and mental health. However, little research has examined emotional resilience during the pandemic. This study investigated the changes in emotional distress among residents in Hubei, the epicenter of the pandemic in China during the early stage of the pandemic, and we examined the sociodemographic differences in their emotional recovery.

**Methods:** We undertook a two-wave panel survey of 3816 residents aged  $\geq 18$  in Hubei, China. The baseline survey was conducted during early February 2020, the peak of the outbreak. The follow-up survey was carried out when the pandemic was mainly under control. The data enabled us to investigate the within-person changes in COVID-19-related negative emotions. Mixed-effect regression models with a random effect for participants were used to accommodate repeated measures.

**Results:** Respondents reported high levels of emotional distress at the peak of the pandemic and experienced a decline in emotional distress when the pandemic was under control. Moreover, respondents aged 35–49, with a college education or above, were employed, and having better self-rated health experienced a more substantial decrease in negative emotions during the COVID-19 pandemic.

**Conclusion:** This study identified vulnerable populations who may experience prolonged emotional distress during the COVID-19 pandemic in China. The results suggest that respondents who aged over 50, with no college education, were not employed, and with worse self-rated health were less resilient during the COVID-19 pandemic in China.

## 1. Introduction

The COVID-19 pandemic has had a profound impact on the emotional and mental well-being of the public due to its high infectivity and fatality rates and prolonged social distancing [35,38]. Individuals' initial reaction to an external stressor, such as a pandemic, often involves negative emotions, such as fear and anxiety [16]. Several studies have revealed that levels of anxiety, stress, and suicidal ideation increased significantly during the COVID-19 pandemic compared to pre-pandemic time [15,20,23,31,48,50]. However, it remains unclear how these trajectories will evolve throughout the pandemic.

Only a few studies have investigated how mental well-being has changed during different stages of the COVID-19 pandemic. Using data

from a nationally representative sample of the US population, Riehm et al. [36] found that the prevalence of mental distress appeared to peak in mid-April to early May 2020 and declined thereafter [29]. Another longitudinal survey of the US population from April to September 2020 showed that acute stress symptoms attenuated over time [39]. Similarly, longitudinal surveys of residents in the UK also revealed a decreasing level of mental health problems and increased positive well-being from March to June 2020 [15,29]. Such findings seemed to be consistent with prior research indicating that when a disaster strikes, individuals experience elevated mental distress; when the crisis eases, mental well-being typically rebounds [28].

Moreover, people's ability to recover or be resilient when facing adversity may also differ. Resilient individuals often experience distress

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for a short period and quickly return to pre-disaster levels of functioning [27], distinguishing them from those who experience a slower return to baseline functioning or even experience a longer period of dysfunction [6]. Previous studies have shown that males, the elderly, and people with socioeconomic advantages are more resilient when experiencing stressful events [8,12]. The COVID-19 studies seemed to be consistent with the prior findings, showing that women, young people, those from more socially disadvantaged backgrounds, and those with poor health conditions have worse mental health outcomes during the pandemic [29,36]. It may be because these groups are known to have an underlying vulnerability to mental health problems [46]. Also, in a crisis situation, socially advantaged groups may be more likely to muster resources to adapt to and cope with the crisis and recover from the shock [37]. Thus, it is reasonable to expect that those with social and health advantages tend to bounce back faster and adapt to the crisis more quickly caused by COVID-19.

Only a limited number of studies have monitored the changes of COVID-19-related mental distress and most of them were conducted in Western societies. We know less about the psychological resilience toward COVID-19 beyond the Western population, such as the Chinese. To our knowledge, only two studies have investigated the changes in mental wellbeing during the COVID-19 pandemic among the general population in China. Wang et al. [40] study found limited changes in stress, anxiety, and depression levels among people in mainland China during the initial outbreak of COVID-19 (from January 31 to March 1, 2020). Zhao et al. [50] study revealed a significant increase in depression, anxiety, and unhappiness during the COVID-19 pandemic compared to 2016 and 2017 among residents in Hong Kong, compared to 2016 and 2017. While informative, these studies employed repeated cross-sectional data and thus cannot examine the within-individual changes in mental health. There is a need for panel data that allow for a direct comparison of within-person change in mental health throughout the pandemic.

The first batch of COVID-19 cases was reported in Wuhan, the capital city of Hubei province, China, in December 2019. Given the quick spread of infection, massive lockdowns were enforced by the Government in Wuhan on January 23, 2020, and 16 neighboring cities in Hubei province. During the following weeks, COVID-19 cases grew rapidly and overwhelmed the health care system, especially in Wuhan. The situation improved when the Chinese government sent many medical personnel to Hubei and built massive temporary medical facilities to house COVID patients. By the end of March, the infection in Hubei was under control, and the lockdowns were gradually eased. On April 8, 2020, the lockdown in Wuhan was lifted [21]. So far, Hubei has accounted for 96% of the deaths from the virus in mainland China [49]. Due to the huge number of infected cases and deaths coupled with the unprecedented lockdown of cities, Hubei residents may have experienced high levels of fear, panic, and distress during the initial outbreak of the COVID-19 pandemic. However, limited studies have focused on the well-being of Hubei residents during the pandemic [10]. Also, Hubei residents were surprisingly underrepresented in previous surveys (e.g., [18]). Moreover, there is a lack of research examining the psychological recovery during the pandemic among the Chinese population.

This study was among the first to assess the longitudinal changes in negative emotions during the COVID-19 pandemic among Hubei residents and the sociodemographic differences in their emotional adaptation to the pandemic. The data were collected during the peak (February 2–8, 2020) and waning periods (March 23–April 8, 2020) of the pandemic in Hubei. Compared to prior research on COVID-19 in China, our advantage lies in using panel data to capture within-person changes and can provide a more accurate description of the trajectory of emotional health status during the COVID-19 pandemic. We also assessed whether emotional and emotional recovery to COVID-19 among Hubei residents varied by their sociodemographic backgrounds. The findings of this research would add incremental knowledge to current literature on the social inequality in mental wellbeing

and are informative for designing effective intervention programs targeting the vulnerable populations in the face of the pandemic.

## 2. Method

### 2.1. Data

The data of this study were obtained from the “Public Attitude toward the Novel Coronavirus Pandemic in Hubei Province” survey conducted by the China Academy of Science and Technology Development Strategy, the Social Policy Research Institute at Renmin University, and the Institute of Sociology of the Chinese Academy of Social Sciences. The baseline survey was conducted between February 2–8, 2020, when China was going through a rapid increase in the number of newly diagnosed COVID-19 cases and related deaths. The follow-up survey was conducted between March 23 and April 9, when the daily number of newly detected cases of COVID-19 decreased to double digits in China [22]. The authorities relaxed the lockdown in Hubei on March 23, and the lockdown on Wuhan was officially lifted on April 8, 2020 [21].

The survey targeted residents aged between 18 and 80 in the urban and rural areas of Hubei. It was a combination of an online and telephone survey. The online survey was conducted on a professional survey platform in China. The survey platform sent a notification to eligible respondents in their database with a link to the questionnaire. Only Hubei residents (with IP addresses located in Hubei) could access the questionnaire. The telephone survey sought to recruit non-Internet users who were usually older, living in rural areas, and with low socioeconomic status. Trained research assistants conducted the study and used a snowball sampling. There were minimal differences between the two methods of data collection. The research staff were instructed not to provide any additional information; they simply read the questions to the participants. Written consent was provided by those who did the online survey. No incentives were provided to the participants. Oral consent was given by those who answered the questions via telephone, and the interviewer signed a document that said he/she had followed the proper procedures for obtaining verbal informed consent.

Respondents who participated in the baseline online survey received the link for the follow-up survey and five reminders for the follow-up survey sent by the same survey platform. For telephone survey participants, their contact information was contained by the research team. At least three follow-up contacts were made before considering a case as a loss to follow up. For data storage, external hard drives will be used instead of online cloud devices. To ensure drive security, the password will be required for accessing any data. The external drives will be locked at the office to lower the possibility of leakage of data. The study was approved by the ethical committee of the Chinese Academy of Social Science, and all procedures were in accordance with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

A total number of 4234 respondents completed the baseline and follow-up surveys. By removing some survey responses with missing values, we derived a final sample of 3816 respondents, of which 3475 (91.1%) completed the online survey, and 341 (8.9%) completed the telephone survey. The sample characteristics were shown in Table 1.

### 2.2. Measures

*Emotional distress* was measured by asking the participants to rate on a five-point Likert scale how anxious, fearful, and depressed they felt during the past week. Fear, anxiety, and depression were among the most prevalent emotional and psychological responses toward the COVID-19 pandemic [1,2,5]. They are also key negative emotions included in the Negative Affect Subscale of the Positive Affect and Negative Affect Schedule (PANAS) [45]. In this study, we used single-item measurement for each negative emotion, which can considerably reduce time consumption and improve data quality [4,19]. A similar measure of emotional distress was validated among the Chinese

**Table 1**  
Descriptive statistics ( $N = 3816$ ).

Variable	Mean/%
Age	
18–34	58.2
35–49	30.1
$\geq 50$	11.7
Sex	
Female	47.0
Male	53.0
Education	
High school or below	40.5
College or above	59.5
Employment	
Unemployed/retired/students/homemakers/peasants	16.0
Employed	84.0
Self-rated health	
Very/poor/poor/so-so	14.6
Good/very good	85.4
Wave1: Emotional distress, Mean (SD) <sup>1</sup>	4.24 (0.82)
Wave2: Emotional distress, Mean (SD)	2.01 (1.00)
Wave 1: Risk exposure, Mean (SD) <sup>2</sup>	0.58 (0.84)
Wave 2: Risk exposure, Mean (SD)	0.60 (0.82)

<sup>1</sup> There was significant difference in emotional distress between two waves ( $t = 107.79, p < 0.001$ ).

<sup>2</sup> There was no significant difference in risk exposure between two waves ( $t = -0.87, p = 0.38$ ).

population during the COVID-19 pandemic [14,24]. The average score of the three items was used to represent the level of emotional distress among respondents, with higher values indicating higher levels of emotional distress. The emotional distress scale showed good internal consistency among survey respondents ( $\alpha = 0.83$ ).

Several demographic variables were measured, including *age* (18–34, 35–49, or  $\geq 50$ ), *sex* (male vs. female), and *self-rated health* (very poor/poor/so-so vs. good/very good). We also included measures of socioeconomic status, such as *education* (high school or below vs. college or above) and *employment status* (employed vs. unemployed/retired/students/homemakers/peasants). Besides, we controlled for COVID-19 exposure. The participants were asked whether they, their co-resident family members, or neighbors were infected with COVID-19. We assumed that participants would have higher levels of risk if they or a person close to them were infected. Thus, participants or their co-resident family members were confirmed as a COVID-19 patient were given a score of 2, participants who had infected patients in their neighborhood were given 1 score, and those reporting zero confirmed cases within their social circle were given a score of 0.

### 2.3. Analytical strategy

All the analyses were performed using Stata 15.0. Descriptive statistics were used to characterize the study population (Table 1). Random-intercept linear regression models were used to account for the repeated measurement of individuals. We computed two-way interaction terms between the wave dummy and each background variable (age, sex, education, employment, and self-rated health) to assess whether the changes in emotional distress across the two waves varied by sociodemographic characteristics and health condition. Variance inflation factors (VIFs) of the independent variables were estimated to check whether multicollinearity exists in the models. All the VIFs were below 2, suggesting that multicollinearity was not a significant concern.

## 3. Results

### 3.1. Sample characteristics

Table 1 displays the background characteristics of the respondents. Among the 3816 respondents, nearly 60% (58.23%) were between 18

and 34, about one-third (30.06%) were aged 35–49, and the remaining 11.71% were aged 50 or above. There were slightly more males (53.00%) than females. About 60% (59.48%) of respondents had a college education or above. About 84% of respondents were employed. Most respondents (85.42%) respondents perceived their health as good or very good.

### 3.2. Longitudinal regression results of changes in emotional distress

Table 2 presents the results of random-effect models of sociodemographic differences in emotional distress over time during the COVID-19 pandemic. Model 1 examines the main effects of wave dummy and background variables on psychological distress. The results suggested that participants in Wave 2 were significantly less emotionally distressed ( $b = -2.16, CI = [-2.20, -2.12], p < 0.001$ ). Compared to those aged 50 or over, respondents aged 18–34 ( $b = 0.13, CI = [0.06, 0.20], p < 0.001$ ) and 35–49 ( $b = 0.08, CI = [0.00, 0.15], p = 0.046$ ) were more distressed. Also, females ( $b = 0.06, CI = [0.02, 0.11], p = 0.002$ ).

Models 2–6 include the main effects of sociodemographic variables, the main effect of the dummy indicating Wave 2, and a series of interaction terms between the background variable and the wave dummy. The results indicated that participants aged between 35 and 49 ( $b = -0.15, CI = [-0.28, -0.02], p = 0.02$ ) experienced a greater decline in emotional distress than those aged at 50 or above. Also, participants with a college education or above bounced back faster than their counterparts from the emotional challenges of COVID-19 ( $b = -0.09, CI = [-0.16, -0.01], p = 0.03$ ). The employed population were more resilient than those who were unemployed, retired, students, homemakers, or peasants ( $b = -0.12, [-0.23, -0.02], p = 0.02$ ). Besides, respondents with better self-rated health were faster to recover from emotional distress than those with worse health ( $b = -0.39, [-0.50, -0.28], p < 0.001$ ). There were no discernible interaction effects between waves of surveys and sex ( $b = -0.02, [-0.09, -0.06], p = 0.66$ ), indicating a similar change of emotional distress between males and females during the two waves.

## 4. Discussion and conclusion

Despite numerous studies on the psychological well-being during the COVID-19 pandemic, limited studies have examined social inequalities in the changes in psychological distress or resilience during different stages of the pandemic. Moreover, there is a paucity of longitudinal research on psychological well-being during the COVID-19 pandemic in China. Using a unique two-wave panel sample of Hubei residents, this study was among the first to examine the within-person changes in emotional distress during the COVID-19 pandemic in China. The respondents reported high levels of emotional distress in the baseline survey. As the circumstances improved, individuals' emotional well-being rebounded. These results suggested that effective measures to contain the spread of the disease can significantly reduce the emotional distress of the general population. Moreover, the emotional recovery was greater for the middle-aged (35–49), the highly-educated, Communist party members, and those with better self-rated health. Such findings illustrated how inequality in emotional well-being unfolded in a disaster situation. Future studies should continue to monitor the populations heavily affected by the COVID-19 epidemic to assess the long-term mental health impact for groups with different socioeconomic and health conditions.

Certain subgroups were more likely to experience emotional distress during the COVID-19 pandemic in China. First, people aged below 50 were more likely to suffer emotional distress, which seemed unexpected as the highest mortality rate of COVID-19 occurred among the elderly. However, such results paralleled prior research showing the vulnerability of young people during the pandemic [40]. Many young adults are at the margins of the labor market and may be disproportionately impacted by the shrinking job opportunities during the pandemic [11].

**Table 2**  
Longitudinal changes in negative affect during the COVID-19 pandemic across different subgroups.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Age (ref: ≥50)						
18–34	0.13*** [0.06,0.20]	0.17*** [0.08,0.27]	0.13*** [0.06,0.20]	0.13*** [0.06,0.20]	0.13*** [0.06,0.20]	0.13*** [0.06,0.20]
35–49	0.08* [0.00,0.15]	0.15** [0.05,0.25]	0.08* [0.00,0.15]	0.08* [0.00,0.15]	0.08* [0.00,0.15]	0.08* [0.00,0.15]
Sex (ref: male)						
Female	0.06** [0.02,0.11]	0.06** [0.02,0.11]	0.07* [0.02,0.13]	0.06** [0.02,0.11]	0.07** [0.02,0.11]	0.06** [0.02,0.11]
Education (ref: high school or below)						
College or above	-0.01 [-0.06,0.03]	-0.01 [-0.06,0.03]	-0.01 [-0.06,0.03]	0.03 [-0.03,0.09]	-0.01 [-0.06,0.03]	-0.02 [-0.06,0.03]
Occupation (ref: Unemployed/student/homemaker/retired/peasant)						
Employed	0.05 [-0.00,0.11]	0.05 [-0.00,0.11]	0.05 [-0.00,0.11]	0.05 [-0.00,0.11]	0.12** [0.04,0.19]	0.05 [-0.00,0.11]
Self-rated health (ref: very poor/poor/so-so)						
Good/very good	0.07* [0.01,0.13]	0.07* [0.01,0.13]	0.07* [0.01,0.13]	0.07* [0.01,0.13]	0.07* [0.01,0.13]	0.26*** [0.18,0.35]
Wave (ref: Wave 1)						
Wave 2	-2.16*** [-2.20,-2.12]	-2.06*** [-2.17,-1.95]	-2.15*** [-2.20,-2.10]	-2.11*** [-2.17,-2.05]	-2.06*** [-2.15,-1.96]	-1.83*** [-1.93,-1.73]
Risk exposure to COVID-19	0.11*** [0.08,0.13]	0.11*** [0.08,0.13]	0.11*** [0.08,0.13]	0.11*** [0.08,0.13]	0.11*** [0.08,0.13]	0.11*** [0.08,0.13]
Age × Wave						
18–34 × Wave 2		-0.10 [-0.22,0.03]				
35–49 × Wave 2		-0.15* [-0.28,-0.02]				
Sex × Wave						
Female × Wave 2			-0.02 [-0.09,0.06]			
Education × Wave						
College or above × Wave 2				-0.09* [-0.16,-0.01]		
Employment × Wave						
Employed × Wave 2					-0.12* [-0.23,-0.02]	
Self-rated health × Wave						
Good/very good × Wave 2						-0.39*** [-0.50,-0.28]

95% confidence intervals in brackets.

\*  $p < 0.05$ .

\*\*  $p < 0.01$ .

\*\*\*  $p < 0.001$ .

Young people also tended to obtain more information about COVID-19 from social media, where misinformation about COVID-19 proliferated and may easily trigger emotional distress [9,18].

We found that females were likely to experience higher levels of emotional distress, which was consistent with other research conducted during the COVID-19 pandemic in China (e.g., [41]). It is understandable since extensive epidemiological studies have shown that women were at a higher risk of depression than men [26,46]. During the COVID-19 pandemic, women may be exposed to a higher risk of the virus since they provide the majority of health services and are more likely to take the caregiving lead in the family. Also, the pandemic has a larger economic impact on females. For example, among parents with young children, women experienced greater increases in childcare responsibilities, interruptions to paid work, and job loss [3,34]. Thus, women may experience higher levels of emotional distress during the pandemic due to their underlying vulnerability to mental health problems, elevated risk exposure toward COVID-19, and disproportional burden of the economic shock associated with COVID-19.

When individuals experienced various levels of negative emotions caused by COVID-19, their ability to recover or be resilient when facing adversity may also differ. Our findings showed that the decrease in emotional distress was more pronounced among participants aged 35–49, who had a college education, were employed, and with better self-rated health. Such findings were consistent with prior evidence showing that people with socioeconomic advantage were more resilient

to stressful events [8,12,32]. When the pandemic unfolded and gradually came under control, well-educated people may have more access to updated information and rational judgments about the epidemic, thereby adjusting their risk perceptions and enjoying better psychological wellbeing when the pandemic passes [7,13]. Similarly, the employed population may be more resilient than their non-working counterparts because they may have higher income and may have more access to resources in times of crisis, which help them adapt more positively to the COVID-19 challenges and experience less psychological disturbance over time.

The study had several limitations. First, the data collection was mostly done online and as it is common in online surveys, the socio-demographic profile of the sample is somewhat different from the general population. The mode of data collection was, however, constrained by circumstances of the pandemic. In accordance with previous methodological and empirical studies [33,47], we adjusted for relevant sociodemographic characteristics in our analysis to account for the differences between our sample and the general population. Previous studies analyzing Internet survey data during the COVID pandemic used this approach [33,40]. Future studies may try various sampling methods to gain a population-based representative sample. Second, we only employed a single item to measure the three negative emotions. However, a similar scale of mental distress was used in previous studies and was validated among the Chinese population [42]. Additionally, this study only looked at two points over a two-month period, which may not



be sufficient to draw definite conclusions about resilience for a pandemic lasting for 20 months (and counting). Future studies may continuously monitor psychological well-being at the population level in different stages of the pandemic.

Despite the limitations, this study adds to our understanding of mental health disparities during a public health crisis. The findings have identified vulnerable groups subject to the more prolonged and more serious psychological impact of COVID-19. Such insights may help reduce health disparities resulting from the disaster. It is worth noting that there is an insufficient focus on mental health interventions because pandemic control is being prioritized and mental health practitioners are lacking in China. Inadequate psychological interventions may pose a serious threat to the mental health of the general public [25,43,44]. Efforts should be made to improve psychological health interventions for high-risk populations. The findings of this study suggest that the government and stakeholders should apply a sociodemographic lens in crisis response and recovery measures and provide long-term mental health services to vulnerable groups. Future research should further examine the mechanisms underlying the socioeconomic differences in mental distress recovery during the COVID-19 pandemic.

### Declaration of Competing Interest

The authors declare that there are no conflicts of interest.

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