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Social factors and worry associated with COVID-19: Evidence from a large survey in China[☆]

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ABSTRACT

Objective: Worry about COVID-19 is an important cognitive component and manifestation of COVID-19-related anxiety. It has a social dimension and is shaped by various social factors.

Data: We employ original data from a large survey (N = 20,632) conducted in China from April 21 to 23, 2020, which provide us with a rare opportunity to investigate COVID-19-induced worry among ordinary Chinese citizens.

Results: We find individuals' socioeconomic status, family characteristics, sense of community, and perceived strictness of lockdown measures all have significant influences on worry about COVID-19.

Conclusions: First, individuals with higher socioeconomic status such as better education, better income, and more prestigious occupations have richer resources in coping with COVID-19 and are thus less worried. Second, the high human-to-human transmissibility of COVID-19 and increased family obligations during the pandemic imply that larger family size can be a worry-inducing burden. Individuals living with larger families are more worried. Third, a greater sense of community lowers worry as it buffers against the stressor and may enhance individuals' faith in the community's efficacy in containing the virus. Last, stringent lockdown measures may actually have positive psychological effects. They provide real and perceived protection and increase individuals' perceived distance from the disease, thereby reducing public worry.

1. Introduction

People all over the world have now been affected by the novel coronavirus (COVID-19), which was declared by the World Health Organization (WHO) as a public health emergency of international concern on January 30, 2020 and a pandemic on March 11, 2020 (World Health Organization, 2020). COVID-19 has led to millions of infected cases and hundreds of thousands of deaths (especially among the elderly and vulnerable) globally (Cao et al., 2020; Liu et al., 2020; Usher et al., 2020). To contain the outbreak, many countries took various lockdown measures to different extents, such as isolation of cases, contact tracing, community quarantine, travel bans, closing of schools, and social

distancing. The measures taken by China were among the most stringent, which kept tens of millions of people in isolation and affected many aspects of people's lives (Qiu et al., 2020; Yang et al., 2020). There has been growing evidence showing that the COVID-19 pandemic has negative psychological effects which may be pervasive and long lasting (Douglas et al., 2020; Holmes et al., 2020; Shanafelt et al., 2020). In particular, psychological and mental health problems, such as anxiety, can significantly grow during COVID-19 (Serafini et al., 2020).

Anxiety impairs health, subjective well-being, and quality of life (Malone and Wachholtz, 2018). The level of anxiety in a population often increases under public health crises. Previous studies found that public anxiety rose notably during virus-induced epidemics or

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pandemics such as SARS 2003, Ebola 2014/2016, and H1N1 2009/2010 (Hansen, 2009; Jalloh et al., 2018; Klemm et al., 2016). According to Taylor's (2019) pandemic psychology, a pandemic is as much a psychological problem as a medical one. Recent survey studies in China found that many respondents suffered from anxiety symptoms or psychological stress during the COVID-19 pandemic (Cao et al., 2020; Qiu et al., 2020). It is important to study COVID-19-related anxiety, because anxiety brings more suffering to those already at higher risks of infection and further weakens their health. Moreover, anxiety shapes people's reactions and behaviors during a pandemic (Taylor, 2019). It may cause people to engage in socially disruptive behaviors, including panic buying, mistrusting and blaming others, and misinterpreting minor symptoms as signs of infection and surging unnecessarily into (and thus overwhelming) hospitals and clinics (Asmundson and Taylor, 2020; Taylor, 2019).

Building upon the emerging scholarship on anxiety associated with a pandemic, this study looks into worry, an important cognitive component and manifestation of anxiety (Lee, 2020; Nikčević and Spada, 2020; Taylor et al., 2020), during the COVID-19 pandemic. The psychology of pandemics has contributed greatly to our knowledge about various psychological factors that influence pandemic-related emotional reactions such as worry, fear, distress, and anxiety (Taylor, 2019). For instance, based on the cognitive-behavioral model of health anxiety (Taylor, 2019), pioneering psychological research (Nikčević et al., 2021) has begun examining which and how psychological factors, personality traits and psychological vulnerability factors in particular, shape the development of COVID-19-related anxiety. This study complements this important psychological literature in the sense that it extends the attention to social factors underlying COVID-19-related anxiety. It stresses that the level of worry about COVID-19 has a social dimension and is shaped by various social factors. Social factors including socioeconomic status, the family and community, and social policies represent a complex dimension of health and influence psychological states including various forms of anxiety (Compton et al., 2005; Donev, 2005; Hart, 2004). It remains understudied how these social factors aggravate or mitigate worry about COVID-19.

In this study we investigate how socioeconomic status, family characteristics, sense of community, and strictness of lockdown measures influence individuals' worry about COVID-19, with a focus on Chinese society. To this end, we use original data from the Survey on COVID-19 Infection Prevention and Control in Nanjing, China, conducted in late April 2020. By highlighting the importance of social factors in shaping worry associated with COVID-19, this study sheds light on the mechanisms that may help inform anxiety-reducing interventions during this globally challenging time. It also broadly contributes to the emerging scholarship on social inequalities in health during a pandemic.

2. Anxiety and worry associated with COVID-19

The outbreak of an infectious disease can lead to heightened levels of stress, and anxiety is a common response to any stressful situation (Roy et al., 2020; Usher et al., 2020). Anxiety associated with the COVID-19 pandemic can have a significant psychological impact and adverse longer-term consequences such as persistent pessimism (Jungmann and Witthöft, 2020). Hypervigilance can arise because of anxiety and, in severe cases, result in massive disruptions to the behavior and psychological well-being of many in the population (Lee, 2020).

Although the literature is only starting to emerge, COVID-19-induced anxiety in China has been found to manifest three notable features. First, the rate of anxiety has been high among frontline medical workers. In a survey on Chinese medical workers who were highly susceptible to coronavirus infections, the rate of generalized anxiety was at an alarming 44.7% (Liu et al., 2020). Second, the rate of anxiety is also high among the general public (Qiu et al., 2020). The vicarious traumatization scores of the general public were sometimes found to be even significantly higher than those of frontline nurses (Li et al., 2020). Third,

the rate of anxiety has been stabilized. A two-wave study, which first surveyed some regions of China during the initial outbreak and again four weeks later, indicated that the level of anxiety had been stable despite sharp increases in the number of COVID-19 cases between the two surveys (Wang et al., 2020).

What are the sources of this increased anxiety during the pandemic? For health care professionals and frontline medical workers, some main sources of anxiety include access to adequate personal protective equipment, being exposed to COVID-19 at work and transmitting the virus to their family at home, not having timely access to testing if they develop COVID-19 symptoms, uncertainty that their personal and family needs will be supported if they contract COVID-19, childcare during increased work hours and school closures, meeting other personal and family needs when work hours and demands increase, and limited access to up-to-date information and communication (Shanafelt et al., 2020: 2133).

For the general public, it is not only the danger of being infected that engenders anxiety. Recent pandemic psychological research reveals that high-risk status, certain personality traits, perceived COVID-19 threat, and work and social adjustment all predict COVID-19-related anxiety (Nikčević et al., 2021). Social isolation related to restrictions and lockdown measures, feelings of uncertainty for the future, as well as the fear of new and unknown infective agents, also result in increased anxiety (Tan et al., 2020). The level of anxiety is also higher among people who follow COVID-19-related news and those people who have at least one family member, relative, or friend who has contracted COVID-19 (Moghanibashi-Mansourieh, 2020). In light of these sources of COVID-19-induced anxiety, it has been suggested that following a healthy and balanced diet, taking the opportunity to pursue hobbies, going outdoors or looking outside, and not reading news and updates about COVID-19 too often help lower levels of anxiety symptoms (Fullana et al., 2020).

Worry is a cognitive component of anxiety and is directly related to health-related anxiety, especially during pandemics (Taylor, 2019). It is commonly seen as an essential manifestation of COVID-19-related anxiety, especially the cognitive dimension of anxiety (Lee, 2020), and constitutes the COVID-19 anxiety syndrome (Nikčević and Spada, 2020) and COVID-19-related stress (Taylor et al., 2020). Worry during a pandemic can lead to "an escalation of obsessional thinking about COVID-19 and the associated emergence of clinical anxiety and maladaptive coping (e.g. addictive behaviours)" (Nikčević and Spada, 2020: 5).

3. Social influences on worry associated with COVID-19

Not all social groups experience COVID-19-induced worry to the same degree, but some groups are more worried than others. For instance, a study on Turkish society revealed that female, living in urban areas and previous psychiatric illness history were risk factors for anxiety during COVID-19 (Özdin and Özdin, 2020). While it is widely acknowledged that social factors shape health and stress disparities within a population (Adler and Newman, 2002), it remains an open empirical question how social factors underlie the distribution of worry in a population during COVID-19. We highlight three sets of social factors that potentially influence different levels of COVID-19-related worry in a society, including socioeconomic status, relations with the family and community, and strictness of lockdown measures.

3.1. Socioeconomic status

Socioeconomic status (SES) is among those most frequently studied as an important factor in health disparity research. SES is commonly found to be associated with depression and anxiety pathology, because individuals with higher SES have richer and more diverse resources to deal with stress (Salami and Walker, 2014). During economic recessions, income decline and unemployment are significantly associated with

increased rates of mental disorders (Fegert et al., 2020), which adds further evidence to the finding that low SES is an important risk factor for worry.

Conventional SES measures include education, income, and occupation, and each of these measures captures a distinct aspect of SES. They may be correlated with each other but are not interchangeable (Shavers, 2007). Disadvantaged SES has long been identified as a risk factor for mental health problems and anxiety including worry is more common in lower education and lower income groups (Buckner and Bassuk, 1997; Farrell et al., 2009). Education and income are considered to be negatively associated with anxiety disorders (Chen et al., 2019). We thus expect those with better education and greater income have lower levels of worry about COVID-19. Different occupations are associated with differential sets of resources that can be utilized to cope with stress. Some occupations have higher prestige in society, provide more opportunities for social networking, and come with better benefits that are not measured by income (Vallas et al., 2009). Nevertheless, the existing literature does not provide a clear clue as to which specific occupations are better at coping with COVID-19-induced worry.

Hypothesis 1. More education reduces the level of worry about COVID-19, other things being equal.

Hypothesis 2. More income reduces the level of worry about COVID-19, other things being equal.

Hypothesis 3. Some occupations have lower levels of worry about COVID-19, other things being equal.

3.2. The family and community

Relationships with the family and community represent another set of important social influences relevant to COVID-19-related worry. In the health literature, personal contacts and social relationships provide health-related resources such as social support (Israel and Rounds, 1987). Evidence from meta-analyses shows the importance of social support as a protective factor against anxiety symptoms (Bauer et al., 2020). A study on medical staff who treated patients with COVID-19 in January and February 2020 in Wuhan of China found that friends and family members help medical staff reduce anxiety levels by providing emotional support and sharing empathy (Xiao et al., 2020). Hence, the family and community may serve as a key psychosocial protective factor that provides support in the context of stress and reduce vulnerability for worry about COVID-19.

Resources embedded in both the family and the community may have direct health-enhancing effects and may diminish the negative effects of stressors on anxiety (Albrecht and Goldsmith, 2003). Being married and living with more family members may provide particularly important emotional and social support during the COVID-19 pandemic when social distancing is being implemented and people's activities are largely confined to their homes. COVID-19 is a highly infectious disease, however, and is thus fundamentally different from other kinds of stressors. Its high human-to-human transmissibility suggests that being married and living with a larger family may be associated with a higher probability of contracting the virus (Van Bavel et al., 2020), thereby heightening people's worry. Moreover, due to emergency measures such as closing of schools and other public facilities in response to COVID-19, living with a larger family means that the individual has to take care of more loved ones at home. This increased family obligation may aggravate worrying too. Taken together, unlike its usual worry-reducing role in normal times, the effect of a larger family on worry during the COVID-19 pandemic remains an open question and needs to be empirically tested. We thus propose the following competing hypotheses that are to be adjudicated by empirical data.

Hypothesis 4-1. Being married reduces the level of worry about COVID-19, other things being equal.

Hypothesis 4-2. Being married increases the level of worry about COVID-19, other things being equal.

Hypothesis 5-1. Living with more family members reduces the level of worry about COVID-19, other things being equal.

Hypothesis 5-2. Living with more family members increases the level of worry about COVID-19, other things being equal.

At the community level, social integration into local communities is considered a key factor for individuals' mental health (World Health Organization, 2007). Sense of belonging is related to both psychological and social functioning, and a higher sense of belonging promotes better functioning (Hagerty et al., 1996). Hence, it is commonly seen as a protective factor against stress and anxiety (Choenarom et al., 2005; Sargent et al., 2002). A greater sense of belonging to the community provides perceived support embedded in the community and promotes collective solidarity in fighting the pandemic. It thus boosts the individual's confidence in the community's efficacy in containing and preventing the disease. It also counteracts the sense of isolation engendered by stringent social distancing and lockdown measures.

Hypothesis 6. A greater sense of community reduces the level of worry about COVID-19, other things being equal.

3.3. Strictness of lockdown measures

The implementation of strict social distancing and lockdown procedures may have two competing effects on worry. On the one hand, these measures disrupt people's normal social interactions and lead to perceived lack of social support, which is associated with elevated anxiety symptoms (Santini et al., 2020). This can be seen as the disruptive effect of lockdown measures during COVID-19. Some scholars thus called for the need for intervention measures that would increase social connections in order to mitigate this disruptive effect of the COVID-19 lockdown (Tull et al., 2020).

On the other hand, it is also possible that the stringent lockdown measures can offer individuals more perceived security and more confidence in the society's efficacy in tackling COVID-19, thereby reducing the level of worry. When people see stringent lockdown measures effectively implemented, they feel better protected and are more likely to perceive a prospect that the virus will be under control. Strict social measures enhance the real and perceived efficacy of the society in fighting COVID-19, which lessens people's worry. This reflects the efficacy-boosting effect of COVID-19 lockdown measures.

Due to these two potentially counteracting effects, it remains to be empirically adjudicated whether stricter lockdown measures increase or decrease worry about COVID-19.

Hypothesis 7-1. (the disruptive effect): Stricter lockdown measures increase worry about COVID-19, other things being equal.

Hypothesis 7-2. (the efficacy-boosting effect): Stricter lockdown measures decrease worry about COVID-19, other things being equal.

4. Data and methods

4.1. Data

The data are from the "Survey on COVID-19 Infection Prevention and Control in Nanjing", jointly conducted by the Nanjing Municipal Government and the School of Social and Behavioral Sciences at Nanjing University from April 21 to 23, 2020. Survey participants were not randomly selected but were recruited from the popular social media app "WeChat" (*weixin*). WeChat, a free application released in 2011 by Tencent, has already become a prevalent tool transforming daily life of ordinary Chinese in many ways rather than just another social media app in China (see the "WeChat Economic and Social Impact Report, 2019-2020" released by the China Academy of Information and

Communications Technology at <http://www.caict.ac.cn/kxyj/qwfb/ztbg/202005/P020200514604388340272.pdf> for the prevalence and influence of WeChat in today's Chinese society). The Chinese public nowadays commonly uses WeChat to communicate and obtain information (Zhang et al., 2017). Currently, WeChat has over 1.2 billion monthly active users worldwide, 90 percent of whom are within China. It is likely that WeChat users are on average younger than the general public, but thanks to this prevalence of WeChat, the average age of the resultant sample (approximately 35 years) recruited from WeChat was very close to that of China's general population (about 37 years).

To improve the representativeness of the final sample, the survey team recruited from each district of Nanjing a subsample that was in proportion to the district's population. Nanjing is officially divided into 12 districts: Xuanwu District, Qinhuai District, Jianye District, Gulou District, Qixia District, Yuhuatai District, Pukou District, Jiangning District, Luhe District, Lishui District, Gaochun District, and Jiangbei New District. The Nanjing Municipal Government has adopted the so-called "grid management" (*wanggehua guanli*) system across the city. With the grid management, a district further divides the territory under its jurisdiction into a number of segments, and each segment is monitored by a designated person who is responsible for collecting information on a specified number of households. With the assistance of the Nanjing Municipal Government, we obtained a list of all grid-management persons of the 12 districts. First, the simple random sampling technique was used to select grid-management persons from the list of each district. Second, we sent the online questionnaire designed through our questionnaire software (Ringdata CAWI) to the selected grid-management persons. Third, the grid-management persons were asked to forward the questionnaire link to the WeChat groups of their segments. To encourage better responses and collect as many valid questionnaires as possible, cash incentives in the form of electronic red envelopes of varying values (between 2 and 5 RMB for each respondent) were randomly distributed. Before filling out the questionnaire, respondents needed to complete a consent form and were provided with a short statement indicating their answers would be anonymous. As required by the Statistics Law of the People's Republic of China, no one would be able to determine the respondent's identity from the questionnaire. This survey was certified as meeting all ethical standards by the Central Ethical Review Board at the Research Council of Nanjing University. The sampling was not totally random so we should use caution when generalizing the findings to the general population. Nevertheless, this sampling made it possible to generate useful and timely information on a large sample in a short period of time when the COVID-19 pandemic was evolving rapidly. A total of 20,632 participants were recruited by the end of April 23, 2020 and their information was contained in the data.

The support from the Nanjing Municipal Government and, in particular, its grid-management persons helped implement the survey and reduce missing data. Various techniques were employed to encourage respondents to complete all questions in the survey, including the use of a short and concise questionnaire, clear and straightforward questions, and monetary incentives. There is no obvious concern for missing data as very few missing data are present in our data analyses. Only 121 out of 20,632 observations (only 0.59%) miss data on some variables. We also tried multiple imputation to handle these few missing data and all the results were substantively the same.

To the best of our knowledge, Nanjing was the only city in China that actually allowed such a large-scale and high-quality social survey to be conducted when the COVID-19 situation in China was still tight. The data provide us with a rare opportunity to look into many ordinary Chinese citizens' worry about COVID-19.

4.2. Background information on the COVID-19 situation in nanjing

By late April 2020, the COVID-19 pandemic had already engulfed China with the total confirmed cases surpassing 82,000 and the number

of deaths from COVID-19 exceeding 4600. Nanjing, the capital city of Jiangsu Province, was not spared in the pandemic. Jiangsu Province is only 453 km away from Hubei Province, China's epicenter of the COVID-19 pandemic (Wang et al., 2020a). Although the Jiangsu Provincial Government launched wartime control measures for COVID-19 on January 24, 2020 after the first confirmed case was found in the province on January 22, 2020, Jiangsu Province reported a total of 656 confirmed cases in early April, including 202 new cases in January, 442 in February, and 12 in March (Jiangsu Commission of Health, 2021). The total rate of infections in early April was 8.2 cases per million people (2.5 in January, 5.5 in February, and 0.2 in March). There had been no deaths reported due to COVID-19 in Jiangsu Province. While it seems that the number of confirmed cases was declining and the rates of infections and deaths during this period were relatively low by international standards, the prospect of another major COVID-19 resurgence was still present and likely (Leung et al., 2020). As COVID-19 was just recently declared a pandemic by the WHO with the numbers of cases and deaths rising dramatically worldwide, people in Jiangsu were still facing the real danger of a new COVID-19 wave when the survey was conducted.

Among the cities in Jiangsu Province, Nanjing is the closest one to Hubei Province and its capital city of Wuhan which was the hardest hit across China. Both located along the Yangtze River, Nanjing has close linkages with Wuhan economically and in transportation. Hospitals in Nanjing have also been serving as the regional referral center for COVID-19 cases. Therefore, Nanjing was assessed as a high-risk region by the Chinese government (Sun et al., 2020). Although the response to COVID-19 has been progressively relaxed in Nanjing since early April (Leung et al., 2020), the Nanjing Municipal Government still issued a series of announcements requiring all residential communities to implement strict closed-off management that lasted until early June. All schools remained closed throughout April. Primary and secondary school students were only allowed to gradually return to schools in batches after early May.

At the time of the survey, the Nanjing Municipal Government had implemented several emergency policies to alleviate economic hardships. These policies included (1) government-issued vouchers worth a total of 300 million RMB were distributed among citizens in Nanjing; (2) all confirmed COVID-19 patients would receive free medical treatment; (3) small- and medium-sized businesses (with an annual revenue under 5 million RMB) received subsidies worth a total of 1.5 billion RMB, reduced interest rates for loans, and reduced rents. The government also provided monetary incentives worth a total of 800 million RMB to encourage firms not to lay off their employees.

4.3. Dependent variable

Worry about COVID-19 is measured by the survey question "At this moment how much are you worried about COVID-19?" Possible responses are on a five-point scale ranging from (1) not worried at all, (2) not very worried, (3) on the fence (neutral), (4) somewhat worried, to (5) very worried. A great value indicates a higher level of worry about COVID-19.

This measure is straightforward and also explicit about COVID-19, which lowers the possibility of people conflating COVID-19-related worry and other existing worry. Nevertheless, we acknowledge the limitation of this simple measure, as a single question measure is subject to more measurement error. In future data collection, it would be better to use a multi-item scale to measure COVID-19-related anxiety symptoms, of which worry is one component or manifestation.

4.4. Independent variables

We use education, income, and occupation to measure socioeconomic status. Education is measured by the highest degree achieved and is on a five-point scale including (1) junior middle school and below, (2)

senior middle school or secondary vocational school, (3) junior college, (4) university, and (5) postgraduate education. Income is assessed by one's annual household income (in Chinese Yuan) in 2019 and is on a seven-point scale including (1) under 10,000, (2) 10,000–25,000, (3) 25,000–50,000, (4) 50,000–100,000, (5) 100,000–250,000, (6) 250,000–400,000, and (7) above 400,000. Occupation is captured by 8 occupational categories including (1) government (including the Communist Party), (2) public services (including schools, hospitals, etc.), (3) state-owned (including collective) enterprises, (4) private (including foreign-owned) enterprises, (5) self-employed, (6) student, (7) other, and (8) unemployed (including laid-off). We create a set of dummy variables representing different occupational categories, with the unemployed used as the reference category.

Family characteristics are measured by marital status and the number of family members. Marital status contains three categories, namely (1) single (never married), (2) married, and (3) divorced or widowed. The number of family members measures how many family members currently live with the respondent. It is worth mentioning that the survey did not identify those who cohabit but are not married in the marital status variable, but the number of family members currently living with the respondent potentially captures cohabitation.

We construct a composite measurement about the respondent's sense of community from six survey items using exploratory factor analysis. The survey asks the respondent "Overall what is your opinion on the following six statements?" The six statements include (1) I consider important concerns for the community my concerns too; (2) I am proud to be a citizen of Nanjing; (3) I will introduce Nanjing to others; (4) I care about the prospect of Nanjing's development; (5) I will recommend coming and working in Nanjing to others; (6) I am willing to live and work in Nanjing in the long term. These statements are all about respondents' self-identification with or sense of belonging to Nanjing. For each statement the possible response is on a five-point scale ranging from (1) agree strongly, (2) somewhat agree, (3) not sure, (4) somewhat disagree, and (5) disagree strongly. According to the factor analysis performed on the six survey items, the six items load onto one factor and the Cronbach's alpha (0.948) indicates strong internal reliability. Accordingly, we use factor score weights to construct the composite variable, which results in a constructed variable with a mean of 0 and a standard deviation of 1. We then reverse the coding so that in this constructed variable a greater number indicates a higher sense of community.

Strictness of lockdown measures is captured by the respondent's self-rated strictness of the lockdown measures taken at the local residential community. The survey first lists typical measures adopted by local residential communities including guarded entrances into the neighborhood, mandatory wearing of masks in public areas within the neighborhood, regular checks on households, taking residents' body temperature regularly, and keeping records of residents' travel history, and regularly sanitizing public spaces within the neighborhood. It then asks the respondent "How strictly do you think these measures have been implemented in your residential community?" While the Nanjing Municipal Government issued an overall lockdown order, lockdown measures were carried out by local residential communities. The strictness of the lockdown measure's implementation varied from community to community. It is measured on a five-point scale ranging from (1) "not strict at all", (2) "not very strict", (3) "just so-so", (4) "somewhat strict", to (5) "very strict".

In addition to these variables of major interest, we also control demographic variables including gender, age, and residence type. Gender is a binary variable with male coded as 1 and female as 0. Age is measured as 10 age groups, including (1) below 18, (2) 18–25, (3) 26–30, (4) 31–35, (5) 36–40, (6) 41–45, (7) 46–50, (8) 51–55, (9) 56–60, and (10) above 60. A greater number indicates an older age. We realize that the effect of age is often not linear but curvilinear (Jorm, 2000) so we also include a quadratic term of age (or age-squared) in the regression model. Residence type is the respondent's household

registration (or *hukou*) type, with rural coded as 1 and urban coded as 0.

Furthermore, we take into account whether the respondent is (1) a non-medical general public, (2) a medical worker, or (3) an immediate family member of medical workers. Medical workers are more directly involved in tackling COVID-19 and more likely to be exposed to the virus, so they may be more worried than other individuals (Shanafelt et al., 2020). We create a set of dummy variables to capture the distinction.

4.5. Modeling strategy

Because of the ordinal nature of the dependent variable (a five-point scale), we choose ordinal logistic regression. We estimate the ordinal logistic model using the *ologit* command in the Stata software (release 14) (StataCorp, 2015). Since the ordinal logistical model is built upon maximum likelihood estimation with an iterative process, we can calculate the McFadden's pseudo- R^2 , a popular indicator for the goodness of model fit (Freese and Long, 2006). This pseudo- R^2 is reported for each model and can be roughly viewed as the proportion of the total variability in the dependent variable explained by the model.

5. Results

5.1. Descriptive statistics

Table 1 presents the descriptive statistics of the variables used in the analysis. On average people appear to be on the fence with respect to worrying about COVID-19. The average level of worry is approximately 2.5 on a five-point scale, somewhere between "not very worried" (2) and neutral (3). However, there is much variation among people. In particular, about 22% of people explicitly express their worries, and are very worried or somewhat worried about COVID-19. Fig. 1 shows the distribution of worry about COVID-19 among the surveyed individuals.

5.2. Results from regression analysis

Next we conduct ordinal regression analysis to examine the effects of social factors on worry about COVID-19. The results from the ordinal regression models are presented in Table 2. In Model 1, we include

Table 1
Descriptive statistics for dependent and independent variables.

Variables	Mean	SD	Minimum	Maximum
Worry about COVID-19	2.489	1.073	1	5
Gender (male)	.477	.499	0	1
Age group	4.673	1.995	1	10
Residence type (rural)	.267	.443	0	1
Education	3.311	1.047	1	5
Income	4.545	1.302	1	7
Occupation				
Government	.110	.313	0	1
Public service	.313	.464	0	1
State-owned enterprise	.140	.347	0	1
Private enterprise	.212	.409	0	1
Self-employed	.095	.293	0	1
Student	.016	.125	0	1
Other	.093	.290	0	1
Unemployed	.022	.147	0	1
Marital status				
Single	.181	.385	0	1
Married	.785	.411	0	1
Divorced/widowed	.034	.182	0	1
Number of family members	2.600	1.177	1	7
Sense of community	0	1	-5.293	.672
Strictness of lockdown	4.220	.757	1	5
Individual type:				
General public	.861	.346	0	1
Medical worker	.113	.317	0	1
Family of medical worker	.025	.157	0	1

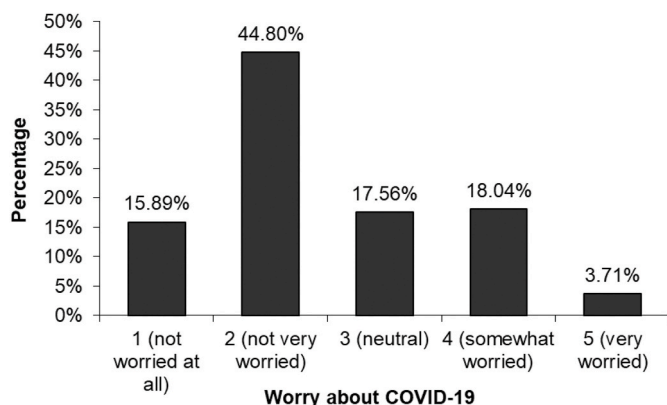


Fig. 1. Distribution of worry about COVID-19.

Table 2
Ordinal logistic regression of worry about COVID-19.

	Model 1	Model 2	Model 3	Model 4
Male	-.504*** (.027)	-.482*** (.029)	-.459*** (.029)	-.452*** (.029)
Age	-.232*** (.032)	-.328*** (.040)	-.316*** (.041)	-.311*** (.041)
Age squared	.014*** (.003)	.022*** (.004)	.021*** (.004)	.021*** (.004)
Rural	-.112*** (.031)	-.100** (.034)	-.068* (.034)	-.067* (.034)
Education	-.042** (.016)	-.030* (.015)	-.043* (.017)	-.046** (.017)
Income	-.070*** (.011)	-.077*** (.012)	-.078*** (.013)	-.078*** (.013)
Occupation				
Government	-.472*** (.098)	-.538*** (.103)	-.312** (.104)	-.310** (.104)
Public service	-.130 (.091)	-.202* (.096)	-.029 (.096)	-.074 (.097)
State-owned enterprise	-.111 (.094)	-.165 (.099)	-.024 (.100)	-.024 (.100)
Private enterprise	-.142 (.092)	-.159 (.096)	-.071 (.097)	-.070 (.097)
Self-employed	-.021 (.096)	-.045 (.101)	.077 (.102)	.077 (.102)
Student	.070 (.136)	.021 (.158)	.122 (.160)	.124 (.160)
Other	-.185 (.097)	-.176 (.102)	-.087 (.102)	-.086 (.102)
Marital status				
Single		-.129* (.051)	-.112* (.051)	-.109* (.051)
Divorced/widowed		.038 (.082)	.034 (.082)	.030 (.082)
Number of family members		.072*** (.012)	.076*** (.012)	.076*** (.012)
Sense of community			-.157*** (.015)	-.156*** (.015)
Strictness of lockdown			-.295*** (.019)	-.292*** (.019)
Individual type				
Medical worker				.153** (.050)
Family of medical worker				.092 (.086)
Pseudo-R ²	.056	.060	.096	.100

Note. (1) values in parentheses are standard errors; (2) from 2-tailed tests, * $P < .05$; ** $P < .01$; *** $P < .001$; (3) the reference group for occupation is unemployed; (4) the reference group for marital status is married; (5) the reference group for individual type is non-medical general public.

major demographic variables, education, income, and a set of dummy variables representing various occupations (with the unemployed as the reference group). The demographic variables, education, income, and, among occupations, the dummy variable of government employee, all have significant influences on worry. Males are less worried than females. Age has a curvilinear relationship with worry. As age increases, people first get less worried up to a point after which they become

increasingly more worried. The turning point of this change in the effect of age is somewhere between age group 8 and age group 9, or people in their 50s. That is, people in their 50s are the least worried, but those who are older become increasingly more worried. Rural residents are less worried than their urban counterparts. Both education and income have negative effects, so people with better education and more household income are less worried about COVID-19. Those working at the government are significantly less worried than the unemployed, while other occupations show no difference from the unemployed.

Model 2 further includes individuals' family characteristics. Compared with the married, single (never married) individuals show a significantly lower level of worry. There is no difference between the married and the divorced or widowed. Living with more family members is significantly associated with a higher level of worry about COVID-19.

In Model 3, we bring in two community variables including the sense of community and the strictness of the lockdown measures against COVID-19 taken by the local community. Their coefficients are both significantly negative. A higher sense of community significantly lowers the level of worry, and stricter lockdown measures significantly reduce individuals' worry about COVID-19.

In Model 4, we further distinguish different individual types by accounting for the differences among ordinary (non-medical) citizens, medical workers, and those who have medical workers in their immediate family. Controlling for this distinction does not substantively change the previous results. As expected, medical workers are more worried about COVID-19 than non-medical ordinary individuals.

6. Discussion

6.1. Key results

In late April 2020 when the survey was conducted, the overall level of worry about COVID-19 was not alarmingly high in Nanjing. 3.71% of the respondents in the survey reported feeling very worried, and another 18.04% were somewhat worried. The majority were either not very worried or not worried at all. These numbers seem to be in contrast to some previous findings regarding the prevalence of various forms of anxiety in mainland China in early 2020. The prior findings reporting higher levels of anxiety among the Chinese public were based on surveys on particular social groups such as medical workers including nurses (Li et al., 2020) and college students (Cao et al., 2020), surveys on hardest-hit areas such as Wuhan (Liu et al., 2020), or surveys at the very beginning of the initial outbreak (Qiu et al., 2020; Wang et al., 2020). The numbers observed in this study supplement the previous ones and provide further information about ordinary Chinese citizens' worry about COVID-19 in such places as Nanjing where by late April there had been strong public health responses and a declining number of cases.

Despite this seemingly low level of worry overall, the variability among individuals is prominent and social factors help explain why some are more worried than others. In light of the empirical results we reflect on the research hypotheses derived from the existing literature. In terms of socioeconomic status, we find that the results are largely consistent with the hypotheses (Hypotheses 1, 2 and 3), in agreement with the emerging literature on COVID-19. Individuals with better education and income have richer resources in coping with COVID-19, so they are less worried than those with less education and less household income (Chen et al., 2019; Fegert et al., 2020). Among different occupations, government employees show a particularly lower level of worry. This may reflect better resources, privileges, and benefits enjoyed by government employees in Chinese society (Lin and Bian, 1991; Hewlett and Rashid, 2011), which make them better-equipped and less worried during the pandemic. In addition, government officials are often involved in the decision-making and implementation of social measures which may provide them with a greater sense of agency and perceived control over the stressor, which in turn helps reduce their worry.

In terms of family characteristics, the results support the worry-worsening effect of larger family structures (*Hypotheses 4-2 and 5-2*). Those who are married and live with more family members are actually more worried about COVID-19. This may be due to the particular nature of COVID-19. Married people and those living with a large family have to worry about more people (especially those vulnerable to COVID-19 such as old parents and young children), which increases their general worry about COVID-19. Because schools and other public facilities are largely closed during the pandemic, respondents living with larger families often have to home school their children and face more family obligations. Moreover, COVID-19 spreads from person to person. Due to the high human-to-human transmissibility, those who live with a larger family come into contact with more people and thus face a greater risk of being infected (*Van Bavel et al., 2020*). Hence, during COVID-19 larger families may not necessarily be a worry-reducing factor as in many other circumstances; to the contrary, they increase the risk of infection and the burden of family responsibilities, thereby inducing greater worry.

In terms of the sense of community, the results show that a sense of pride and belonging to Nanjing reduces worry about COVID-19, confirming *Hypothesis 6*. A higher sense of belonging to a given community suggests a greater level of social integration and promotes an individual's social and psychological functioning (*Hagerty et al., 1996*). Potentially through a shared lived experience, it may serve as a buffer against the stressor and thus reduces worry (*Choenarom et al., 2005; Sargent et al., 2002*). A higher sense of belonging may imply that the individual possibly has more faith in potential support from the community and the community's efficacy in dealing with crises, but this potential connection needs further empirical testing in future research.

In terms of the strictness of lockdown measures, the evidence is more in support of the efficacy-boosting argument (*Hypothesis 7-2*) rather than the disruptive argument. Strict measures lockdown local communities and disrupt normal social interactions. However, they boost people's confidence in the local community's efficacy in containing the spread of the disease. Lockdown measures have been proven effective in previous epidemics such as the SARS outbreak in 2003 (*Wilder-Smith et al., 2020*). The Chinese general public has fresh memories about the SARS epidemic and is generally aware of the effectiveness of strict lockdown measures. Additionally, these measures cut off interpersonal contact, restrict traffic and social activities, and construct a local safety "bubble". All these, consciously or subconsciously, increase individuals' perceived "remoteness" of COVID-19 from their local community and weaken the perceived immediacy of the virus. This increased "psychological distance" from COVID-19 reduces individuals' worry (*Trope and Liberman, 2010; Zheng et al., 2020*).

6.2. Limitations

This study is not without its limitations, however. First, while many social factors do show significant effects on worry about COVID-19 in our models, the pseudo- R^2 of these models is not particularly high. For instance, the pseudo- R^2 of the final model is 0.100, suggesting approximately 10% of the total variability in individuals' worry about COVID-19 can be explained by the model. A large proportion of the variability remains unexplained in our models. Other variables such as personality traits (*Nikčević et al., 2021; Taylor, 2019*) may also play an important role and their information should be collected in future surveys. Including these additional explanatory variables could further increase the model's explanatory power.

Second, while the survey data here provided timely and insightful information on many ordinary Chinese responses to COVID-19, they were not generated from a strictly random sample. The low rate of COVID-19 infection in Nanjing, relative to other more hard-hit areas, and the exclusion from the survey of individuals who do not use WeChat, also limit the generalizability of the findings. Additionally, potential sociocultural factors specific to China may further limit the generalization of findings to non-Chinese societies. For instance, public

compliance with the government's guidance and instructions is very strong in China, which may not be observed in many other countries with different political structures. We should thus use caution when applying the findings here to other societies.

Third, some measures used in the survey are not ideal and can be improved in future surveys. Multiple survey questions, instead of a single question about worry, could have been used, which could more accurately measure COVID-19-related anxiety and more effectively reduce potential measurement error. The single-question measurement used in this study only reports individuals' perceived worry and is not a validated diagnostic tool for measuring anxiety symptoms. Newly developed measurements, such as the 5-item Coronavirus Anxiety Scale (*Lee, 2020*), the 9-item COVID-19 Anxiety Syndrome Scale (*Nikčević and Spada*), and the 36-item COVID-19 Stress Scales (*Taylor et al., 2020*), are all better validated multi-item ones that should be utilized in future surveys and studies. When asking about marital status, the survey could also have explicitly included cohabitation without being married as a category. Most surveys in China nowadays still do not include this category when measuring marital status, despite the increasing popularity of cohabitation (*Song and Lai, 2020; Zhang, 2017*). In future surveys, more detailed questions on individuals' family structure (e.g., specific characteristics of family members) and social networks beyond the family would also help. For instance, it would be interesting to examine whether multi-generational families with 3 or more generations are more worried than others.

7. Conclusions

A pandemic is not merely a global medical challenge but also a psychological one as it creates widespread anxiety, fear, and worry (*Taylor, 2019*). Public health authorities so far have devoted insufficient attention to pandemic-related mental health issues even though these issues loom large during the current COVID-19 crisis (*Lee, 2020*). Although this analysis is conducted in the Chinese context based on a large dataset from China, the findings here may contribute to the emerging literature on anxiety and worry related to COVID-19 more generally.

First, in all societies, there are health disparities resulting from socioeconomic inequalities, and some occupations carry with them greater privileges and a higher sense of control over stressors. During the COVID-19 pandemic these socioeconomic inequalities can be magnified and those who are socioeconomically disadvantaged face a more depressing situation due to their lack of resources to protect themselves. Second, the fast human-to-human transmission of COVID 19 potentially turns larger family structures, a source of supportive resources in normal times, into a worry-inducing burden during the pandemic. Individuals with larger families encounter harsher challenges and may need more support. Third, during a time of increased social distancing all over the globe, communities matter a great deal. A greater sense of community buffers against the stressor and may enhance individuals' faith in winning the fight against a novel virus. Fourthly, stringent lockdown measures taken by local communities may offer individuals a greater sense of protection. Societies affected by COVID-19 have all taken quarantine and lockdown measures to varying degrees. Our findings suggest that while these measures are aimed at preventing and containing the spread of the disease, they may also have positive psychological effects. Last but not least, with the COVID-19 pandemic still ongoing and continuing imperiling global health, this study also serves as a call for more data and research on different societies to advance our understanding of the social dimension underlying this global medical and psychological challenge.

Author credit statement

Wei Guo: conceived the study design, designed early analysis, interpreted the results, as well as wrote the first draft of the manuscript,

reviewed and edited the final manuscript. Min Zhou: designed early analysis, interpreted the results, as well as wrote the first draft of the manuscript, designed the final analysis, reviewed and edited the final manuscript.

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