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Out of the shadows: Impact of SARS experience on Chinese netizens’ willingness to donate for COVID-19 pandemic prevention and control

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ABSTRACT
While charitable donations help to raise funds and contribute to pandemic prevention and control, there are many unanswered questions about how people make such donation decisions, especially in countries like China where charitable donations have played an increasing role in recent years. This study contributes to the literature by assessing the potential impacts of Chinese netizens’ experience with the 2002 severe acute respiratory syndrome (SARS) epidemic on their willingness to donate for COVID-19 pandemic prevention and control. Specifically, this study applies a difference-in-differences (DID) model to a dataset collected from a nationwide survey to examine how individuals’ exposure to the SARS epidemic affects their willingness to donate to alleviate the COVID-19 pandemic. The results suggest that individuals’ SARS epidemic experiences in their early lives, especially during the “childhood-adolescence” period, had a lasting and far-reaching impact on their willingness to donate toward COVID-19 pandemic prevention and control. Also, the impacts were likely heterogeneous by such sociodemographic factors as educational background, health status, and income level. The empirical findings highlight the importance of considering early-life experiences in developing and implementing epidemic prevention and control policies. While the SARS experience likely affected Chinese netizens’ willingness to donate toward COVID-19 pandemic prevention and control, lessons learned from both the SARS epidemic and COVID-19 pandemic could be used to develop more effective public health education and prevention programs as well as to increase public donations for future pandemic prevention and control.

1. Introduction
Coronavirus disease 2019 (COVID-19) has emerged as one of the most widely influential global epidemics in recent decades. According to the statistics of WHO, as of March 25, 2022, a total of 479,006,033 COVID-19 cases had been confirmed globally and a total of 6,118,499 people had died. COVID-19 has been the most serious global pandemic since the outbreak of the Spanish flu in 1918 and will continue to bring about many unprecedented impacts on public health and socioeconomic development. Regarding COVID-
19’s impacts on human beings, the pandemic has influenced people’s mental health and happiness, in addition to the pressure it has placed on individuals’ physical health, and research has identified significant increases in individuals’ sense of isolation, fear, and uncertainty (Karim, Islam, & Talukder, 2020).

Containing the global spread of disease not only requires significant funds but also the public’s strength and confidence. Charitable donations help contribute to containing pandemics (Clay, Egedeso, Hansen, Jensen, & Calkins, 2020; Desai & Randeria, 2020). Through painstaking efforts and tremendous sacrifice, China succeeded in turning the COVID-19 pandemic around in approximately 3 months in early 2020 as shown in Fig. 1. China’s rapid recovery from COVID-19 in 2020 can be attributed not only to the efforts of the central and local governments, medical workers, community workers, and media reporters, but also the active cooperation of the residents. Epidemic prevention and control requires a lot of manpower, materials, and financial resources. Residents’ donations have become a defense against public health emergencies in many countries and regions (Ballesteros & Gatignon, 2019) and are often an important source of funding for emergency relief and public programs. For instance, private charitable donations were about a quarter of government development aid in the UK (Atkinson, Backus, & Micklewright, 2012) and accounted for about 5% of GDP in the United States (Kolm, 2006).

During the severe acute respiratory syndrome (SARS) epidemic in the early 2000s, China received 4.074 billion yuan in donations. Of this, about 2.744 billion yuan from mainland enterprises and individuals, 215 million yuan from foreign companies, individuals, and non-governmental organizations, and 1.115 billion yuan from party and government organizations of China, Hong Kong, Macao and Taiwan of the greater China region, as well as foreign nations and international organizations, etc. As report by China’s State Council Information Office, by May 31, 2020, the Red Cross and other charitable organizations in China received 38.93 billion yuan of social donations and about 990 million pieces of materials, which by far exceeded the amounts of social donations during the SARS epidemic. To some extent, this reflects individuals’ increasing enthusiasm to donate after the SARS epidemic.

Donation decisions are likely influenced by tax incentives (Almunia, Guceri, Lockwood, & Scharf, 2020), priority rule (Kessler & Roth, 2014), information (Metzger & Günther, 2019), media exposure (Aldashev, Limardi, & Verdier, 2015), economic income status (Auten, Sieg, & Clofelter, 2002), firm-government relationship (Long & Yang, 2016), supplier heterogeneous perceptions (Yang, Yao, He, & Ou, 2019), and other exogenous factors. Recently, some studies have explored the impact of public health emergencies on individual behavior decision-making. For instance, Masser, White, Hamilton and McKinnie (2011) found that avian influenza outbreak affected people’s intention to donate blood. The study of Spokman et al. (2021) suggested that public health emergencies could inspire individuals to donate blood as well as to make contributions to public interest. Similarly, we assume that the experience of public health emergencies (i.e., SARS) could exert a positive influence on individuals’ willingness to donate for COVID-19 pandemic prevention and control.

Currently, insights from COVID-19 on health and economic outcomes are of high interest. Several recent studies have discussed the current situation and the impact of COVID-19, as well as the coping strategies (Binder, 2020; Chen, 2020; Leslie & Wilson, 2020). However, our literature review suggests that the impacts of previous public health emergency experiences on public donation decision for COVID-19 prevention and control has yet to be elucidated and this study presents one of the first efforts in assessing such impacts by addressing the following three research questions:

(1) Are Chinese residents willing to donate toward COVID-19 pandemic prevention and control in terms of participation rate and amount?
(2) What are the major reasons and factors that determine their donations toward COVID-19 pandemic prevention and control?
(3) Does the residents’ experience with the SARS epidemic may affect their donations toward COVID-19 pandemic prevention and control and if so, how?

The potential contributions of this paper are twofold. First, based on a theoretical perspective, this paper offers some interesting insights into the potential effects of early exposure to SARS on the willingness to donate in support of COVID-19 relief efforts. Second, this paper empirically assesses the impacts of Chinese residents’ SARS experience on their willingness to donate for COVID-19 pandemic prevention and control, using data collected from a nationwide survey in 2020. Because the data used in our empirical analysis are collected from an online survey, our analysis focuses on the netizens’ willingness to donate for COVID-19 prevention and control.

This paper is organized into five sections. Following this introduction section, Section 2 provides background information and proposes an analytical framework for assessing the impacts of the exposure to the SARS epidemic on the netizens’ willingness to donate toward COVID-19 prevention and control, Section 3 reports the data source, model selections, and variable definitions and descriptive statistics, Section 4 presents the empirical test results, and Section 5 summarizes the major conclusions and potential policy implications.

2. Potential impacts of SARS experience on the willingness to donate for COVID-19 pandemic prevention and control

Individual charitable donations are one of the important ways for residents to participate in emergency prevention and control efforts (Lobb, Mock, & Hutchinson, 2012). The United Nations Office for the Coordination of Humanitarian Affairs estimated that individuals’ humanitarian donations reached 6.5 billion or 23.81% of the total global humanitarian donations in 2017. As noted by Atkinson et al. (2012), individuals’ charitable donations contributed significantly to emergency relief and played an important role in

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1 Data Source: http://media.news.sohu.com/98/58/news213375898.shtml
social assistance. The study focuses on residents’ experience with SARS in the early 2000s and its impacts on their willingness to donate for COVID-19 prevention and control.

SARS as a major epidemic caused serious harm to individuals’ mental and physical health, as well as harm to national and regional economies and societies (Bennett, Chiang, & Malani, 2015; Chou, Kuo, & Peng, 2004). Specially, the SARS epidemic profoundly influenced regional public health systems and netizens’ living habits (Cheung, Fong, & Bressington, 2020; Ren, Ng, & Katzschner, 2011). Therefore, it is vital to understand how exposure to SARS might affect netizens’ decisions to donate toward COVID-19 pandemic prevention and control due to the following three considerations.

First, the SARS epidemic seriously impacted personal health as well as social and economic development, and led to people paying more attention to similar public health emergencies (i.e., COVID-19 pandemic). According to the imprinting theory, our interactions with the world, from perception to action, are continually informed and shaped by the retrieval of memories of previous experiences (Ren et al., 2018). A previous experience, especially an unusual or stressful one, can affect an individual’s cognitive ability and knowledge structure, thus influencing their decision-making behavior (Marquis & Tilcsik, 2013; Simsek, Fox, & Heavey, 2015). In addition, some researchers have also revealed that the SARS epidemic experience could significantly affect individuals’ health literacy and further influence the implementation of epidemic prevention measures (Cheung et al., 2020).

Although the COVID-19 pandemic occurred close to 20 years after the SARS epidemic, there are similarities between these two health emergencies. Therefore, we have reasons to believe that local governments in the SARS epidemic areas may pay more attention to the prevention and control of COVID-19. Compared with residents in other areas, the residents in these areas may have higher health literacy and be more willing to donate. The imprinting theory also emphasizes that experiences during the period of ego development and self-esteem formation exert a more continuous impact on individual behavioral decisions (Marquis & Tilcsik, 2013). So, it is possible that individuals who were exposed to SARS during their childhood, youth, and other character formation periods are more likely to donate toward COVID-19 prevention and control.

Second, SARS prevention and control could arouse netizens’ enthusiasm to unite and improve their sense of social responsibility and identity (Haslam, Haslam, Jetten, Tegan, & Sarah, 2021). Thus, individuals would be more likely to spontaneously make donations that are beneficial to the society. In fact, individuals often form a common memory and identity in fighting against the epidemic, which helps to enhance their sense of collectivism and their willingness to help others. Charitable donation is an important embodiment of individuals’ social responsibility and identity (Zou & Li, 2016). Therefore, when new public health emergencies occur, they may be motivated to contribute to the collective interests and tend to give up more of their personal interests (Thührmer, Nieber, & Gollwitzer, 2021), making them more willing to donate.

Third, individuals with SARS epidemic experience may have more affective empathies and cognitive empathies for similar events. The outbreak of SARS in 2002 may cause them to be more compassionate, thus increasing their willingness to donate, especially in the areas where the SARS epidemic was more severe. In addition, netizens’ awareness of similar public health emergencies to a certain extent was also deepened (Chen, Paris, & Reeson, 2020). All of these may make them more inclined to donate money and materials to others experiencing the same situation. Netizens’ donations not only reflect their selfish preference for personal economic interests, but also reflect their altruistic concern for others’ welfare (Sharfman, 1994).

Based on the above conceptual analysis, this study empirically tests the hypothesis that SARS epidemic experience affects Chinese netizens’ donations for the COVID-19 pandemic prevention and control. The research design and empirical results are reported in the following two sections, respectively.

3. Research design

This section first introduces the data, then defines the variables, and finally presents the empirical model.

3.1. Data

To analyze how exposure to the SARS epidemic influences netizens’ willingness to donate toward COVID-19 pandemic prevention...
and control, we collected data via an online survey. The survey was conducted from February 27 to March 24, 2020, through the Questionnaire Star Platform (https://www.wjx.cn/). Since the launch of Questionnaire Star in 2006, the platform had gained over 4 billion questionnaires through February 2020, making it one of the largest online survey platforms in China. Although studies have shown that online surveys and field surveys are equivalent (Ekman, Dickman, Klint, Weiderpass, & Litton, 2006), some scholars still hold critical views on the potential sample bias caused by online surveys. To overcome this potential problem, this survey was conducted using two different methods.

The first was a full-coverage survey with diverse respondents from 31 provinces (including autonomous regions and municipalities) in mainland China. Because the geographical distribution of sample groups was scattered in society, snowball sampling, one of the non-probabilistic sampling methods, was used in the survey to obtain sufficiently large samples. This method can extract many samples at a lower cost in the selection of research objects (Bunclark et al., 2018; Goodman, 1961). It should be noted that, in snowball sampling, the initially selected survey subjects may determine the quality of the survey sample to a certain extent. Therefore, we made great efforts in selecting the first 200 or so respondents. Specifically, we conducted stratified random sampling from the aspects of demographic factors such as gender, age, occupation, and residence in selecting the first 200 mainland Chinese residents as the respondents. After the first 200 respondents completed the questionnaires, they were then asked to forward the questionnaire to 3 or more residents they knew. Each of the respondents invited by the first 200 respondents were then instructed to invite three or more respondents. Following this snowball method, a total of 6130 participated in the survey. After excluding the samples from the non-mainland Chinese respondents (from Hong Kong and overseas) or samples with inconsistent responses, 5353 valid samples were obtained. Note that participation in the survey was voluntary and the respondents were instructed to complete the questionnaire themselves. They could also obtain technical assistance in completing the survey using mobile phones, computers, or other devices.

The second survey was conducted at two colleges in China using a random sampling method. Using the student rosters provided by the two colleges, randomly selected college students were invited to participate in the survey. This survey yielded a total of 1888 valid observations. Data from this survey were mainly used for robustness testing.

3.2. Measures

3.2.1. Development of the willingness to donate question

Contingent valuation (CV) method has been widely used to measure the willingness to pay or donate (Champ, Bishop, Brown, & McCollum, 1997). To overcome the payment vehicle bias, we followed He, Zhang, and Zeng (2020) and chose the most accepted and widely used payment vehicle in the survey – money. During the survey period, the Chinese government implemented very strict population movement control measures and traffic control measures, making it less likely that people would use a payment vehicle other than money, such as labor contributions, in a donation plan. Therefore, the CV question of netizens’ willingness to donate toward COVID-19 pandemic prevention and control in the questionnaire was “If a non-profit organization initiates a one-year donation plan for COVID-19 prevention and control that has been approved by the government and all funds raised through this plan will be forwarded to the National Pneumonia Epidemic Prevention and Control Emergency Command of Novel Coronavirus Infection to fight the COVID-19, what is the maximum amount that you are willing to donate per month for one year?”

To overcome the starting point bias in determining the choices for this question, we took the following measures. First, we drew on the default donation amount set by the charity donation platforms of Alibaba and Tencent, the first two Internet companies in China. Second, we checked 200,000 donation records of the warm winter charity fundraising platform, “No. 1 fundraising against the COVID-19 pandemic”, on February 25, 2020, to determine the question bids. Third, we conducted a pre-survey to further test the applicability of the donation set. Finally, the options in the formal survey were 0, 1, 5, 10, 20, 40, 60, 80, 100, 200, and 500 yuan and other (which required the respondent to fill in the specific amount directly).

To avoid strong subjectivity in the measurement of willingness to donate, certain measures were taken to reduce survey bias. Following the study of Cummings and Taylor (1999), before respondents replied to their willingness to donate, the following direction considering individual economic situations was displayed to respondents to reflect their true preferences as much as possible: “Now everyone attaches great importance to the epidemic, but our income level is limited. Please think about it when answering the following questions. Please do not overstate or understate your willingness to donate”. Meanwhile, respondents were reminded that “If you want to donate items like masks, please seriously think about their real monetary value in the market.”

3.2.2. Explanatory variables

As two key explanatory variables in our research, SARS intensity is used to measure the individuals’ exposure to the SARS epidemic and the birth date is used to measure the birth cohort of residents. These two variables are defined as follows:

(1) SARS intensity: Based on relevant epidemiological studies (Weinberger, Chen, Cohen, Crawford, & Viboud, 2020), estimates of excess deaths can provide information on the burden of death that may be associated with the epidemic, including deaths directly or indirectly attributable to the epidemic. Although previous studies on the severity of major epidemics mainly used excess mortality as the index, comparing the mortality rate during the SARS epidemic period with the average mortality rate in ordinary years may fail to accurately reflect the severity of the epidemic situation in an area because the mortality rate of SARS was pretty low. Therefore, in order to ensure the accuracy of the measurement index, we used a more intuitive index, namely “number of confirmed cases per 100 people” as the proxy measure of the severity of the SARS epidemic in each province. The specific algorithm is the number of confirmed cases of SARS per 100 people in each province. The greater the number of confirmed cases of SARS per 100 people in each province, the more serious the SARS epidemic.

(2) Birth cohort: The birth year provided by respondents in the survey was used to calculate the age of respondents at the time of the
SARS outbreak. Then the birth cohort was further divided according to the stage of human growth. Following the studies of Köhler-Forsberg et al. (2019) and Palomäki et al. (2019), the entire childhood of human beings includes infancy (before 3 years old), early childhood (3–6 years old), childhood (7–11 years old), and adolescence (12–18 years old) periods. Among these, childhood and adolescence periods are the most critical stages for children to recognize and understand the world, preserving permanent memory and forming characters. Therefore, the life stages of respondents during the SARS epidemic were divided into six groups: unborn, infancy, early childhood, childhood, adolescence, and adulthood. Following the works of Tan and Zhang (2016), infancy and unborn respondents during the SARS epidemic were grouped into the same birth cohort due to the consideration that childhood and adolescent respondents were in the most important stage of cognitive formation during the SARS epidemic. In the empirical analysis, the four birth cohorts were measured by three dummy variables. The division of respondents’ birth cohorts is shown in Table 1.

### 3.2.3. Control variables

The following four categories of variables were controlled in the regression analysis. (1) Variables related to the SARS epidemic, such as respondents’ residence type during the SARS epidemic. (2) Variables related to the COVID-19 pandemic, including respondents’ awareness of the epidemic, diagnosis status of relatives and friends, diagnosis status of community/village/street, the mortality rate of residence during the epidemic, and respondents’ residence type during COVID-19 pandemic. (3) Respondents’ characteristics, such as gender, education level (whether junior high school or below, high school, university or above; the benchmark group was junior college), after-tax monetary income groups in 2019 (whether personal annual income was below 10,000 yuan, between 10,000 and 100,000 yuan, or over 100,000 yuan), religious beliefs, domicile place, member of the Communist Party of China, health, and risk attitude. Also, considering that donations toward COVID-19 pandemic prevention and control as a social welfare behavior may be affected by related charitable organizations, this study controlled the variable “trust in nonprofit organizations”. (4) Household characteristics, including family size, the number of members younger than 16, and the number of members over 65. The definition and descriptive statistics of the variables are reported in Table 2.

### 3.3. Empirical model

The SARS epidemic was likely an exogenous shock to residents and therefore can be regarded as a natural experiment. To identify the effects of respondents’ SARS experience on their willingness to donate toward COVID-19 pandemic prevention and control, one strategy is to take advantage of both the temporal and geographic variations in the SARS intensity. According to the research of Chen and Zhou (2007), Angrist and Pischke (2009), and Fan and Qian (2015), one could track donation outcomes for respondents residing in less affected provinces and born before, during, or after the SARS epidemic, and then compare these differences with the corresponding differences for respondents residing in the hard-hit provinces. This comparison can be used to assess the impacts of SARS experience on the willingness to donate for COVID-19 prevention and control through the estimation of the following difference-in-differences (DID) model:

\[ y_{ic} = \beta_0 + \sum_{c=2}^{4} \alpha_c \text{Birth cohort}_c + \gamma_s \text{SARS intensity}_s + \sum_{c=2}^{4} \delta_{ic} \text{Birth cohort}_c \times \text{SARS intensity}_s + X_{ic} \beta + \epsilon_{ic} \]  

(1)

Where \( y_{ic} \) denotes the \( i \)th respondent’s willingness to donate during the COVID-19 outbreak period, and the \( i \)th respondent was located in the region \( s \) during the SARA outbreak and belonged to the \( c \)th birth cohort. \( \text{Birth cohort}_c \) denotes the dummy variable that whether the \( i \)th respondent belonged to the \( c \)th birth cohort, and respondents born after 2000 belong to the 1 birth cohort that is the benchmark group. \( \alpha_c \) denotes the fixed effect of \( \text{Birth cohort}_c \). \( \text{SARS intensity}_s \) denotes the number of confirmed persons per 100 people in the SARA outbreak region \( s \), and it is a proxy variable to measure the severity of SARS in different regions. \( \gamma_s \) denotes the fixed effect of SARS severity. \( \alpha_c \) is the coefficient of interaction item between \( \text{Birth cohort}_c \) and \( \text{SARS intensity}_s \), and it indicates the impact of SARS severity the \( i \)th respondent experienced on his willingness to donate during COVID-19 outbreak period. We mainly concern about the coefficient of SARS intensity × Birth cohort 3 that measures the impact of SARS severity the \( i \)th respondent experienced in childhood-adolescence on his willingness to donate during COVID-19 outbreak period in adulthood. \( X \) are a series of control variables such as personal and family characteristics, and the definition of these control variables are shown in Table 2.

According to previous research (e.g., Archibong & Annan, 2017), we included the interaction term, \( \text{Birth cohort}_c \times \text{SARS intensity}_s \) in the model. It identifies the effects of two-dimension variations: across individuals and over time. First, the SARS intensity in each province was different, implying that the treatment of each birth cohort in each province was different. Second, individuals belonging to birth cohort 1 were still young at the time of the SARS epidemic and had little knowledge and memory of the epidemic. Meanwhile, individuals belonging to birth cohort 2, 3, and 4 likely had the ability of thinking and mature memory when they experienced the SARS epidemic. They also had stronger cognition and memory feeling about the epidemic, hence they were more likely to have a strong

| Table 1 | Division of respondents’ birth cohorts. |
|---------|---------------------------------------|
| Age     | Birth Year | Age in 2003 | Life cycle in 2003 | Birth cohort |
| Less than or equal to 20 | After 2000 | Before 3 years old | Unborn-Infancy | Birth cohort 1 |
| Greater than or equal to 20, less than 24 | From 1996 to 2000 | Greater than or equal to 3, less than 7 years old | Early Childhood | Birth cohort 2 |
| Greater than or equal to 24, less than 35 | From 1985 to 1996 | Greater than or equal to 7, less than 18 years old | Childhood-Adolescence | Birth cohort 3 |
| Greater than or equal to 35 | Before 1985 | Greater than or equal to 18 years old | Adolescence | Birth cohort 4 |
reaction toward COVID-19 pandemic prevention and control in the future. Thus, we considered the birth cohort 1–4 as the intervention time point in the standard DID model. In the interaction item, Birth cohortc × SARS intensityp, first cohorts 2, 3, 4 were compared with cohort 1 (i.e., the first difference), and then the different results were compared under different SARS intensity, (i.e., the second difference). Finally, the influence of the SARS epidemic on donations toward COVID-19 pandemic prevention and control was obtained.

Particularly, this study focused on the interaction coefficient with cohort = 3 and SARS intensity. The coefficient evaluates the varying degrees of SARS impacts on people during their most critical childhood-adolescence stage and their willingness to donate toward COVID-19 pandemic prevention and control. We predict that, compared with the other birth cohorts, the respondents of birth cohort 3 likely have more profound memory and feeling of the epidemic period and are therefore more likely to have a stronger behavioral response to COVID-19.

4. Empirical results

This section first reports the descriptive results, then presents the empirical results, and finally reports the robustness test results and inter-group dissimilarity analysis results.

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Table 2
Variable definitions and descriptive statistics.

| Categories             | Variables                                      | Descriptions of variables                                      | Mean     | Std. dev |
|------------------------|------------------------------------------------|-----------------------------------------------------------------|----------|----------|
| Dependent variable     | Willingness to donate                          | Respondents’ willingness to donate for COVID-19 pandemic         | 46.160   | 56.554   |
|                        | SARS intensity                                 | Confirmed cases per 100 people                                  | 1.132    | 3.794    |
| Core independent       | Birth cohort 2                                 | Dummy = 1 if the respondent’s life cycle during the SARS epidemic was early childhood; 0 = otherwise | 0.218    | 0.413    |
| variables              | Birth cohort 3                                 | Dummy = 1 if the respondent’s life cycle during the SARS epidemic was childhood-adolescence; 0 = otherwise | 0.260    | 0.439    |
|                        | Birth cohort 4                                 | Dummy = 1 if the respondent’s life cycle during the SARS epidemic was adulthood; 0 = otherwise | 0.365    | 0.482    |
|                        | Residence type 1                               | Dummy = 1 if the respondent lived in a city during the SARS epidemic; 0 = otherwise | 0.501    | 0.500    |
|                        | Residence type 2                               | Dummy = 1 if the respondent lived in a city during the COVID-19 pandemic; 0 = otherwise | 0.617    | 0.486    |
|                        | Perception of COVID-19 pandemic                | Perception of COVID-19 pandemic. 5-point Likert-type scale(1 = strongly unknown, 5 = strongly know) | 3.671    | 0.863    |
|                        | Diagnosis of relatives and friends             | Dummy = 1 if the respondent’s relatives and friends are diagnosed or suspected of COVID-19; 0 = otherwise | 0.041    | 0.199    |
|                        | Diagnosis in the community/village/street      | Dummy = 1 if there are confirmed cases in the community/village/street; 0 = otherwise | 0.142    | 0.349    |
| Epidemic characteristics| Mortality rate                                 | The ratio of COVID-19 deaths to confirmed cases in the respondent’s area | 0.014    | 0.024    |
|                        | Gender                                         | 1 = Male; 0 = Female                                             | 0.443    | 0.497    |
|                        | Junior high school and below                   | The benchmark group is junior college; Dummy = 1 if the respondent’s education level is not higher than junior high school; 0 = otherwise | 0.065    | 0.247    |
|                        | High school                                    | The benchmark group is junior college; Dummy = 1 if the respondent’s education level is high school; 0 = otherwise | 0.082    | 0.275    |
|                        | University and above                           | The benchmark group is junior college; Dummy = 1 if the respondent’s education level is not lower than a university; 0 = otherwise | 0.762    | 0.426    |
|                        | Income below 10,000 yuan                       | Dummy = 1 if monetary salary after tax for the whole year of 2019 is not more than 10,000 yuan; 0 = otherwise | 0.534    | 0.499    |
|                        | Income over 100,000 yuan                       | Dummy = 1 if monetary salary after tax for the whole year of 2019 is not lower than 100,000 yuan; 0 = otherwise | 0.157    | 0.364    |
| Personal Characteristics| Beliefs                                        | Dummy = 1 if respondent has religious beliefs; 0 = otherwise | 0.070    | 0.256    |
|                        | Registered permanent residence                 | Dummy = 1 if respondent has an urban “hukou”; 0 = otherwise | 0.642    | 0.480    |
|                        | Member of the Communist Party of China         | Dummy = 1 if respondent is the member of the communist party of China; 0 = otherwise | 0.326    | 0.469    |
|                        | Self-rated health                              | Respondents’ perception of their health                         | 3.757    | 0.768    |
|                        | Risk attitude                                  | 5-point Likert-type scale(1 = strongly bad; 5 = strongly good) | 3.102    | 0.962    |
|                        | Trust in nonprofit organizations               | 1 = Very distrustful; 2 = Relatively distrustful; 3 = General; 4 = Relatively trustworthy; 5 = Very trustworthy | 3.602    | 1.010    |
|                        | Family size                                    | Total family population                                         | 4.553    | 2.465    |
| Family characteristics  | Number of young members                        | Number of members younger than 16 in the household             | 0.809    | 1.502    |
|                        | Number of old members                          | The number of members over 65 in the family                     | 0.917    | 1.069    |
4.1. Descriptive results

4.1.1. SARS intensity by province in China

As mentioned earlier, SARS intensity is defined as the number of confirmed cases per 100 people during the SARS epidemic. SARS intensity, presented in Fig. 2, indicates that Beijing had the highest value of 25.21, followed by Guangdong at 15.11 and Shanxi at 4.5, and seven provinces had the lowest value of zero (Guizhou, Hainan, Heilongjiang, Qinghai, Tibet, Xinjiang, and Yunnan).

4.1.2. Residents’ willingness to donate to COVID-19 pandemic prevention and control

While the survey data indicate that 93.5% of the respondents were willing to participate in donations toward COVID-19 pandemic prevention and control, the average amount of willingness to donate toward COVID-19 pandemic prevention and control was 46.16 yuan per month. As shown in Fig. 3, the provinces with high levels of willingness to donate were Ningxia (65.79 yuan), Shanghai (64.15 yuan), Jiangsu (59.29 yuan), Liaoning (58.37 yuan), and Jilin (55.55 yuan). On the other hand, the provinces with low levels of the willingness to donate were Anhui (36.89 yuan), Guangxi (36.60 yuan), Guizhou (35.09 yuan), Heilongjiang (34.86), and Henan (34.80).

4.1.3. Identification of the likely protest respondents

The use of the CV method is limited by its inherent methodological limitations. When a significant number of respondents reported zero willingness to pay or to donate in a CV survey, it may require further investigation on the reasons behind the zero willingness to pay or donate (Lo & Jim, 2015). For example, those who were willing to donate 0 yuan per month toward COVID-19 pandemic prevention and control can be divided into two groups: true zero values and protest response. The former usually stems from the respondents’ belief that COVID-19 pandemic prevention and control was not important enough for them to donate or their limited income did not allow them to donate. In the latter cases, respondents might report zero willingness to donate due to other reasons such as being dissatisfied with the donation method or payment tool, they thought their donations were not needed, or such donations should be made by others such as people with significantly higher income (Strazzera et al., 2003). Such respondents, named as protest respondents by some researchers, have often been deleted to avoid underestimation of the true willingness to pay or donate (Lo & Jim, 2015). In this study, efforts were made to identify such protest respondents following the studies of Strazzera et al. (2003), Meyerhoff and Liebe (2006), and Lo and Jim (2015). Specifically, the following statement questions were included in the survey and the respondents who agreed with the statements were identified as protest respondents: “The COVID-19 prevention and control is government business and has nothing to do with me”, “People who caused the spread of the COVID-19 pandemic should pay for it”, “I am worried that donations will not play a role in the COVID-19 prevention and control”, “I don’t think donations are the best way to promote COVID-19 pandemic prevention”. After the protest respondents were excluded from the dataset, the remaining sample of 5113 respondents was used in our empirical analysis.

4.2. Empirical results

The regression results of the DID model with three alternative specifications are reported in Table 3. While the results in Columns (1) and (2) are for the models that include only the core independent variables and control variables, respectively, and Column (3) is the result for the model with all the explanatory variables. The R-squared for the model in column (3) is nearly doubled as compared with that in Column (1), and is nearly 30% higher than that for the model in Column (2). With other conditions held the same,
individuals in birth cohort 3 or 4 are willing to donate significantly more for COVID-19 prevention and control than their counterparts at a 1% significance level. This finding suggests that residents who were in the childhood-adolescence and adulthood cohorts during the SARS epidemic had a higher level of willingness to donate. This is likely due to the age group’s better memory during the epidemic. However, Birth cohort 2 showed a negative influence on the level of willingness to donate for COVID-19 pandemic prevention and control and the negative impacts is significant at the 5% significant level. This suggests that social memories and incorporating feedback into these memories may be not clear in early childhood (Murty, Fain, Hlutkowsky, & Perlman, 2020). Therefore, the impact of SARS on early childhood residents was limited but had an indelible impression on adult residents.

Regression results of the interaction between the SARS intensity and birth cohort indicate that only “SARS intensity × Birth cohort 3” was statistically significant at the 1% significant level. Residents who were exposed to SARS in their early years, especially during their childhood-adolescence (birth cohort 3), were likely to have a positive impact on their willingness to donate for COVID-19 pandemic prevention and control.

4.3. Robustness tests

Five tests have been conducted to test the robustness of our empirical analysis.

(1) Placebo test results. Because cross-sectional data were used in this study, it is necessary to conduct falsification or sensitivity tests to ensure the reliability of our main results (Archibong & Annan, 2017). We were concerned that the changes in the common trends in the treatment group and the control group after the SARS outbreak may have not been caused by the SARS epidemic but by other events. To this end, we followed the study of Moser and Voena (2012) by selecting a variable completely unaffected by the SARS epidemic as a dependent variable to conduct a regression analysis again to verify the exclusivity of the effect of the treatment variable on the dependent variable. Theoretically, significant DID estimator results indicate that the original results are likely to be biased. However, this could further enhance the credibility of our main results. As the SARS epidemic was a major public health emergency in history, it would not be affected by the current health status of residents. Thus, “whether or not you have been unwell in the past two weeks” was used as the dependent variable and the results are shown in Table 4. The coefficients of the main explanatory variables are significant, suggesting that that our main results, reported in Table 3, are robust.

(2) Follow-up certainty test. To reduce the potential uncertainty likely caused the survey design in which each respondent chose one value from the alternative choices as her or his donation, a certainty follow-up method was used to measure and test such uncertainty. After respondents chose the value of the donation, they were further asked to evaluate how sure they were about the answers they chose. The corresponding question was “What is your degree of certainty about the amount of donation you just selected?” The choices were from 0 to 10, with 0 to be totally uncertain and 10 to be completely certainty. Only samples with a certainty degree greater than or equal to 5 were included in the regression model.

(3) Data replacement test. Though previous studies have shown that online survey and field surveys are equivalent (Ekman et al., 2006), there are still some criticisms on the internet sampling method. Therefore, data obtained from the questionnaire survey specific to college students with strict probability sampling were used to conduct the robustness test. It was noted that since the subjects of this data set were all college students and their age was relatively concentrated, variables in birth cohort 4 and the interaction term SARS intensity × birth cohort 4 were not included in the regression model. The results are presented in column 4 of Table 4.

(4) Quality control test I. To ensure the quality of the samples collected, we randomly set a question which has nothing to do with the content of the questionnaire as a quality control test question. In this question, we told the respondents they need to answer it, so as to identify whether the respondents have answered the questions carefully or not. The question “Please answer the following question according to your actual feeling (the real answer is ‘relatively agree’)” had four options: “A: strongly disagree; B: relatively disagree; C: agree; D: relatively agree; E: strongly agree.” If the respondent does not choose the correct answer (D) or did not answer the question,
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Table 3
Basic regression results.

|                          | (1)       | (2)       | (3)       |
|--------------------------|-----------|-----------|-----------|
| Birth cohort 2           | -3.174    |           | -4.593**  |
|                          | (2.064)   |           | (1.974)   |
| Birth cohort 3           | 19.095*** |           | 9.628***  |
|                          | (2.816)   |           | (2.567)   |
| Birth cohort 4           | 18.188*** |           | 7.735***  |
|                          | (2.118)   |           | (2.719)   |
| SARS intensity           | 1.085***  |           | 0.876*    |
|                          | (0.410)   |           | (0.479)   |
| SARS intensity × Birth cohort 2 | 0.196    |           | 0.065     |
|                          | (0.661)   |           | (0.650)   |
| SARS intensity × Birth cohort 3 | 9.456*** |           | 9.229***  |
|                          | (3.472)   |           | (3.573)   |
| SARS intensity × Birth cohort 4 | -0.063   |           | 0.129     |
|                          | (0.56)    |           | (0.604)   |
| Residence type 1         |           | -0.905    | -1.462    |
|                          |           | (2.594)   | (2.510)   |
| Residence type 2         |           | 5.653**   | 5.571**   |
|                          |           | (2.39)    | (2.352)   |
| Perception of COVID-19 pandemic | 2.620**  |           | 2.476**   |
|                          |           | (1.028)   | (1.028)   |
| Diagnosis status of relatives and friends | 18.063**  |           | 18.100**  |
|                          |           | (7.3)     | (7.281)   |
| Diagnosis status of community/village/street | 3.403    |           | 3.83      |
|                          |           | (2.728)   | (2.656)   |
| Mortality rate           | 54.322**  |           | 61.394**  |
|                          | (27.497)  |           | (28.330)  |
| Gender                   | 5.615***  |           | 5.180***  |
|                          | (1.724)   |           | (1.697)   |
| Junior high school and below | -9.037*  |           | -11.029** |
|                          | (5.171)   |           | (4.992)   |
| High school              | -11.147** |           | -11.597***|
|                          | (4.352)   |           | (4.134)   |
| University and above     | -6.983**  |           | -5.467    |
|                          | (3.446)   |           | (3.630)   |
| Income below 10,000 yuan | -13.017***|           | -9.208*** |
|                          | (1.997)   |           | (2.032)   |
| Income over 100,000 yuan | 7.319*    |           | 5.932     |
|                          | (3.821)   |           | (3.697)   |
| Religious belief         | 4.272     |           | 3.762     |
|                          | (3.920)   |           | (3.899)   |
| Registered permanent residence | 2.06     |           | 1.346     |
|                          | (2.132)   |           | (2.214)   |
| Member of the Communist Party of China | 8.001***  |           | 5.520***  |
|                          | (1.745)   |           | (1.808)   |
| Self-rated health        | 1.36      |           | 1.797     |
|                          | (1.386)   |           | (1.366)   |
| Risk attitude            | -2.954*** |           | -3.292*** |
|                          | (0.843)   |           | (0.806)   |
| Trust in nonprofit organizations | 1.369    |           | 1.490*    |
|                          | (0.889)   |           | (0.863)   |
| Family size              | 0.144     |           | 0.109     |
|                          | (0.280)   |           | (0.283)   |
| Number of younger members | 0.847    |           | 0.695     |
|                          | (0.513)   |           | (0.506)   |
| Number of old members    | 0.421     |           | 0.772     |
|                          | (0.746)   |           | (0.772)   |
| Province dummy variable  | Controlled |           | Controlled |
|                          | 0.0524    |           | 0.0775    |
| R-squared                |           |           | 0.1013    |

Note: * significant at the 10% level; ** significant at the 5% level; ***significant at the 1% level; Robust standard errors in parentheses clustered by city.

(5) Quality control test II. There were differences in the time it took for respondents to complete the survey. Generally, the quality of a survey may be low if the time used to fill out the questionnaire is too short. Therefore, after considering the length of the questionnaire and the average time respondents might spend in filling out the questionnaire, respondents who spent fewer than 150 s to complete the survey were excluded from the test regression model with the estimation results reported in Table 4.

As shown in Table 4, the impacts of birth cohorts 2 and 4, as well as interaction terms SARS intensity × birth cohort 3 on netizens’
Table 4
Robustness test results.

|                      | Placebo test | Follow-up certainty test | Data replacement test | Quality control test I | Quality control test II |
|----------------------|--------------|--------------------------|-----------------------|------------------------|------------------------|
| Birth cohort 2       | 0.021        | –5.134**                 | –3.214*               | –4.370*                | –4.781**               |
|                      | (0.015)      | (2.061)                  | (1.769)               | (2.282)                | (1.981)                |
| Birth cohort 3       | 0.006        | 8.958**                  | 30.136***             | 7.910***               | 9.293***               |
|                      | (0.016)      | (2.651)                  | (7.235)               | (2.757)                | (2.604)                |
| Birth cohort 4       | –0.030       | 8.348***                 | –                      | 7.515**                | 7.185***               |
|                      | (0.017)      | (2.883)                  | (3.116)               | (2.729)                |                       |
| SARS intensity       | 0.005        | 0.801*                   | 19.136***             | 1.246**                | 0.888*                 |
|                      | (0.003)      | (0.491)                  | (2.877)               | (0.512)                | (0.478)                |
| SARS intensity × Birth cohort 2 | 0.002 | 0.144                  | 0.912               | –0.457                 | 0.063                 |
|                      | (0.006)      | (0.655)                  | (8.229)               | (6.643)                | (0.650)                |
| SARS intensity × Birth cohort 3 | 0.006 | 8.765**                  | 21.045***             | 13.153***              | 9.241***               |
|                      | (0.010)      | (3.549)                  | (8.143)               | (2.584)                | (3.576)                |
| SARS intensity × Birth cohort 4 | –0.003 | 0.190                  | –                      | –0.140                 | 0.115                 |
|                      | (0.003)      | (0.608)                  | (0.603)               | (0.598)                |                       |
| Control variable     | Controlled   | Controlled               | Controlled            | Controlled             | Controlled             |
| Observations         | 5113         | 4939                     | 1817                  | 4274                   | 5099                   |

Note: * significant at the 10% level; ** significant at the 5% level; ***significant at the 1% level; Robust standard errors in parentheses clustered by city.

willingness to donate were consistent with those in Table 3. The robustness checks discussed earlier ensured that spurious or confounding effects in our main results were not statistically significant.

4.4. Inter-group dissimilarity analysis

Group comparisons can be used to explore the impacts of the SARS epidemic experience on netizens’ willingness to donate toward COVID-19 pandemic prevention and control under different scenarios. Methods to achieve cross-model comparison of regression coefficients mainly include interaction terms in Seemingly Unrelated Regression (SUR) models. However, when interaction terms are used to analyze heterogeneity, a very strict assumption is imposed: only the coefficients of the core independent variables, rather than those of other control variables, can differ between the two groups. To address this strict assumption, this study used SUR tests based on seemingly uncorrelated models with relatively loose assumptions to explore the differences in the impact of the exposure to the SARS epidemic among residents with different education, health, and income levels. The results are shown in Table 5.

Table 5
Results of inter-group dissimilarities analysis.

|                      | Education level group | Self-rated health group | Income level group |
|----------------------|-----------------------|-------------------------|--------------------|
|                      | Low-education group   | High-education group    | Coefficient difference | Low-health group | High-health group | Coefficient difference | Low-income group | High-income group | Coefficient difference |
| Birth cohort 2       | –6.741 (5.597)        | –3.712* (2.197)         | –3.029 (P = 0.608) | 2.974 (3.544)    | –6.639*** (2.229) | (P = 0.022)           | –4.699*** (2.055) | 3.560 (P = 0.521)  | –8.259             |
| Birth cohort 3       | 20.657*** (5.959)     | 8.327*** (3.091)        | 12.330* (P = 0.077) | 16.258*** (4.618) | 7.316*** (2.617)  | (P = 0.086)           | 8.940* (2.592)     | 30.664*** (14.147) | –23.808            |
| Birth cohort 4       | 7.794* (4.406)        | 11.759*** (3.333)       | –3.965 (P = 0.476)  | 13.555*** (4.739) | 6.221* (3.659)    | (P = 0.239)           | 7.334 (2.809)      | 28.363*** (13.192) | –22.403            |
| SARS intensity       | 1.564 (1.659)         | 0.836 (0.537)           | 0.728 (P = 0.681)   | –0.957 (0.976)    | 1.012* (0.520)    | (P = 0.065)           | –1.969* (0.407)    | 8.964 (P = 0.019)  | 21.127**            |
| SARS intensity × Birth cohort 2 | –0.427 (1.939) | 0.171 (0.720) | –0.598 (P = 0.778) | 2.029** (1.027)  | –0.134 (0.827)    | (P = 0.094)           | 2.163* (0.068)    | 22.911** (9.065)   | –22.933**           |
| SARS intensity × Birth cohort 3 | 14.645* (8.211) | 9.256** (3.649) | 5.389 (P = 0.546) | 10.766** (4.995) | 9.825*** (2.989)  | (P = 0.871)           | 0.941 (3.157)      | 28.562*** (10.276) | –15.218            |
| SARS intensity × Birth cohort 4 | –0.157 (1.712) | –0.125 (0.592) | –0.032 (P = 0.986) | 1.667 (1.182)    | 0.313 (0.525)    | (P = 0.217)           | 1.354 (0.626)      | 20.976** (8.984)   | –20.349**           |
| Control variables    | Controlled           | Controlled              | Controlled          | Controlled         | Controlled         |                       | Controlled         |                       |                   |
| Constant             | 66.605*** (15.908)   | 32.196*** (7.998)       | –                  | 64.549*** (20.047) | 26.361*** (12.313) | –            | 42.228*** (8.408)   | 22.968             |                   |
| Observations         | 1221                 | 3892                    | –                  | 1671               | 3442              | –              | 4341               | 772                | –                  |
| R-squared            | 0.1489               | 0.1071                  | –                  | 0.1254             | 0.1173            | –              | 0.0876             | 0.1179             | –                  |

Notes: * significant at the 10% level; ** significant at the 5% level; ***significant at the 1% level; the empirical p value is shown in the bracket of coefficient difference, and the cluster (per city) robust standard error is shown in the other brackets.
5. Concluding remarks

This study aimed to assess the potential effect of previous health shocks on netizens’ willingness to donate toward COVID-19 pandemic prevention and control using the 2003 SARS epidemic in China as a quasi-experiment. Using data from 5113 respondents, this study has estimated a DID model by interacting an indicator for SARS intensity with a birth cohort variable. The results suggest that the level of netizens’ willingness to donate was closely related to their exposure to the SARS epidemic. With other conditions to be the same, residents who were exposed to severe SARS during their childhood-adolescence (when their ego and self-esteem were formed) had a high level of willingness to donate. This conclusion was validated after a series of robustness tests.

Differences in willingness to donate among residents with different education, self-rated health, and income levels were also explored. Residents who were exposed to severe SARS during their childhood-adolescence would have a higher level of willingness to contribute to Covid-19 pandemic prevention and control regardless of their education level, while those with low education level would be more affected. If those whose current health level was relatively high were exposed to SARS in their early childhood, their willingness to donate would be low. In addition, if those whose current income levels were high were exposed to SARS in early childhood and adulthood, their level of willingness to donate would be high. Similarly, if those whose income level was high were exposed to a more serious SARS epidemic in early childhood and adulthood, their level of willingness to donate toward COVID-19 pandemic prevention and control would be high.

Taken together, it can be concluded that netizens’ willingness to donate toward COVID-19 pandemic prevention and control is endogenous, reflecting at least in part qualities that relate to the exposure to the SARS epidemic, rather than being completely exogenous. Generally, this means that an individual’s previous experience might have a lasting and profound impact on their current behaviors and decision-making, and the experiences during the period of ego development and self-esteem formation might influence relevant decision-making after adulthood. The SARS epidemic that broke out at the end of 2002 as a worldwide public health event had an impact on residents of different ages in multiple regions. Exposure to the SARS epidemic had both short-term and continuous long-term effects. This implies that while coordinating epidemic prevention and control with economic and social development, the COVID-19 pandemic should also be treated as a typical prevention and control case to learn lessons from it to better cope with public health emergencies that may occur in the future. Therefore, the government should disseminate information on epidemic prevention and control, evoke positivity from the public, and provide timely responses to public concerns, leaving the public with the experience and memory of solidarity, optimistic and positive.

Though we attempt to explore the impact of SARS experience on Chinese netizens’ donations toward COVID-19 pandemic prevention and control, limitations still exist mainly in the following two aspects. First, because of the inconvenience caused by COVID-19, we conducted the investigation with an online survey. The online survey may cause a sample selection bias since people who had
access to the network were more likely to participate in the survey. Though we carry out the questionnaire survey based on probability sampling to test the robustness of the research results, it is undeniable that the problem of sample selection bias should not be completely avoided. Future research may make some attempts. For instance, with households’ contact information in various regions provided by local governments, scholars can randomly select some households for online research or telephone interviews. Second, though we propose several possible influence channels of SARS experience on netizens’ donation intentions toward COVID-19 pandemic prevention and control in the theoretical framework analysis based on the previous literature, we could not empirically test these channels in our manuscript due to the data limitations. Future research could analyze these issues when data are available.

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Appendix A. Appendix

Analysis has also been conducted for the whole sample of 5353 respondents, including the protest group of 166 respondents. The basic regression results of the whole sample are reported in Table A1. Regression results show that, although the interaction term of SARS intensity and birth cohort 3 had a positive effect, it is not statistically significant. This suggests that the impact of SARS intensity on donation was obviously underestimated, which indicates that protest responses do not explain the change of positive level of willingness to donate. In addition, as compared to the results in Table A1, the regression results in Table 3 that excluded the protest sample, showed that the impact of the interaction term of SARS intensity and birth cohort 3 is not only significantly larger, but the R-squared also increases from 0.0781 to 0.1013. This means that the explanatory power of the model in Table 3 is enhanced, suggesting that excluding protest sample would help to improve the accuracy of the estimation results.

Table A1

| Basic regression results (samples with protest answers included). | Coef.       | Cluster Robust Std. Err. |
|------------------------------------------------------------------|-------------|--------------------------|
| Birth cohort 2                                                   | −4.540**    | 1.949                    |
| Birth cohort 3                                                   | 9.937***    | 2.488                    |
| Birth cohort 4                                                   | 6.657**     | 2.671                    |
| SARS intensity                                                  | 0.653*      | 0.395                    |
| SARS intensity × Birth cohort 2                                  | 0.212       | 0.563                    |
| SARS intensity × Birth cohort 3                                  | 2.307       | 2.419                    |
| SARS intensity × Birth cohort 4                                  | −0.396      | 0.442                    |
| Residence type 1                                                | −1.345      | 2.477                    |
| Residence type 2                                                | 4.109*      | 2.266                    |
| Perception of COVID-19 pandemic                                  | 2.527**     | 1.050                    |
| Diagnosis of relatives and friends                              | 17.335**    | 7.233                    |
| Diagnosis in the community/village/street                       | 2.163       | 2.714                    |
| Mortality rate                                                  | 59.536**    | 27.696                   |
| Gender                                                          | 4.421***    | 1.668                    |
| Junior high school and below                                    | −10.460**   | 4.880                    |
| High school                                                     | −11.083***   | 4.148                    |
| University and above                                            | −5.986*     | 3.578                    |
| Income below 10,000 yuan                                        | −8.187****  | 2.068                    |
| Income over 100,000 yuan                                        | 4.478       | 3.854                    |
| Religious belief                                                | 3.600       | 3.791                    |
| Registered permanent residence                                   | 1.514       | 2.174                    |
| Member of the Communist Party of China                           | 6.883***    | 1.720                    |
| Self-rated health                                               | 1.624       | 1.343                    |
| Risk attitude                                                   | −3.729****  | 0.798                    |
| Trust in nonprofit organizations                                | 2.810***    | 0.848                    |
| Family size                                                     | 0.240       | 0.278                    |
| Number of younger members                                       | 0.527       | 0.514                    |
| Number of old members                                           | 0.664       | 0.720                    |
| Province dummy variable                                         | Controlled   |                          |
| Constant                                                        | 35.787***    | 8.143                    |
| Observations                                                    | 5353        |                          |
| R-squared                                                       | 0.0781      |                          |

Note: * significant at the 10% level; ** significant at the 5% level; ***significant at the 1% level; Robust standard errors in parentheses clustered by city.
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