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Behavioural Compliance with Personal Protection in Chinese Community-Dwellers During the COVID-19: Correlates and Indicators

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ABSTRACT

Objectives:

Examine compliance with personal protective measures in communities for the prevention and control of local transmission of the coronavirus (COVID-19), and explore indicators for such behavioral compliance.

Design:

Cross-sectional design. Data collected in February 2020.

Setting:

Community dwellers in China.

Participants:

2956 participants aged 16 and above completed the study and were included in the analysis.

Outcome measures:

Nationwide COVID-19 survey. Demographics and individual compliance with four major personal protective measures—home quarantine, mask-wearing, temperature-taking and hand-sanitizing were collected and recorded. Outbreak severity and timeliness of personal protection order were obtained from the China Centre Disease Control (China CDC) website. Linear and logistic regression models were employed to examine the association between demographic and social indicators and personal behavioral compliance.

Results:

An increasing age (β[95%CI]=2.58[2.38-2.78] and higher regional risk-exposure (β[95%CI]=0.16[0.12-0.20]) were independently associated with higher level of overall behavioural compliance. Male was found the least accordance with home quarantine order, whilst the most compliant with others. Younger adults (<21) abided the least with protective measures, whilst the middle-age group (21-49) was the most compliant group, except for home quarantine order.

Conclusion:

The non-compliance with public health mitigation measures was largely attributed to the male gender, and being in the middle-aged group. In light of ongoing pandemic, public health authorities should tailor the policy implementation to this specific demographic.

Strengths and limitations of this study

- To our knowledge, our study is the first to examine the effect of demographical and social correlates on the compliance of public health mitigation measures, especially social distancing, during the COVID-19 outbreak.
- Extensive data collected during the peak of the COVID-19 outbreak in China.
- Findings provide important insight into the motivations behind the lack of compliance to personal protection measures,

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especially during the heightened period of the outbreak, which can be used by public health authorities in the implementation of future mitigation measures.

- Although the study could examine the effect of age and gender on behavioral compliance, the effect of education and occupational status was limited due to the lack of data.
- Survey was available online only, hence sample limited to those with access to digital technology and Internet

INTRODUCTION

In light of the coronavirus disease 2019 (COVID-19) outbreak that started from December 2019, The Chinese Government has taken a number of strict mitigation strategies to expedite tracking, testing and treating COVID-19. To prevent and control the transmission of the virus in local communities, the aggressive social distancing order has been enforced nationwide in China as early as from January 25, 2020. Through strict compliance of Chinese citizens to the order, social distancing has been proven the most effective measure to ease the rapid spreading of the virus.[1 2]

A nationwide movement restriction order was announced by the Chinese government soon after the lockdown of Wuhan city on January 23, 2020. The social distancing order then has been introduced and enforced subsequently, requiring all citizens to remain at home and avoid most forms of face-to-face social contact when outside. The order was implemented with the recommendation of other personal protective measurements, such as regular hand sanitizing, daily temperature taking, and masking-wearing.[3]

The implementation of the social distancing order was challenging. Social distancing means staying away from mass gatherings and keeping a distance of 6 feet or 2 meters.[1] Due to the Chinese New Year celebration, which took place around the same time (January 25, 2020) when the outbreak happened, movements among cities and suburban areas, as well as family gatherings were inevitable and difficult to contain. Voluntary behavioural intervention during an infectious disease outbreak, such as social distancing, requires not only sufficient realization of the situation severity, but more importantly, determined commitment to such action from individuals in the community. Compliance with such action is not only determined by the severity of the disease, but also a number of demographic (e.g., gender) and interpersonal psychosocial factors.[4 5] Interestingly, while previous literature have demonstrated that older people and females are typically more likely to practice protective behaviors in public health emergencies such as the severe acute respiratory syndrome (SARS) and H1N1 swine flu, the results are mixed.[6 7] Hence in the present study, we sought to understand the demographic indicators and correlates of individual's compliance to social distancing during the COVID-19.

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METHODS

Study design and sampling

With a cross-sectional study design, two nationwide online surveys on the COVID-19 were carried out during February 14-20, 2020, among Chinese citizens in China. Community dwellers aged 16 and above were enrolled in the survey. To avoid bias in the sample, the study team disseminate the survey questionnaire in multiple provinces with different levels of risk exposure. All participants provided electronic informed consent prior to taking the survey. The study protocol was approved by the Ethics Commission of Zhejiang University prior to the commencement of the study and was in accordance with the Declaration of Helsinki. STROBE cross-sectional reporting guidelines were used.[8]

Questionnaires

De-identified demographic information (age, gender, current living area) was collected.

Outbreak Severity: Severity of the outbreak in each province and regions in all survey areas were sorted into 5 categories according to the confirmed coronavirus cases which was published on the China Center for Disease Control and Prevention (CDC) website on the day of the survey (February 14, 2020): <100 cases, 100-499 cases, 500-999 cases, 1000-1999 cases, >2000 cases.

Policy Timeliness: Timeliness of social distancing order implemented by the provincial government was assessed by the length (in days) between the implementation date of the social distancing order to the date of the survey. For those areas where the order was implemented after the survey, the score "0" was granted, e.g. Nei Meng province. Scores were subsequently transformed into fractional rank for analysis purpose.

Compliance to Mitigation Measures

Individual's compliance with a number of mitigation measures introduced by the local government, including:

1. home quarantine, as defined by leaving residential address for ≤1 in 3 days' time, as per the Chinese government's regulation;
2. mask-wearing, as defined by wearing a mask when leaving the residential address, as per the Chinese government's regulation;
3. daily temperature taking, as defined by taking one's own temperature at least once every day per the Chinese government's regulation;
4. daily hand sanitizing, as defined by sanitizing one's hands with a sanitizer with >75% alcohols per the Chinese government's regulation.

Statistical Analysis

Linear regression models were employed to examine the association between compliance to mitigation measures and demographic and social determinants. Logistic regression models were applied to investigate the indicators for accordance with each one of the mitigation measures. All analyses were performed using SPSS version 25 software, and statistical significance

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was determined as two-tailed p-value < 0.05.

Patient and Public Involvement

No patients and none of the public were involved in the study planning, design and interpretation of results. Results from the paper will be disseminated to the general public through online article format.

RESULTS

A total of 3,000 participants completed the survey, among whom, 7 had incomplete data and 37 had repeated answers and were removed from the dataset, leaving a total of 2,956 in the current analysis. All 2,956 subjects completed all questionnaires in the survey. Sample descriptives are in Table 1.

	Whole Sample	*Range*
Demographics		
Age (mean±SD)	28.5±8.6	16-72
Gender, female, n (%)	1178 (39.9%)	
Current Living Area, n (%)		
Extremely High Risk (≥2000 confirmed cases)	106 (3.5%)	
High Risk (1000-1999 confirmed cases)	667 (22.2%)	
Moderate-High Risk (500-599 confirmed cases)	770 (25.7%)	
Moderate Risk (100-499 confirmed cases)	1290 (43.0%)	
Mild-Moderate Risk (<100 confirmed cases)	167 (5.6%)	
The average length of implementation of mitigation measures, days (mean±SD)	15±5.1	0-20
Compliance to Mitigation Measures		
Social Distancing, compliant, n (%)	2234 (75.6%)	
Mask Wearing, compliant, n (%)	2353 (79.6%)	
Hand Sanitizing, compliant, n (%)	2257 (76.4%)	
Daily Temperature Taking, compliant, n (%)	2350 (79.5%)	

Table 1. Study sample descriptives

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Overall behavioural compliance

Linear regression analysis was done to examine the indicators for total compliance with mitigation measures. Among all demographics and social indicators, age (β[95%CI]=2.58[2.38-2.78] and regional risk-exposure (β[95%CI]=0.16[0.12-0.20]) were independently associated with an increased level of behavioural compliance.

Interestingly, a trend was noticed in the adverse association between timeliness of social distancing order in the local province (β[95%CI]=-1.31[-0.26-0.02]) and overall behavioural compliance.

Compliance with individual protective measures

Compliance with social distancing was associated with compliance with hand-sanitizing (χ^2=4.21, p=0.023), but not with mask-wearing and temperature-taking (p=0.07 and 0.08, respectively). Compliance with mask-wearing was significantly associated with temperature-taking (χ^2=493.11, p<0.001) and hand-sanitizing (χ^2=498.55, p<0.001). Compliance with temperature-taking was significantly associated with hand-sanitizing (χ^2=802.16, p<0.001).

Logistic regression analysis was employed to investigate the predictors for compliance with each mitigation measures: social, distancing, mask-wearing, temperature-taking and hand-sanitizing.

Results showed that gender (female) was the only significant indicator for accordance with home quarantine order; whilst male gender, higher exposure risk and age were positively associated with compliance with the other 3 measures (Table 2).

	Compliance vs. Non. Compliance OR (95%CI)
Home Quarantine	
Gender, Female	1.56 (1.31-1.87)
Mask-Wearing	
Gender, Male	1.76 (1.47-2.12)
Regional Risk-exposure	1.43 (1.30-1.57)
Age	1.03 (1.02-1.04)
Temperature-taking	
Gender, Male	1.29 (1.07-1.55)
Age	1.01 (1.001-1.02)
Regional Risk-exposure	1.02 (1.001-1.04)
Timeliness for Policy Implementation	1.018 (1.000-1.036)*

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Hand-sanitizing	
Age	1.02 (1.01-1.03)
Regional Risk-exposure	1.38 (1.26-1.50)

Table 2. Indicators for compliance with respective mitigation measures

**. Trend for significance (p=0.052)*

Gender-specific compliance with each personal protective measure is presented in figure 1. Whilst male was less prone to be compliant with home quarantine order; they were more likely to abide other 3 personal protective measures.

Interestingly, the mid-age group (21-49) was the most non-compliant age group for social-distancing, nevertheless also the most compliant group for other protective behaviors (Figure 2). Further stratified analysis showed that, in the 21-49 age group, those who are aged 31-40 were the least compliant to the social distancing order (OR=1.95, 95% CI=1.47-2.59), twice less likely to stay at home compared to the most compliant age group (<21 years of age), yet the most compliant group for mask-wearing (OR=1.86, 95%CI=1.38-2.52).

DISCUSSION

To our knowledge, the present study is the first to examine psychosocial indicators and correlates of the general public's compliance to personal protective measures during the COVID-19 outbreak in China. The main findings from the present study is that among all demographic and psychosocial factors, age and gender are the two main indicators for behavioural compliance to the protective measures.

Among all of the mitigation measures various countries have been taking in the COVID-19, social distancing has been the most emphasized measure, and proven the most effective one.[9] China introduced the strict social distancing order in February when the epidemic was spreading at an alarming rate and causing an increasing number of deaths in the nation.[3] The execution of such an order was combined with home quarantine, the shutdown of all public places, including shops, malls, restaurants and entertainment venues, and forbidding of mass gatherings. With such a rigorous combination, the domestic and global spreading speed of the virus showed a significant slowdown from mid-February till mid-March.[10]

In the present study, males were found less likely to be compliant with the social-distancing order (72% vs. 74%), nevertheless more likely to follow other personal protective approaches, such as mask-wearing (83% vs. 74%), temperature taking (81% vs.

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77%), and hand sanitizing (77% vs. 75%). One plausible explanation for the gender difference in the behavioral compliance is that males, especially in the mid-age group, are identified to be the pillar in the family hence during a public health emergency like the COVID-19, males are more expected to carry on with family errands and even go to work. In the present study, 87 reported violation of the home-quarantine order. Among whom, 60 went out for shopping/collection of essential goods (home supplies and grocery), with 67% of them being male. Apart from this, 24 reported to have left home for work purposes, among whom 67% were male. Our findings support previous literature that reported males were more likely to partake in riskier behaviors such as going to crowded places during the early stages of the COVID-19 outbreak in the Hubei Province and other parts of China.[5] While gender roles have become increasingly blurred in modern-day China, the male breadwinner model still exists in China's social fabric today.[11]. In relation to Confucian culture, the model posits a gender role divide between males and females where males undertake an 'outside' role and are expected to provide for the family, while females take on the caregiving role ('inside' role) to tend to household matters.[12-14] Qian and Qian[13] reported greater happiness in males when they are employed and providing for the family compared to females' employment status. Therefore, nonconformity to expectations of social roles particularly on the economic aspect may inevitably affect the health and welfare of both males and females. As a result, the conformity to role expectations in society may explain the non-compliance by males to social distancing measures as they are expected to continue providing for the family even during a public health crisis. Furthermore, gender only affected social distancing compliance in people above 21 years old, an age group where most working-class fall into, hence supporting our findings where more males reported leaving their homes for work purposes. While previous studies have shown that females are more likely to adhere to more avoidant behaviors such as hand washing and wearing masks,[6 7 15] the present study reported a higher likelihood for males to comply with those behaviors apart from social distancing. The present study found a higher percentage of men leaving the house for essential services, amongst which 53% reported moderate levels of anxiety, therefore demonstrating that levels of anxiety were high enough to encourage males to comply with other protective measures when they were out of the house or when they were not practicing social distancing.

Though gender played an important role in predicting compliance with home-quarantine in people aged 21 years old and above, it did not make a difference in people under 21 years old. Studies have shown that late adolescents tend not to comply with social distancing and stay home orders due to their likelihood in engaging in risky behaviors.[5] However, our study found that those aged between 16-21 were more likely to stay home, unlike people in the mid-age group, especially those between 31-40 years old. A possible explanation for the reduced social distancing and staying home compliance in the 31-40 age group is that a large number of these people may belong to the working class and may have to leave the house for work. Previous literature on pandemics (e.g., SARS) have reported high levels of anxiety in populations worldwide with a correlation between higher levels of anxiety and greater compliance to public health measures such as social distancing.[4] Perceived social support might play a

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crucial role in moderating individual's psychological resilience against such a crisis. Furthermore, greater perceived social support has shown to contribute to a greater sense of belongingness.[16] According to Maslow's hierarchy of needs, a sense of belonging is an important factor that drives human behavior.[17] Therefore, individuals who have greater perceived social support may be more likely to display greater social responsibility and comply with rules and recommendations set out to mitigate the COVID-19 outbreak, specifically through social distancing, because they may feel obligated to adhere to these rules to elicit a sense of affiliation and belonging as well as protect the vulnerable in their community in these times of uncertainty.

The present study has several strengths and weaknesses. To our knowledge, the present study is amongst the first to examine the effect of demographical and social correlates on the compliance of public health mitigation measures, especially social distancing, during the COVID-19 outbreak. Furthermore, the study was conducted during the peak of the spread of COVID-19 in China and gathered nationwide data from participants in China. Therefore, the findings obtained are especially vital in understanding the motivations behind the lack of compliance with mitigation measures, particularly during the heightened period of the outbreak. These results help inform public health authorities and political leaders in the way they implement mitigation measures and administer financial and psychological aid to the community. Notably, the present study lacked important demographic factors such as education level and occupational status, which could have further informed future mitigation measures. Moreover, as the study was conducted through an online survey, the sample was limited to those with access to digital technology and Internet. Therefore, we were unable to determine if this subset of the population complied to mitigation measures as well as the factors associated with it. Information obtained from this subset is essential as they may be more vulnerable to the virus due to lack of access to extensive public health awareness and mitigation measures online. While the lack of access to digital technology is a real limitation, future studies should attempt to reach out to this subset of the population. Retrospective studies could be conducted to assess their accordance with mitigation measures, specifically social distancing, and the role of psychosocial indicators and correlates on the compliance. Additionally, it would be interesting to examine the anxiety levels of those in the under 21 group that had a significant impact on their compliance with social distancing during the outbreak. Access to social media and overwhelming information provided by the media every day could be a factor that fueled the heightened levels of anxiety.

The non-compliance with public health mitigation measures, particularly home quarantine, was largely attributed to the male gender, and being in the middle-aged group. Our study found that while male in the mid-age group was least compliant with social distancing, they were most compliant to other measures (i.e., mask-wearing, hand-sanitizing, and temperature-taking), possibly due to the need to fulfil the role expectation of being the provider and breadwinner of the family. As the COVID-19 outbreak is still ongoing, public health authorities and governments could target this population in their future measures and aid that are provided during this pandemic.

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Contributors: XX and YQ conceptualized and designed the study. XX drafted the manuscript. YQ supervised data analysis and interpretation of data. XX, WZ and XXH acquired the data. XX and KAC analyzed and interpreted the data. WZ and XXH revised the manuscript for intellectual content. YQ and KAC critically revised the manuscript for intellectual content.

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Competing interests: None declared.

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Patient consent for publication: Not required.

Ethics approval: This study has been approved by the Ethics Commission of Zhejiang University (ID: ZGL202005-01). Informed consent was obtained from participants prior to taking part in the study.

Data availability statement: Data are available upon request. Original data can be requested from the study team (xuxinsummer@zju.edu.cn).

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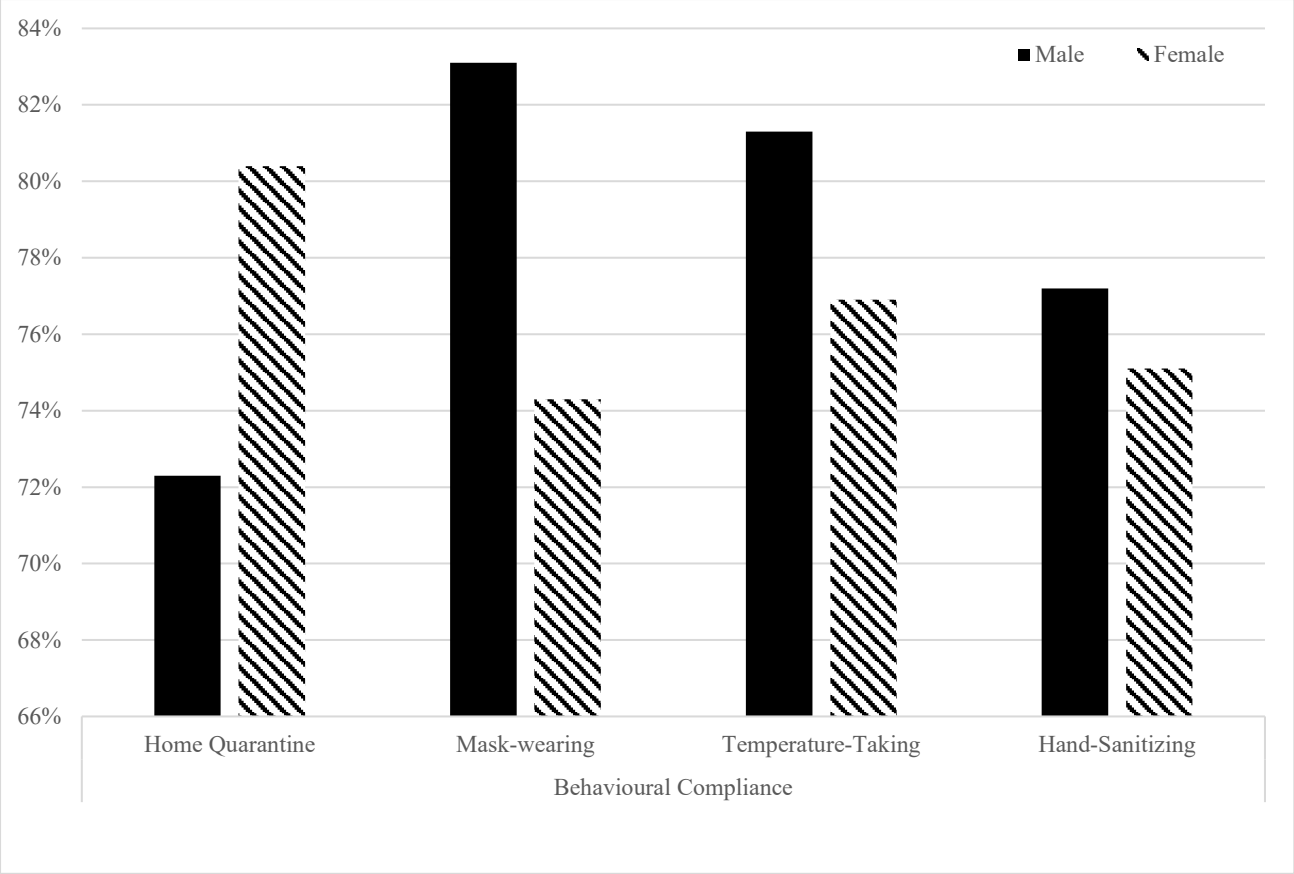

Figure 1. Gender-specific percentages for behavioural compliance

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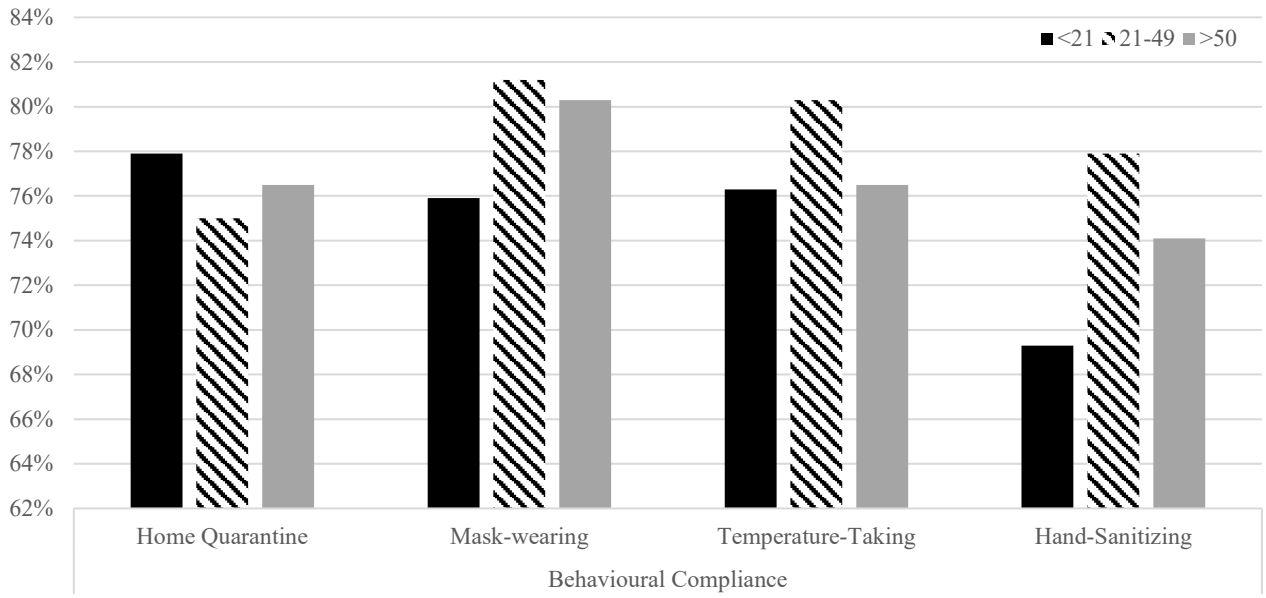

Figure 2. Age-specific percentages for behavioural compliance

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新型冠状病毒（2019-nCoV）肺炎

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课题名称：公共卫生科普宣传干预对稳定民众心理的大数据研究

申 请 者：杨 芊

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3	徐欣	1988 年 1 月	研究员	浙江大学医学院公共卫生学系	项目规划，问卷设计，数据分析及论文写作
4	张克俊	1979 年 4 月	副教授	浙江大学计算机科学与技术学院	数据挖掘，云计算，机器情感分析
5	叶元庆	1977 年 1 月	研究员	浙江大学医学院公共卫生学系	大数据计算，模型建立
6	吴健	1975 年 10 月	教授	浙江大学医学院公共卫生学系	大数据分析，技术指导
7	宋海东	1970 年 4 月	副主任医师	杭州市第七人民医院	心理健康干预和评估

8	张川霞	1983 年 5 月	中级	浙江大学党委宣传部	宣传渠道管理，数据获取
9	张紫徽	1975 年 9 月	无	浙江大学信息与技术中心	平台沟通协作，数据获取

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项目名称：公共卫生科普宣传干预对稳定民众心理的大数据研究

摘　　要：

正文：参照以下提纲撰写，要求内容翔实、清晰，层次分明，标题突出。

（一）立项依据与研究内容：

1．项目的立项依据；

2019 年 12 月中旬以来，中国湖北省武汉市短期内出现了以发热、咳嗽、乏力，呼吸不畅为主要症状的不明原因肺炎病例。各级政府、卫生健康行政主管部门高度重视，快速组织及空机构、医疗单位和科研院所展开调查、救治和协作攻关，迅速确定这类病例的病原为新型冠状病毒，世界卫生组织（WHO）确认并命名为 2019-nCoV，该病原感染所致的肺炎称为新型冠状病毒感染引起的肺炎。

公共卫生是“通过社会的有组织努力来预防疾病，延长寿命和促进健康的艺术和科学”。其工作范围包括环境卫生、控制传染病、进行个体健康教育、组织医护人员对疾病进行早期诊断和治疗，发展社会体制，保证每个人都享有足以维持健康的生活水平和实现其健康地出生和长寿。在传染病的防治中，公共卫生专家的角色必不可少。在此次肺炎疫情，公共卫生的贡献不仅仅是病毒检测，2019-nCoV 的特点是毒性弱而传染性强，未表现出症状的潜伏期感染者也具有传染性，且 2019-nCoV 作为烈性传染病，其特效药和疫苗的开发具有相对长的周期，这决定了防控工作的重点放在了科学地识别、上报和隔离上。

因此，这次疫情防控的希望是切断传播，所以要谨防恐慌，号召居家隔离、在有效利用医疗资源的前提下促进健康行为。近期有很多网络评论地方政府失能造成事件升级，但对于政府在疫情这种突发性公共卫生事件的情景下，明确多少程度的真相披露老百姓是可以承受的，不会引起恐慌，但足以引起重视；以及对不同人群采取合适的宣传途径和方式，对政府采取合理的公卫宣传措施、增进公信力、维护社会稳定和促进防控工作是非常有指导意义的。

新型冠状病毒（以下简称为新冠病毒）感染的肺炎给人民健康带来了严重威胁。为了增进大众以及有关专业人员对新冠病毒的认识和

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理解，指导个人预防，降低传播风险，从 2020 年 1 月 25 日起，以浙江大学公共卫生学院为首开始了一些列针对公众的科普宣传，为疫情防控贡献了很多力量。这些宣传内容包括考虑专门针对负面情绪和认知功能下降的小视频、专门针对本次疫情细节的《50 个防控关键问题》问答宣传、大众自我居家防护行为、学在浙大平台的疫情知识网络课程、杭州电视台的疫情解读及预测系列访谈等等。

本项目希望能评估公卫科普宣传的效果，包括不同宣传途径和平台，比如媒，手机（微信朋友圈、QQ、各大网络平台），电脑，电视，或者河南乡下那种敲锣打鼓的公卫宣传，对疫情的健康行为信息起到的接受和依从效果（normless behavior），以及心理健康反应（恐慌，应激和创伤后成长）。

拟通过建立突发公共卫生事件中的心理行为社会学模型，为不同年龄、受教育程度、居住地、感染状态的人群设立最合适的公卫宣传教育途径，最大化信息接收效果、促进健康行为的依从、防止社会恐慌、促进创伤后成长、保护医务人员、增加政府公信力、为政府谏言最合理的公卫宣传社会治理方式。

2. 项目的研究内容（包括研究方案、可行性分析，以及拟解决的关键科学问题）

2.1 研究模块：

本项目的研究主要包括以下几个模块：

模块一 **公共卫生科普宣传的信息接受渠道和防控效果的大数据调查**。拟利用大数据的分析方法，探究占主流地位的公共卫生宣传的信息接受渠道并建立与不同等级疫区活动匹配的大数据模型。

模块二 **公共卫生科普宣传渠道和疫情人群匹配的大数据模型建立**。拟评估公卫科普宣传在心理健康、健康知识信念和公信力提升方面的效果。

模块三 **基于阿里大数据平台的公卫宣传模型的防控效果研究**。基于阿里集团的支付和便民平台，针对不同疫区和感染状态的民众活动精准推送公卫宣传科普信息，并验证防控效果

2.2 拟解决的关键科学问题

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本课题主要拟解决以下关键科学问题：

2.3.1 不同信息传播渠道或途径中民众的接受程度分别如何？不同疫情地区、不同角色和不同感染状况的人群分别偏好哪一种或哪几种途径的公卫宣传途径？

2.3.2 不同公卫科普宣传的传播途径在不同疫情地区、不同角色和不同感染状况的人群中的传播效果有何差异？组合的选项有哪些？对于心理健康、行为健康知识信念和公信力的效果促进是最好的？

2.3.3 本项目所提出的公共卫生宣传的大数据模型，在阿里的支付和便民平台上推广后，是否能收获好的防控治理效果？需要做哪些优化与完善？

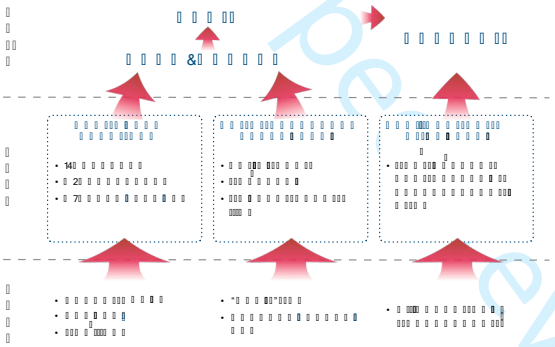

图 1 研究流程技术路线图

3. 本项目的特色与创新之处；

3.1. 立项基础深厚扎实--本项目是基于目前浙大公卫学院在本次疫情防控工作中宣传工作的标杆作用，继续深度展开。浙大公卫在本次疫情防控工作中火速响应、全心投入，为大众科普防控知识、减轻大众心情压力、提倡积极行为与健康生活方式作出了大量贡献。

3.2. 研究内容独具特色--该项目不仅仅是对大众心理健康的调查，更是突破表层心理反应，去深究大众媒体以及大众获得信息渠道的差异对心理的影响。充分体现了时代的特征。

针对大众心理健康及心理疏导的很多。各大高校和科研机构都已开展了疫情防控的心理学调查。然而，除考虑疫情本身对心理的影响外，在当下的海量信息时代，疫情信息的带来的心理健康问题也不容忽视。信息的来源、内容的真伪、信息传播的途径等关键因素都会影

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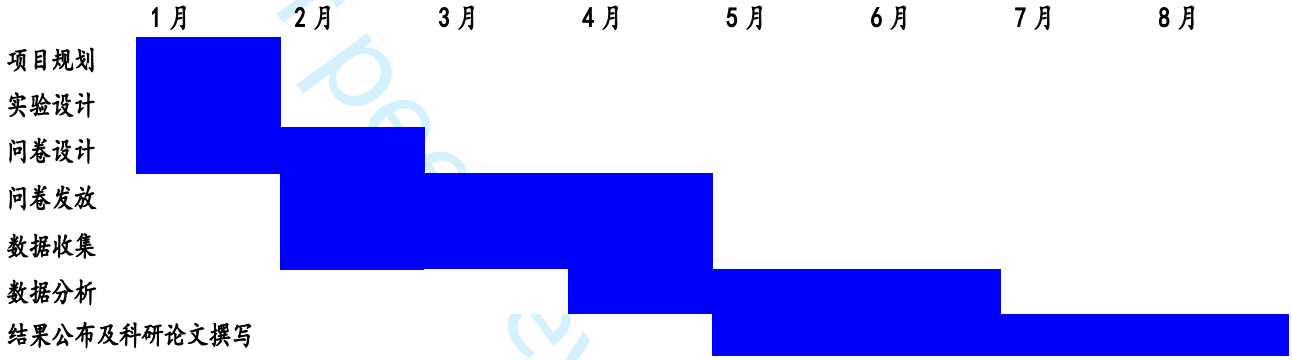
响大众对疫情发展和国家防控工作效率的判断。而这些判断，则会进一步影响大众的心理健康。

3.3. 研究团队交叉多样化--本项目齐聚多专业，多领域的专家，充分体现了交叉学科的优势。本项目由公卫学院牵头，计算机学院、传媒学院、宣传部、信息技术部鼎力支持，还有北京大学的科研团队配合。在科研实力、实践操作和数据平台方面具有优势。这为项目的转化提供了支撑，方便指导今后公卫突发事件的科普精准宣传和心理疏导工作。

4．进度安排及预期研究结果。



（二）研究基础与工作条件

1．已取得的研究工作基础积累及水平，包括创新性研究成果、在国内外同行中的水平及优势；

1.1. 在国内外同行中的水平及优势

项目申请人目前身处湖北疫区，对此次危机，尤其是宣传带来的心理健康和行为模式影响有深刻的切实体会。虽然不少高校的研究团队受疫情互联网传播的启发，开展相关研究，但浙江大学公共卫生学院行动最为迅捷、宣传力度最大，不仅在自己的疫情防控平台上进行了科普宣传，还通过浙江大学官方微博和钱江财经频道、人民网、科学网等等新媒体平台发布了一些列针对疫情的公共卫生宣传，甚至建立了自己的疫情平台，本项目的核心成员均担任浙大疫情宣传的核心策划与制作人。

表 1 浙江大学公共卫生学院已发布的疫情相关宣传科普信息

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信息类型	标题	主创/嘉宾	日期
视频	新型冠状病毒感染的肺炎疫情防控小知识	杨芊	1.27
文章	50 个防控关键问题	朱益民	2.1
视频	这些居家小细节，祝您远离病毒	徐欣、吴息凤	2.2
电视直播	众志成城，防控疫情	吴息凤、宋海东等	2.2
视频	“终于来了！轮到我宅家立功了！”	杨芊、吴息凤、张克俊	2.3
视频	疫情面前显担当	赵灿、吴息凤	2.4
视频	隔离在家不知所措，浙大家齐来帮你	杨芊、吴息凤、张克俊	2.5
视频	心理疏导有干货，浙大家齐来教你	杨芊、吴息凤、张克俊	2.5
视频	预防新冠肺炎饮食须知	杨敏	2.6

申请人及课题组核心成员有浙江大学流行学和大数据研究的重量级专家教授和百人研究员，也有来自北京大学心理学院自非典以后就主持国家级公共卫生应急项目的心理学专家教授，还有两位具有计算机科学技术专业背景，擅长数据挖掘、云计算、情感分析的教授和专家。研究团队长期从事公共卫生心理健康、健康行为、公共卫生应急管理、大数据的理论和实证研究，并且在这些领域有着较为丰富的学术成果（见 1.3 创新性研究成果部分）。

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1.2. 已取得的研究工作基础累积及水平

1.2.1 面向公众的公共卫生科普宣传途径和效果的大数据研究

以政府宣传手册和《第 44 次中国互联网发展统计报告》等官方材料为依据，项目组已对常见的面向公众的公共卫生科普宣传途径进行科学分类，开发针对信息接受渠道的问题，并完成了疫情相关的大数据调查，覆盖全国所有省份，第一轮回收网络平台有效问卷 2000 多。

本项目合作方北京大学心理与行为科学院的研究团队从 1 月 31 日开始收集基线数据，开展为期 14 天的问卷跟踪研究。而浙江大学从数据收集的第 2 天开始在浙江大学官方微博、人民网、科学网等主流媒体陆续上线本团队策划的针对本次疫情的公共卫生科普宣传视频、文章，并与杭州文广集团合作电视节目等科普信息。

同时，本项目已从跟踪研究的第 7 天开始，嵌入面向公众的公共卫生科普宣传途径和效果有关信息接受渠道的问题。并另外采取滚雪球的问卷发放方法收集信息渠道和与防控效果有关的问卷数据，包括抑郁和焦虑的权威性心理健康标准化量表、社会支持准化量表、甄别谣言和科学行为健康信息的判断题和有关政府公信力和医院关系的问题。

相关数据将与模块二的数据进行交叉分析，为建立公共卫生科普宣传的信息接受渠道与不同等级疫区活动匹配的大数据模型提供依据。

1.2.2 基于高校网课平台的公共卫生科普课程和防控效果研究

疫情期间，很多学校都推迟了开学，然而科研和学习不应该中断。浙江大学信息技术中心面对目前师生居家不便外出的特殊情况，为做好线上防疫工作、时刻保障师生返校前后激增的信息化需求，在“学在浙大”网络平台上上线了一些列有防疫期特色的网络课程，其中，包括项目申请人主讲的《新型冠状病毒肺炎科普》，利用学在浙大平台覆盖全校师生用户的传播力，已设计好将模块一所涉及到的变量调查放在学在浙大平台进行施测，并进行课前课后比较和上过课 vs 没上过课的匹配对照比较，提供不同学科、不同年龄、不同隔离状况和疫区的学生的心理、行为、思想等防控数据，为模块一的模型构建提

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供补充。

1.2.3 基于阿里集团的支付和便民平台的大数据科普投放研究

阿里集团旗下有支付宝、淘宝等支付平台和医疗、健康等便民平台，这些数据为我们精准区分不同疫情地区、不同角色和不同感染状况的人的活动空间、时间和重要生活活动提供了支撑。基于上述两项研究中构建的模型，在进行公共卫生科普宣传时，本项目会根据不同疫情地区、不同角色和不同感染状况的人针对性地筛选和制作科普材料和宣传方案，以此来获得心理健康、行为健康和稳定民心的综合防控效果。

1.3. 创新性研究成果

本团队共计主持省级以上基础研究计划项目数百项，合计经费超过1亿美金，篇幅所限每位参与者仅列与项目最相关的3项。

杨芊主持的项目：

1) 国家自然科学基金面上项目，71974170，医患关系中“替罪羊”效应的消减与社会心理治理研究，2020/01-2023/12，48.5万元。
2) 国家自然科学基金青年科学基金项目,71603233,“替罪羊”理论对社会转型时期患方医暴倾向心理机制的解释和干预研究，2017/01-2019/12，17万元。
3) The International Union Against Tuberculosis and Lung Disease,China-RI1-15,Tobacco Control Courses in Smoke-free Universities with Public Health Faculties, 2010/01-2011/12, $199,855。

吴息凤主持的项目：

1) Principal Investigator, Molecular Pathways Linking Obesity and RCC Tumorigenesis (PQ1), R01 CA170298, NIH/NCI, 9/1/2012-6/30/2018, ~$2,800,000
2) Multiple Principal Investigator, Transdisciplinary Research in Cancer of the Lung (TRICL), U19 CA148127, NIH/NCI, 7/9/2010-6/30/2014, ~$4,559,755

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3) Principal Investigator, Genome-Wide Association Analysis of Bladder Cancer, U01 CA127615, NIH/NCI, 4/1/2008-3/31/2015, ~$4,803,014

王垒主持的代表性项目：

1) 国家自然科学基金重大研究计划集成项目“非常规突发事件应急项目”子课题
2) Co-PI:国家自然科学基金重大项目，91224008，非常规突发事件应急管理基础科学问题与“情景-应对”型总集成升华平台研究，2013/01-2016/12,1500 万元。
3) Co-PI:国家自然科学基金重大项目，91324201，非常规突发事件下社会群体心理与行为变化规律和机制，2014/01-2016/12,200 万元。

吴健主持的项目：

1) PI：国家自然科学基金面上项目，61672453，移动互联网环境下的 API 发现与聚合研究,2017/01-2020/12,63 万元。
2) National Science and Technology Supporting Program of China ，2015BAH18F02（国家科技支撑计划资助项目基金）
3) National Key Science and Technology Research Program of China ，2013AA01A604（国家科技攻关计划）

叶元庆主持的项目：

1) PI: Next generation sequencing to identify novel colorectal cancer genes, R01 CA177935, NIH/NCI, PI - Multiple PI mechanism with Yuanqing Ye as contact PI and Chad Huff as co-PI, 2014/06-2019/04, $3,314,158.
2) PI: Predicting the risk of developing lung cancer: A multigenic statistical approach to microRNA, Duncan Family Institute - Seed Funding Research Program Grant, Duncan Family Institute for Cancer Prevention and Risk Assessment, 2010/03-2012/02,

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$100,000

3) PI: A pilot study of global serum metabolomic profiling and lung cancer risk, P50 CA070907, UT SPORE in Lung Cancer Development Award, 2011/11-2012/04, $23,750

张克俊主持的项目

1) 2019-2022 浙江省重点自然科学基金，多模态数据驱动的音乐积极情感反馈与生成模型研究，负责人 2014-2018 中国工程科技知识中心，创新设计知识服务系统，子课题负责人

2) 2016-2019 国家重点研发计划课题，大数据驱动的气溶胶光学物理属性统计与分析，负责人

3) 2014-2016 国家自然科学基金，基于云模型的音乐情感表示与识别研究，负责人

徐欣主持的项目：

1) PI: NUS-Cambridge Seed Funding, 2017 （SGD 30,000）

2) Co-PI: NUS Centre For Healthy Ageing Funding, 2018 （SGD 500,000）

2. **工作条件；**

• 本项目合作方北京大学心理与行为科学院的研究团队从 1 月 31 日开始收集基线数据，开展为期 14 天的问卷跟踪研究，为项目的成果开展提供了基线数据、问卷嫁接平台和对比机会。

• 本项目的三位主要参与者都具有计算机科学背景，并与阿里集团签署了数据合作协议，在数据挖掘、云计算、情感分析等方面有坚实的理论、技术和实践基础。为达到精准投放公卫宣传效果最好的信息，并通过阿里的数据平台收集阅读、点赞、使用、评论等用户数据，验证模型的推广使用效果提供了切实的保证。

• 本项目的主要参与者来自浙江大学宣传部和浙江大学信息技术中心，对于研究对象——公共卫生宣传科普材料——的制作、发行和网络问卷的嵌入和网络行为的跟踪提供了完美的支持。其中，宣传

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部将会对接转发的各大媒体平台，信息技术中心旗下的“学在浙大”网课平台将会设计课后练习、计算机学院将会解决微信官网的代码插入，跟踪朋友圈阅读、转发等数据以及网络评论的分析计算等。

• 杭州第七医院在精神卫生和心理健康工作方面有丰富的经验，而且拥有隔离病房。其它团队成员具有良好的科研素质和相关领域的项目经验、研究成果。梯队构成合理，团队的科研实力能够保证课题的有效开展和顺利完成。

（三）资金需求与预算

资金预算合计 38 万元，说明如下：

1. 设备费 9 万元，用于模型计算和数据存储的服务器购买。

2. 材料费 1.5 万元，主要用于购买与项目相关的纸质和电子书籍、文献等材料。其中 0.5 万元拨付给合作单位，用于调查相关开支。

3. 差旅费 0.5 万元，用于调研人员在市内调研时产生的出行费用，如出租车和其他公共交通的支出。

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Based on the STROBE cross sectional guidelines.

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Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

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		Reporting Item	Page Number
Title and abstract			
Title	#1a	Indicate the study's design with a commonly used term in the title or the abstract	1

Abstract	#1b	Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background / rationale	#2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	#3	State specific objectives, including any prespecified hypotheses	3
Methods			
Study design	#4	Present key elements of study design early in the paper	4
Setting	#5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4
Eligibility criteria	#6a	Give the eligibility criteria, and the sources and methods of selection of participants.	4
	#7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	n/a
Data sources / measurement	#8	For each variable of interest give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. Give information separately for for exposed and unexposed groups if applicable.	4

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Bias	#9	Describe any efforts to address potential sources of bias	4
Study size	#10	Explain how the study size was arrived at	5
Quantitative variables	#11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	5
Statistical methods	#12a	Describe all statistical methods, including those used to control for confounding	4
Statistical methods	#12b	Describe any methods used to examine subgroups and interactions	5
Statistical methods	#12c	Explain how missing data were addressed	5
Statistical methods	#12d	If applicable, describe analytical methods taking account of sampling strategy	n/a
Statistical methods	#12e	Describe any sensitivity analyses	n/a
Results			
Participants	#13a	Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed. Give information separately for for exposed and unexposed groups if applicable.	5
Participants	#13b	Give reasons for non-participation at each stage	5

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Participants	#13c	Consider use of a flow diagram	n/a
Descriptive data	#14a	Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders. Give information separately for exposed and unexposed groups if applicable.	5
Descriptive data	#14b	Indicate number of participants with missing data for each variable of interest	5
Outcome data	#15	Report numbers of outcome events or summary measures. Give information separately for exposed and unexposed groups if applicable.	4
Main results	#16a	Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	6
Main results	#16b	Report category boundaries when continuous variables were categorized	6
Main results	#16c	If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	#17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses	6
Discussion			
Key results	#18	Summarise key results with reference to study objectives	7

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Limitations	#19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.	9
Interpretation	#20	Give a cautious overall interpretation considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.	7-9
Generalisability	#21	Discuss the generalisability (external validity) of the study results	9
Other Information			
Funding	#22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	10

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Behavioural Compliance with Personal Protection Among Chinese Community-Dwellers During COVID-19: Correlates and Indicators

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Behavioural Compliance with Personal Protection Among Chinese Community-Dwellers During COVID-19: Correlates and Indicators

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Key words: covid-19 coronavirus, behavioural compliance, social distancing, personal protective measures

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ABSTRACT

Objectives:

Examine compliance with personal protective measures in communities for the prevention and control of local transmission of the coronavirus (COVID-19), and explore indicators for such behavioural compliance.

Design:

Cross-sectional design. Data collected in February 2020.

Setting:

Community dwellers in China.

Participants:

2956 participants aged 16 and above completed the study and were included in the analysis.

Outcome measures:

Nationwide COVID-19 survey. Demographics and compliance with four individual major personal protective measures—home quarantine, mask-wearing, temperature-taking and hand-sanitising were collected and recorded. Outbreak severity and timeliness of personal protection order were obtained from the China Centre Disease Control (China CDC) website. Linear and logistic regression models were employed to examine the association between demographic and social indicators and personal behavioural compliance.

Results:

An increasing age (β[95%CI]=0.059[0.003-0.012] and higher regional risk-exposure (β [95%CI]=0.155[0.131-0.209]) were independently associated with higher level of overall behavioural compliance. Males were found the least accordant with home quarantine order, whilst the most compliant with others. Younger adults (<21) abided the least with protective measures, whilst the middle-age group (21-49) was the most compliant group, except for home quarantine order.

Conclusion:

The non-compliance with public health mitigation measures was largely attributed to the male gender, and being in the middle-aged group. In light of ongoing pandemic, public health authorities should tailor the policy implementation to this specific demographic.

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Strengths and limitations of this study

- Extensive data collected during the peak of the COVID-19 outbreak in China ($n_{completed}$ = 2956).
- Data was collected from multiple provinces with various levels of risk exposure to avoid bias in the sample (categorised using the number of confirmed cases reported by China CDC).
- The effect of other demographical variables (e.g., education, occupational status) was limited due to the lack of data.
- Survey was available online only, hence sample was limited to those with access to digital technology and Internet.
- More mental health-related questionnaires (e.g., depression, anxiety) should be collected and analysed as potential indicators for behavioural compliance.

INTRODUCTION

In light of the coronavirus disease 2019 (COVID-19) outbreak that started in December 2019, the Chinese Government has taken a number of strict mitigation strategies to expedite the tracking, testing and treatment of COVID-19. To prevent and control the transmission of the virus in local communities, the aggressive social distancing order has been enforced nationwide in China as early as from January 25, 2020. Notably, prevention and control measures were implemented in three phases: 1) suspension of intra-city and intercity transportation, and strict control of importation and exportation of COVID-19 cases from Wuhan and other provinces, 2) delaying the severity and rise in cases through several safety measures, 3) decreasing clusters, using standardised protocols and execution of "scientific evidence-based policy". Examples of such measures include the closure of wet markets, contact tracing, temperature-taking, health declarations, quarantine, disallowing large gatherings, and implementation of strict travel restrictions.[1 2] Through strict compliance of Chinese citizens to the order, social distancing has been proven the most effective measure to ease the rapid spreading of the virus.[3 4]

Among all prevention and control measures, a nationwide movement restriction order was announced by the Chinese government soon after the lockdown of Wuhan city on January 23, 2020. This social distancing order was introduced and enforced subsequently, requiring all citizens to remain at home and avoid most forms of face-to-face social contact when outside.

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The order was implemented with the recommendation of other personal protective measurements, such as regular hand sanitising, daily temperature-taking, and mask-wearing.[5]

The implementation of the personal protection order was challenging. Social distancing means staying away from mass gatherings and keeping a distance of 6 feet or 2 meters.[3] Due to the Chinese New Year celebration, which took place around the same time (January 25, 2020) when the outbreak happened, movements among cities and suburban areas, as well as family gatherings were inevitable and difficult to contain. Voluntary behavioural intervention during an infectious disease outbreak, such as social distancing, requires not only sufficient realisation of the situation severity, but more importantly, determined commitment to such action from individuals in the community.

Hence prior to the enforcement of the nationwide home quarantine order, the Chinese government announced a series of precautionary regulations, including 1) refusal of entry into public places without wearing a mask and obtaining a normal body temperature; 2) set-up of a detailed individual purchase record of fever/cough/flu-related medications in local pharmacies; 3) screening and a detailed registry of suspected cases with high fever in the community. The entire enforcement was accompanied by thorough public health education and promotion which started as early as late January. Violation of the above-mentioned regulations could result in further investigation or even legal liability.[6]

After the implementation of the four personal protective behaviours, including home quarantine, mask-wearing, temperature-taking, and hand-sanitising, non-compliance would lead to strict education and immediate correction from various levels of management, ranging from the street and community, to district and city levels of local authority.

The implementation of these personal protective behaviours is necessary. However, compliance to these actions is not only determined by the severity of the disease, but also a number of demographic (e.g., gender, age) and interpersonal psychosocial factors.[7 8] Interestingly, while previous literature have demonstrated that older people and females are typically more likely to practice protective behaviours in public health emergencies such as the severe acute respiratory syndrome (SARS) and H1N1 swine flu, the results are mixed.[9 10] Hence in the present study, we sought to understand the demographic indicators and correlates of individuals' compliance to social distancing during COVID-19.

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METHODS

Study design and sampling

With a cross-sectional study design, a nationwide online survey on behavioural compliance during COVID-19 was carried out during February 14-17, 2020, among Chinese citizens in China. Community dwellers aged 16 and above were enrolled in the survey. To avoid bias in the sample, the study team disseminated the survey questionnaire in multiple provinces with different levels of risk exposure. All participants provided electronic informed consent prior to taking the survey. The study protocol was approved by the Ethics Commission of Zhejiang University prior to the commencement of the study and was in accordance with the Declaration of Helsinki. STROBE cross-sectional reporting guidelines were used.[11]

Questionnaires

De-identified demographic information (age, gender, current living area) was collected.

Outbreak Severity: Severity of the outbreak in each province and regions in all survey areas were sorted into 5 categories according to the confirmed coronavirus cases published on the China Center for Disease Control and Prevention (CDC) website on the day of the survey (February 14, 2020): <100 cases, 100-499 cases, 500-999 cases, 1000-1999 cases, >2000 cases.

Policy Timeliness: Timeliness of the social distancing order implemented by the provincial government was assessed by the length (in days) between the implementation date of the social distancing order to the date of the survey. For those areas where the order was implemented after the survey, the score "0" was granted, e.g. Nei Meng province. Scores were subsequently transformed into fractional rank for analysis purposes.

Compliance to Mitigation Measures

An individual's compliance with a number of mitigation measures introduced by the local government was defined as:

1. home quarantine, as defined by leaving residential address for ≤1 in 3 days' time, as per the Chinese government's regulation;

2. mask-wearing, as defined by wearing a mask when leaving the residential address, as per the Chinese government's regulation;

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3. daily temperature-taking, as defined by taking one's own temperature at least once every day per the Chinese government's regulation;

4. daily hand-sanitising, as defined by sanitising one's hands with a sanitiser with >75% alcohol per the Chinese government's regulation.

Overall compliance is defined as the sum of compliance score on 4 protective behaviours, rated at 0 (none), 1 (compliant with 1 behaviour), 2 (compliant with 2 behaviours), 3 (compliant with 3 behaviours), and 4 (compliant with all 4 behaviours).

Statistical Analysis

Linear regression models were employed to examine the association between overall compliance to 4 mitigation measures and demographics, including age as a continuous variable, and gender, as well as social determinants such as regional risk exposure and days to regional implementation of mitigation measures. Logistic regression models were applied to investigate the indicators for accordance with each individual mitigation measure. All analyses were performed using SPSS version 25 software, and statistical significance was determined as two-tailed p-value < 0.05. Bonferroni correction was employed to obtain an adjusted significance level for each protective behaviour: $\approx 0.05/4=0.0125$.

Patient and Public Involvement

No patients and none of the public were involved in the study planning, design and interpretation of results. Results from the paper will be disseminated to the general public through online article format.

RESULTS

A total of 3,000 participants completed the survey, among whom, 7 had incomplete data and 37 had repeated answers and were removed from the dataset, leaving a total of 2,956 in the current analysis. All 2,956 subjects completed all questionnaires in the survey. Sample descriptives are in Table 1.

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Table 1. Study sample descriptives

	Whole Sample	Range
Demographics		
Age (mean±SD)	28.5±8.6	16-72
Gender, female, n (%)	1178 (39.9%)	
Current Living Area, n (%)		
Extremely High Risk (≥2000 confirmed cases)	106 (3.5%)	
High Risk (1000-1999 confirmed cases)	667 (22.2%)	
Moderate-High Risk (500-599 confirmed cases)	770 (25.7%)	
Moderate Risk (100-499 confirmed cases)	1290 (43.0%)	
Mild-Moderate Risk (<100 confirmed cases)	167 (5.6%)	
Average length of implementation of mitigation measures, days (mean±SD)	15±5.1	0-20
Compliance to Mitigation Measures		
Social Distancing, compliant, n (%)	2234 (75.6%)	
Mask-Wearing, compliant, n (%)	2353 (79.6%)	
Hand-Sanitising, compliant, n (%)	2257 (76.4%)	
Daily Temperature-Taking, compliant, n (%)	2350 (79.5%)	

Overall behavioural compliance

Linear regression analysis was done to examine the indicators for total compliance with mitigation measures. Among all demographics and social indicators, age (β[95%CI]=0.06[0.003-0.012] and regional risk-exposure (β [95%CI]=0.155[0.131-0.209]) were independently associated with an increased level of behavioural compliance (Table 2).

Table 2. Indicators of overall behavioural compliance levels

	Beta (95% CI)
Age	**0.06 (0.003, 0.012)**
Gender (female)	-0.07 (-0.15, 0.01)
Regional Risk-exposure	**0.16 (0.13, 0.21)**
Timeliness for Policy Implementation	0.02 (-0.003, 0.01)

Boldface indicates p<0.05

Compliance with individual protective measures

Compliance with social distancing was positively associated with compliance with hand-sanitising (χ^2=4.21, p=0.023), but not with mask-wearing and temperature-taking (p=0.07 and 0.08, respectively). Compliance with mask-wearing was positively associated with

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temperature-taking (χ^2=493.11, p<0.001) and hand-sanitising (χ^2=498.55, p<0.001). Compliance with temperature-taking was positively associated with hand-sanitising (χ^2=802.16, p<0.001).

Logistic regression analysis was employed to investigate the predictors for compliance with each mitigation measure: social distancing, mask-wearing, temperature-taking and hand-sanitising.

Results showed that higher risk-exposure was positively associated with compliance with all measures except home quarantine. Advanced age was also borderline associated with higher compliance with all measures (p<0.05) except home quarantine (inverse association). Interestingly, whilst the female gender was associated with higher compliance with home quarantine order, it was found inversely associated with mask-wearing and temperature-taking behaviours (Table 3).

Table 3. Indicators for compliance with respective mitigation measures

	Compliance vs. Non. Compliance OR (95%CI)
Home Quarantine	
Gender, Female	**1.66 (1.38-1.97)**
Age	0.99 (0.98-0.999)*
Regional Risk-exposure	0.99 (0.90-1.08)
Timeliness for Policy Implementation	1.003 (0.99-1.02)
Mask-Wearing	
Gender, Female	**0.56 (0.46-0.67)**
Age	1.03 (1.02-1.04)*
Regional Risk-exposure	**1.41 (1.28-1.54)**
Timeliness for Policy Implementation	0.99 (0.98-1.01)
Temperature-taking	
Gender, Female	**0.79 (0.66-0.95)**
Age	1.005 (0.995-1.02)*
Regional Risk-exposure	**1.40 (1.28-1.54)**

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Timeliness for Policy Implementation	1.016 (0.998 -1.035)*
Hand-sanitising	
Gender, Female	0.88 (0.74-1.05)
Age	1.02 (1.01-1.04)*
Regional Risk-exposure	**1.39 (1.27-1.52)**
Timeliness for Policy Implementation	1.01 (0.995-1.03)

Boldface indicates significance, $p < 0.0125$

**. Trend to significance (0.0125<p<0.05)*

Gender-specific compliance with each personal protective measure is presented in Figure 1. Whilst males were less prone to be compliant with home quarantine order, they were more likely to abide by the other 3 personal protective measures.

Interestingly, the mid-age group (21-50) was the most non-compliant age group for social-distancing, nevertheless also the most compliant group for other protective behaviours (Figure 2). Further stratified analysis showed that, in the mid-age group, those aged 31-40 were the least compliant to the social distancing order (OR=4.17, 95% CI=3.07-5.66), four times as low to stay at home compared to the most compliant age group (<21 years of age). Yet they were the most compliant group for mask-wearing (OR=1.96, 95%CI=1.46-2.64), hand-sanitising (OR=2.24, 95% CI=1.70-2.96), and temperature-taking (OR=1.65, 95% CI=1.23-2.21). In addition, the 41-50 age group was found more compliant for mask-wearing (OR=1.88, 95% CI=1.24-2.87), whilst the 21-30 age group was found more compliant for hand-sanitising (OR=1.43, 95% CI=1.13-1.80), as compared to the younger adult group.

DISCUSSION

To our knowledge, the present study is amongst the first to examine psychosocial indicators and correlates of the general public's compliance to personal protective measures during the COVID-19 outbreak in China. The main findings from the present study is that among all demographic and psychosocial factors, age and gender are the two main indicators for behavioural compliance to the protective measures.

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Among all of the mitigation measures various countries have implemented during COVID-19, social distancing has been the most emphasised measure, and proven the most effective one.[12] China introduced the strict social distancing order in February when the epidemic was spreading at an alarming rate and causing an increasing number of deaths in the nation.[5] The execution of such an order was combined with home quarantine, the shutdown of all public places, including shops, malls, restaurants and entertainment venues, and forbidding of mass gatherings. With such a rigourous combination, the domestic and global spreading speed of the virus showed a significant slowdown from mid-February till mid-March.[13]

In the present study, males were found less likely to be compliant with the social-distancing order (72% vs. 74%), nevertheless more likely to follow other personal protective approaches, such as mask-wearing (83% vs. 74%), temperature-taking (81% vs. 77%), and hand-sanitising (77% vs. 75%). One plausible explanation for the gender difference in the behavioural compliance is that males, especially in the mid-age group, are identified to be the pillar of the family. Hence during a public health emergency like COVID-19, males are more expected to carry on with family errands and even go to work. In the present study, 87 reported violation of the home quarantine order. Among whom, 60 went out for shopping/collection of essential goods (home supplies and grocery), with 67% of them being male. Apart from this, 24 reported to have left home for work purposes, among whom 67% were male. Our findings support previous literature that reported males were more likely to leave their homes during the early stages of the COVID-19 outbreak in the Hubei Province and other parts of China.[8] Interestingly, recent studies investigating behavioural compliance to safety measures (including mask-wearing, isolation) outside of China during COVID-19 have mixed results.[14-18] Nonetheless, explanations for non-compliance to safety measures centres around the level of knowledge and perception of the COVID-19 pandemic. Similarly, past pandemic research have shown that females are more likely to adhere to more avoidant behaviours such as wearing masks.[8-10 19] Conversely, we found that males are more likely to comply with these avoidant behaviours apart from social distancing. Our findings may be explained by the male breadwinner model that still exists in China's social fabric today despite the increasingly blurred gender roles in modern-day China.[20] In relation to Confucian culture, the over 2000-year old model posits a gender role divide between males and females where males undertake an ‘outside’ role and are expected to provide for the family, while females take on the caregiving role (‘inside’ role) to tend to household matters.[21-24] Furthermore, a strong emphasis is placed on filial piety, where providing and caring for one’s

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elderly parents is an esteemed and obligatory duty.[25] Qian and Qian[22] reported greater happiness in males when they are employed and providing for the family compared to females' employment status. Therefore, nonconformity to expectations of social roles particularly in the economic aspect may inevitably affect the health and welfare of both males and females. As a result, the conformity to role expectations in Chinese society may explain the non-compliance by males to social distancing measures as they are expected to continue providing and caring for the family, including their parents, even during a public health crisis. Additionally, gender only affected social distancing compliance in people above 21 years old, an age group where most working-class fall into, hence supporting our findings where more males reported leaving their homes for work purposes. Our study lends some support to Zhong and colleagues' findings that males were more likely to leave the house to go to crowded places during the outbreak in China,[8] but contradict in mask-wearing compliance. Higher likelihood of risk-taking behaviour in males was noted as an explanation for their non-compliance. On the contrary, we found that males were compliant to other preventive measures to mitigate risk. Notably, Zhong and colleagues gathered their data between January 27 and February 1 2020,[8] a week after the lockdown in China, three weeks earlier than when our data were collected. Therefore, strict restrictions and public health education by authorities during the three weeks may have been effective and enabled males to engage in more preventive measures even though they were still leaving home for work. Moreover, in a separate survey conducted as part of the large project, we found a higher percentage of men leaving the house for essential services, amongst which 53% reported moderate levels of anxiety, therefore demonstrating that levels of anxiety were high enough to encourage males to comply with other protective measures when they were out of the house or when they were not practising social distancing. Thus, all these coupled with the importance of filial piety and the male breadwinner role in Confucianism may explain why males were more non-compliant to social distancing orders during the outbreak.

Though gender played an important role in predicting compliance with home-quarantine in people aged 21 years old and above, it did not make a difference in people under 21 years old. Studies have shown that late adolescents tend not to comply with social distancing and stay home orders due to their likelihood in engaging in risky behaviors.[8 26] However, our study found that those aged between 16-21 were more likely to stay home, unlike people in the mid-age group, especially those between 31-40 years old. A possible explanation for the reduced social distancing and staying home compliance in the 31-40 age group is that a large

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number of these people may belong to the working class and may have to leave the house for work. Previous literature on pandemics (e.g., SARS) have reported high levels of anxiety in populations worldwide with a correlation between higher levels of anxiety and greater compliance to public health measures such as social distancing.[7] Perceived social support might play a crucial role in moderating an individual's psychological resilience against such a crisis. Furthermore, greater perceived social support has shown to contribute to a greater sense of belongingness.[27] According to the belongingness hypothesis posited by Baumeister and Leary, a sense of belonging is a fundamental human need that ultimately motivates and drives human behavior.[28] Therefore, individuals who have greater perceived social support may be more likely to display greater social responsibility and comply with rules and recommendations set out to mitigate the COVID-19 outbreak, specifically through social distancing. This is because they may feel obligated to adhere to these rules to elicit a sense of affiliation and belonging as well as protect the vulnerable in their community in these times of uncertainty.

The present study has several strengths and weaknesses. To our knowledge, the present study is amongst the first to examine the effect of demographical and social correlates on the compliance of public health mitigation measures, especially social distancing, during the COVID-19 outbreak. Furthermore, the study was conducted during the peak of the spread of COVID-19 in China and gathered nationwide data from participants in China. Therefore, the findings obtained are especially vital in understanding the motivations behind the lack of compliance with mitigation measures, particularly during the heightened period of the outbreak. We observed a difference in adherence to safety measures (e.g., mask-wearing) by males between two timeframes of the pandemic in China,[8] suggesting that public health education and strict restrictions may have impacted the public's perception and compliance. Hence, these results help further inform public health authorities and political leaders in the way they implement mitigation measures and administer financial and psychological aid to the community. Notably, the present study lacked important demographic factors such as education level and occupational status, which could have further informed future mitigation measures. Moreover, as the study was conducted through an online survey, the sample was limited to those with access to digital technology and Internet. Therefore, we were unable to determine if this subset of the population complied to mitigation measures as well as the factors associated with it. Information obtained from this subset is essential as they may be more vulnerable to the virus due to lack of access to extensive public health awareness and

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mitigation measures online. While the lack of access to digital technology is a real limitation, future studies should attempt to reach out to this subset of the population. Retrospective studies could be conducted to assess their accordance with mitigation measures, specifically social distancing, and the role of psychosocial indicators and correlates on the compliance. Additionally, it would be interesting to examine the anxiety levels of those in the under 21 group that had a significant impact on their compliance with social distancing during the outbreak. Access to social media and overwhelming information provided by the media every day could be a factor that fuelled the heightened levels of anxiety.

The non-compliance with public health mitigation measures, particularly home quarantine, was largely attributed to the male gender, and being in the middle-aged group. Our study found that while males in the mid-age group were least compliant with social distancing, they were most compliant to other measures (i.e., mask-wearing and temperature-taking), possibly due to the need to fulfil the role expectation of being the provider and breadwinner of the family. As the COVID-19 outbreak is still ongoing, public health authorities and governments could target this population in their future measures and aid that are provided during this pandemic.

Figure Legends:

Figure 1. Gender-specific percentages for behavioural compliance

Figure 2. Age-specific percentages for behavioural compliance

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Contributors: XX and YQ conceptualized and designed the study. XX drafted the manuscript. YQ supervised data analysis and interpretation of data. XX, WZ and XXH acquired the data. XX and KAC analyzed and interpreted the data. WZ and XXH revised the manuscript for intellectual content. YQ and KAC critically revised the manuscript for intellectual content.

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Data availability statement: Data are available upon request. Original data can be requested from the study team (xuxinsummer@zju.edu.cn).

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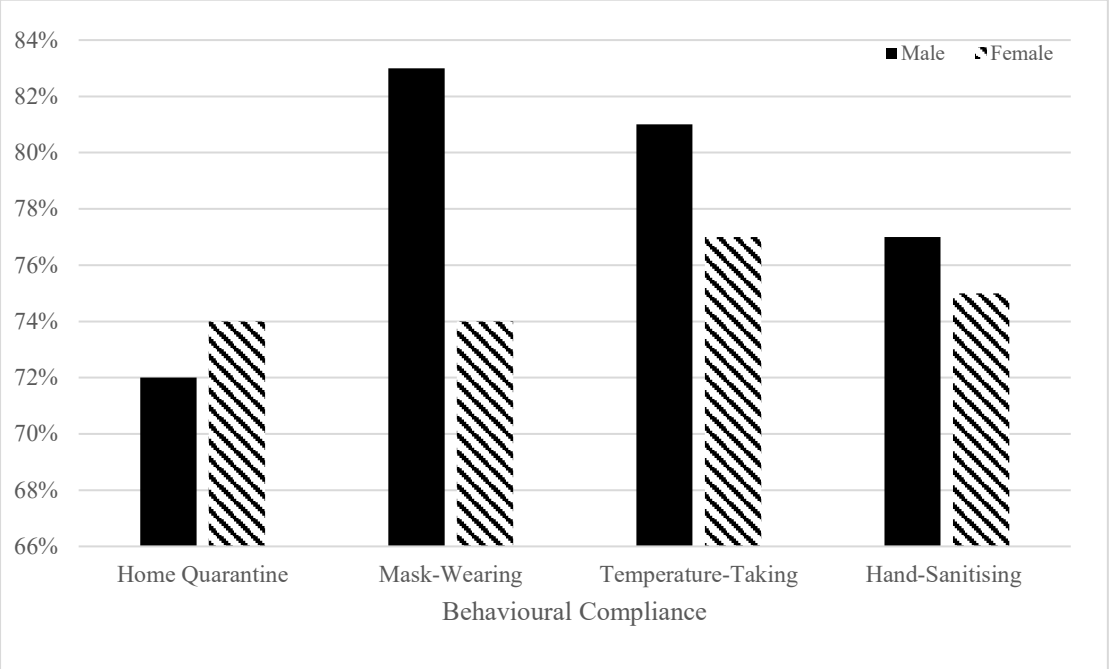

Figure 1. Gender-specific percentages for behavioural compliance

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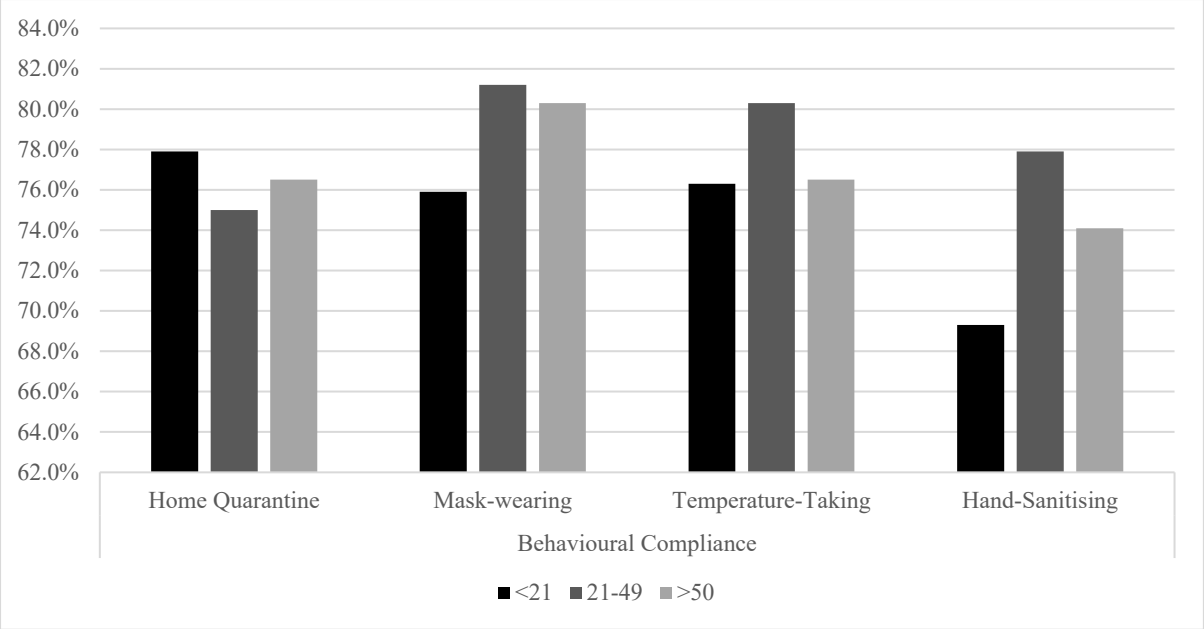

Figure 2. Age-specific percentages for behavioural compliance

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Reporting checklist for cross sectional study.

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		Reporting Item	Page Number
Title and abstract			
Title	#1a	Indicate the study's design with a commonly used term in the title or the abstract	1

Abstract	#1b	Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background / rationale	#2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	#3	State specific objectives, including any prespecified hypotheses	3
Methods			
Study design	#4	Present key elements of study design early in the paper	4
Setting	#5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4
Eligibility criteria	#6a	Give the eligibility criteria, and the sources and methods of selection of participants.	4
	#7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	n/a
Data sources / measurement	#8	For each variable of interest give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. Give information separately for for exposed and unexposed groups if applicable.	4

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Bias	#9	Describe any efforts to address potential sources of bias	4
Study size	#10	Explain how the study size was arrived at	5
Quantitative variables	#11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	5
Statistical methods	#12a	Describe all statistical methods, including those used to control for confounding	4
Statistical methods	#12b	Describe any methods used to examine subgroups and interactions	5
Statistical methods	#12c	Explain how missing data were addressed	5
Statistical methods	#12d	If applicable, describe analytical methods taking account of sampling strategy	n/a
Statistical methods	#12e	Describe any sensitivity analyses	n/a
Results			
Participants	#13a	Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed. Give information separately for for exposed and unexposed groups if applicable.	5
Participants	#13b	Give reasons for non-participation at each stage	5

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Participants	#13c	Consider use of a flow diagram	n/a
Descriptive data	#14a	Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders. Give information separately for exposed and unexposed groups if applicable.	5
Descriptive data	#14b	Indicate number of participants with missing data for each variable of interest	5
Outcome data	#15	Report numbers of outcome events or summary measures. Give information separately for exposed and unexposed groups if applicable.	4
Main results	#16a	Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	6
Main results	#16b	Report category boundaries when continuous variables were categorized	6
Main results	#16c	If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	#17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses	6
Discussion			
Key results	#18	Summarise key results with reference to study objectives	7

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Limitations	#19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.	9
Interpretation	#20	Give a cautious overall interpretation considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.	7-9
Generalisability	#21	Discuss the generalisability (external validity) of the study results	9
Other Information			
Funding	#22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	10

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Demographic and Social Correlates and Indicators for Behavioural Compliance with Personal Protection Among Chinese Community-Dwellers During COVID-19: A Cross-sectional Study

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Demographic and Social Correlates and Indicators for Behavioural Compliance with Personal Protection Among Chinese Community-Dwellers During COVID-19: A Cross-sectional Study

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Key words: COVID-19 coronavirus, behavioural compliance, social distancing, personal protective measures

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ABSTRACT

Objectives:

Examine compliance with personal protective measures in communities for the prevention and control of local transmission of the coronavirus (COVID-19), and explore indicators for such behavioural compliance.

Design:

Cross-sectional design with a self-selecting sample. Data collected in February 2020.

Setting:

Community dwellers in China.

Participants:

2956 participants aged 16 and above completed the study and were included in the analysis.

Outcome measures:

Nationwide COVID-19 survey. Demographics and self-reported compliance with four individual major personal protective measures—home quarantine, mask-wearing, temperature-taking and hand-sanitising were collected and recorded. Outbreak severity and timeliness of personal protection order were obtained from the China Centre Disease Control (China CDC) website. Logistic regression models were employed to examine the association between demographic and social indicators and personal behavioural compliance.

Results:

Compliance with home quarantine was only associated with gender (male, OR=0.61[0.51-0.73], inverse association) but no other indicators. In contrast, male had higher compliance with mask-wearing (OR=1.79[1.49-2.16]) and temperature taking (OR=1.27[1.05-1.53]). Compared to younger adults (≤20 years), the middle-age groups (31-40 and 41-50 years of age) were more compliant with all protective behaviours, except for home quarantine (OR=0.71[0.54-0.93] and 0.67[0.46-0.97], respectively).

Conclusion:

Male gender was associated with lower compliance with home quarantine yet higher compliance with mask-wearing and temperature-taking. The middle-age participants (31-50 years of age) had lower compliance with home quarantine order but higher with other measures. In light of the ongoing COVID-19 pandemic, public health authorities should tailor policy implementation to disparities in demographic and social indicators.

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Strengths and limitations of this study

- Extensive data collected during the peak of the COVID-19 outbreak in China ($n_{completed}$ = 2956).
- Data was collected from multiple provinces with various levels of risk exposure to avoid bias in the sample (categorised using the number of confirmed cases reported by China CDC).
- The effect of other demographical variables (e.g., education, occupational status) was limited due to the lack of data.
- Survey was available online only, hence sample was limited to those with access to digital technology and Internet.
- More mental health-related questionnaires (e.g., depression, anxiety) should be collected and analysed as potential indicators for behavioural compliance.

INTRODUCTION

In light of the coronavirus disease 2019 (COVID-19) outbreak that started in December 2019, the Chinese Government has taken a number of strict mitigation strategies to expedite the tracking, testing and treatment of COVID-19. To prevent and control the transmission of the virus in local communities, the aggressive social distancing order has been enforced nationwide in China as early as from January 25, 2020. Notably, prevention and control measures have been implemented in three phases: 1) suspension of intra-city and intercity transportation, and strict control of importation and exportation of COVID-19 cases from Wuhan and other provinces, 2) delaying the severity and rise in cases through several safety measures, 3) decreasing clusters, using standardised protocols and execution of "scientific evidence-based policy". Examples of such measures include the closure of wet markets, contact tracing, temperature-taking, health declarations, quarantine, disallowing large gatherings, and implementation of strict travel restrictions.[1 2] Through strict compliance of Chinese citizens to the order, social distancing has been proven the most effective measure to ease the rapid spreading of the virus.[3 4]

Among all prevention and control measures, a nationwide movement restriction order was announced by the Chinese government soon after the lockdown of Wuhan city on January 23, 2020. This social distancing order was introduced and enforced subsequently, requiring all citizens to remain at home and avoid most forms of face-to-face social contact when outside. The order was implemented with the recommendation of other personal protective

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measurements, such as regular hand sanitising, daily temperature-taking, and mask-wearing.[5] The implementation of the personal protection order was challenging. Social distancing means staying away from mass gatherings and keeping a distance of 6 feet or 2 meters.[3] Due to the Chinese New Year celebration, which took place around the same time (January 25, 2020) when the outbreak happened, movements among cities and suburban areas, as well as family gatherings were inevitable and difficult to contain. Voluntary behavioural intervention during an infectious disease outbreak, such as social distancing, requires not only sufficient realisation of the situation severity, but more importantly, determined commitment to such action from individuals in the community.

Hence prior to the enforcement of the nationwide home quarantine order, the Chinese government announced a series of precautionary regulations, including 1) refusal of entry into public places without wearing a mask and obtaining a normal body temperature; 2) set-up of a detailed individual purchase record of fever/cough/flu-related medications in local pharmacies; 3) screening and a detailed registry of suspected cases with high fever in the community. The entire enforcement was accompanied by thorough public health education and promotion which started as early as late January. Violation of the above-mentioned regulations could result in further investigation or even legal liability.[6]

After the implementation of the four personal protective behaviours, including home quarantine, mask-wearing, temperature-taking, and hand-sanitising, non-compliance would lead to strict education and immediate correction from various levels of management, ranging from the street and community, to district and city levels of local authority.

The implementation of these personal protective behaviours is necessary. However, compliance to these actions is not only determined by the severity of the disease, but also a number of demographic (e.g., gender, age) and social factors.[7 8] Interestingly, while previous literature have demonstrated that older people and females are typically more likely to practice protective behaviours in public health emergencies such as the severe acute respiratory syndrome (SARS) and H1N1 swine flu, the results are mixed.[9 10] Hence in the present study, we sought to understand the demographic indicators and correlates of individuals' compliance to preventive measures during COVID-19.

METHODS

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Study design and sampling

With a cross-sectional study design, a nationwide online survey on behavioural compliance during COVID-19 was carried out during February 14-17, 2020, among Chinese citizens in China. Community dwellers aged 16 and above were enrolled in the survey. To avoid bias in the sample, the study team disseminated the survey questionnaire nationwide in all 31 provinces and regions in China with different levels of risk exposure. Study description and questionnaires were posted through various social media platforms, such as Wechat and Weibo, with a notice and invitation on these platforms for better visibility. All participants from this self-selecting sample provided electronic informed consent prior to taking the survey (Supplemental Material). The study protocol was approved by the Ethics Commission of Zhejiang University prior to the commencement of the study and was in accordance with the Declaration of Helsinki. STROBE cross-sectional reporting guidelines were used.[11]

Questionnaires

De-identified demographic information (age, gender, current living area) was collected.

Outbreak Severity: Severity of the outbreak in each province and region in all survey areas were sorted into 5 categories according to the confirmed coronavirus cases published on the China Center for Disease Control and Prevention (CDC) website on the day of the survey (February 14, 2020): <100 cases, 100-499 cases, 500-999 cases, 1000-1999 cases, >2000 cases.

Policy Timeliness: Timeliness of the social distancing order implemented by the provincial government was assessed by the length (in days) between the implementation date of the social distancing order to the date of the survey. For those areas where the order was implemented after the survey, the score "0" was granted, e.g. Nei Meng province. Scores were subsequently transformed into fractional rank for analysis purposes.

Compliance to Mitigation Measures

An individual's compliance with a number of mitigation measures introduced by the local government was defined as:

1. home quarantine, as defined by leaving residential address for ≤1 in 3 days' time, as per the Chinese government's regulation;
2. mask-wearing, as defined by wearing a mask when leaving the residential address, as per the Chinese government's regulation;
3. daily temperature-taking, as defined by taking one's own temperature at least once every day per the Chinese government's regulation;
4. daily hand-sanitising, as defined by sanitising one's hands with a sanitiser with >75% alcohol per the Chinese government's regulation.

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Overall compliance is defined as the sum of compliance score on 4 protective behaviours, rated at 0 (none), 1 (compliant with 1 behaviour), 2 (compliant with 2 behaviours), 3 (compliant with 3 behaviours), and 4 (compliant with all 4 behaviours).

Statistical Analysis

Associations among 4 individual protective behaviours were examined using Chi-square. Logistic regression models were applied to investigate the indicators for accordance with each individual mitigation measure. All analyses were performed using SPSS version 25 and SAS version 9.4. Statistical significance was determined as two-tailed p-value < 0.05. Bonferroni correction was employed to obtain an adjusted significance level for each protective behaviour: ≈0.05/4=0.0125.

Patient and Public Involvement

No patients and none of the public were involved in the study planning, design and interpretation of results. Results from the paper will be disseminated to the general public through online article format.

RESULTS

A total of 3,000 participants completed the survey, among whom, 7 had incomplete data and 37 had repeated answers and were removed from the dataset, leaving a total of 2,956 in the current analysis. All 2,956 subjects completed all questionnaires in the survey. Sample descriptives are in Table 1.

Table 1. Study sample descriptives

	Whole Sample	Range
Demographics		
Age (mean±SD)	28.5±8.6	16-72
Gender, female, n (%)	1178 (39.9%)	
Current Living Area, n (%)		
Extremely High Risk (≥2000 confirmed cases)	106 (3.5%)	
High Risk (1000-1999 confirmed cases)	667 (22.2%)	
Moderate-High Risk (500-599 confirmed cases)	770 (25.7%)	
Moderate Risk (100-499 confirmed cases)	1290 (43.0%)	
Mild-Moderate Risk (<100 confirmed cases)	167 (5.6%)	
Average length of implementation of mitigation measures, days (mean±SD)	15±5.1	0-20
Compliance to Mitigation Measures		

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Home Quarantine, compliant, n (%)	2234 (75.6%)
Mask-wearing, compliant, n (%)	2353 (79.6%)
Temperature-taking, compliant, n (%)	2350 (79.5%)
Hand-sanitising, compliant, n (%)	2257 (76.4%)

Compliance with individual protective measures

Compliance with home quarantine was positively associated with compliance with hand-sanitising (χ^2=4.21, p=0.023), but not with mask-wearing and temperature-taking (p=0.07 and 0.08, respectively). Compliance with mask-wearing was positively associated with temperature-taking (χ^2=493.11, p<0.001) and hand-sanitising (χ^2=498.55, p<0.001). Compliance with temperature-taking was positively associated with hand-sanitising (χ^2=802.16, p<0.001).

Logistic regression analysis was employed to investigate the predictors for compliance with each mitigation measure: home quarantine, mask-wearing, temperature-taking and hand-sanitising. Results showed that higher risk-exposure was positively associated with compliance with all measures except home quarantine. Age was positively associated with higher compliance with masking-wearing and hand-sanitising (p<0.0125), yet inversely associated with home quarantine. Interestingly, whilst the male gender was associated with lower compliance with home quarantine order, it was found positively associated with mask-wearing and temperature-taking behaviours (Table 2).

Table 2. Indicators for compliance with respective mitigation measures

	Compliance vs. Non. Compliance OR (95%CI)
Home Quarantine	
Gender, Male	**0.61 (0.51-0.73)**
Age	0.99 (0.98-0.999)*
Regional Risk-exposure	0.99 (0.90-1.08)
Timeliness for Policy Implementation	1.003 (0.99-1.02)
Mask-Wearing	
Gender, Male	**1.79 (1.49-2.16)**
Age	**1.03 (1.02-1.04)**
Regional Risk-exposure	**1.41 (1.28-1.54)**
Timeliness for Policy Implementation	0.99 (0.98-1.01)
Temperature-taking	
Gender, Male	**1.27 (1.05-1.53)**
Age	1.005 (0.995-1.02)

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Regional Risk-exposure	**1.40 (1.28-1.54)**
Timeliness for Policy Implementation	1.016 (0.998 -1.035)
Hand-sanitising	
Gender, Male	1.14 (0.95-1.36)
Age	**1.02 (1.01-1.04)**
Regional Risk-exposure	**1.39 (1.27-1.52)**
Timeliness for Policy Implementation	1.01 (0.995-1.03)

Boldface indicates significance, $p < 0.0125$

**. Trend to significance (0.0125<p<0.05)*

Gender-specific compliance with each personal protective measure is presented in Figure 1.

Whilst males were less prone to be compliant with home quarantine order, they were more likely to abide by the other 3 personal protective measures.

Interestingly, from the distribution graph, the mid-age groups (31-40 and 41-50) was the most non-compliant age group for home quarantine order, nevertheless also the most compliant for other protective behaviours (Figure 2).

Further analysis showed that, the 31-40 age group was less compliant to the home quarantine order (OR=0.71 [0.54-0.93]), compared to the reference group (≤20; Figure 3). Yet they were compliant to mask-wearing (OR=1.96, 95%CI=1.46-2.64), hand-sanitising (OR=2.24, 95% CI=1.70-2.96), and temperature-taking (OR=1.65, 95% CI=1.23-2.21). A similar pattern for compliance was also observed in the 41-50 age group, where they were less compliant to home quarantine (OR=0.67 [0.46-0.97]), nonetheless more compliant to mask-wearing (OR=1.88[1.24-2.87]) and hand-sanitising (OR=1.51[1.03-2.19]).

DISCUSSION

To our knowledge, the present study is amongst the first to examine demographic and social indicators and correlates of the general public's compliance to personal protective measures during the COVID-19 outbreak in China. The main findings from the present study is that among all demographic and social factors, age, gender and risk of exposure are the three main indicators for behavioural compliance to the protective measures.

Among all of the mitigation measures various countries have implemented during COVID-19, social distancing has been the most emphasised measure, and proven the most effective one.[12]

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China introduced the strict social distancing order in February when the epidemic was spreading at an alarming rate and causing an increasing number of deaths in the nation.[5] The execution of such an order was combined with home quarantine, the shutdown of all public places, including shops, malls, restaurants and entertainment venues, and forbidding of mass gatherings. With such a rigourous combination, the domestic and global spreading speed of the virus showed a significant slowdown from mid-February till mid-March.[13]

In the present study, males were found less likely to be compliant with the social-distancing order (72% vs. 74%), nevertheless more likely to follow other personal protective approaches, such as mask-wearing (83% vs. 74%), temperature-taking (81% vs. 77%), and hand-sanitising (77% vs. 75%). One plausible explanation for the gender difference in the behavioural compliance is that males, especially in the mid-age group, are identified to be the pillar of the family. Hence during a public health emergency like COVID-19, males are more expected to carry on with family errands and even go to work. In the present study, 87 reported violation of the home quarantine order. Among whom, 60 went out for shopping/collection of essential goods (home supplies and grocery), with 67% of them being male. Apart from this, 24 reported to have left home for work purposes, among whom 67% were male. Our findings support previous literature that reported males were more likely to leave their homes during the early stages of the COVID-19 outbreak in the Hubei Province and other parts of China.[8] Interestingly, recent studies investigating behavioural compliance to safety measures (including mask-wearing, isolation) outside of China during COVID-19 have mixed results.[14-18] Nonetheless, explanations for non-compliance to safety measures centres around the level of knowledge and perception of the COVID-19 pandemic. Similarly, past pandemic research have shown that females are more likely to adhere to more avoidant behaviors such as hand washing and wearing masks.[8-10 19] Conversely, we found that males are more likely to comply with these avoidance behaviours apart from social distancing. Our findings thus demonstrate that the impact of economic conditions alongside the desire to remain safe may be the predominant drivers for the disparities in behavioural compliance. However, behind such a potential driving force lies cultural expectations that adult males are subjected to in Chinese society. From a cultural standpoint, the male breadwinner model still exists in China's social fabric today despite the increasingly blurred gender roles in modern-day China.[20] The over 2000-year old Confucian model posits a gender role divide between males and females where males undertake an ‘outside’ role and are expected to provide for the family, while females take on the caregiving role (‘inside’ role) to tend to household matters.[21-24] A strong emphasis is also

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placed on filial piety, where providing and caring for one's elderly parents is an esteemed and obligatory duty.[25] As a result, the conformity to role expectations in Chinese society may explain the non-compliance by males to social distancing measures as they feel more obligated to meet their economic responsibilities to continue providing for the family, even during a public health crisis. Our results challenge several work on COVID-19 preventive behaviours that view behavioural compliance singularly as the result of partisanship, perceptions surrounding its effectiveness and the infection risks.[17 26] Our study lends some support to Zhong and colleagues' findings that males were more likely to leave the house to go to crowded places during the outbreak in China,[8] but contradict in mask-wearing compliance. Higher likelihood of risk-taking behaviour in males was noted as an explanation for their non-compliance. On the contrary, we found that males were compliant to other preventive measures to mitigate risk. Notably, Zhong and colleagues gathered their data between January 27 and February 1 2020,[8] a week after the lockdown in China, three weeks earlier than when our data were collected. Therefore, strict restrictions and public health education by authorities during the three weeks may have been effective and enabled males to engage in more preventive measures even though they were still leaving home for work.

Though gender played an important role in predicting compliance with home quarantine in people aged 21 years old and above, it did not make a difference in people under 21 years old. Studies have shown that late adolescents tend not to comply with social distancing and stay home orders due to their likelihood in engaging in risky behaviors.[8 27] However, our study found that people in the mid-age group, especially those between 31-40 and 41-50 years old (Figure 2) were driving this significance of lower compliance with home quarantine order, as compared to younger adults <21 years of age. Notably, those above 50 years old had a higher likelihood of staying home similar to those below 21. A plausible explanation for the reduced social distancing compliance in the 31-50 age group is that a large number of these people may be salarymen and have to leave home for work. On the other hand, those above 50 may be aware of the risks involved and have fewer reasons to leave the house. Furthermore, people in the >50 age group may have reduced mobility function.[28] Hence, those between 31 to 50 years old have lesser compliance to home quarantine due to economic reasons where they have to go out to work compared to those under 21 where majority of them were likely to be high school or university students, hence could not access campus due to temporary shutdown of all schools nationwide during the epidemic.[29]

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The present study has several strengths and weaknesses. To our knowledge, the present study is amongst the first to examine the effect of demographical and social correlates on the compliance of public health mitigation measures, especially social distancing, during the COVID-19 outbreak. Furthermore, the study was conducted during the peak of the spread of COVID-19 in China and gathered nationwide data from participants in China. Therefore, the findings obtained are especially vital in understanding the motivations behind the lack of compliance with mitigation measures, particularly during the heightened period of the outbreak. We observed a difference in adherence to safety measures (e.g., mask-wearing) by males between two timeframes of the pandemic in China[8], suggesting that public health education and strict restrictions may have impacted the public's perception and compliance. Hence, these results help further inform public health authorities and political leaders in the way they implement mitigation measures and administer financial and psychological aid to the community. Notably, the present study lacked important demographic factors such as education level and occupational status, which could have further informed future mitigation measures. A non-probability sample was used in this study, thus rendering the effect of p-values and confidence intervals not strictly valid, or valid only under the assumption that the sample is comparable to a random sample. The study's outcome variables were also self-reported compliance instead of actual compliance, suggesting the potential impact of social desirability bias in under- or over-reporting compliance to safety measures.[30] However, the online mode of data collection and the anonymity of the survey may have mitigated such potential biases. Moreover, as the study was conducted through an online survey, the sample was limited to those with access to digital technology and Internet. Therefore, we were unable to determine if this subset of the population complied to mitigation measures as well as the factors associated with it. Information obtained from this subset is essential as they may be more vulnerable to the virus due to lack of access to extensive public health awareness and mitigation measures online. While the lack of access to digital technology is a real limitation, future studies should attempt to reach out to this subset of the population. Retrospective studies could be conducted to assess their accordance with mitigation measures, specifically social distancing, and the role of psychosocial indicators and correlates on the compliance. Additionally, it would be interesting to examine the anxiety levels of those in the under 21 group that had a significant impact on their compliance with social distancing during the outbreak. Access to social media and overwhelming information provided by the media every day could be a factor that fuelled the heightened levels of anxiety.

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The non-compliance with public health mitigation measures, particularly home quarantine, was largely attributed to the male gender, and being in the middle-aged group. Our study found that while males in the mid-age group were least compliant with social distancing, they were most compliant to other measures (i.e., mask-wearing, hand-sanitising, and temperature-taking), possibly due to their economic responsibilities and need to fulfil the breadwinner role expectation. As the COVID-19 outbreak is still ongoing, public health authorities and governments could target this population in their future measures and aid that are provided during this pandemic.

Figure Legends:

Figure 1. Gender-specific percentages for behavioural compliance

Figure 2. Age-specific percentages for compliance with individual protective behaviours

Figure 3. Adjusted ORs and 95% CI of different age-blocks for compliance with individual protective behaviours. Analysis controlled for gender, days to policy implementation and risk exposure

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Contributors: XX* and YQ conceptualized and designed the study. XX* drafted the manuscript. YQ supervised data analysis and interpretation of data. XX*, WZ and XXH acquired the data. XX* and KAC analyzed and interpreted the data. XX, WZ and XXH revised the manuscript for intellectual content. YQ and KAC critically revised the manuscript for intellectual content.

*Xu Xin

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Competing interests: None declared.

Patient consent for publication: Not required.

Ethics approval: This study has been approved by the Ethics Commission of Zhejiang University (ID: ZGL202005-01). Informed consent was obtained from participants prior to

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taking part in the study.

Data availability statement: Data are available upon request. Original data can be requested from the study team (xuxinsummer@zju.edu.cn and chianyoung@zju.edu.cn).

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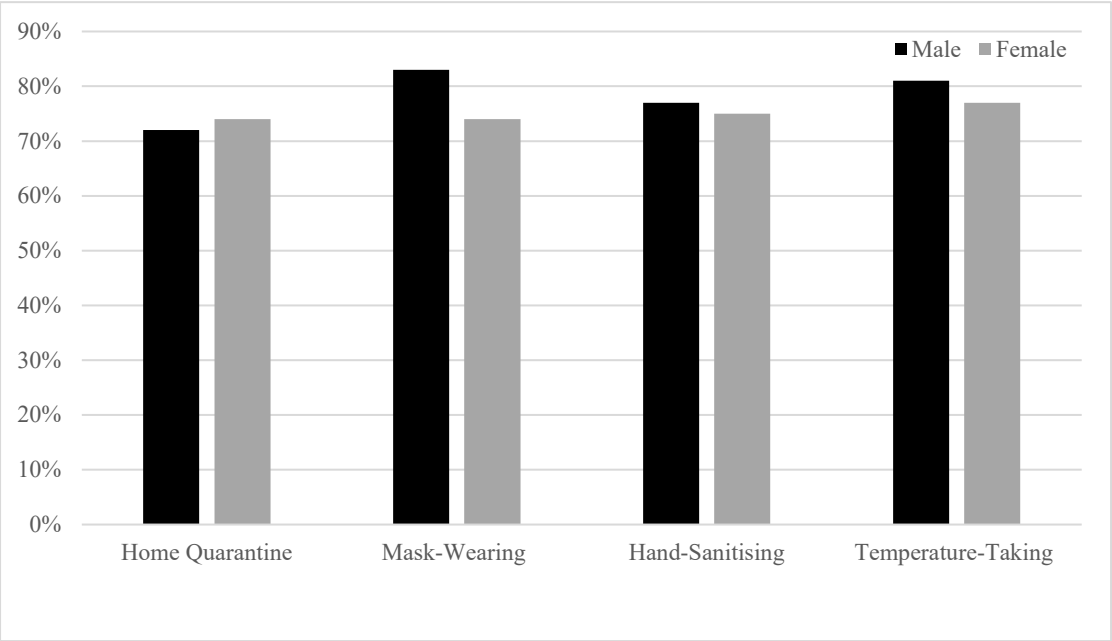

Figure 1. Gender-specific percentages for behavioural compliance

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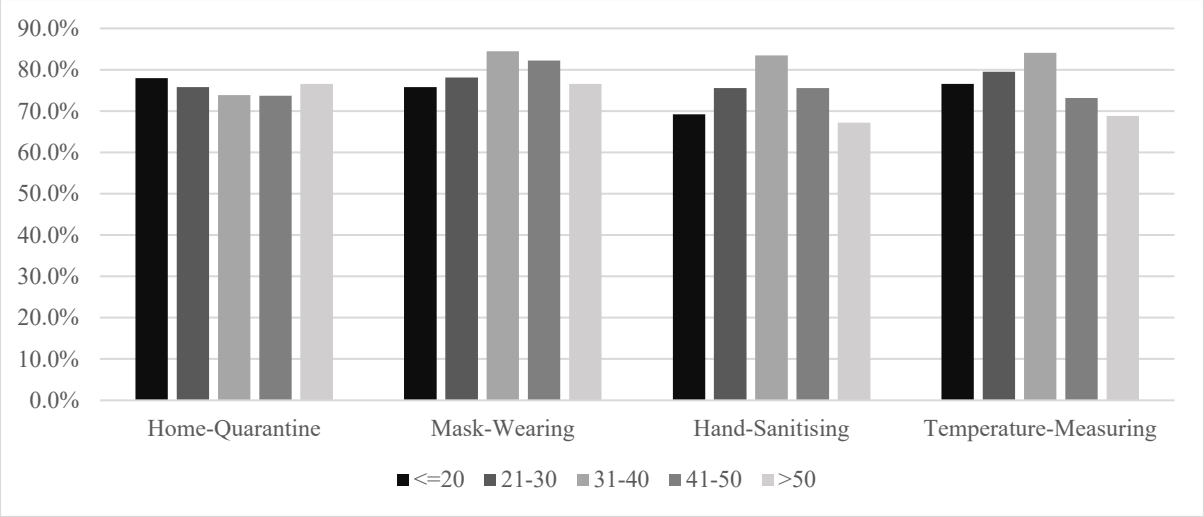

Figure 2. Age-specific distribution for compliance with individual protective behaviours

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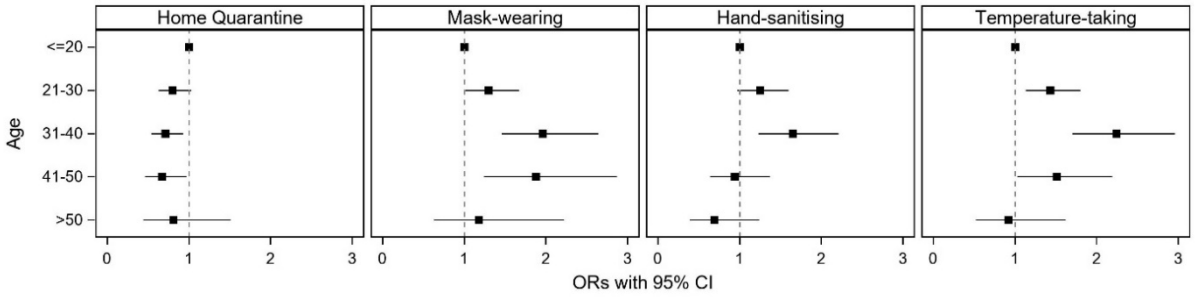

Figure 3. Adjusted ORs and 95% CI of different age-blocks for compliance with individual protective behaviours. Analysis controlled for gender, days to policy implementation and risk exposure.

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中国社区居民在 COVID-19 期间个人保护行为的调查

你好！这里是浙江大学公共卫生学院发起的新冠疫情调研组。新冠肺炎的肆虐给人民健康带来了极大的威胁。但是我们定会众志成城，共同战“疫”！我们在此诚挚邀请您参加本次调研,您的参与将会帮助我们更好地了解民众个人保护行为。

本次调研将会分两次进行。我们会邀请您参与多次答题。本次问卷大约需要 1-2 分钟完成。请仔细读清楚问题之后填写。每次提交问卷后，经过系统核查，第一次问卷您将得到 3 元红包，第二次问卷您将得到 5 元红包。感谢您一如既往的支持和参与，让我们上下一心，携手并进，共同抗击新冠病毒！

本问卷不涉及您的任何隐私。您的所有答案将严格保密，仅用于疫情应对的研究。您有权随时退出本次调研。

如您已知晓您的全部权利，乐于自愿参与，并能和我们一起坚持每一次的答题，请点击下面的“下一页”按钮参与调研。

和您一起参与答题的，还有千万个和您一样在意疫情发展，支持疫情防控工作的中国民众。让我们万众一心，赢得这场没有硝烟的战役！

1. [填空题] 请选择省份城市与地区：_____
2. [填空题] 您的手机号后 4 位为 _____ （仅用于编号）
3. [单选题] 您的性别是
   ○男
   ○女
4. [填空题] 请输入您的出生年份：_____
5. [单选题] 最近三天，您的出门次数为
   ○0-1 次（请跳至第 8 题）
   ○>1 次
6. [单选题] 您今天是否出门
   ○是
   ○否（请跳至第 8 题）
7. [单选题] 您今天出门的原因是
   ○购物
   ○取东西
   ○工作
   ○去医院
   ○其他原因，请说明_____
8. [单选题] 您今天是否佩戴口罩
   ○是
   ○否
9. [单选题] 您今天是否使用消毒液或 75%酒精消毒
   ○是
   ○否
10. [单选题] 您今天是否自测体温
   ○是
   ○否

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Survey translated to English:

Investigation of individual protection behaviour of Chinese community residents during COVID-19

Hello! This is the COVID-19 research group launched by the School of Public Health, Zhejiang University. COVID-19 poses a significant threat to people's health. However, we will come together to fight COVID-19. We sincerely invite you to participate in this survey, and your participation will help us better understand people's personal protection behaviours.

There are two surveys in this study. You will be invited to answer several questions. It will take about 1-2 minutes to complete the questionnaire. Please read the questions carefully and fill them out. After submitting the questionnaire, you will receive 3 yuan for the first survey and 5 yuan for the second survey. Thank you for your continued support and participation. Let us fight COVID-19 hand in hand.

This questionnaire is strictly private and confidential. All your answers will be kept strictly confidential and used only for research in response to the outbreak, and you have the right to withdraw from the survey at any time.

If you fully understand your rights, are willing to volunteer, and can answer every question, please click the "next page" button below to participate in the research.

There are thousands of people who care about the evolution of the epidemic and support epidemic prevention and control efforts like you who are participating in the survey. Let us unite as one to win the battle without smoke!

1. [Completion] Please state your province and city: _____
2. [Completion] Please fill in the last 4 digits of your cell phone number: _____(Just for numbering)
3. [Multiple Choice] What is your gender?
   ○Male ○Female
4. [Completion] Please fill in your year of birth: _____
5. [Multiple Choice] The number of times you have gone out in the last three days is
   ○0-1 time (Please skip to question 8) ○>1
6. [Multiple Choice] Have you been out today?
   ○YES ○No
7. [Multiple Choice] The reason you went out today is
   ○shopping
   ○take things
   ○work
   ○go to the hospital
   ○other reasons. Please indicate the reason in detail_____

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8. [Multiple Choice] Are you wearing a mask today?

○YES ○No

9. [Multiple Choice] Have you used disinfectant or 75% alcohol today?

○YES ○No

10. [Multiple Choice] Have you taken your temperature today?

○YES ○No

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Reporting checklist for cross sectional study.

Based on the STROBE cross sectional guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

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In your methods section, say that you used the STROBE cross sectionalreporting guidelines, and cite them as:

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		Reporting Item	Page Number
Title and abstract			
Title	#1a	Indicate the study's design with a commonly used term in the title or the abstract	1

Abstract	#1b	Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background / rationale	#2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	#3	State specific objectives, including any prespecified hypotheses	3
Methods			
Study design	#4	Present key elements of study design early in the paper	4
Setting	#5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4
Eligibility criteria	#6a	Give the eligibility criteria, and the sources and methods of selection of participants.	4
	#7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	n/a
Data sources / measurement	#8	For each variable of interest give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. Give information separately for for exposed and unexposed groups if applicable.	4

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Bias	#9	Describe any efforts to address potential sources of bias	4
Study size	#10	Explain how the study size was arrived at	5
Quantitative variables	#11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	5
Statistical methods	#12a	Describe all statistical methods, including those used to control for confounding	4
Statistical methods	#12b	Describe any methods used to examine subgroups and interactions	5
Statistical methods	#12c	Explain how missing data were addressed	5
Statistical methods	#12d	If applicable, describe analytical methods taking account of sampling strategy	n/a
Statistical methods	#12e	Describe any sensitivity analyses	n/a
Results			
Participants	#13a	Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed. Give information separately for for exposed and unexposed groups if applicable.	5
Participants	#13b	Give reasons for non-participation at each stage	5

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Participants	#13c	Consider use of a flow diagram	n/a
Descriptive data	#14a	Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders. Give information separately for exposed and unexposed groups if applicable.	5
Descriptive data	#14b	Indicate number of participants with missing data for each variable of interest	5
Outcome data	#15	Report numbers of outcome events or summary measures. Give information separately for exposed and unexposed groups if applicable.	4
Main results	#16a	Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	6
Main results	#16b	Report category boundaries when continuous variables were categorized	6
Main results	#16c	If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	#17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses	6
Discussion			
Key results	#18	Summarise key results with reference to study objectives	7

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Limitations	#19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.	9
Interpretation	#20	Give a cautious overall interpretation considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.	7-9
Generalisability	#21	Discuss the generalisability (external validity) of the study results	9
Other Information			
Funding	#22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	10

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Demographic and Social Correlates and Indicators for Behavioural Compliance with Personal Protection Among Chinese Community-Dwellers During COVID-19: A Cross-sectional Study

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Demographic and Social Correlates and Indicators for Behavioural Compliance with Personal Protection Among Chinese Community-Dwellers During COVID-19: A Cross-sectional Study

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Key words: COVID-19 coronavirus, behavioural compliance, social distancing, personal protective measures

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ABSTRACT

Objectives:

Examine compliance with personal protective measures in communities for the prevention and control of local transmission of the coronavirus (COVID-19), and explore indicators for such behavioural compliance.

Design:

Cross-sectional design with a self-selecting sample. Data collected in February 2020.

Setting:

Community dwellers in China.

Participants:

2956 participants aged 16 and above completed the study and were included in the analysis.

Outcome measures:

Nationwide COVID-19 survey. Demographics and self-reported compliance with four personal protective measures—home quarantine, mask-wearing, temperature-taking and hand-sanitising were collected. Outbreak severity and timeliness of personal protection order were obtained from the China Centre Disease Control (China CDC) website. Logistic regression models were employed to examine the association between demographic and social indicators and behavioural compliance.

Results:

Compliance with home quarantine was only associated with gender (male, OR=0.61[0.51-0.73], inverse association) but no other indicators. In contrast, male had higher compliance with mask-wearing (OR=1.79[1.49-2.16]) and temperature taking (OR=1.27[1.05-1.53]). Compared to younger adults (≤20 years), the middle-age groups (31-40 and 41-50 years of age) were more compliant with all protective behaviours, except for home quarantine (OR=0.71[0.54-0.93] and 0.67[0.46-0.97], respectively).

Conclusion:

Male gender was associated with lower compliance with home quarantine yet higher compliance with mask-wearing and temperature-taking. The middle-age participants (31-50 years) had lower compliance with home quarantine but higher with other measures. These findings may be supported by the economic considerations and the long-inherited Confucian values among Chinese. In light of the ongoing COVID-19 pandemic, public health authorities should tailor policy implementation to disparities in psychosocial indicators.

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Strengths and limitations of this study

- Extensive data collected during the peak of the COVID-19 outbreak in China ($n_{completed}$ = 2956).
- Data was collected from multiple provinces with various levels of risk exposure to avoid bias in the sample (categorised using the number of confirmed cases reported by China CDC).
- The effect of other demographical variables (e.g., education, occupational status) was limited due to the lack of data.
- Survey was available online only, hence sample was limited to those with access to digital technology and Internet.
- More mental health-related questionnaires (e.g., depression, anxiety) should be collected and analysed as potential indicators for behavioural compliance.

INTRODUCTION

In light of the coronavirus disease 2019 (COVID-19) outbreak that started in December 2019, the Chinese Government has taken a number of strict mitigation strategies to expedite the tracking, testing and treatment of COVID-19. To prevent and control the transmission of the virus in local communities, the aggressive social distancing order has been enforced nationwide in China as early as from January 25, 2020. Notably, prevention and control measures have been implemented in three phases: 1) suspension of intra-city and intercity transportation, and strict control of importation and exportation of COVID-19 cases from Wuhan and other provinces, 2) delaying the severity and rise in cases through several safety measures, 3) decreasing clusters, using standardised protocols and execution of "scientific evidence-based policy". Examples of such measures include the closure of wet markets, contact tracing, temperature-taking, health declarations, quarantine, disallowing large gatherings, and implementation of strict travel restrictions.[1 2] Through strict compliance of Chinese citizens to the order, social distancing has been proven the most effective measure to ease the rapid spreading of the virus.[3 4]

Among all prevention and control measures, a nationwide movement restriction order was announced by the Chinese government soon after the lockdown of Wuhan city on January 23, 2020. This social distancing order was introduced and enforced subsequently, requiring all citizens to remain at home and avoid most forms of face-to-face social contact when outside.

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The order was implemented with the recommendation of other personal protective measurements, such as regular hand sanitising, daily temperature-taking, and mask-wearing.[5] The implementation of the personal protection order was challenging. Social distancing means staying away from mass gatherings and keeping a distance of 6 feet or 2 meters.[3] Due to the Chinese New Year celebration, which took place around the same time (January 25, 2020) when the outbreak happened, movements among cities and suburban areas, as well as family gatherings were inevitable and difficult to contain. Voluntary behavioural intervention during an infectious disease outbreak, such as social distancing, requires not only sufficient realisation of the situation severity, but more importantly, determined commitment to such action from individuals in the community.

Hence prior to the enforcement of the nationwide home quarantine order, the Chinese government announced a series of precautionary regulations, including 1) refusal of entry into public places without wearing a mask and obtaining a normal body temperature; 2) set-up of a detailed individual purchase record of fever/cough/flu-related medications in local pharmacies; 3) screening and a detailed registry of suspected cases with high fever in the community. The entire enforcement was accompanied by thorough public health education and promotion which started as early as late January. Violation of the above-mentioned regulations could result in further investigation or even legal liability.[6]

After the implementation of the four personal protective behaviours, including home quarantine, mask-wearing, temperature-taking, and hand-sanitising, non-compliance would lead to strict education and immediate correction from various levels of management, ranging from the street and community, to district and city levels of local authority.

The implementation of these personal protective behaviours is necessary. However, compliance to these actions is not only determined by the severity of the disease, but also a number of demographic (e.g., gender, age) and social factors.[7 8] Interestingly, while previous literature have demonstrated that older people and females are typically more likely to practice protective behaviours in public health emergencies such as the severe acute respiratory syndrome (SARS) and H1N1 swine flu, the results are mixed.[9 10] Hence in the present study, we sought to understand the demographic indicators and correlates of individuals' compliance to preventive measures during COVID-19.

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METHODS

Study design and sampling

With a cross-sectional study design, a nationwide online survey on behavioural compliance during COVID-19 was carried out during February 14-17, 2020, among Chinese citizens in China. Community dwellers aged 16 and above were enrolled in the survey. To avoid bias in the sample, the study team disseminated the survey questionnaire nationwide in all 31 provinces and regions in China with different levels of risk exposure. Study description and questionnaires were posted through various social media platforms, such as Wechat and Weibo, with a notice and invitation on these platforms for better visibility. All participants from this self-selecting sample provided electronic informed consent prior to taking the survey (Supplemental Material 1). The study protocol was approved by the Ethics Commission of Zhejiang University prior to the commencement of the study and was in accordance with the Declaration of Helsinki. STROBE cross-sectional reporting guidelines were used.[11]

Questionnaires

De-identified demographic information (age, gender, current living area) was collected.

Outbreak Severity: Severity of the outbreak in each province and region in all survey areas were sorted into 5 categories according to the confirmed coronavirus cases published on the China Center for Disease Control and Prevention (CDC) website on the day of the survey (February 14, 2020): <100 cases, 100-499 cases, 500-999 cases, 1000-1999 cases, >2000 cases.

Policy Timeliness: Timeliness of the social distancing order implemented by the provincial government was assessed by the length (in days) between the implementation date of the social distancing order to the date of the survey. For those areas where the order was implemented after the survey, the score "0" was granted, e.g. Nei Meng province. Scores were subsequently transformed into fractional rank for analysis purposes.

Compliance to Mitigation Measures

An individual's compliance with a number of mitigation measures introduced by the local government was defined as:

1. home quarantine, as defined by leaving residential address for ≤1 in 3 days' time, as per the Chinese government's regulation;
2. mask-wearing, as defined by wearing a mask when leaving the residential address on the day of the survey, as per the Chinese government's regulation;
3. temperature-taking, as defined by taking one's own temperature at least once on the day of the survey, as per the Chinese government's regulation;
4. hand-sanitising, as defined by sanitising one's hands with a sanitiser with >75% alcohol

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on the day of the survey, as per the Chinese government's regulation.

Statistical Analysis

Associations among 4 individual protective behaviours were examined using Chi-square. Logistic regression models were applied to investigate the indicators for accordance with each individual mitigation measure. All analyses were performed using SPSS version 25 and SAS version 9.4. Statistical significance was determined as two-tailed p-value < 0.05. Bonferroni correction was employed to obtain an adjusted significance level for each protective behaviour: ≈0.05/4=0.0125.

Patient and Public Involvement

No patients and none of the public were involved in the study planning, design and interpretation of results. Results from the paper will be disseminated to the general public through online article format.

RESULTS

A total of 3,000 participants completed the survey, among whom, 7 had incomplete data and 37 had repeated answers and were removed from the dataset, leaving a total of 2,956 in the current analysis. All 2,956 subjects completed all questionnaires in the survey. Sample descriptives are in Table 1.

Table 1. Study sample descriptives

	Whole Sample	Range
Demographics		
Age (mean±SD)	28.5±8.6	16-72
Gender, female, n (%)	1178 (39.9%)	
Current Living Area, n (%)		
Extremely High Risk (≥2000 confirmed cases)	106 (3.5%)	
High Risk (1000-1999 confirmed cases)	667 (22.2%)	
Moderate-High Risk (500-599 confirmed cases)	770 (25.7%)	
Moderate Risk (100-499 confirmed cases)	1290 (43.0%)	
Mild-Moderate Risk (<100 confirmed cases)	167 (5.6%)	
Average length of implementation of mitigation measures, days (mean±SD)	15±5.1	0-20
Compliance to Mitigation Measures		
Home Quarantine, compliant, n (%)	2234 (75.6%)	
Mask-wearing, compliant, n (%)	2353 (79.6%)	
Temperature-taking, compliant, n (%)	2350 (79.5%)	

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Hand-sanitising, compliant, n (%)	2257 (76.4%)

Compliance with individual protective measures

Compliance with home quarantine was positively associated with compliance with hand-sanitising (χ^2=4.21, p=0.023), but not with mask-wearing and temperature-taking (p=0.07 and 0.08 in the positive direction, respectively). Compliance with mask-wearing was positively associated with temperature-taking (χ^2=493.11, p<0.001) and hand-sanitising (χ^2=498.55, p<0.001). Compliance with temperature-taking was positively associated with hand-sanitising (χ^2=802.16, p<0.001).

Logistic regression analysis was employed to investigate the predictors for compliance with each mitigation measure: home quarantine, mask-wearing, temperature-taking and hand-sanitising. Results showed that higher risk-exposure was positively associated with compliance with all measures except home quarantine. Age was positively associated with higher compliance with masking-wearing and hand-sanitising (p<0.0125), yet inversely associated with home quarantine. Interestingly, whilst the male gender was associated with lower compliance with home quarantine order, it was found positively associated with mask-wearing and temperature-taking behaviours (Table 2).

Table 2. Indicators for compliance with respective mitigation measures

	Compliance vs. Non. Compliance OR (95%CI)
Home Quarantine	
Gender, Male	**0.61 (0.51-0.73)**
Age	0.99 (0.98-0.999)*
Regional Risk-exposure	0.99 (0.90-1.08)
Timeliness for Policy Implementation	1.003 (0.99-1.02)
Mask-Wearing	
Gender, Male	**1.79 (1.49-2.16)**
Age	**1.03 (1.02-1.04)**
Regional Risk-exposure	**1.41 (1.28-1.54)**
Timeliness for Policy Implementation	0.99 (0.98-1.01)
Temperature-taking	
Gender, Male	**1.27 (1.05-1.53)**
Age	1.005 (0.995-1.02)
Regional Risk-exposure	**1.40 (1.28-1.54)**
Timeliness for Policy Implementation	1.016 (0.998 -1.035)
Hand-sanitising	

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Gender, Male	1.14 (0.95-1.36)
Age	**1.02 (1.01-1.04)**
Regional Risk-exposure	**1.39 (1.27-1.52)**
Timeliness for Policy Implementation	1.01 (0.995-1.03)

Boldface indicates significance, $p < 0.0125$

**. Trend to significance (0.0125<p<0.05)*

Gender-specific compliance with each personal protective measure is presented in Figure 1.

Whilst males were less prone to be compliant with home quarantine order, they were more likely to abide by the other 3 personal protective measures.

Interestingly, from the distribution graph, the mid-age groups (31-40 and 41-50) was the most non-compliant age group for home quarantine order, nevertheless also the most compliant for other protective behaviours (Figure 2).

Further analysis showed that, the 31-40 age group was less compliant to the home quarantine order (OR=0.71 [0.54-0.93]), compared to the reference group (≤20; Figure 3). Yet they were compliant to mask-wearing (OR=1.96, 95%CI=1.46-2.64), hand-sanitising (OR=2.24, 95% CI=1.70-2.96), and temperature-taking (OR=1.65, 95% CI=1.23-2.21). A similar pattern for compliance was also observed in the 41-50 age group, where they were less compliant to home quarantine (OR=0.67 [0.46-0.97]), nonetheless more compliant to mask-wearing (OR=1.88[1.24-2.87]) and hand-sanitising (OR=1.51[1.03-2.19]). See Supplemental Material 2 for complete regression model output.

DISCUSSION

To our knowledge, the present study is amongst the first to examine demographic and social indicators and correlates of the general public's compliance to personal protective measures during the COVID-19 outbreak in China. The main findings from the present study is that among all demographic and social factors, age, gender and risk of exposure are the three main indicators for behavioural compliance to the protective measures.

Among all of the mitigation measures various countries have implemented during COVID-19, social distancing has been the most emphasised measure, and proven the most effective one.[12] China introduced the strict social distancing order in February when the epidemic was

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spreading at an alarming rate and causing an increasing number of deaths in the nation.[5] The execution of such an order was combined with home quarantine, the shutdown of all public places, including shops, malls, restaurants and entertainment venues, and forbidding of mass gatherings. With such a rigourous combination, the domestic and global spreading speed of the virus showed a significant slowdown from mid-February till mid-March.[13]

In the present study, males were found less likely to be compliant with the social-distancing order (72% vs. 74%), nevertheless more likely to follow other personal protective approaches, such as mask-wearing (83% vs. 74%), temperature-taking (81% vs. 77%), and hand-sanitising (77% vs. 75%). One plausible explanation for the gender difference in the behavioural compliance is that males, especially in the mid-age group, are identified to be the pillar of the family. Hence during a public health emergency like COVID-19, males are more expected to carry on with family errands and even go to work. In the present study, 87 reported violation of the home quarantine order. Among whom, 60 went out for shopping/collection of essential goods (home supplies and grocery), with 67% of them being male. Apart from this, 24 reported to have left home for work purposes, among whom 67% were male. Our findings support previous literature that reported males were more likely to leave their homes during the early stages of the COVID-19 outbreak in the Hubei Province and other parts of China.[8] Interestingly, recent studies investigating behavioural compliance to safety measures (including mask-wearing, isolation) outside of China during COVID-19 have mixed results.[14-18] Nonetheless, explanations for non-compliance to safety measures centres around the level of knowledge and perception of the COVID-19 pandemic. Similarly, past pandemic research have shown that females are more likely to adhere to more avoidant behaviors such as hand washing and wearing masks.[8-10 19] Conversely, we found that males are more likely to comply with these avoidance behaviours apart from social distancing. Our findings thus demonstrate that the impact of economic conditions alongside the desire to remain safe may be the predominant drivers for the disparities in behavioural compliance. However, behind such a potential driving force lies cultural expectations that adult males are subjected to in Chinese society. From a cultural standpoint, the male breadwinner model still exists in China's social fabric today despite the increasingly blurred gender roles in modern-day China.[20] The over 2000-year old Confucian model posits a gender role divide between males and females where males undertake an ‘outside’ role and are expected to provide for the family, while females take on the caregiving role (‘inside’ role) to tend to household matters.[21-24] A strong emphasis is also placed on filial piety, where providing and caring for one’s elderly parents is an esteemed and

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obligatory duty.[25] As a result, the conformity to role expectations in Chinese society may explain the non-compliance by males to social distancing measures as they feel more obligated to meet their economic responsibilities to continue providing for the family, even during a public health crisis. Our results challenge several work on COVID-19 preventive behaviours that view behavioural compliance singularly as the result of partisanship, perceptions surrounding its effectiveness and the infection risks.[17 26] Our study lends some support to Zhong and colleagues' findings that males were more likely to leave the house to go to crowded places during the outbreak in China,[8] but contradict in mask-wearing compliance. Higher likelihood of risk-taking behaviour in males was noted as an explanation for their non-compliance. On the contrary, we found that males were compliant to other preventive measures to mitigate risk. Notably, Zhong and colleagues gathered their data between January 27 and February 1 2020,[8] a week after the lockdown in China, three weeks earlier than when our data were collected. Therefore, strict restrictions and public health education by authorities during the three weeks may have been effective and enabled males to engage in more preventive measures even though they were still leaving home for work.

Nevertheless, timeliness of policy implementation at provincial level did not have a significant impact on behavioural compliance in the present study. A plausible explanation could be that policy implementation was launched in a prompt manner, according to the outbreak spreading speed in each province. It is worth noting that most provinces announced and implemented the COVID policy within 15 days since the lockdown of Wuhan city.[1] Such equally speedy reaction at the governmental level may be the reason why there was no difference of policy implementation on personal protective behaviours among community dwellers in China.

Though gender played an important role in predicting compliance with home quarantine in people aged 21 years old and above, it did not make a difference in people under 21 years old. Studies have shown that late adolescents tend not to comply with social distancing and stay home orders due to their likelihood in engaging in risky behaviors.[8 27] However, our study found that people in the mid-age group, especially those between 31-40 and 41-50 years old (Figure 2) were driving this significance of lower compliance with home quarantine order, as compared to younger adults <21 years of age. Notably, those above 50 years old had a higher likelihood of staying home similar to those below 21. A plausible explanation for the reduced social distancing compliance in the 31-50 age group is that a large number of these people may be salarymen and have to leave home for work. On the other hand, those above 50 may be aware of the risks involved and have fewer reasons to leave the house. Furthermore, people in

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the >50 age group may have reduced mobility function.[28] Hence, those between 31 to 50 years old have lesser compliance to home quarantine due to economic reasons where they have to go out to work compared to those under 21 where majority of them were likely to be high school or university students, hence could not access campus due to temporary shutdown of all schools nationwide during the epidemic.[29]

The present study has several strengths and weaknesses. To our knowledge, the present study is amongst the first to examine the effect of demographical and social correlates on the compliance of public health mitigation measures, especially social distancing, during the COVID-19 outbreak. Furthermore, the study was conducted during the peak of the spread of COVID-19 in China and gathered nationwide data from participants in China. Therefore, the findings obtained are especially vital in understanding the motivations behind the lack of compliance with mitigation measures, particularly during the heightened period of the outbreak. We observed a difference in adherence to safety measures (e.g., mask-wearing) by males between two timeframes of the pandemic in China[8], suggesting that public health education and strict restrictions may have impacted the public's perception and compliance. Hence, these results help further inform public health authorities and political leaders in the way they implement mitigation measures and administer financial and psychological aid to the community. Notably, the present study lacked important demographic factors such as education level and occupational status, which could have further informed future mitigation measures. A non-probability sample was used in this study, thus rendering the effect of p-values and confidence intervals not strictly valid, or valid only under the assumption that the sample is comparable to a random sample. The study's outcome variables were also self-reported compliance instead of actual compliance, suggesting the potential impact of social desirability bias in under- or over-reporting compliance to safety measures.[30] However, the online mode of data collection and the anonymity of the survey may have mitigated such potential biases. Moreover, as the study was conducted through an online survey, the sample was limited to those with access to digital technology and Internet. Therefore, we were unable to determine if this subset of the population complied to mitigation measures as well as the factors associated with it. Information obtained from this subset is essential as they may be more vulnerable to the virus due to lack of access to extensive public health awareness and mitigation measures online. While the lack of access to digital technology is a real limitation, future studies should attempt to reach out to this subset of the population. Retrospective studies could be conducted to assess their accordance with mitigation measures, specifically social distancing, and the role

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of psychosocial indicators and correlates on the compliance. Additionally, it would be interesting to examine the anxiety levels of those in the under 21 group that had a significant impact on their compliance with social distancing during the outbreak. Access to social media and overwhelming information provided by the media every day could be a factor that fuelled the heightened levels of anxiety.

The non-compliance with public health mitigation measures, particularly home quarantine, was largely attributed to the male gender, and being in the middle-aged group. Our study found that while males in the mid-age group were least compliant with social distancing, they were most compliant to other measures (i.e., mask-wearing, hand-sanitising, and temperature-taking), possibly due to their economic responsibilities and need to fulfil the breadwinner role expectation. As the COVID-19 outbreak is still ongoing, public health authorities and governments could target this population in their future measures and aid that are provided during this pandemic.

Figure Legends:

Figure 1. Gender-specific percentages for behavioural compliance

Figure 2. Age-specific percentages for compliance with individual protective behaviours

Figure 3. Adjusted ORs and 95% CI of different age-blocks for compliance with individual protective behaviours. Analysis controlled for gender, days to policy implementation and risk exposure

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Contributors: XX* and YQ conceptualized and designed the study. XX* drafted the manuscript. YQ supervised data analysis and interpretation of data. XX*, WZ and XXH acquired the data. XX* and KAC analyzed and interpreted the data. XX, WZ and XXH revised the manuscript for intellectual content. YQ and KAC critically revised the manuscript for intellectual content.

*Xu Xin

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Competing interests: None declared.

Patient consent for publication: Not required.

Ethics approval: This study has been approved by the Ethics Commission of Zhejiang University (ID: ZGL202005-01). Informed consent was obtained from participants prior to taking part in the study.

Data availability statement: Data are available upon request. Original data can be requested from the study team (xuxinsummer@zju.edu.cn and chianyoung@zju.edu.cn).

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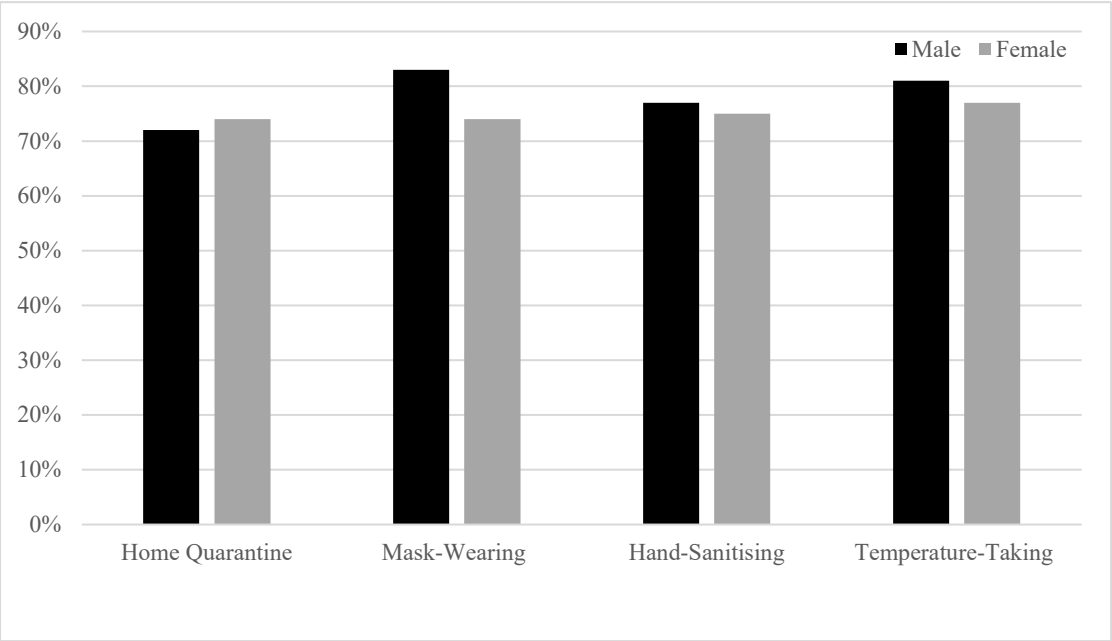

Figure 1. Gender-specific percentages for behavioural compliance

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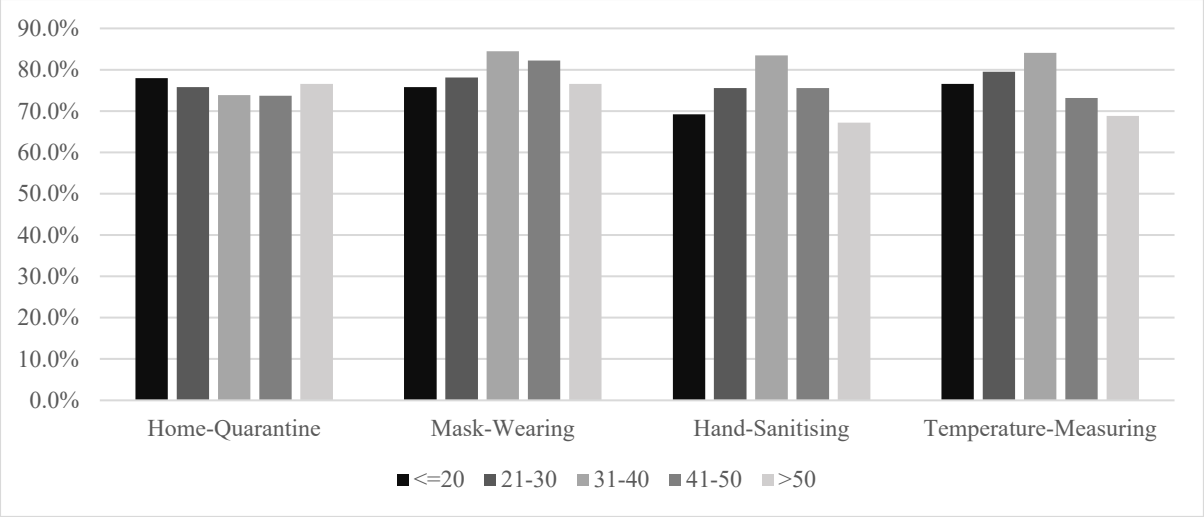

Figure 2. Age-specific distribution for compliance with individual protective behaviours

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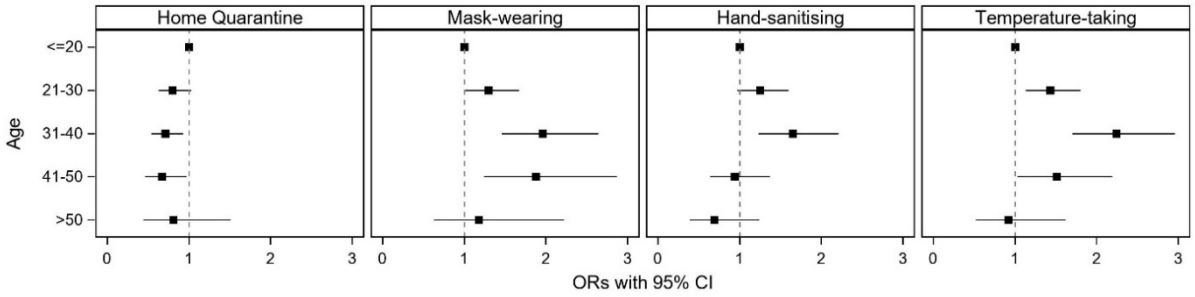

Figure 3. Adjusted ORs and 95% CI of different age-blocks for compliance with individual protective behaviours. Analysis controlled for gender, days to policy implementation and risk exposure.

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Supplemental Material 1

中国社区居民在 COVID-19 期间个人保护行为的调查

你好！这里是浙江大学公共卫生学院发起的新冠疫情调研组。新冠肺炎的肆虐给人民健康带来了极大的威胁。但是我们定会众志成城，共同战“疫”！我们在此诚挚邀请您参加本次调研,您的参与将会帮助我们更好地了解民众个人保护行为。

本次调研将会分两次进行。我们会邀请您参与多次答题。本次问卷大约需要 1-2 分钟完成。请仔细读清楚问题之后填写。每次提交问卷后，经过系统核查，第一次问卷您将得到 3 元红包，第二次问卷您将得到 5 元红包。感谢您一如既往的支持和参与，让我们上下一心，携手并进，共同抗击新冠病毒！

本问卷不涉及您的任何隐私。您的所有答案将严格保密，仅用于疫情应对的研究。您有权随时退出本次调研。

如您已知晓您的全部权利，乐于自愿参与，并能和我们一起坚持每一次的答题，请点击下面的“下一页”按钮参与调研。

和您一起参与答题的，还有千万个和您一样在意疫情发展，支持疫情防控工作的中国民众。让我们万众一心，赢得这场没有硝烟的战役！

1. [填空题] 请选择省份城市与地区: _____
2. [填空题] 您的手机号后 4 位为 _____ （仅用于编号）
3. [单选题] 您的性别是
   ○男
   ○女
4. [填空题] 请输入您的出生年份：_____
5. [单选题] 最近三天，您的出门次数为
   ○0-1 次（请跳至第 8 题）
   ○>1 次
6. [单选题] 您今天是否出门
   ○是
   ○否（请跳至第 8 题）
7. [单选题] 您今天出门的原因是
   ○购物
   ○取东西
   ○工作
   ○去医院
   ○其他原因，请说明_____
8. [单选题] 您今天是否佩戴口罩
   ○是
   ○否
9. [单选题] 您今天是否使用消毒液或 75%酒精消毒
   ○是
   ○否
10. [单选题] 您今天是否自测体温
   ○是
   ○否

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Survey translated to English:

Investigation of individual protection behaviour of Chinese community residents during COVID-19

Hello! This is the COVID-19 research group launched by the School of Public Health, Zhejiang University. COVID-19 poses a significant threat to people's health. However, we will come together to fight COVID-19. We sincerely invite you to participate in this survey, and your participation will help us better understand people's personal protection behaviours.

There are two surveys in this study. You will be invited to answer several questions. It will take about 1-2 minutes to complete the questionnaire. Please read the questions carefully and fill them out. After submitting the questionnaire, you will receive 3 yuan for the first survey and 5 yuan for the second survey. Thank you for your continued support and participation. Let us fight COVID-19 hand in hand.

This questionnaire is strictly private and confidential. All your answers will be kept strictly confidential and used only for research in response to the outbreak, and you have the right to withdraw from the survey at any time.

If you fully understand your rights, are willing to volunteer, and can answer every question, please click the "next page" button below to participate in the research.

There are thousands of people who care about the evolution of the epidemic and support epidemic prevention and control efforts like you who are participating in the survey. Let us unite as one to win the battle without smoke!

1. [Completion] Please state your province and city: _____
2. [Completion] Please fill in the last 4 digits of your cell phone number: _____(Just for numbering)
3. [Multiple Choice] What is your gender?
   ○Male ○Female
4. [Completion] Please fill in your year of birth: _____
5. [Multiple Choice] The number of times you have gone out in the last three days is
   ○0-1 time (Please skip to question 8) ○>1
6. [Multiple Choice] Have you been out today?
   ○YES ○No
7. [Multiple Choice] The reason you went out today is
   ○shopping
   ○take things
   ○work
   ○go to the hospital
   ○other reasons. Please indicate the reason in detail_____

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8. [Multiple Choice] Are you wearing a mask today?

○YES ○No

9. [Multiple Choice] Have you used disinfectant or 75% alcohol today?

○YES ○No

10. [Multiple Choice] Have you taken your temperature today?

○YES ○No

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Supplemental Material 2

Home Quarantine

	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
Gender	0.489	0.092	28.482	1	0	1.63	1.363	1.951
Policy implementation timeliness	0.001	0.008	0.025	1	0.875	1.001	0.985	1.018
Risk Exposure	-0.019	0.044	0.193	1	0.66	0.981	0.899	1.07
Age ≤20			7.138	4	0.129			
Age 21-30	-0.208	0.127	2.712	1	0.1	0.812	0.633	1.04
Age 31-40	-0.342	0.139	6.035	1	0.014	0.71	0.54	0.933
Age 41-50	-0.382	0.192	3.955	1	0.047	0.683	0.469	0.995
Age >50	-0.165	0.28	0.349	1	0.555	0.848	0.49	1.467
Constant	0.723	0.249	8.407	1	0.004	2.061		

Mask-Wearing

	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
Gender	-0.575	0.095	36.715	1	0	0.563	0.468	0.678
Policy implementation timeliness	-0.005	0.009	0.271	1	0.603	0.995	0.977	1.014
Risk Exposure	0.331	0.047	50.582	1	0	1.393	1.271	1.526
Age ≤20			22.317	4	0			
Age 21-30	0.248	0.127	3.793	1	0.051	1.281	0.998	1.643
Age 31-40	0.646	0.151	18.394	1	0	1.908	1.42	2.564
Age 41-50	0.616	0.212	8.428	1	0.004	1.851	1.221	2.805
Age >50	0.367	0.303	1.471	1	0.225	1.444	0.797	2.614
Constant	0.891	0.26	11.762	1	0.001	2.439		

Hand-Sanitising

	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
Gender	-0.152	0.091	2.804	1	0.094	0.859	0.719	1.026
Policy implementation timeliness	0.013	0.009	2.263	1	0.133	1.013	0.996	1.03
Risk Exposure	0.317	0.044	51.548	1	0	1.373	1.259	1.497
Age ≤20			31.556	4	0			
Age 21-30	0.342	0.118	8.395	1	0.004	1.408	1.117	1.775
Age 31-40	0.785	0.142	30.698	1	0	2.193	1.661	2.895
Age 41-50	0.411	0.19	4.662	1	0.031	1.508	1.039	2.188
Age >50	0.206	0.27	0.58	1	0.446	1.228	0.723	2.086
Constant	-0.19	0.246	0.596	1	0.44	0.827		

Temperature-Taking

	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
Gender	-0.266	0.095	7.886	1	0.005	0.767	0.637	0.923
Policy implementation timeliness	0.016	0.009	3.165	1	0.075	1.016	0.998	1.035
Risk Exposure	0.328	0.046	50.121	1	0	1.388	1.267	1.519
Age ≤20			15.457	4	0.004			
Age 21-30	0.241	0.128	3.578	1	0.059	1.273	0.991	1.634
Age 31-40	0.502	0.149	11.303	1	0.001	1.651	1.233	2.212

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Age 41-50	-0.035	0.191	0.033	1	0.856	0.966	0.664	1.405
Age >50	-0.006	0.281	0	1	0.984	0.994	0.573	1.725
Constant	0.234	0.257	0.826	1	0.364	1.264		

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Reporting checklist for cross sectional study.

Based on the STROBE cross sectional guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

Upload your completed checklist as an extra file when you submit to a journal.

In your methods section, say that you used the STROBE cross sectionalreporting guidelines, and cite them as:

von Elm E, Altman DG, Egger M, Pocock SJ, Gotzsche PC, Vandenbroucke JP. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies.

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		Reporting Item	Page Number
Title and abstract			
Title	#1a	Indicate the study's design with a commonly used term in the title or the abstract	1

Abstract	#1b	Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background / rationale	#2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	#3	State specific objectives, including any prespecified hypotheses	3
Methods			
Study design	#4	Present key elements of study design early in the paper	4
Setting	#5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4
Eligibility criteria	#6a	Give the eligibility criteria, and the sources and methods of selection of participants.	4
	#7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	n/a
Data sources / measurement	#8	For each variable of interest give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. Give information separately for for exposed and unexposed groups if applicable.	4

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Bias	#9	Describe any efforts to address potential sources of bias	4
Study size	#10	Explain how the study size was arrived at	5
Quantitative variables	#11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	5
Statistical methods	#12a	Describe all statistical methods, including those used to control for confounding	4
Statistical methods	#12b	Describe any methods used to examine subgroups and interactions	5
Statistical methods	#12c	Explain how missing data were addressed	5
Statistical methods	#12d	If applicable, describe analytical methods taking account of sampling strategy	n/a
Statistical methods	#12e	Describe any sensitivity analyses	n/a
Results			
Participants	#13a	Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed. Give information separately for for exposed and unexposed groups if applicable.	5
Participants	#13b	Give reasons for non-participation at each stage	5

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Participants	#13c	Consider use of a flow diagram	n/a
Descriptive data	#14a	Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders. Give information separately for exposed and unexposed groups if applicable.	5
Descriptive data	#14b	Indicate number of participants with missing data for each variable of interest	5
Outcome data	#15	Report numbers of outcome events or summary measures. Give information separately for exposed and unexposed groups if applicable.	4
Main results	#16a	Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	6
Main results	#16b	Report category boundaries when continuous variables were categorized	6
Main results	#16c	If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	#17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses	6
Discussion			
Key results	#18	Summarise key results with reference to study objectives	7

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Limitations	#19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.	9
Interpretation	#20	Give a cautious overall interpretation considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.	7-9
Generalisability	#21	Discuss the generalisability (external validity) of the study results	9
Other Information			
Funding	#22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	10

None The STROBE checklist is distributed under the terms of the Creative Commons Attribution License CC-BY. This checklist can be completed online using https://www.goodreports.org/, a tool made by the EQUATOR Network in collaboration with Penelope.ai

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