BMJ Open Association between contact with a general practitioner and depressive symptoms during the COVID-19 pandemic and lockdown: a large community-based study in Hangzhou, China

Fei Yang,^{1,2} Wenhui Lin,^{1,3} Eleanor Frost,⁴ Yan Min ,^{4,5} Xiaochen Xu,^{1,2} Xiaoyan Wang,^{1,2} Wei Li,^{1,6} Yue Leng,⁷ Xueyin Zhao,^{1,2} Wei He,^{1,2} Ann W Hsing,^{4,5,8} Shankuan Zhu ^{1,2}

To cite: Yang F, Lin W, Frost E, *et al.* Association between contact with a general practitioner and depressive symptoms during the COVID-19 pandemic and lockdown: a large community-based study in Hangzhou, China. *BMJ Open* 2021;**11**:e052383. doi:10.1136/bmjopen-2021-052383

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online. (<http://dx.doi.org/10.1136/bmjopen-2021-052383>).

FY and WL are joint first authors. AWH and SZ are joint senior authors.

Received 16 April 2021

Accepted 29 July 2021

© Author(s) (or their employer(s)) 2021. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

For numbered affiliations see end of article.

Correspondence to

Dr Ann W Hsing;
annhsing@stanford.ed and
Dr Shankuan Zhu;
zsk@zju.edu.cn

ABSTRACT

Objectives To determine the association of general practitioner (GP) contact with depressive symptoms during the COVID-19 pandemic and lockdown in China.

Design In April 2020, a follow-up survey was conducted on the basis of a baseline survey conducted between October 2018 and May 2019.

Setting The survey was embedded in the Stanford Wellness Living Laboratory-China (WELL China) study, an ongoing prospective community-based cohort study during 2018–2019.

Participants The survey was conducted by telephone interview among 4144 adult urban residents participating in the WELL China study at baseline. We collected information on sociodemographic characteristics, depressive symptoms and GP contact during the lockdown period (February to March 2020).

Primary and secondary outcome measures Depressive symptoms were measured using the WHO-Five Well-being Index, comprising five questionnaire items that briefly indicate psychological well-being. Logistic regression models were applied to assess the association between GP contact and depressive symptoms.

Results In total, 3356 participants responded to the survey; 203 were excluded owing to missing data on depressive symptoms, leaving 3153 participants in the present study. During lockdown, 449 participants had GP contact. GP contact was significantly negatively associated with prevalent depressive symptoms (OR, 0.67; 95% CI 0.51 to 0.89; $p < 0.01$) and incident depressive symptoms (OR 0.68; 95% CI 0.51 to 0.93; $p < 0.05$). Stratified analysis showed a significant negative association between depressive symptoms and GP contact in individuals who were 45–64 years old ($p < 0.01$), had a middle or high education ($p < 0.01$) and had self-reported non-communicable diseases ($p < 0.05$).

Conclusions Contact with GPs during the COVID-19 pandemic and lockdowns may have a negative association with depressive symptoms in community-dwelling populations. Given the possibility of further surges in

Strengths and limitations of this study

- This was a longitudinal study using the WHO-Five Well-being Index, health assessment and socio-demographic characteristics at both baseline and during the lockdown period.
- The sample size of our study was large, which provided sufficient statistical power.
- Most respondents to the baseline survey responded to the follow-up survey.
- Selection bias may exist owing to the use of telephone interviews.
- Causation cannot be established owing to the cross-sectional study design.

COVID-19 infections, GPs' contact in the community should be enhanced.

INTRODUCTION

The outbreak of COVID-19 has had negative health impacts around the world. According to the WHO, there were 134 508 532 confirmed cases of COVID-19, causing 2 914 774 deaths by 9 April 2021.¹ COVID-19 is not only threatening to physical health but also has impacts on short-term and long-term mental health. According to reports, the rate of depressive symptoms in the general population was 14.6%–48.3% during the COVID-19 epidemics in China, Spain, Italy, Iran, the USA, Turkey, Nepal and Denmark, using different measurement tools.² Furthermore, physical symptoms similar to COVID-19 infection can increase people's perceived risk and lead to adverse mental health outcomes, including depressive symptoms.³

The COVID-19 pandemic has changed people's lifestyles owing to restricted movements; temporary unemployment; new realities of working from home; lack of physical contact with family members, friends and colleagues and homeschooling of children, among other factors.⁴ Added to these changes is fear of contracting the disease. Psychological impacts during lockdowns have been reported.^{5–8} Stressful life events, pessimism, home quarantine, social distancing, wearing face masks and increased exposure to social media have been reported to influence mental health during lockdown, exacerbating various mental health conditions, including depression, anxiety and grief-related symptoms.^{9–12} Good mental health is fundamental to overall health and well-being.⁴ Thus, it is important to properly manage mental health problems both in the short and long term during the COVID-19 pandemic.

In China, mental health during the COVID-19 pandemic has attracted attention. Wang *et al* found that during the initial stages of the outbreak in China, 16.5% of respondents to an online survey reported moderate to severe depressive symptoms.¹³ A longitudinal study in a Chinese community-dwelling population showed that 4 weeks after the pandemic peak, depressive symptoms were similar to those at the initial stage, using the Depression, Anxiety and Stress Scale (DASS) depression subscale.¹⁴ Additionally, some surveys have focused on depression in a specific population, such as patients with COVID-19, psychiatric patients and workers returning to the workplace after lockdown. Results from these studies suggest that patients with COVID-19 and psychiatric patients are more vulnerable to and have relatively high levels of depression.^{15–17} Studies have shown that personal precautionary measures, confidence in doctors and satisfaction with health education may relieve depression and anxiety.^{13 14 18} Chinese general practitioners (GPs) may play an essential role during the pandemic by giving professional support to people at risk of impaired mental health.

Community-based prevention and control of mental diseases (or mental health) are important for controlling the COVID-19 pandemic.¹⁹ In response to the outbreak of COVID-19 in China during late January 2020, GPs acted as frontline health workers in the community healthcare response to the epidemic,^{20 21} undertaking responsibilities including the dissemination of up-to-date information regarding prevention methods, monitoring of patients' health status, guidance for appropriate responses and provision of prompt treatment for diseases among local residents. Normally, GPs are involved in health improvement and the control of non-communicable diseases (NCDs).^{21 22} During the COVID-19 epidemic in China, GPs have contacted residents with or without NCDs via telephone. However, there is no evidence regarding the impact of such contact with a GP on mental health.

Given the possibility of further surges in COVID-19 infections,^{23 24} it is important to understand the role of GPs in community-based prevention and control of

COVID-19 epidemics, including the impact of contact with a GP on mental health. Therefore, in the present study, we investigated the association between having contact with a GP by telephone (GP contact) and depressive symptoms among community residents before and during the COVID-19 lockdown period in Hangzhou, China. These findings may inform new healthcare initiatives to meet future challenges.

METHODS

Study design and participants

Telephone interviews were conducted in April 2020 among 4144 urban residents who participated in the baseline survey of the Stanford Wellness Living Laboratory-China (WELL China) study between October 2018 and May 2019 in Gongshu District, Hangzhou City in Zhejiang, China, which is an urban area.²⁵ Of the 4144 baseline participants, 3356 responded to the survey, with a response rate of 81%. We excluded 203 participants owing to missing data regarding educational attainment (n=29), WHO-Five Well-being Index (WHO-5) values at baseline (n=3), WHO-5 values during lockdown in response to the COVID-19 outbreak (n=45), or GP contact (n=126). In total, 3153 participants were included in the final analysis.

Data collection and variable definitions

At the baseline survey between October 2018 and May 2019, face-to-face interviews were performed to collect demographic characteristics, WHO-5 data and history of clinical diagnoses. In the follow-up survey in April 2020, we collected WHO-5 data and information about GP contact with residents via telephone during lockdown in response to the COVID-19 outbreak between February and March in 2020.

In the present study, we used the WHO-5 to indirectly assess depressive symptoms. The WHO-5 is a short questionnaire comprising five simple, non-invasive questions reflecting well-being, which includes the following five items²⁶: (1) 'I have felt cheerful and in good spirits', (2) 'I have felt calm and relaxed', (3) 'I have felt active and vigorous', (4) 'I woke up feeling fresh and rested' and (5) 'My daily life has been filled with things that interest me'. Participants reported their feelings (WHO-5 index) during lockdown on a 6-point scale ranging from 'all of the time' (5 points) to 'at no time' (0 points). A summed score less than 13 or scores of 0 or 1 for any item are considered to indicate depressive symptoms.²⁷ Although the WHO-5 is not considered the gold standard for defining depression, it has relatively good psychometric performance in terms of reliability and validity, and it has a strong correlation with depressive symptoms.²⁶ The WHO-5 can be used as a sensitive and specific screening tool for depression in epidemiological studies. Considering the time limit of telephone interviews, we chose to use the WHO-5 as an indicator of depressive symptoms in this large population health survey.

GP contact was defined as a GP providing health guidance, including advice regarding health improvement, the management of NCDs and prevention of infectious diseases, to residents with or without NCDs via telephone during the COVID-19 pandemic and lockdown.

NCDs included a history of hypertension, diabetes, clinically diagnosed cardiovascular disease, cancer, endocrine and metabolic diseases, osteoarthritis, respiratory system diseases, digestive system diseases, mental diseases, nervous system diseases, urinary system diseases, immune diseases and allergies at baseline.

Statistical analysis

We used t-tests and χ^2 tests to analyse participants' characteristics according to GP contact status. Logistic regression analysis was performed to test the association between GP contact (yes/no) and prevalent and incident depressive symptoms; baseline depressive symptoms were excluded to test for incident symptoms. Results are presented as ORs and 95% CIs. Model 1 was adjusted for age, sex, educational attainment and marital status. Model 2 was additionally adjusted for NCDs. Model 3 was additionally adjusted for depressive symptoms at baseline.

We conducted stratified analysis according to: (1) age group (young, 18–44 years old; middle aged, 45–64 years old and older ≥ 65 years old), (2) educational attainment groups (illiterate or primary school, middle school or high school and college or above) and (3) groups with or without NCDs.

Data analysis was performed using R software V.4.0.2 (The R Project for Statistical Computing, Vienna, Austria). The threshold for statistical significance was set at $p < 0.05$ (two sided).

Patient and public involvement

No patients or the public were involved in the study design, setting the research questions, interpretation or writing up of the results or reporting of the research.

RESULTS

Of 3153 participants, 449 participants had contact with a GP and 2704 had no contact with a GP during the COVID-19 lockdown. Sociodemographic characteristics and NCDs at baseline among participants with and without GP contact via telephone (GP contact) during lockdown are shown in table 1. The results revealed significant differences in age, educational attainment, marital status and NCDs between participants with and without GP contact ($p < 0.05$). Participants with and without GP contact did not differ according to sex ($p > 0.05$).

Table 2 shows the ORs and 95% CIs of depressive symptoms at baseline and during lockdown for participants who had GP contact during the COVID-19 lockdown. In our telephone interview study of 3153 individuals, depressive symptoms among residents at baseline were analysed according to GP contact during lockdown, revealing no differences in prevalent depressive symptoms at baseline

Table 1 Sociodemographic characteristics, NCDs, and GP contact among participants

Variables	Total (n=3153)	GP contact		P
		No (n=2704)	Yes (n=449)	
Age, years (mean $\pm$ SD)	55.5 $\pm$ 12.9	55.0 $\pm$ 12.9	59.0 $\pm$ 12.0	<0.001
Age stratification, n (%)				<0.001
18–44	613 (100)	557 (90.9)	56 (9.1)	
45–64	1698 (100)	1474 (86.8)	224 (13.2)	
≥ 65	842 (100)	673 (79.9)	169 (20.1)	
Gender, n (%)				0.14
Male	1186 (100)	1003 (84.6)	183 (15.4)	
Female	1967 (100)	1701 (86.5)	266 (13.5)	
Educational attainment, n (%)				<0.001
Illiterate or primary school	672 (100)	563 (83.8)	109 (16.2)	
Middle school or high school	1795 (100)	1518 (84.6)	277 (15.4)	
College or above	686 (100)	623 (90.8)	63 (9.2)	
Marital status, n (%)				0.04
Married/remarried	2915 (100)	2489 (85.4)	426 (14.6)	
Unmarried/divorced/separate	238 (100)	215 (90.3)	23 (9.7)	
NCDs, n (%)				<0.001
Without	1168 (100)	1047 (89.6)	121 (10.4)	
With	1985 (100)	1657 (83.5)	328 (16.5)	

Data of sociodemographic characteristics and NCDs among residents are from the baseline survey.

Data of GP contact with residents are from the follow-up survey during COVID-19 lockdown.

GP, general practitioner; NCD, non-communicable disease.

Table 2 Association of GP contact with depressive symptoms among residents

Variables Depressive symptom prevalent	Total n (%)	GP contact	
		No n (%)	Yes n (%)
Baseline (before lockdown)	n=3153	n=2704	n=449
No	2722 (86.3)	2329 (86.1)	393 (87.5)
Yes	431 (13.7)	375 (13.9)	56 (12.5)
Model 1 OR (95% CI), P		Ref	0.96 (0.70 to 1.29), 0.77
Model 2 OR (95% CI), P		Ref	0.94 (0.70 to 1.28), 0.71
Prevalent lockdown	n=3153	n=2704	n=449
No	2517 (79.8)	2135 (79.0)	382 (85.1)
Yes	636 (20.2)	569 (21.0)	67 (14.9)
Model 1 OR (95% CI), P		Ref	0.68 (0.52 to 0.90), 0.007
Model 2 OR (95% CI), P		Ref	0.67 (0.51 to 0.88), 0.004
Model 3 OR (95% CI), P		Ref	0.67 (0.51 to 0.89), 0.005
Incident*	n=2722	n=2329	n=393
No	2210 (81.2)	1873 (80.4)	337 (85.8)
Yes	512 (18.8)	456 (19.6)	56 (14.2)
Model 1 OR (95% CI), P		Ref	0.70 (0.52 to 0.95), 0.02
Model 2 OR (95% CI), P		Ref	0.68 (0.51 to 0.93), 0.02

Model 1: Adjusted for age, sex, educational attainment, marital status.

Model 2: Further adjusted for NCDs.

Model 3: Further adjusted for depressive symptoms at baseline.

Data of sociodemographic characteristics and NCDs among residents are from the baseline survey.

Data of GP contact with residents are from the follow-up survey during COVID-19 lockdown.

Data of depressive symptoms from baseline and follow-up surveys.

*Individuals who reported no depressive symptoms at baseline but reported depressive symptoms at the follow-up interview in April 2020.

GP, general practitioner; NCD, non-communicable disease.

between those who were or were not contacted by a GP ($p>0.05$) (table 2, top panel). In the analysis of prevalent depressive symptoms during lockdown, GP contact was associated with a lower risk of depressive symptoms among respondents (OR=0.67, $p=0.005$), after adjusting for age, sex, educational attainment, marital status and NCDs and depressive symptoms at baseline (table 2, middle panel). In the analysis of new cases of depressive symptoms occurring after baseline (incident depressive symptoms) assessed using WHO-5 scores, we further excluded 431 individuals with depressive symptoms at baseline (prevalent cases of depressive symptoms) assessed using WHO-5 scores, leaving 2722 individuals in the analysis.

The associations between incident depressive symptoms among residents and GP contact during the COVID-19 lockdown are shown in table 2 (bottom panel). After adjusting for age, sex, educational attainment, marital status and NCDs at baseline, individuals who had contact with a GP were less likely to develop incident depressive symptoms (OR=0.68, $p=0.02$).

Associations between prevalent depressive symptoms and GP contact during lockdown among individuals with and without NCDs are shown in table 3. After adjusting for age, sex, educational attainment, marital status and depressive symptoms at baseline, depressive symptoms were negatively associated with GP contact during the

Table 3 Association between GP contact and prevalent depressive symptoms among residents stratified by NCD groups

Without NCDs n=1168				With NCDs n=1985		
Without contact		With contact		Without contact		P
		OR (95% CI)	P			
Model 1	Ref	0.69 (0.40 to 1.20)	0.19	Ref	0.66 (0.48 to 0.92)	0.01
Model 3	Ref	0.69 (0.40 to 1.20)	0.19	Ref	0.67 (0.48 to 0.92)	0.01

Model 1: Adjusted for age, sex, educational attainment, marital status.

Model 3: Further adjusted for depressive symptoms at baseline.

Data of sociodemographic characteristics and NCDs among residents are from the baseline survey.

Data of GP contact with residents are from the follow-up survey during COVID-19 lockdown.

Data of depressive symptoms are from baseline and follow-up surveys.

GP, general practitioner; NCD, non-communicable disease.

COVID-19 lockdown (OR=0.67, $p=0.01$) among individuals with NCDs. In individuals without NCDs, no significant associations were found between depressive symptoms and GP contact during lockdown ($p>0.05$).

We further assessed the associations between prevalent depressive symptoms among residents and GP contact, by age group (table 4). After adjusting for sex, educational attainment, marital status, NCDs and depressive symptoms at baseline, GP contact was associated with a lower risk of depressive symptoms during lockdown in the middle-aged group (OR=0.53, $p=0.005$). In the young and older groups, no significant differences were found between depressive symptoms among residents and GP contact during lockdown ($p>0.05$).

Table 5 shows the associations between prevalent depressive symptoms and GP contact during lockdown according to educational attainment. After adjusting for age, sex, marital status, NCDs and depressive symptoms at baseline, GP contact was associated with a lower risk of depressive symptoms during the COVID-19 lockdown among individuals in the groups with middle school or high school educational attainment (OR=0.60, $p=0.007$). In the illiterate or primary school groups and the college or above group, no significant relationships were found between depressive symptoms and GP contact during lockdown ($p>0.05$).

DISCUSSION

In the present study, GP contact was negatively associated with prevalent depressive symptoms and new depressive symptoms among residents of Gongshu District, Hangzhou, China during the COVID-19 pandemic and lockdown between February and March 2020. There was no difference in baseline depressive symptoms (from October 2018 to May 2019) between residents with and without GP contact.

Some strategies have been proposed for managing mental health during the pandemic. Although patients with or survivors of COVID-19,²⁸ patients with severe mental illness²⁹ and healthcare workers³⁰ require mental healthcare, the general public also requires mental health attention during the COVID-19 pandemic and lockdown periods. Online-based cognitive behavioural therapy may be one effective solution.^{31–33} It is also important to promote communication of up-to-date information on the prevention and control of COVID-19 in consideration of mental health content.^{34 35} Improving management of community-based primary mental healthcare is an important goal.³⁶

GPs are the foundation of community health services, including prevention, health education, basic clinical services, women and children's care, elder care, immunisation and physical rehabilitation.³⁷ In China, GPs are also known as family doctors or family physicians. In 2015, these contract services were implemented throughout Zhejiang Province.³⁸ A previous study reported that services for mental health management had improved

Table 4 Association between GP contact and prevalent depressive symptoms among residents stratified by age group

	18–44 years n=613			45–64 years n=1698			≥65 years n=842		
	Without contact		With contact	Without contact		With contact	Without contact		With contact
	Ref	OR (95% CI)	P	Ref	OR (95% CI)	P	Ref	OR (95% CI)	P
Model 1	Ref	0.78 (0.40 to 1.53)	0.48	Ref	0.55 (0.35 to 0.85)	0.007	Ref	0.81 (0.52 to 1.25)	0.35
Model 2	Ref	0.77 (0.40 to 1.52)	0.46	Ref	0.53 (0.34 to 0.82)	0.004	Ref	0.81 (0.52 to 1.25)	0.34
Model 3	Ref	0.76 (0.38 to 1.48)	0.42	Ref	0.53 (0.34 to 0.82)	0.005	Ref	0.81 (0.52 to 1.25)	0.34

Model 1: Adjusted for sex, educational attainment, marital status.

Model 2: Further adjusted for NCDs.

Model 3: Further adjusted for depressive symptoms at baseline.

Data of sociodemographic characteristics and NCDs among residents are from the baseline survey.

Data of GP contact with residents are from the follow-up survey during COVID-19 lockdown.

Data of depressive symptoms are from baseline and follow-up surveys.

GP, general practitioner; NCD, non-communicable disease.

Table 5 Association between GP contact and prevalent depressive symptoms among residents stratified by educational attainment

	Illiterate or primary school n=672			Middle school or high school n=1795			College or above n=686		
	Without contact		With contact	Without contact		With contact	Without contact		With contact
	Ref	OR (95% CI)	P	Ref	OR (95% CI)	P	Ref	OR (95% CI)	P
Model 1	Ref	0.79 (0.46 to 1.39)	0.41	Ref	0.62 (0.43 to 0.89)	0.01	Ref	0.75 (0.39 to 1.46)	0.40
Model 2	Ref	0.78 (0.45 to 1.37)	0.39	Ref	0.60 (0.42 to 0.87)	0.007	Ref	0.75 (0.38 to 1.45)	0.39
Model 3	Ref	0.78 (0.44 to 1.37)	0.39	Ref	0.60 (0.42 to 0.87)	0.007	Ref	0.75 (0.39 to 1.46)	0.40

Model 1: Adjusted for age, sex, marital status.

Model 2: Further adjusted for NCDs.

Model 3: Further adjusted for depressive symptoms at baseline.

Data of sociodemographic characteristics and NCDs among residents are from the baseline survey. GP, general practitioner; NCD, non-communicable disease.

depressive symptoms among local residents via health education and organisational interventions.³⁹

To the best of our knowledge, this is the first study to report the association of GP contact with the mental health of individuals during COVID-19 lockdown periods. Previous studies have reported the negative psychological impacts of quarantine^{9 40 41} related to overwhelming stress levels owing to unemployment, deaths and isolation caused by the COVID-19 pandemic.⁴² For this reason, relieving fear and anxiety in the community is considered an important task.⁴³ In the battle against COVID-19, GPs have been involved in all aspects of the pandemic response. GPs with good communication skills work with local community staff to perform daily health monitoring and provide psychological support to help relieve fear and panic, such as through psychological counselling via telephone-based and internet-based communication. Local residents may have greater reliance on GPs during an emergency, enabling these health professionals to have an intervening role in residents' mental health during lockdown periods.

NCDs, including diabetes mellitus, endocrine dysfunction, cardiovascular diseases, inflammation and asthma, may occur concomitantly with diagnosed or undiagnosed depression.^{36 44} Under normal circumstances, GPs provide health guidance to their patients, with a particular focus on those with NCDs, via home visits, telephone contact or face-to-face consultations at community hospitals. Because patients with NCDs receive more attention from and have closer relationships with GPs, they may rely more on GPs during lockdown periods, in comparison with local residents who do not have NCDs. Therefore, the mental health of residents with NCDs might be more strongly influenced by GPs.

In our study, we found that young (age 18–44 years old) and older (≥65 years old) residents had a higher proportion of depressive symptoms than middle-aged residents (age 45–64 years) during lockdown, with 26.6% of young people, 17.7% of middle-aged people and 20.4% of older people indicating depressive symptoms. These results suggest that young and older people are more likely to be affected by the COVID-19 epidemic, leading to depressive symptoms. Although in our study, the rates of GP contact increased from young to older age groups, only middle-aged residents who had contact with a GP showed a significant decrease in depressive symptoms. We speculated that middle-aged residents may be more capable of resisting the various pressures that can result in depression, making it easier for GPs to intervene positively in these patients' mental health.

In the present study, we found a significant negative association of GP contact with a risk of having depressive symptoms only among local residents with middle or high school educational attainment. To understand why middle or high school education levels were an advantage in the association between depressive symptoms and GP contact, we additionally analysed the age distribution in these groups (n=1795). We found that individuals in the middle-aged

group (n=1134) constituted 63.2% of the total residents with middle or high school educational attainment, those in the young group (n=189) constituted 10.5% of the total and those in the older group (n=472) constituted 26.3%. We speculated that the negative association between depressive symptoms and GP contact among people with middle or high school educational attainment was likely owing to most of these individuals being middle aged.

The study has several strengths. First, the present study consisted of surveys of residents at baseline and during lockdown; which enabled comparisons of such points as mental health, health assessment, socioeconomic status, lifestyle and disease condition among the residents between the baseline and lockdown periods. Additionally, the seasonal characteristics of the baseline and lockdown periods were similar because the baseline survey was conducted approximately 1 year ahead of lockdown. Second, the response rate in our follow-up survey was 81%, and we have built strong relationships with communities and residents. These relationships enabled us to conduct follow-up surveys to examine the situations of the residents during lockdown in this extremely difficult time. Third, we performed the stratified analysis of the relationship between depressive symptoms from different characteristics of the population and GP contact. The results would be helpful for proposing targeted strategy.

The study had several limitations that should be addressed. First, causation could not be established owing to the cross-sectional design of this study. Second, selection bias may exist. During the COVID-19 epidemic, telephone interviewing was used, which may have introduced volunteer bias. To identify the potential influence of selection bias, we conducted a non-response analysis by comparing the general characteristics between the study population (n=3153) and the population excluded from the study (n=991). The results showed that the study population had higher educational levels ($p<0.05$) and had more NCDs ($p<0.05$) than individuals who were excluded from the study (see online supplemental table 1). A potential explanation is that people with higher education levels and more health conditions may pay greater attention to their own health and would, thus, be more likely to participate in health-related research projects. Third, we defined depressive symptoms using the WHO-5, whose psychometric performance is not the same as that of traditional measures of depression, such as Zung's Self-Rating Depression Scale⁴⁵ and the 21-item DASS.¹⁸ We recommend that future studies apply multiple approaches to precisely measure depression, including short-version screening tools, gold standard instruments and clinical diagnosis, such as structured clinical interviews and functional neuroimaging.^{46–48} Additionally, we did not record the reasons for contact with a GP.

In response to the high prevalence of common mental disorders, including depression and anxiety disorders, the WHO has proposed that primary care includes mental health services.⁴⁹ As the foundation of primary care in community health services and frontline workers

in the prevention and control of infectious diseases in the community,³⁷ GPs play an important role in mental healthcare in the community.⁵⁰ The present study further supports the notion that GPs have an important role in improving mental health, including depressive symptoms, particularly during public health emergencies. Although the system of health provision by GPs is continually developing, when overwhelming numbers of patients require care, the quality and quantity of GP care are often insufficient.^{37 51} Thus, systems of healthcare provision by GPs in the community should be enhanced, particularly given the risk of further epidemic waves of COVID-19. Additionally, with the advancement of COVID-19 vaccine development together with the existing problem of vaccine hesitancy,⁵² it is necessary to explore the impact of GPs on COVID-19 vaccine uptake in future studies.

Author affiliations

¹Chronic Disease Research Institute, The Children's Hospital, and National Clinical Research Center for Child Health, School of Public Health, School of Medicine, Zhejiang University, Hangzhou, Zhejiang, China

²Department of Nutrition and Food Hygiene, School of Public Health, Zhejiang University, Hangzhou, China

³Department of Social Medicine and Health Administration, School of Public Health, Zhejiang University, Hangzhou, Zhejiang, China

⁴Stanford Prevention Research Center, Department of Medicine, Stanford University School of Medicine, Stanford, California, USA

⁵Department of Epidemiology and Population Health, Stanford University School of Medicine, Stanford, California, USA

⁶Department of Hospital Management, Zhejiang University, Hangzhou, Zhejiang, China

⁷Department of Psychiatry and Behavioral Sciences, University of California, San Francisco, California, USA

⁸Stanford Cancer Institute, Stanford University School of Medicine, Stanford, California, USA

Acknowledgements We thank WELL-China participants in Gongshu District, Hangzhou, China for their time and valuable contributions to this study.

Contributors FY, WL, XZ and SZ designed the study. FY and WL analysed the data and drafted the manuscript. FY, WL, XZ, XX and XW collected data. FY, WL, EF, YM, XX, XW, WL, YL, XZ, WH, AWH and SZ provided comments and revised the manuscript. All authors approved the final version of the manuscript.

Funding This work was supported by Nutrilite Health Institute Wellness Fund (519000-X11501), the Cyrus Tang Foundation (419600-11102), Zhejiang University Education Foundation (100000-11320) and Hsun K. Chou Fund of Zhejiang University Education Foundation (419600-11107).

Competing interests None declared.

Patient consent for publication Not required.

Ethics approval This study was approved by the Institutional Review Boards of Stanford University, California, USA (IRB-35020) and Zhejiang University, Hangzhou, China (Number. ZGL201507-3). Informed consent was obtained from all participants.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. All data sharing and collaboration requests should be directed to the corresponding authors (Shankuan Zhu, zsk@zju.edu.cn; Ann Hsing, annhsing@stanford.edu).

Supplemental material This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines,

terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

ORCID iDs

Yan Min <http://orcid.org/0000-0002-7775-3153>

Shankuan Zhu <http://orcid.org/0000-0002-9509-7364>

REFERENCES

- Organization WH. Coronavirus disease, 2019. Available: https://www.who.int/emergencies/diseases/novel-coronavirus-2019?gclid=CjwKCAjw0qOIBhEiwAyyVcfzicbDhnToTLiswWiYFW62QbRRwPddvCs0PKrrBurvOfiyNzMHsA7xoCDUEQAvD_BwE
- Xiong J, Lipsitz O, Nasri F, et al. Impact of COVID-19 pandemic on mental health in the general population: a systematic review. *J Affect Disord* 2020;277:55–64.
- Wang C, Chudzicka-Czupala A, Tee ML, et al. A chain mediation model on COVID-19 symptoms and mental health outcomes in Americans, Asians and Europeans. *Sci Rep* 2021;11:6481.
- Organization WH. Mental health & COVID-19, 2020
- Le HT, Lai AJX, Sun J, et al. Anxiety and depression among people under the nationwide partial lockdown in Vietnam. *Front Public Health* 2020;8:589359.
- Moghanibashi-Mansourieh A. Assessing the anxiety level of Iranian general population during COVID-19 outbreak. *Asian J Psychiatry* 2020;51:102076.
- Mazza C, Ricci E, Biondi S, et al. A nationwide survey of psychological distress among Italian people during the COVID-19 pandemic: immediate psychological responses and associated factors. *Int J Environ Res Public Health* 2020;17. doi:10.3390/ijerph17093165. [Epub ahead of print: 02 05 2020].
- Rossi R, Socci V, Talevi D, et al. COVID-19 pandemic and lockdown measures impact on mental health among the general population in Italy. *Front Psychiatry* 2020;11:790.
- Gao J, Zheng P, Jia Y, et al. Mental health problems and social media exposure during COVID-19 outbreak. *PLoS One* 2020;15:e0231924.
- Guessoum SB, Lachal J, Radjack R, et al. Adolescent psychiatric disorders during the COVID-19 pandemic and lockdown. *Psychiatry Res* 2020;291:113264.
- Tran BX, Nguyen HT, Le HT, et al. Impact of COVID-19 on economic well-being and quality of life of the Vietnamese during the National social distancing. *Front Psychol* 2020;11:565153.
- Wang C, Chudzicka-Czupala A, Grabowski D, et al. The association between physical and mental health and face mask use during the COVID-19 pandemic: a comparison of two countries with different views and practices. *Front Psychiatry* 2020;11:569981.
- Wang C, Pan R, Wan X, et al. Immediate psychological responses and associated factors during the initial stage of the 2019 coronavirus disease (COVID-19) epidemic among the general population in China. *Int J Environ Res Public Health* 2020;17:1729.
- Wang C, Pan R, Wan X, et al. A longitudinal study on the mental health of general population during the COVID-19 epidemic in China. *Brain Behav Immun* 2020;87:40–8.
- Hao F, Tan W, Jiang L, et al. Do psychiatric patients experience more psychiatric symptoms during COVID-19 pandemic and lockdown? a case-control study with service and research implications for immunopsychiatry. *Brain Behav Immun* 2020;87:100–6.
- Tan W, Hao F, McIntyre RS, et al. Is returning to work during the COVID-19 pandemic stressful? a study on immediate mental health status and psychoneuroimmunity prevention measures of Chinese workforce. *Brain Behav Immun* 2020;87:84–92.
- Hao F, Tan W, Hu X, et al. A quantitative and qualitative study on the neuropsychiatric sequelae of acutely ill COVID-19 inpatients in isolation facilities. *Transl Psychiatry* 2020;10:355.
- Wang C, Tee M, Roy AE, et al. The impact of COVID-19 pandemic on physical and mental health of Asians: a study of seven middle-income countries in Asia. *PLoS One* 2021;16:e0246824.
- Nacheha JB, Grimwood A, Mahomed H, et al. From easing lockdowns to scaling up community-based coronavirus disease 2019 screening, testing, and contact tracing in Africa-shared approaches, innovations, and challenges to minimize morbidity and mortality. *Clin Infect Dis* 2021;72:327–31.
- Vermeulen L, Schäfer W, Pavlic DR, et al. Community orientation of general practitioners in 34 countries. *Health Policy* 2018;122:1070–7.
- Shu Z, Wang L, Sun X. An evaluation of the effects of general practitioner-supported patient noncommunicable diseases control model in Shanghai, China. *Int J Health Plann Manage* 2019;34:947–59.
- Zhang Y, Liu S, Sheng X, et al. Evaluation of a community-based hypertension self-management model with general practitioners. *Int J Health Plann Manage* 2019;34:960–74.
- Leung K, Wu JT, Liu D, et al. First-wave COVID-19 transmissibility and severity in China outside hubei after control measures, and second-wave scenario planning: a modelling impact assessment. *The Lancet* 2020;395:1382–93.
- Xu S, Li Y. Beware of the second wave of COVID-19. *The Lancet* 2020;395:1321–2.
- Min Y, Zhao X, Stafford RS, Hsing AW, et al. Cohort profile: well living laboratory in China (well-China). *Int J Epidemiol* 2021;40.
- Topp CW, Østergaard SD, Søndergaard S, et al. The WHO-5 well-being index: a systematic review of the literature. *Psychother Psychosom* 2015;84:167–76.
- Health WCCiM. Chinese version of the WHO-five well-being index. Available: <https://www.corc.uk.net/outcome-experience-measures/the-world-health-organisation-five-well-being-index-who-5/>
- Council JPaCMoTs. Guideline for psychosocial support during the COVID-19 epidemic 2020.
- China NHCo. Notifications of strengthening treatment and management of severe mental illness during the COVID-19 epidemic, 2020
- Zandifar A, Badrfam R, Mohammadian Khonsari N, et al. COVID -19 and medical staff's mental health in educational hospitals in Alborz province, Iran. *Psychiatry Clin Neurosci* 2020;74:499–501.
- Ho CS, Chee CY, Ho RC. Mental health strategies to combat the psychological impact of coronavirus disease 2019 (COVID-19) beyond paranoia and panic. *Ann Acad Med Singap* 2020;49:155–60.
- Zhang MWB, Ho RCM. Moodle: the cost effective solution for Internet cognitive behavioral therapy (I-CBT) interventions. *Technol Health Care* 2017;25:163–5.
- Soh HL, Ho RC, Ho CS, et al. Efficacy of digital cognitive behavioural therapy for insomnia: a meta-analysis of randomised controlled trials. *Sleep Med* 2020;75:315–25.
- Tran BX, Dang AK, Thai PK, et al. Coverage of health information by different sources in communities: implication for COVID-19 epidemic response. *Int J Environ Res Public Health* 2020;17. doi:10.3390/ijerph17103577. [Epub ahead of print: 20 05 2020].
- Tran BX, Phan HT, Nguyen TPT, et al. Reaching further by village health collaborators: the informal health taskforce of Vietnam for COVID-19 responses. *J Glob Health* 2020;10:010354.
- Lotfaliani M, Bowe SJ, Kowal P, et al. Depression and chronic diseases: co-occurrence and communality of risk factors. *J Affect Disord* 2018;241:461–8.
- Kong X, Yang Y. The current status and challenges of community general practitioner system building in China. *QJM* 2015;108:89–91.
- Shang X, Huang Y, Li Bi'e, et al. Residents' awareness of family doctor contract services, status of contract with a family doctor, and contract service needs in Zhejiang province, China: a cross-sectional study. *Int J Environ Res Public Health* 2019;16. doi:10.3390/ijerph16183312. [Epub ahead of print: 09 09 2019].
- Gilbody S, Whitty P, Grimshaw J, et al. Educational and organizational interventions to improve the management of depression in primary care: a systematic review. *JAMA* 2003;289:3145–51.
- Brooks SK, Webster RK, Smith LE, et al. The psychological impact of quarantine and how to reduce it: rapid review of the evidence. *Lancet* 2020;395:912–20.
- Lai J, Ma S, Wang Y, et al. Factors associated with mental health outcomes among health care workers exposed to coronavirus disease 2019. *JAMA Netw Open* 2020;3:e203976.
- Shader RI. COVID-19 and depression. *Clin Ther* 2020;42:962–3.
- Li DKT, Zhu S. Contributions and challenges of general practitioners in China fighting against the novel coronavirus crisis. *Fam Med Community Health* 2020;8:e000361.
- Memel D. Chronic disease or physical disability? the role of the general practitioner. *Br J Gen Pract* 1996;46:109–13.
- Dunstan DA, Scott N, Todd AK. Screening for anxiety and depression: reassessing the utility of the zung scales. *BMC Psychiatry* 2017;17:329.
- Husain SF, Yu R, Tang T-B, et al. Validating a functional near-infrared spectroscopy diagnostic paradigm for major depressive disorder. *Sci Rep* 2020;10:9740.
- Husain SF, Tang T-B, Yu R, et al. Cortical haemodynamic response measured by functional near infrared spectroscopy during a verbal

- fluency task in patients with major depression and borderline personality disorder. *EBioMedicine* 2020;51:102586.
- 48 Ho CSH, Lim LJH, Lim AQ, *et al*. Diagnostic and predictive applications of functional near-infrared spectroscopy for major depressive disorder: a systematic review. *Front Psychiatry* 2020;11:378.
 - 49 Organization WH. *Integrating mental health into primary care: a global perspective*. Geneva: WHO, 2008.
 - 50 Lam TP, Sun KS, Piterman L, Lam KF, *et al*. Impact of training for general practitioners on their mental health services: the Hong Kong experience. *Aust J Gen Pract* 2018;47:550–5.
 - 51 Zhang Y, Zhao Q, Hu B. Community-based prevention and control of COVID-19: experience from China. *Am J Infect Control* 2020;48:716–7.
 - 52 Chew NWS, Cheong C, Kong G, *et al*. An Asia-Pacific study on healthcare workers' perceptions of, and willingness to receive, the COVID-19 vaccination. *Int J Infect Dis* 2021;106:52–60.