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Knowledge, Attitude and Behavior of GPs in Shanghai during the Pandemic of COVID-19: A Cross Sectional Study

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4 **Knowledge, Attitude and Behavior of GPs in Shanghai during the Pandemic of**
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6 **COVID-19: A Cross Sectional Study**
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Abstract

Objectives To grasp the knowledge, attitude and behavior of general practitioners (GPs) towards COVID-19, and to provide evidence for better prevention and control of the pandemic.

Setting/participants A cross-sectional study was conducted with 1018 GPs in Shanghai from February 21 to March 2, 2020 by using online questionnaire platform, Wechat..

Main outcomes measures Stratified random sampling was adopted according to the regional division of urban area, urban-rural fringe area, and rural area. A mobile self-designed questionnaire was used. The questionnaire collected: knowledge of COVID-19, attitude towards COVID-19 behavior for COVID-19 prevention and control.

Results 989 questionnaires were valid. The average score of GPs' knowledge, attitude and behavior towards COVID-19 was 6.14 ± 1.42 (range 0-10), 13.59 ± 4.42 (range 0-25), 7.82 ± 1.53 (range 0-10), respectively. Multiple linear regression analysis showed that knowledge score of male GPs was lower than that of female GPs ($P=0.002$). Attitude score of female GPs was higher than that of male GPs ($P=0.004$). Married GPs was higher than that of unmarried GPs ($P=0.021$). Behavior score of GPs in urban areas was lower than that of GPs in urban-rural fringe areas ($P<0.001$). Male GPs' behavior scores were lower than female GPs' ($P=0.002$). The higher the knowledge score, the higher the behavior score ($P<0.001$).

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4 **Conclusions** The scores for knowledge, attitude and behavior of Shanghai GPs
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6 towards COVID-19 was limited at the beginning of COVID-19 outbreak. Pandemic
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8 prevention training for GPs should be strengthened to win the pandemic prevention
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10 and control campaign.
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12

13 **Keywords**

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17 General practitioner·COVID-19·Knowledge· Attitude·Behavior
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22 **Strengths and limitations of this study**

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24 This is a first large-scale cross-sectional survey of General practitioners' (GPs)
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26 knowledge, attitude and behavior towards COVID-19 at the early stage in Shanghai, a
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28 city with highly developed economy and high population mobility. And stratified
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30 random cluster sampling was adopted.
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35 GPs had first become the main force of community pandemic prevention and control
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37 and were in the front line of community grid management system. Their knowledge,
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39 attitude and behavior would directly affect the results of prevention and control of the
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41 pandemic.
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45 However,the scores for knowledge, attitude and behavior of Shanghai GPs towards
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47 COVID-19 was limited at the beginning of COVID-19 outbreak. Pandemic prevention
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49 training for GPs should be strengthened to win the pandemic prevention and control
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51 campaign.
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55 The survey has some limitations. Although stratified random cluster sampling was
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57 adopted, one-to-one interview could not be conducted during the pandemic. All the
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4 participants completed the questionnaire using Wechat, so the quality of the
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6 questionnaire can not be guaranteed. Thus, although the study did provide necessary
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8 reference for the gap in knowledge, attitude and practice of GPs, the extrapolation of
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10 conclusions was limited to some extent. Secondly, as the study was based on a cross-
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12 sectional design, a causal relationship could not be inferred with certainty. We can do
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14 in-depth research in the future.
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27 **Background**

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30 Coronavirus disease (COVID-19) is an emerging infectious disease[1].In December
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32 2019, COVID-19 cases were first confirmed in Wuhan, China, and subsequently
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34 reported nationwide and globally [1]. Up to February 20th, 2020, within the launch of
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36 the first-level response measures for major public health emergencies[2], the
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38 cumulative number of confirmed cases across the country had reached 125,529, and the
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40 cumulative number of deaths has reached 5,695 [3]. Meanwhile, 2,055 medical workers
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42 who participated in the treatment were reported to be infected with COVID-19 [4],
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44 mainly due to the lack of sufficient knowledge of COVID-19 [5].
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51 Shanghai was the largest port city in China as well as international trade and shipping
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53 center [6]. The Shanghai municipal government issued regulation on community
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55 prevention and control network [7] as early as January 23rd, the same day Wuhan was
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57 closed down. However, by February 20th, 2020, the number of confirmed cases had
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4 reached 334.

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6 The main force to undertake the task of community pandemic prevention and control is
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9 general practitioners (GPs), the gatekeeper of the health of community residents [8].

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11 But, GPs have never been involved in community pandemic prevention before. In the
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13 face of the challenge of this emerging infectious disease, whether the GPs had mastered
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15 the correct knowledge, had high morale and normative behavior, so that they can protect
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17 themselves and educate community residents well, to win the tough fight? To this end,
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19 we launched a survey of GPs' knowledge, attitude and behavior towards COVID-19 in
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21 Shanghai, aiming to find out the problems and provide a basis for improving the
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23 pandemic prevention and control capacity at the grassroots level, so as to better control
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25 the pandemic.
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35 **Methods**

36 **Study Design and Population**

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38 This cross-sectional survey was conducted from February 21st to March 2nd, 2020.

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40 Stratified random cluster sampling was adopted. According to the regional division of
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42 Shanghai, regions were divided into the urban, urban-rural fringe, and rural areas [9].

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44 Three districts were randomly selected from each of the three areas, and three
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46 community health service centers (CHCs) were randomly selected from each district
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51 [10].

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55 According to the formula
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$$n = \frac{\mu_{\alpha/2}^2 P (1 - P)}{\delta^2}$$

$P=0.0222$, $1-P=0.9778$, $\alpha=0.05$, $\mu_{\alpha/2}=1.96$, $\delta=0.5P=0.0111$,

$$n = \frac{1.96^2 \times 0.0222 \times 0.9778}{0.0111^2} = 676.1 \approx 677$$

n stands for the required sample size. $\mu_{\alpha/2}$ stands for the μ value when the cumulative probability from left to right is $1-\alpha/2$ (both sides) in the standard normal distribution. P stands for the accuracy rate of all the questions in the pre-survey. δ stands for the allowable error. Based on the pre-survey results of 30 respondents, $P=0.0222$, $1-P=0.9778$, $\alpha=0.05$ was set, $\mu_{\alpha/2}=1.96$, a 5 percent margin of error was set, then $\delta=0.05$, $P=0.0222$, the required sample size would be at least 677. At a 20% shedding rate, the total sample size would be at least 847. Finally, a total of 1018 on-the-job GPs in the above 27 CHCs were investigated, including 341 GPs in urban area, 415 GPs in urban-rural fringe area, and 262 GPs in rural area (Fig 1). No incentive was offered for completion of the questionnaire.

Questionnaire design

A self-designed questionnaire was used in the survey, based on the COVID-19 literature published by the Chinese Center for Disease Control and Prevention (CDC) and World Health Organization [11-14]. The questionnaire was pre-tested on a small sample of 30 GPs from three CHCs and some of the questions were adjusted after the pre-survey. The questionnaire collected: ① General information of the respondents, including region, gender, age, education, years of work, professional title, and marital status. ②

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4 Knowledge of COVID-19, including 6 single-choice questions and 4 multiple-choice
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6 questions. For all multiple-choice questions, respondents must check all the correct
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8 items to be judged as correct. Each correctly answered question scores 1 point and the
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10 total score is 10 points. ③ Attitude towards COVID-19 pandemic: There are 5
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12 questions in total. In answering each question, the extent of concern about COVID-19
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14 is graded into 5 degrees. The score of 1 point for "not worried at all", 2 for "not very
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16 worried", 3 for "somewhat worried", 4 for "quite worried" and 5 for "very worried".
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18 The total score is 25 points. ④ Behavior for COVID-19 prevention and control. There
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20 are 10 single-choice questions. Each correctly answered question scores 1 point and the
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22 total score is 10 points. The total Cronbach's alpha coefficient for the questionnaire was
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24 0.844, indicating that the internal consistency was acceptable.
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35 **Data Collection**

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37 The cross-sectional study was conducted by using online questionnaire platform,
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39 Wechat. All items in the questionnaire were required. If there were uncompleted items,
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41 the questionnaire could not be submitted, and the same IP address could only be used
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43 to submit the questionnaire once. Written consent was obtained from all respondents
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45 before they participated in the study. The study was conducted in accordance with the
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47 Declaration of Helsinki, and the protocol was approved by the Ethics Committee of
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49 Zhongshan Hospital, Fudan University(B2020-027).
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58 **Statistical Analysis**

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4 Excel (Microsoft Office Professional Plus 2010) was used to establish the database, and
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6 SAS (Version 9.4) was used for data processing and analysis. Continuous variables
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8 were presented as mean±standard deviation($\bar{x} \pm SD$) and categorical variables as
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10 frequency (percentage). Kruskal-Wallis test was used as univariate analysis to compare
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12 the knowledge, attitude and behavior scores in different subgroups. The factors which
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14 had statistical significance in the single-factor analysis, or based on our hypotheses,
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16 were taken as the predictors in the multiple linear regression analysis to identify the
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18 potential impact factors related to knowledge, attitude and behavior scores. All of the
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20 tests for significance were two-sided. The P-Values of univariate analysis <0.1 and
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22 multiple linear regression analysis <0.05 were considered statistically significant.
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32 **Patient and public involvement**

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34 The public were not involved in the design, or conduct, or reporting, or dissemination
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36 plans of this research
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43 **Results**

44 **Descriptive Characteristic Results**

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46 1018 GPs were invited to participate in the survey, and 996 questionnaires were
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48 collected, with a response rate of 97.84% (996/1018). Among the 996 questionnaires,
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50 989 questionnaires were valid, with a quality conformity rate of 99.30% (989/996).
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52 There were 279 males and 710 females and the average age was 39.18, ranging from
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54 23 to 59. Bachelor degree and above accounted for 88.47% (Table 1) .
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Table 1 The score of Knowledge, Attitude and Behavior on COVID-19 of Shanghai GPs by demographic variables

Characteristics	Number of participants (%)	Knowledge score ($\bar{x} \pm SD$)	Attitude score ($\bar{x} \pm SD$)	Behaviour score ($\bar{x} \pm SD$)
Total	989(100)	6.14±1.42	13.59±4.42	7.82±1.53
Region				
Urban area	336(33.97)	6.09±1.46	13.63±4.26	7.64±1.60
Urban-rural fringe area	396(40.04)	6.20±1.40	14.04±4.29	8.14±1.35
Rural area	257(25.99)	6.12±1.42	12.85±4.74	7.57±1.60
χ^2		1.288	10.975	28.570
P		0.525	0.004	<.001
Gender				
Male	279(28.21)	5.90±1.41	12.89±4.89	7.49±1.71
Female	710(71.79)	6.24±1.42	13.87±4.20	7.95±1.43
χ^2		11.548	9.400	14.710
P		<.001	0.002	<.001
Age (year)				
≤29	131(13.25)	6.23±1.40	12.96±4.27	8.13±1.46
30~39	414(41.86)	6.22±1.39	13.87±4.32	7.84±1.49
40~49	327(33.06)	6.08±1.49	13.98±4.31	7.80±1.54
≥50	117(11.83)	5.96±1.39	12.21±4.94	7.47±1.62
χ^2		4.757	15.274	11.976
P		0.191	0.002	0.008
Education				
College degree and Bachelor degree	114(11.53)	5.90±1.42	12.55±4.54	7.67±1.71
Master degree or above	736(74.42)	6.15±1.42	13.72±4.42	7.85±1.50
χ^2	139(14.05)	6.31±1.44	13.73±4.27	7.78±1.53
P		5.172	6.290	0.590
P		0.075	0.043	0.745
Years of work				
83(8.39)		6.29±1.49	12.96±4.32	8.14±1.62
5~9	202(20.42)	6.09±1.40	13.91±4.36	7.95±1.45
10~19	317(32.05)	6.29±1.34	13.72±4.22	7.81±1.46
≥20	387(39.13)	6.03±1.48	13.45±4.63	7.69±1.59
χ^2		7.773	3.333	9.209
P		0.051	0.343	0.027
Professional title				
Resident	227(22.95)	6.03±1.41	13.37±4.56	7.91±1.56
Attending physician	591(59.76)	6.16±1.42	13.90±4.26	7.80±1.51
Associate chief physician or above	171(17.29)	6.25±1.44	12.81±4.71	7.79±1.55
χ^2		1.759	9.153	1.979
P		0.415	0.010	0.372
Marriage				
Unmarried	195(19.72)	6.06±1.38	12.71±4.44	7.76±1.67
Married	794(80.28)	6.17±1.43	13.81±4.40	7.84±1.49
χ^2		0.963	8.763	0.009
P		0.327	0.003	0.926

Abbreviation: SD=Standard Deviation

Knowledge scores of GPs on COVID-19

The correct percentage of the 989 GPs of each knowledge question was 25.58%-97.88% (Table 2). The average knowledge score was 6.14 ± 1.42 (Table 1). Among them, the correct percentage for ‘Which of the following objects or conditions can kill Novel Coronavirus?’ was the lowest, accounting for 25.58% . The correct percentage for ‘What are the transmission route of Novel Coronavirus’ was the second lowest, accounting for 29.63% (Table 2).

Table 2 The Correct Percentage of GPs on Knowledge and Behavior on COVID-19 (N=989)

Questions	n (%)
Knowledge	
1. Which of the following objects or conditions can kill Novel Coronavirus?	253(25.58)
2. What are the transmission route of Novel Coronavirus?	293(29.63)
3. What kind of face mask should you wear when you make home visits to quarantined residents?	302(30.54)
4. Does disposable surgical mask need to be replaced if it is wet or dirty?	318(32.15)
5. What do you think is the minimum social safe distance between people ?	686(69.36)
6. What is the replacement time of disposable surgical masks?	769(77.76)
7. Do you know the steps of "six-step hand-washing method"?	806(81.50)
8. What kind of face mask should you wear in community clinics during epidemic period?	808(81.70)
9. Do you know what kind of face mask has the effect of preventing Novel Coronavirus?	874(88.37)
10. How long should close contacts be quarantined?	968(97.88)
Behavior	
1. Do your hands touch the external surface of the face mask after you put it on?	512(51.77)
2. What is your step to remove a disposable surgical mask?	579(58.54)
3. When you wear a disposable surgical mask, how to fit it entirely to the face?	630(63.70)
4. Have you taken the initiative to publicize the "six-step hand-washing method" since the COVID-19 outbreak?	633(64.00)
5. Do your hands touch the external surface of the face mask while removing it?	823(83.22)
6. Have you started using the “six-step hand-washing method” since the COVID-19 outbreak?	853(86.25)
7. Do you wash your hands before putting on a face mask?	899(90.90)
8. Have you increased hand-washing frequency since the COVID-19 outbreak?	913(92.32)
9. When you wear disposable surgical masks, how to recognize the external and inner face mask surface correctly?	933(94.34)
10. When you wear disposable surgical masks, how to recognize the upper and lower edge correctly?	960(97.07)

Attitude scores of GPs on COVID-19

The average attitude score of 989 GPs on COVID-19 was 13.59 ± 4.42 (Table 1). 26.29% of the GPs were very worried that themselves or their family member might get infected by Novel Coronavirus. 7.58% were very worried that their life was threatened by COVID-19 (Table 3).

Table 3 GPs' Attitude Score on COVID-19 (N=989)

Questions	n (%)					Score
	Not worried at all	not worried	somewhat worried	quite worried	very worried	
1. Are you worried that yourself or your family member might get infected by Novel Coronavirus?	98(9.91)	159(16.08)	281(28.41)	191(19.31)	260(26.29)	3.36 \pm 1.29
2. Are you worried you'll be quarantined if you get infected?	114(11.53)	188(19.01)	338(34.18)	170(17.19)	179(18.10)	3.11 \pm 1.24
3. Are you worried that the pandemic might be out of control and the virus will spread widely?	141(14.26)	221(22.35)	341(34.48)	155(15.67)	131(13.25)	2.91 \pm 1.21
4. Do you feel your life threatened by COVID-19?	241(24.37)	317(32.05)	258(26.09)	98(9.91)	75(7.58)	2.44 \pm 1.18
5. Do you suspect that you have been infected with	460(46.51)	366(37.01)	120(12.13)	25(2.53)	18(1.82)	1.76 \pm 0.89

Novel Coronavirus?	
Total	13.59±4.42

Behavior scores of GPs on COVID-19

The correct percentage of the 989 GPs of each behaviour question was 51.77-97.07% (Table 2). The average behaviour score was 7.82±1.53 (Table 1). Among them, the correct percentage of the behaviors ‘Do your hands touch the external surface of the face mask after you put it on?’, ‘What is your step to remove a disposable surgical mask?’, ‘When you wear a disposable surgical mask, how to fit it entirely to the face?’, ‘Have you taken the initiative to publicize the "six-step hand-washing method" since the COVID-19 outbreak’ were the lowest, accounting for 51.77%, 58.54% , 63.70% and 64.00% , respectively (Table 2).

Univariate analysis of influencing factors of GPs' knowledge, attitude and behavior towards COVID-19

Univariate analysis showed that male GPs’ knowledge score was lower than female GPs’ ($P < 0.01$). GPs with college education and below, and those who had worked for 20 years or longer had the lowest knowledge score ($P < 0.1$). Female GPs were more worried than male GPs ($P=0.002$). GPs who worked in urban-rural fringe area, aged 40-49, having master's degree or above, being attending physician and married were the most worried ($P < 0.05$). Male GPs had the lower behavior score ($P < 0.01$) . GPs

worked in rural areas, age 50 or above, had worked for 20 years or longer had the lowest behavior score ($P < 0.05$) (Table 1).

Multiple Linear Regression Analysis of the influencing factors of GPs' knowledge, attitude and behavior towards COVID-19

Multiple linear regression analysis showed that knowledge score of male GPs was lower than that of female GPs ($P=0.002$). Attitude score of female GPs was higher than that of male GPs ($P=0.004$). Married GPs was higher than that of unmarried GPs ($P=0.021$). Behavior score of GPs in urban areas was lower than that of GPs in urban-rural fringe areas ($P<0.001$). Male GPs' behavior scores were lower than female GPs' ($P=0.002$). The higher the knowledge score, the higher the behavior score ($P<0.001$) (Table 4).

Table 4 Multiple linear regression on factors associated with Shanghai GPs' knowledge, attitude and practice score on COVID-19

Variable	Knowledge Score	
	Coefficient (95% CI)	<i>P</i>
Knowledge Score		
Female	0.32 (0.12, 0.52)	0.002
Education Level*	0.15 (-0.01, 0.31)	0.074
Years of work Level*	-0.03 (-0.13, 0.07)	0.532
Attitude Score		
Urban-rural fringe area	0.42 (-0.23, 1.06)	0.203
Rural area	-0.43 (-1.18, 0.32)	0.258
Female	0.90 (0.29, 1.51)	0.004
Age group level*	-0.02 (-0.46, 0.41)	0.913
Education Level*	0.37 (-0.19, 0.92)	0.200
Professional title Level*	-0.20 (-0.73, 0.33)	0.458
Married	0.88 (0.13, 1.63)	0.021
Knowledge Score	0.01 (-0.18, 0.21)	0.890
Behaviour Score		
Urban-rural fringe area	0.44 (0.23, 0.66)	<.001
Rural area	-0.05 (-0.28, 0.18)	0.673

Female	0.32 (0.12, 0.52)	0.002
Age group Level*	-0.12 (-0.31, -0.06)	0.198
Years of work Level*	0.01 (-0.16,0.17)	0.951
Knowledge Score	0.28 (0.22, 0.34)	<.001
Attitude Score	0.02 (0, 0.04)	0.065

* Education Level: 1=College degree and below, 2=Bachelor degree, 3=Master degree or above;

*Years of work Level: 1=less than 5, 2=5~9, 3=10~19, 4=greater or equal than 20;

*Age group Level: 1=less and equal than 29, 2=30~39, 3=40~49, 5=greater or equal than 50;

*Professional title Level: 1=Resident, 2=Attending physician, 3=Associate chief physician or above.

Abbreviation: CI=Confidence Interval

Discussion

Of the 989 GPs who were respondents of our study, their average age was 39.18 years old, among whom 88.2% were younger than 50, and 88.47% had bachelor's degree or above. This was a relatively young team with high education background. However, the average score was 6.14 ± 1.42 (range 0-10), which was much lower than that of the online survey of 1357 medical workers in Henan Province conducted by Zhang M et al. at the same time[15]. This is worrying. GPs are the main force in this community pandemic prevention and control campaign against COVID-19 in Shanghai[16]. How can GPs with poor knowledge on COVID-19 lead the community to win the pandemic prevention and control campaign? It was necessary for GPs to master the transmission route of Novel Coronavirus [17], so as to protect themselves and to educate the population well. However, the percentage of Shanghai GPs with correct knowledge of transmission route was only 29.63%. Feng Xiang et al. demonstrated the correct rate of 43.27% in an online survey of 617 medical workers in Jiangsu Province in early March 2020[18]. Cutting the route of transmission is especially important for infectious diseases. Therefore, it is necessary to strengthen training of basic knowledge of

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4 infectious diseases. During the pandemic, people need to keep a safe social distance of
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6 one meter [19]. However, only 69.36% of the GPs have mastered the social safety
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8 distance of at least one meter during the pandemic[20], which was much lower than the
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10 rate shown by Parikh PA's survey of 744 medical personnel in India in March 2020
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12 [20]. Thus, social safety distance is another weak point that needs to be focused on in
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14 pandemic training. CDC recommends using medical masks and N95 masks in
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16 preventing novel coronavirus[21]. Our study showed that GPs had a high rate of 88.37%
17
18 for choosing the correct face masks. But the rate for choosing the correct face mask
19
20 when making home visits to quarantined residents was only 30.54%. Many GPs only
21
22 chose N95 masks on this occasion. However, when visiting people quarantined at home,
23
24 either of the disposable surgical mask or N95 mask is optional[12]. Compared with
25
26 disposable surgical masks, N95 respirators are optimized in structure with core
27
28 filtration and their filtering efficiency raised up to 95%[22]. Such choice might be due
29
30 to the great fear caused by the outbreak of the pandemic at that time, and many GPs
31
32 prefer excessive protection. Under the circumstances of lacking medical supplies for
33
34 pandemic prevention, it is necessary to ensure not only the safety of GPs, but also the
35
36 scientific and rational use of medical supplies. Disposable surgical masks should be
37
38 discarded at the interval of 4 hours and should also be replaced when they are wet or
39
40 dirty [11,21]. If the filter layer of a disposable surgical mask absorbs moisture or gets
41
42 dirty, the filtering function will be reduced or even lost[11]. However, the correct
43
44 awareness of GPs of the discard interval and occasion was 35.19% and 51.26%,
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4 respectively. Therefore, it is essential to make GPs master the correct discard interval
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6 and occasion of disposable surgical masks in pandemic training.
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8
9 Univariate and multivariate analyses showed that male GPs had lower knowledge
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11 scores than female GPs, which was consistent with the results of an online survey of
12
13 residents around the country on COVID-19 conducted by Qi Y at the end of January
14
15 2020.[23] Women tend to be in the center of family life and were usually more nervous
16
17 about the pandemic[24]. They were more serious about the prevention of the pandemic
18
19 for the health of themselves and their families and were more willing to follow
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21 standardized measures[24].
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26
27 The score of worry of GPs on COVID-19 was 13.59 ± 4.42 , which was between not
28
29 worried and somewhat worried. The proportion of GPs who were somewhat worried,
30
31 quite worried and very worried that themselves or their family members might get
32
33 infected by Novel Coronavirus was 28.41%, 19.31% and 26.29%, respectively. In
34
35 general, the proportions of worry were slightly lower than the studies conducted by
36
37 Zhang M et al.[15] and Abdel Wahed WY et al.[25]. Our results can indirectly reflect
38
39 the relatively perfect prevention and control work in Shanghai. For the question, 'Do
40
41 you feel your life threatened by COVID-19?', the proportion of those GPs who were
42
43 not worried at all and not worried was 56.42%. And those who were quite worried and
44
45 very worried was only 17.49%. This demonstrated that Shanghai GPs had confidence
46
47 in China's pandemic prevention and control capability although they knew the highly
48
49 contagious nature of Novel Coronavirus. This confidence might also be related to the
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51 experience in handling pandemic of Severe Acute Respiratory Syndrome in Shanghai
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4 in 2003. Shanghai's pandemic control and prevention capability has improved step by
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6 step in the past 17 years [26].
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9 Multivariate analysis showed that gender and marriage were the influencing factors
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11 of attitude on COVID-19 for GPs, which was consistent with the online survey of Zhu
12
13 Z et al. of 5,062 medical workers in Wuhan Tongji Hospital in February 2020
14
15 [27]. Female GPs were more anxiety in the face of COVID-19. An online survey
16
17 conducted by Shiyang Yan et al. on 3088 people in February 2020 also showed gender
18
19 differences on stress [28]. Married people take more responsibilities for their families
20
21 and worry more. Therefore, for these GPs, appropriate psychological support should be
22
23 provided to reduce their psychological pressure.
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30 Doctor is a high-risk profession. If GPs wore face mask in an incorrect way, they
31
32 would be at the risk of being infected [29]. In our study, although 88.37% of the GPs
33
34 selected the correct type of face mask to prevent the invasion of COVID-19, only 63.70%
35
36 of them knew how to fit disposable surgical mask entirely to the face. The correct
37
38 percentage of GPs for hands not touching the external surface of the face mask while
39
40 wearing it was only 51.77%, and the percentage of GPs who had mastered the correct
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42 step to remove a disposable surgical mask was only 58.54%. Therefore, it is necessary
43
44 to emphasize the proper way to wear face masks in detail in GP training. Contact
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46 transmission is a major route of COVID-19 transmission. Therefore, hand hygiene is
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48 as important as wearing masks and keeping a safe social distance [30]. Ran L et al.
49
50 demonstrated that hand hygiene was closely related to COVID-19 infection through his
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52 investigation of 72 medical workers in Wuhan in January 2020 [31, 32]. After the
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4 outbreak of COVID-19, Shanghai GPs' hand-washing frequency increased by 92.32%
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6 and the number of GPs who strictly used 'six-step hand-washing method' increased by
7
8 86.25% compared with that before the outbreak[32]. The majority of GPs performed
9
10 well in hand hygiene, which was consistent with the survey of 744 medical personnel
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12 in India [20]. Moreover, educating the public is also the social responsibility that GPs
13
14 should take on their initiative. However, only 64.00% of Shanghai GPs actively
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16 publicized the "six-step hand-washing method" to the public. Therefore, GPs should
17
18 have the awareness of educating the public to improve the efficiency of pandemic
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20 prevention and control.
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28 Both of the univariate and multivariate analysis showed that behaviour score of male
29
30 GPs was lower than that of female GPs, which was consistent with the survey of 461
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32 medical workers conducted by Dimitrios Papagiannis et al. in Greece in February 2020
33
34 [33]. Women are better than men in knowledge mastery and more nervous than men in
35
36 attitude. It is understandable that they are more serious in behavior implementation. The
37
38 study also showed that the higher the knowledge score, the higher the behavior score.
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40 Which was consistent with the survey of 706 Syrian residents conducted by Sanaa Al
41
42 ahdab et al. in April 2020 [34]. Therefore, there is a need for further training of GPS to
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44 improve their understanding of the disease and their behaviour of epidemic prevention
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46 in their communities.
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56 **Conclusions**

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58 This is a large-scale cross-sectional survey of GPs' knowledge, attitude and behavior
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4 towards COVID-19 in Shanghai, a city with highly developed economy and high
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6 population mobility. GPs, as the "health gatekeepers" of the community , are in the
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8 important position of the community grid management system, and their knowledge,
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10 attitude and behavior will greatly affect the results of prevention and control of
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12 pandemic. However, according to our survey of GPs in Shanghai, their related
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14 knowledge was limited at the beginning of COVID-19 outbreak and their behaviors
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16 towards COVID-19 needed improving. At the same time, we should also care about the
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18 physical and mental health of GPs to build a strong frontline of community prevention
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20 and control. Pandemic prevention training for GPs should be strengthened to win the
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22 pandemic prevention and control campaign.
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29 **Limitations**

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31 The survey has some limitations. Although stratified random cluster sampling was adopted, one-to-
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33 one interview could not be conducted during the pandemic. All the participants completed the
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35 questionnaire using Wechat, so the quality of the questionnaire can not be guaranteed. Thus,
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37 although the study did provide necessary reference for the gap in knowledge, attitude and practice
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39 of GPs, the extrapolation of conclusions was limited to some extent. Secondly, as the study was
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41 based on a cross-sectional design, a causal relationship could not be inferred with certainty. We can
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43 do in-depth research in the future.
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53 **Abbreviations** Coronavirus disease(COVID-19); Chinese Center for Disease Control
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55 and Prevention(CDC); community health service center (CHC); general practitioners
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58 (GPs)
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4 **Contribution** JW conceived and designed the study, implemented the research and
5
6 helped to draft and revise the manuscript. HY T implemented the research, conducted
7
8 data collection and helped to draft the manuscript. JL F and BX T performed data
9
10 collection and statistical analysis. All the authors contributed to the preparation of the
11
12 final document, and had read and approved the final manuscript
13
14

15
16
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18
19 Committee Community Health Discipline Leader Training Project (PWRsd 2019-04)
20
21
22 The role of the funder is to help to train general practitioners in healthcare, education,
23
24 and research.
25

26
27 **Competing interests** None declared
28

29
30 **Ethics approval and consent to participate** The study was conducted in accordance
31
32 with the Declaration of Helsinki, and the protocol was approved by the Ethics
33
34 Committee of Zhongshan Hospital, Fudan University(B2020-027).
35

36
37 **Provenance and peer review** Not commissioned; externally peer reviewed.
38

39
40 **Data availability statement** All data relevant to the study are included in the article
41
42 or uploaded as supplementary information. No additional data are available.
43
44

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49
50 assisted in this investigation.
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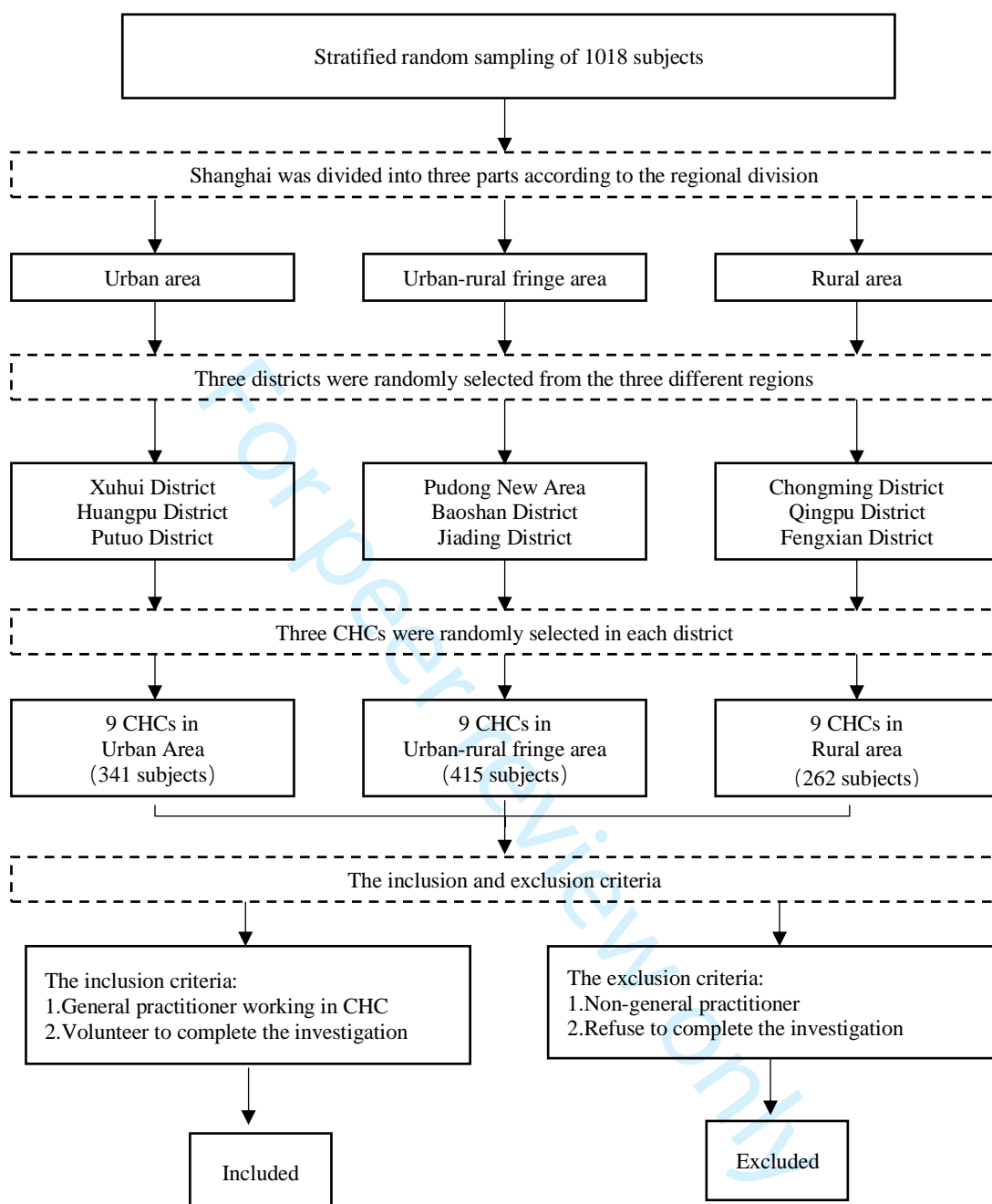
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Fig. 1 Sampling flow chart



STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No.	Recommendation	Page No.	Relevant text from manuscript
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) 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	5	
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6	
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants (b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case	5	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6	
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	7	
Bias	9	Describe any efforts to address potential sources of bias	7	
Study size	10	Explain how the study size was arrived at	7	

Continued on next page

Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7-8
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	7-8
		(b) Describe any methods used to examine subgroups and interactions	7-8
		(c) Explain how missing data were addressed	7-8
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed	7-8
		<i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	7-8
		(e) Describe any sensitivity analyses	7-8
Results			
Participants	13*	(a) 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	8
		(b) Give reasons for non-participation at each stage	8
		(c) Consider use of a flow diagram	8
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8-9
		(b) Indicate number of participants with missing data for each variable of interest	8-9
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	8-9
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	8-9
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	8-9
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	8-9
Main results	16	(a) 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	8-9
		(b) Report category boundaries when continuous variables were categorized	8-9
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	8-9

Continued on next page

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Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	9–18
Discussion			
Key results	18	Summarise key results with reference to study objectives	18
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	18–19
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	18–19
Generalisability	21	Discuss the generalisability (external validity) of the study results	18–19
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	19

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Secondary Subject Heading:	Public health
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Knowledge, Attitude and Behavior of General Practitioners in Shanghai during the Pandemic of COVID-19: A Cross Sectional Study

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Abstract

Objectives To grasp the knowledge, attitude and behavior of general practitioners (GPs) towards COVID-19, and to provide evidence for better prevention and control of the pandemic. **Study design** A cross-sectional study was conducted with 1018 GPs in Shanghai from February 21 to March 2, 2020 by using wechat platform. **Methods** Stratified random cluster sampling was adopted according to the regional division of urban area, urban-rural fringe area, and rural area. A

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4 mobile self-designed questionnaire was used. The questionnaire collected knowledge, attitude and
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6 behavior regarding COVID-19 prevention and control. **Results** 989 questionnaires were valid. The
7
8 average score of GPs' knowledge, attitude and behavior towards COVID-19 was 6.14 ± 1.42 (range
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10 0-10), 13.59 ± 4.42 (range 0-25), 7.82 ± 1.53 (range 0-10), respectively. Multiple linear regression
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12 analysis showed that knowledge score of male GPs was lower than that of female GPs ($P=0.002$).
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14 Attitude score of female GPs was higher than that of male GPs ($P=0.004$). Behavior score of GPs
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16 in urban areas was lower than that of GPs in urban-rural fringe areas ($P<0.001$). The higher the
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18 knowledge score, the higher the behavior score ($P<0.001$). **Conclusions** The scores for knowledge,
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20 attitude and behavior of Shanghai GPs towards COVID-19 was limited at the beginning of COVID-
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22 19 outbreak. The scores for knowledge, attitude and behavior of Shanghai GPs towards COVID-19
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24 was limited at the beginning of COVID-19 outbreak. Early implementation of proper training
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26 programs for GPs in times of crisis will contribute to disease control and prevention. Lessons
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28 learned from the current pandemic will help GPs in effectively handling any possible similar future
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30 challenges and possible new pandemics in the future.

31 **Keywords** General practitioner; COVID-19; Knowledge; Attitude; Behavior

32 33 34 **Strengths and limitations of this study**

- 35 ● This study was conducted on general practitioners who participated in community pandemic
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37 prevention and control as the main force for the first time at the early stage of the COVID-19
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39 pandemic in Shanghai, a city with highly developed economy and high population mobility.
- 40 ● According to the regional division of Shanghai, stratified random cluster sampling was adopted.
- 41 ● This was one of the first large-scale cross-sectional study of knowledge, attitude and behavior
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43 of general practitioners at the early beginning of COVID-19.
- 44 ● Although stratified random cluster sampling was adopted, one-to-one interview could not be
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46 conducted during the pandemic. All the participants completed the questionnaire using Wechat.
- 47 ● As the study was based on a cross-sectional design, a causal relationship could not be inferred
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55 56 57 **Introduction**

58 Coronavirus disease (COVID-19) is an emerging infectious disease[1]. In December 2019, COVID-
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4 19 cases were first confirmed in Wuhan, China, and subsequently reported nationwide and globally
5 [1]. Up to February 20th, 2020, within the launch of the first-level response measures for major
6 public health emergencies[2], the cumulative number of confirmed cases across the country had
7 reached 125,529, and the cumulative number of deaths had reached 5,695 [3]. Meanwhile, 2,055
8 medical workers who participated in the treatment were reported to be infected with COVID-19 [4],
9 mainly due to the lack of sufficient knowledge of COVID-19 [5].

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15 Shanghai was the largest port city in China as well as international trade and shipping center [6].
16 The Shanghai municipal government issued regulation on community prevention and control
17 network [7] as early as January 23rd, the same day Wuhan was closed down. However, by February
18 20th, 2020, the number of confirmed cases had reached 334.

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23 The main force to undertake the task of community pandemic prevention and control is general
24 practitioners (GPs), the gatekeeper of the health of community residents [8]. But, GPs have never
25 been involved in community pandemic prevention before. In the face of the challenge of this
26 emerging infectious disease, whether the GPs had mastered the correct knowledge, had high morale
27 and normative behavior, so that they can protect themselves and educate community residents well,
28 to win the tough fight? According to literature and theory, knowledge influences behavior directly
29 or indirectly by attitude. We hypothesized that in this context, GP's knowledge could predict their
30 attitude, and their knowledge and attitude could predict their behavior. To this end, we launched a
31 survey of GPs' knowledge, attitude and behavior towards COVID-19 in Shanghai, aiming to find
32 out the gaps and provide a basis for improving the pandemic prevention and control capacity at the
33 grassroot level, so as to better control the pandemic.

44 45 46 **Methods**

47 48 **Study Design and Population**

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50 This cross-sectional survey was conducted from February 21st to March 2nd, 2020. Stratified
51 random cluster sampling was adopted. According to the regional division of Shanghai, regions were
52 divided into the urban, urban-rural fringe, and rural areas [9]. Three districts were randomly selected
53 from each of the three areas, and three community health service centers (CHCs) were randomly
54 selected from each district [10].

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60 According to the formula

$$n = \frac{\mu_{\alpha/2}^2 P (1 - P)}{\delta^2}$$

$P=0.0222$, $1-P=0.9778$, $\alpha=0.05$, $\mu_{\alpha/2}=1.96$, $\delta=0.5P=0.0111$,

$$n = \frac{1.96^2 \times 0.0222 \times 0.9778}{0.0111^2} = 676.1 \approx 677$$

n stands for the required sample size. $\mu_{\alpha/2}$ stands for the μ value when the cumulative probability from left to right is $1-\alpha/2$ (both sides) in the standard normal distribution. P stands for the accuracy rate of all the questions in the pre-survey. δ stands for the allowable error. Based on the pre-survey results of 30 respondents, $P=0.0222$, $1-P=0.987$, $\alpha=0.05$ was set, $\mu_{\alpha/2}=1.96$, a 5 percent margin of error was set, then $\delta=0.5$, $P=0.00715$, the required sample size would be at least 677. At a 20% shedding rate, the total sample size would be at least 847. Finally, a total of 1018 on-the-job GPs in the above 27 CHCs were investigated, including 341 GPs in urban area, 415 GPs in urban-rural fringe area, and 262 GPs in rural area (Fig 1). No incentive was offered for completion of the questionnaire.

Measurement Tool

A self-designed questionnaire was used in the survey, based on the COVID-19 literature published by World Health Organization and the Chinese Center for Disease Control and Prevention (CDC) [11-14]. The questionnaire was pre-tested on a small sample of 30 GPs from three CHCs and some of the questions were adjusted after the pre-survey. The questionnaire collected: ① General information of the respondents: region, gender, age, education level, years of work, professional title, and marital status. ② Knowledge regarding COVID-19: There are 6 single-choice questions and 4 multiple-choice questions. For all multiple-choice questions, respondents must check all the correct items to be judged as correct. Each correctly answered question scores 1 point and the total score is 10 points. ③ Attitude towards COVID-19 pandemic: There are 5 questions in total. In answering each question, the extent of concern about COVID-19 is graded into 5 degrees. The score of 1 point for "not worried at all", 2 for "not very worried", 3 for "somewhat worried", 4 for "quite worried" and 5 for "very worried". The total score is 25 points. ④ Behavior for COVID-19

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4 prevention and control: There are 10 single-choice questions. Each correctly answered question
5 scores 1 point and the total score is 10 points. The total Cronbach's alpha coefficient for the
6 questionnaire was 0.844, indicating that the internal consistency was acceptable.
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9 10 **Data Collection**

11 The cross-sectional study was conducted by using wechat platform. All items in the questionnaire
12 were required. If there were uncompleted items, the questionnaire could not be submitted, and the
13 same IP address could only be used to submit the questionnaire once. Written consent was obtained
14 from all respondents before they participated in the study. The study was conducted in accordance
15 with the Declaration of Helsinki, and the protocol was approved by the Ethics Committee of
16 Zhongshan Hospital, Fudan University (B2020-027).
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23 **Statistical Analysis**

24 Excel (Microsoft Office Professional Plus 2010) was used to establish the database, and SAS
25 (Version 9.4) was used for data processing and analysis. Continuous variables were presented as
26 mean±standard deviation($\bar{x} \pm SD$) and categorical variables as frequency (percentage). Kruskal-
27 Wallis test was used as univariate analysis to compare the knowledge, attitude and behavior scores
28 in different subgroups. The factors which had statistical significance in the single-factor analysis,
29 were taken as the predictors in the multiple linear regression analysis to identify the potential impact
30 factors related to knowledge, attitude and behavior scores. For categorical variables, such as region,
31 were entered as dummy variables. For ranked variables, such as education level and professional
32 title, were entered as ordinal variables. All of the tests for significance were two-sided. The P-Values
33 of univariate analysis<0.1 and multiple linear regression analysis<0.05 were considered statistically
34 significant.
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47 **Patient and public involvement**

48 The public were not involved in the design, or conduct, or reporting, or dissemination plans of this
49 research.
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54 **Results**

55 **Characteristics of participants**

56 1,018 GPs were invited to participate in the survey, and 996 questionnaires were collected, with a
57 response rate of 97.84% (996/1018). Among the 996 questionnaires, 989 questionnaires were valid,
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with a quality conformity rate of 99.30% (989/996). There were 279 males and 710 females and the average age was 39.18, ranging from 23 to 59. Bachelor degree and above accounted for 88.47% (Table 1) .

Table 1 The score of Knowledge, Attitude and Behavior regarding COVID-19 of GPs

Characteristics	Number of participants (%)	Knowledge score ($\bar{x} \pm SD$)	Attitude score ($\bar{x} \pm SD$)	Behaviour score ($\bar{x} \pm SD$)
Total	989(100)	6.14±1.42	13.59±4.42	7.82±1.53
Region				
Urban area	336(33.97)	6.09±1.46	13.63±4.26	7.64±1.60
Urban-rural fringe area	396(40.04)	6.20±1.40	14.04±4.29	8.14±1.35
Rural area	257(25.99)	6.12±1.42	12.85±4.74	7.57±1.60
χ^2		1.288	10.975	28.570
P		0.525	0.004	<.001
Gender				
Male	279(28.21)	5.90±1.41	12.89±4.89	7.49±1.71
Female	710(71.79)	6.24±1.42	13.87±4.20	7.95±1.43
χ^2		11.548	9.400	14.710
P		<.001	0.002	<.001
Age (year)				
≤29	131(13.25)	6.23±1.40	12.96±4.27	8.13±1.46
30~39	414(41.86)	6.22±1.39	13.87±4.32	7.84±1.49
40~49	327(33.06)	6.08±1.49	13.98±4.31	7.80±1.54
≥50	117(11.83)	5.96±1.39	12.21±4.94	7.47±1.62
χ^2		4.757	15.274	11.976
P		0.191	0.002	0.008
Education				
College degree and Bachelor degree	114(11.53)	5.90±1.42	12.55±4.54	7.67±1.71
Master degree or above	736(74.42)	6.15±1.42	13.72±4.42	7.85±1.50
χ^2	139(14.05)	6.31±1.44	13.73±4.27	7.78±1.53
P		5.172	6.290	0.590
P		0.075	0.043	0.745
Years of work				
5~9	83(8.39)	6.29±1.49	12.96±4.32	8.14±1.62
10~19	202(20.42)	6.09±1.40	13.91±4.36	7.95±1.45
≥20	317(32.05)	6.29±1.34	13.72±4.22	7.81±1.46
χ^2	387(39.13)	6.03±1.48	13.45±4.63	7.69±1.59
P		7.773	3.333	9.209
P		0.051	0.343	0.027
Professional title				
Resident	227(22.95)	6.03±1.41	13.37±4.56	7.91±1.56
Attending physician	591(59.76)	6.16±1.42	13.90±4.26	7.80±1.51
Associate chief physician or above	171(17.29)	6.25±1.44	12.81±4.71	7.79±1.55
χ^2		1.759	9.153	1.979
P		0.415	0.010	0.372
Marriage				
Unmarried	195(19.72)	6.06±1.38	12.71±4.44	7.76±1.67
Married	794(80.28)	6.17±1.43	13.81±4.40	7.84±1.49
χ^2		0.963	8.763	0.009
P		0.327	0.003	0.926

Abbreviation: SD=Standard Deviation

Knowledge and behavior scores of GPs regarding COVID-19

The correct response rate of the 989 GPs of each question on knowledge was 25.58%-97.88% (Table 2). The average knowledge score was 6.14 ± 1.42 (Table 1). Among them, the correct response rate of 'Which of the following objects or conditions can kill Novel Coronavirus?' was the lowest, accounting for 25.58%. The correct response rate of 'What are the transmission route of Novel Coronavirus' was the second lowest, accounting for 29.63% (Table 2).

The average behaviour score was 7.82 ± 1.53 (Table 1). The correct response rate of the 989 GPs of each behaviour question was 51.77%-97.07% (Table 2). Among them, the correct response rate of 'Do your hands touch the external surface of the face mask after you put it on?' , 'What is your step to remove a disposable surgical mask?' , 'When you wear a disposable surgical mask, how to fit it entirely to the face?' , 'Have you taken the initiative to publicize the "six-step hand-washing method" since the COVID-19 outbreak' were the lowest, accounting for 51.77%, 58.54% , 63.70% and 64.00%, respectively (Table 2).

Table 2 The Correct Response Rate of GPs on Knowledge and Behavior regarding COVID-19 (N=989)

Questions	n (%)
Knowledge	
1. Which of the following objects or conditions can kill Novel Coronavirus?	253(25.58)
2. What is the transmission route of Novel Coronavirus?	293(29.63)
3. What kind of face mask should you wear when you make home visits to quarantined residents?	302(30.54)
4. Does disposable surgical mask need to be replaced if it is wet or dirty?	318(32.15)
5. What do you think is the minimum social safe distance between people ?	686(69.36)
6. What is the appropriate replacement time of disposable surgical masks?	769(77.76)
7. Do you know the steps of "six-step hand-washing method"?	806(81.50)
8. What kind of face mask should you wear in community clinics during epidemic period?	808(81.70)
9. Do you know what kind of face mask has the effect of preventing Novel Coronavirus?	874(88.37)
10. How long should close contacts be quarantined?	968(97.88)
Behavior	
1. Do your hands touch the external surface of the face mask after you put it on?	512(51.77)
2. What is your step to remove a disposable surgical mask?	579(58.54)
3. When you wear a disposable surgical mask, how to fit it entirely to the face?	630(63.70)

4. Have you taken the initiative to publicize the "six-step hand-washing method" since the COVID-19 outbreak?	633(64.00)
5. Do your hands touch the external surface of the face mask while removing it?	823(83.22)
6. Have you started using the "six-step hand-washing method" since the COVID-19 outbreak?	853(86.25)
7. Do you wash your hands before putting on a face mask?	899(90.90)
8. Have you increased hand-washing frequency since the COVID-19 outbreak?	913(92.32)
9. When you wear disposable surgical masks, how to recognize the external and inner face mask surface correctly?	933(94.34)
10. When you wear disposable surgical masks, how to recognize the upper and lower edge correctly?	960(97.07)

Attitude scores of GPs regarding COVID-19

The average attitude score of 989 GPs on COVID-19 was 13.59±4.42 (Table 1). 26.29% of the GPs were very worried that themselves or their family member might get infected by Novel Coronavirus.

7.58% were very worried that their life was threatened by COVID-19 (Table 3).

Table 3 GPs' Attitude Score Regarding COVID-19 (N=989)

Questions	n (%)					Score
	Not worried at all	not worried	somewhat worried	quite worried	very worried	
1. Are you worried that yourself or your family member might get infected by Novel Coronavirus?	98(9.91)	159(16.08)	281(28.41)	191(19.31)	260(26.29)	3.36±1.29
2. Are you worried you'll be quarantined if you get infected?	114(11.53)	188(19.01)	338(34.18)	170(17.19)	179(18.10)	3.11±1.24
3. Are you worried that the pandemic might be out of control and the virus will spread widely?	141(14.26)	221(22.35)	341(34.48)	155(15.67)	131(13.25)	2.91±1.21
4. Do you feel	241(24.37)	317(32.05)	258(26.09)	98(9.91)	75(7.58)	2.44±1.18

your life threatened by COVID-19?						
5.Do you suspect that you have been infected with Novel Coronavirus?	460(46.51)	366(37.01)	120(12.13)	25(2.53)	18(1.82)	1.76±0.89
Total						13.59±4.42

Univariate analysis of GPs' knowledge,attitude and behavior towards COVID-19

Univariate analysis showed that male GPs' knowledge score was lower than female GPs' ($P < 0.01$). GPs with college education and below, and those who had worked for 20 years or longer had the lowest knowledge score ($P < 0.1$). Female GPs were more worried than male GPs ($P = 0.002$). GPs who worked in urban-rural fringe area, aged 40-49, master degree or above, attending physician and married were the most worried ($P < 0.05$). Male GPs had the lower behavior score ($P < 0.01$). GPs worked in rural areas, age 50 or above, over 20 years of work had the lowest behavior score ($P < 0.05$) (Table 1).

Multiple linear regression analysis of GPs' knowledge,attitude and behavior towards COVID-19

Multiple linear regression analysis showed that knowledge score of male GPs was lower than that of female GPs ($P = 0.002$). Attitude score of female GPs was higher than that of male GPs ($P = 0.004$). Married GPs was higher than that of unmarried GPs ($P = 0.021$). Behavior score of GPs in urban areas was lower than that of GPs in urban-rural fringe areas ($P < 0.001$). Male GPs' behavior scores were lower than female GPs' ($P = 0.002$). The higher the knowledge score, the higher the behavior score ($P < 0.001$) (Table 4).

Table 4 Multiple linear regression on factors associated with Shanghai GPs' knowledge, attitude and behaviour score regarding COVID-19

Variable	Knowledge Score	
	Coefficient (95% CI)	P
Knowledge Score		
Female	0.32 (0.12, 0.52)	0.002
Education Level*	0.15 (-0.01, 0.31)	0.074

Years of work Level*	-0.03 (-0.13, 0.07)	0.532
Attitude Score		
Urban-rural fringe area	0.42 (-0.23, 1.06)	0.203
Rural area	-0.43 (-1.18, 0.32)	0.258
Female	0.90 (0.29, 1.51)	0.004
Age group level*	-0.02 (-0.46, 0.41)	0.913
Education Level*	0.37 (-0.19, 0.92)	0.200
Professional title Level*	-0.20 (-0.73, 0.33)	0.458
Married	0.88 (0.13, 1.63)	0.021
Knowledge Score	0.01 (-0.18, 0.21)	0.890
Behaviour Score		
Urban-rural fringe area	0.44 (0.23, 0.66)	<.001
Rural area	-0.05 (-0.28, 0.18)	0.673
Female	0.32 (0.12, 0.52)	0.002
Age group Level*	-0.12 (-0.31, -0.06)	0.198
Years of work Level*	0.01 (-0.16, 0.17)	0.951
Knowledge Score	0.28 (0.22, 0.34)	<.001
Attitude Score	0.02 (0, 0.04)	0.065

* Education Level: 1=College degree and below, 2=Bachelor degree, 3=Master degree or above;

*Years of work Level: 1=less than 5, 2=5~9, 3=10~19, 4=greater or equal than 20;

*Age group Level: 1=less and equal than 29, 2=30~39, 3=40~49, 5=greater or equal than 50;

*Professional title Level: 1=Resident, 2=Attending physician, 3=Associate chief physician or above.

Abbreviation: CI=Confidence Interval

Discussion

Of the 989 GPs who were respondents of our study, their average age was 39.18 years old, among whom 88.2% were younger than 50, and 88.47% had bachelor's degree or above. This was a relatively young team with high education level. However, the average score was 6.14 ± 1.42 (range 0-10), which was much lower than that of the online survey of 1,357 medical workers in Henan Province conducted by Zhang M et al. at the same time[15]. This is worrying. GPs are the main force in this community pandemic prevention and control campaign against COVID-19 in Shanghai[16]. How can GPs with poor knowledge on COVID-19 lead the community to win the pandemic prevention and control campaign? It was necessary for GPs to master the transmission route of Novel Coronavirus [17], so as to protect themselves and to educate the population well. However, the correct response rate of Shanghai GPs' knowledge of transmission route was only 29.63%. Feng Xiang et al. demonstrated the correct response rate of 43.27% in an online survey of 617 medical workers in Jiangsu Province in early March 2020[18]. Blocking transmission route is

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4 especially important for infectious diseases. Therefore, it is necessary to strengthen training of basic
5 knowledge of infectious diseases. During the pandemic, people need to keep a safe social distance
6 of at least one meter [19]. However, only 69.36% of the GPs have mastered the social safety distance
7 during the pandemic [20], which was much lower than the correct response rate of Parikh PA's
8 survey of 744 medical personnel in India in March 2020 [20]. Thus, social safety distance is another
9 weak point that needs to be focused on in pandemic training. CDC recommends using medical masks
10 and N95 masks in preventing novel coronavirus [21]. Our study showed that GPs had a high rate of
11 88.37% for choosing the correct face masks. But the rate for choosing the correct face mask when
12 making home visits to quarantined residents was only 30.54%. Many GPs only chose N95 masks
13 on this occasion. However, when visiting people quarantined at home, either of the disposable
14 surgical mask or N95 mask is optional [12]. Compared with disposable surgical masks, N95
15 respirators are optimized in structure with core filtration and their filtering efficiency raised up to
16 95% [22]. Such choice might be due to the great fear caused by the outbreak of the pandemic at that
17 time, and many GPs prefer excessive protection. Under the circumstances of lacking medical
18 supplies for pandemic prevention, it is necessary to ensure not only the safety of GPs, but also the
19 scientific and rational use of medical supplies. Disposable surgical masks should be discarded at the
20 interval of 4 hours and should also be replaced when they are wet or dirty [11,21]. If the filter layer
21 of a disposable surgical mask absorbs moisture or gets dirty, the filtering function will be reduced
22 or even lost [11]. However, the correct awareness of GPs of the discard interval and occasion was
23 35.19% and 51.26%, respectively. Therefore, it is essential to make GPs master the correct discard
24 interval and occasion of disposable surgical masks.

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Univariate and Multivariate analysis showed that male GPs had lower knowledge scores than
female GPs, which was consistent with the results of an online survey of residents around the
country on COVID-19 conducted by Qi Y at the end of January 2020.[23] Women tend to be in the
center of family life and were usually more nervous about the pandemic [24]. They were more
serious about the prevention of the pandemic for the health of themselves and their families and
were more willing to follow standardized measures [24].

The score of worry of GPs regarding COVID-19 was 13.59 ± 4.42 , which was between not worried
and somewhat worried. The proportion of GPs who were somewhat worried, quite worried and very
worried that themselves or their family members might get infected by Novel Coronavirus was
28.41%, 19.31% and 26.29%, respectively. In general, the proportions of GPs with worry were
slightly lower than the studies conducted by Zhang M et al.[15] and Abdel Wahed WY et al.[25].
This can indirectly reflect the relatively perfect prevention and control work in Shanghai. For the

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4 question, 'Do you feel your life threatened by COVID-19?', the proportion of those GPs who were
5 not worried at all and not worried was 56.42%. And those who were quite worried and very worried
6 was only 17.49%. This demonstrated that Shanghai GPs had confidence in China's pandemic
7 prevention and control capability although they knew the highly contagious nature of Novel
8 Coronavirus. This confidence might also be related to the experience in handling pandemic of
9 Severe Acute Respiratory Syndrome in Shanghai in 2003. Shanghai's pandemic control and
10 prevention capability has improved step by step in the past 17 years [26].

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Multivariate analysis showed that gender and marriage were the influencing factors of attitude
regarding COVID-19 for GPs, which was consistent with the online survey of Zhu Z et al. of 5,062
medical workers in Wuhan Tongji Hospital in February 2020 [27]. Female GPs were more anxiety
in the face of COVID-19. An online survey conducted by Shiyan Yan et al. on 3,088 people in
February 2020 also showed gender differences on stress [28]. Married people take more
responsibilities for their families and worry more. Therefore, for these GPs, appropriate
psychological support should be provided to reduce their psychological pressure.

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Doctor is a high-risk profession. If GPs wore face mask in an incorrect way, they would be at the
risk of being infected [29]. In our study, although 88.37% of the GPs selected the correct type of
face mask to prevent the invasion of COVID-19, only 63.70% of them knew how to fit disposable
surgical mask entirely to the face. The correct percentage of GPs for hands not touching the external
surface of the face mask while wearing it was only 51.77%, and the percentage of GPs who had
mastered the correct step to remove a disposable surgical mask was only 58.54%. Therefore, it is
necessary to emphasize the proper way to wear face masks in detail in GP training. Contact
transmission is a major route of COVID-19 transmission. Therefore, hand hygiene is as important
as wearing masks and keeping a safe social distance [30]. Ran L et al. demonstrated that hand
hygiene was closely related to COVID-19 infection through his investigation of 72 medical workers
in Wuhan in January 2020 [31,32]. After the outbreak of COVID-19, Shanghai GPs' hand-washing
frequency increased by 92.32% and the number of GPs who strictly used 'six-step hand-washing
method' increased by 86.25% compared with that before the outbreak[32]. The majority of GPs
performed well in hand hygiene, which was consistent with the survey of 744 medical personnel in
India [20]. Moreover, educating the public is also the social responsibility that GPs should take on
their initiative. However, only 64.00% of Shanghai GPs actively publicized the "six-step hand-
washing method" to the public. Therefore, GPs should have the awareness of educating the public
to improve the efficiency of pandemic prevention and control.

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4 Both of the univariate and multivariate analysis showed that behaviour score of male GPs was
5 lower than that of female GPs, which was consistent with the survey of 461 medical workers
6 conducted by Dimitrios Papagiannis et al. in Greece in February 2020 [33]. Women are better than
7 men in knowledge mastery and more nervous than men in attitude. It is understandable that they are
8 more serious in behavior implementation. Our study also showed that the higher the knowledge
9 score, the higher the behavior score. It was consistent with the survey of 706 Syrian residents
10 conducted by Sanaa Al ahdab et al. in April 2020 [34]. Therefore, there is a need for further training
11 of GPs to improve their understanding of the disease and the correct behaviour towards pandemic
12 prevention in their communities.
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19 **Conclusions**

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21 This is a large-scale cross-sectional survey of GPs' knowledge, attitude and behavior towards
22 COVID-19 in Shanghai, a city with highly developed economy and high population mobility. GPs,
23 as the "health gatekeepers" of the community, are in the important position of the community grid
24 management system, and their knowledge, attitude and behavior will greatly affect the results of
25 prevention and control of pandemic. However, according to our survey of GPs in Shanghai, their
26 related knowledge was limited at the difficult initial phase when protective equipment and
27 knowledge of COVID-19 were lacking and their behaviors towards COVID-19 needed improving.
28 When confronted with the sudden breakout of a new emerging contagious disease, it is important to
29 train GPs the appropriate coping strategies in time. At the same time, we should also care about the
30 physical and mental health of GPs to build a strong frontline of community prevention and control.
31 Lessons learned from the current pandemic will help GPs in effectively handling any possible
32 similar future challenges and possible new pandemics in the future.
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44 **Limitations**

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46 The survey has some limitations. Although stratified random cluster sampling was adopted, one-to-
47 one interview could not be conducted during the pandemic. Thus, although the study did provide
48 necessary reference for the gap in knowledge, attitude and practice of GPs, the extrapolation of
49 conclusions to the population was limited to some extent. Secondly, as the study was based on a
50 cross-sectional design, a causal relationship could not be inferred with certainty. We can do in-depth
51 research in the future.
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Contributors

Jian Wang conceived and designed the study, implemented the research and helped to draft and revise the manuscript. Huiyun Tang implemented the research, conducted data collection and helped to draft the manuscript. Jialiang Fang and Boxiang Tu performed data collection and statistical analysis. All the authors contributed to the preparation of the final document, and had read and approved the final manuscript.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not reported

Ethics approval This study involves human participants. Written consent was obtained from all respondents before the investigation which was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Ethics Committee of Zhongshan Hospital, Fudan University (B2020-027). Participants gave informed consent to participate in the study before taking part.

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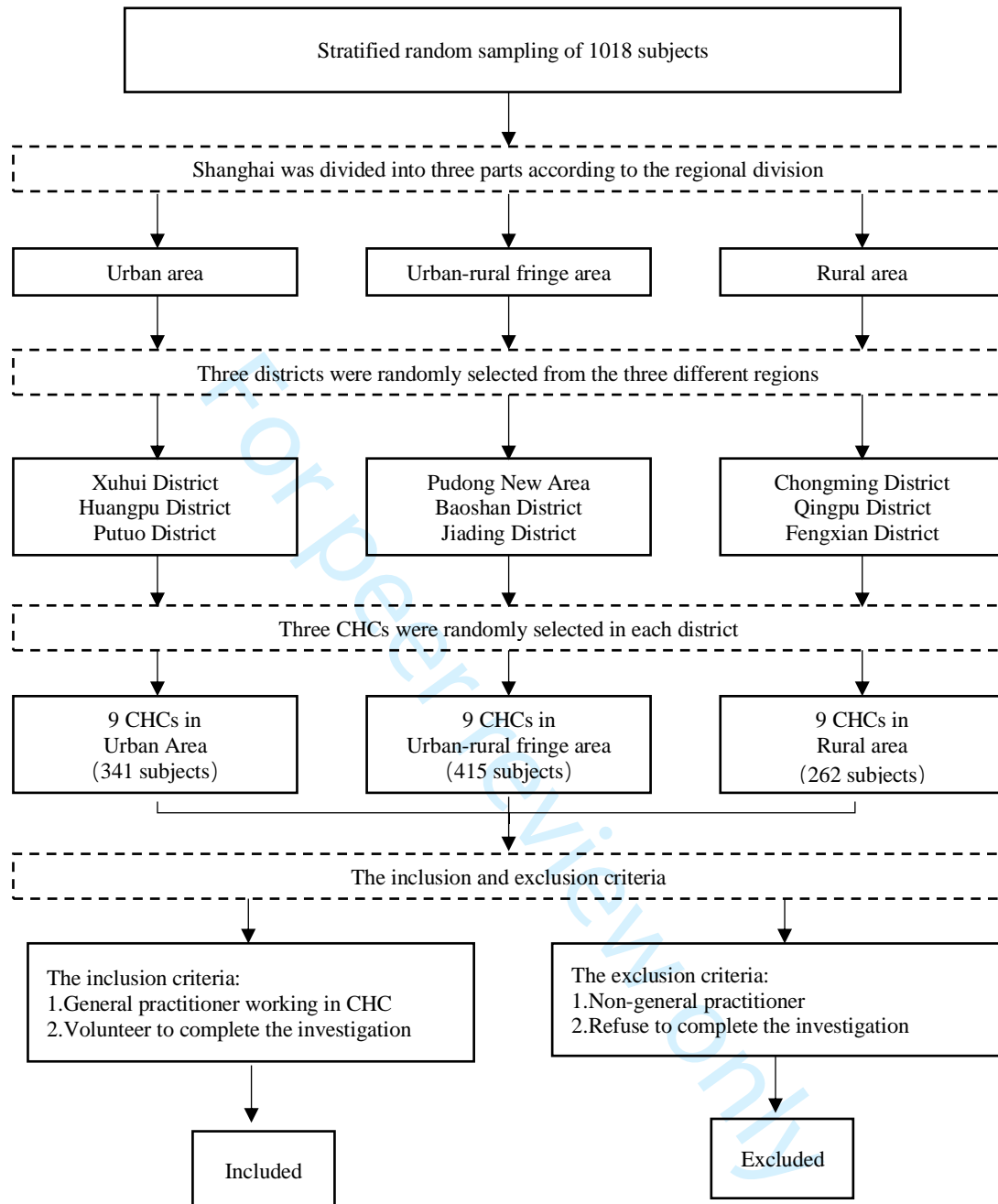
Data availability statement Data are available upon reasonable request.

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Fig. 1 Sampling flow chart

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No.	Recommendation	Page No.	Relevant text from manuscript
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) 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	5	
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6	
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants (b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case	5	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6	
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	7	
Bias	9	Describe any efforts to address potential sources of bias	7	
Study size	10	Explain how the study size was arrived at	7	

Continued on next page

Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7-8
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	7-8
		(b) Describe any methods used to examine subgroups and interactions	7-8
		(c) Explain how missing data were addressed	7-8
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed	7-8
		<i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	7-8
(e) Describe any sensitivity analyses	7-8		
Results			
Participants	13*	(a) 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	8
		(b) Give reasons for non-participation at each stage	8
		(c) Consider use of a flow diagram	8
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8-9
		(b) Indicate number of participants with missing data for each variable of interest	8-9
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	8-9
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	8-9
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	8-9
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	8-9
Main results	16	(a) 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	8-9
		(b) Report category boundaries when continuous variables were categorized	8-9
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	8-9

Continued on next page

Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	9–18
Discussion			
Key results	18	Summarise key results with reference to study objectives	18
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	18–19
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	18–19
Generalisability	21	Discuss the generalisability (external validity) of the study results	18–19
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	19

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Knowledge, Attitude and Behavior of General Practitioners in Shanghai during the Pandemic of COVID-19: A Cross Sectional Study

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1 Knowledge, Attitude, and Behavior of General Practitioners in Shanghai during the 2 Pandemic of COVID-19: A Cross-Sectional Study

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24 25 Abstract

26 **Objectives** To grasp the knowledge, attitude, and behavior of the general practitioners (GPs)
27 toward COVID-19, and to provide evidence for better prevention and control of the
28 pandemic. **Study design** A cross-sectional study was conducted with 1018 GPs in Shanghai from
29 February 21 to March 2, 2020, by using the WeChat platform. **Methods** Stratified random cluster
30 sampling was adopted according to the regional division of urban area, urban-rural fringe area,
31 and rural area. A mobile self-designed questionnaire was used. The questionnaire collected

32 knowledge, attitude, and behavior regarding COVID-19 prevention and control. **Results** 989
33 questionnaires were valid. The average score of GPs' knowledge, attitude, and behavior toward
34 COVID-19 were 6.14 ± 1.42 (range 0-10), 13.59 ± 4.42 (range 0-25), 7.82 ± 1.53 (range 0-10),
35 respectively. Multiple linear regression analysis showed that the knowledge score of male GPs
36 was lower than that of female GPs ($P=0.002$). The attitude score of female GPs was higher than
37 that of male GPs ($P=0.004$). The behavior score of GPs in urban areas was lower than that of GPs
38 in urban-rural fringe areas ($P<0.001$). The higher the knowledge score, the higher the behavior
39 score ($P<0.001$). **Conclusions** The scores for knowledge, attitude, and behavior of Shanghai GPs
40 towards COVID-19 were limited at the beginning of the COVID-19 outbreak. The scores for
41 knowledge, attitude, and behavior of Shanghai GPs towards COVID-19 were limited at the
42 beginning of the COVID-19 outbreak. Early implementation of proper training programs for GPs
43 in times of crisis will contribute to disease control and prevention. Lessons learned from the current
44 pandemic will help GPs effectively handle any similar future challenges and possible new
45 pandemics in the future.

46 **Keywords** General practitioner; COVID-19; Knowledge; Attitude; Behavior

48 **Strengths and limitations of this study,**

- 49 ● This study was conducted on general practitioners who participated in community pandemic
50 prevention and control as the leading force for the first time at the early stage of the COVID-
51 19 pandemic in Shanghai, a city with a highly developed economy and high population
52 mobility.
- 53 ● According to the regional division of Shanghai, stratified random cluster sampling was
54 adopted.
- 55 ● This was one of the first large-scale cross-sectional studies of general practitioners' knowledge,
56 attitude, and behavior at the early beginning of COVID-19.
- 57 ● Although stratified random cluster sampling was adopted, the one-to-one interview could not
58 be conducted during the pandemic. All the participants completed the questionnaire using
59 Wechat.
- 60 ● As the study was based on a cross-sectional design, a causal relationship could not be inferred
61 with certainty.

62

63 Introduction

64 Coronavirus disease (COVID-19) is an emerging infectious disease[1]. In December 2019,
65 COVID-19 cases were first confirmed in Wuhan, China, and reported nationwide and globally [1].
66 Up to February 20, 2020, within the launch of the first-level response measures for major public
67 health emergencies[2], the cumulative number of confirmed cases across the country had reached
68 125,529, and the cumulative number of deaths had reached 5,695 [3]. Meanwhile, 2,055 medical
69 workers who had helped to treat COVID-19 were infected[4], mainly due to insufficient
70 knowledge of COVID-19 [5].

71 Shanghai was the largest port city in China and international trade and shipping center [6]. The
72 Shanghai municipal government issued a regulation on community prevention and control network
73 [7] as early as January 23, the same day Wuhan was closed down. However, by February 20, 2020,
74 confirmed cases had reached 334.

75 The main force to undertake the task of community pandemic prevention and control was
76 general practitioners (GPs), the gatekeeper of the health of community residents [8]. Nevertheless,
77 GPs had never been involved in community pandemic prevention before. In the face of the
78 challenge of this emerging infectious disease, did the GPs master the correct knowledge; have high
79 morale and normative behavior to protect themselves; educate community residents well to win
80 the tough fight? According to literature and theory, knowledge influences behavior directly or
81 indirectly by attitude. We hypothesized that in this context, GP's knowledge could predict their
82 attitude, and their knowledge and attitude could predict their behavior. To this end, we launched a
83 survey of GPs' knowledge, attitude, and behavior towards COVID-19 in Shanghai, aiming to find
84 the gaps and provide a basis for improving the pandemic prevention and control capacity at the
85 grassroots level to control the pandemic better.

86

87 Methods

88 Study Design and Population

89 This cross-sectional survey was conducted from February 21st to March 2nd, 2020. Stratified
90 random cluster sampling was adopted. According to the regional division of Shanghai, regions
91 were divided into the urban, urban-rural fringe, and rural areas [9]. Three districts were randomly

92 selected from each of the three areas, and three community health service centers (CHCs) were
93 randomly selected from each district [10].

94 According to the formula

$$n = \frac{\mu_{\alpha/2}^2 P (1-P)}{\delta^2}$$

96 $P=0.0222$, $1-P=0.9778$, $\alpha=0.05$, $\mu_{\alpha/2}=1.96$, $\delta=0.5P=0.0111$,

$$97 \quad n = \frac{1.96^2 \times 0.0222 \times 0.9778}{0.0111^2} = 676.1 \approx 677$$

98 n stands for the required sample size. $\mu_{\alpha/2}$ stands for the μ value when the cumulative probability
99 from left to right is $1-\alpha/2$ (both sides) in the standard normal distribution. P stands for the accuracy
100 rate of all the questions in the pre-survey. δ stands for the allowable error. Based on the pre-survey
101 results of 30 respondents, $P=0.0222$, $1-P=0.987$, $\alpha=0.05$ was set, $\mu_{\alpha/2}=1.96$, a 5 percent margin of
102 error was set, then $\delta=0.5$, $P=0.00715$, the required sample size would be at least 677. At a 20%
103 shedding rate, the total sample size would be at least 847. Finally, a total of 1018 on-the-job GPs
104 in the above 27 CHCs were investigated, including 341 GPs in urban area, 415 GPs in urban-rural
105 fringe area, and 262 GPs in rural area (Fig 1) . No incentive was offered for completion of the
106 questionnaire.

107 **Measurement Tool**

108 A self-designed questionnaire was used in the survey, based on the COVID-19 literature published
109 by World Health Organization and the Chinese Center for Disease Control and Prevention (CDC)
110 [11-14]. The questionnaire was pre-tested on a small sample of 30 GPs from three CHCs, and
111 some of the questions were adjusted after the pre-survey. The questionnaire collected: ①General
112 information of the respondents: region, gender, age, education level, years of work, professional
113 title, and marital status. ②Knowledge regarding COVID-19: There are 6 single-choice questions
114 and 4 multiple-choice questions. For all multiple-choice questions, respondents must check all the
115 correct items to be judged as correct. Each correctly answered question scores 1 point, and the
116 total score is 10 points. ③Attitude towards COVID-19 pandemic: There are 5 questions in total.
117 In answering each question, the extent of concern about COVID-19 is graded into 5 degrees. The
118 score of 1 point for "not worried at all", 2 for "not very worried", 3 for "somewhat worried", 4 for

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3 119 "quite worried", and 5 for "very worried". The total score is 25 points. ④Behavior for COVID-19
4
5 120 prevention and control: There are 10 single-choice questions. Each correctly answered question
6
7 121 scores 1 point, and the total score is 10 points. The total Cronbach's alpha coefficient for the
8
9 122 questionnaire was 0.844, indicating that the internal consistency was acceptable.

10 123 **Data Collection**

11
12 124 The cross-sectional study was conducted using the WeChat platform. All items in the questionnaire
13
14 125 were required. If there were uncompleted items, the questionnaire could not be submitted, and the
15
16 126 same IP address could only be used to submit the questionnaire once. Written consent was obtained
17
18 127 from all respondents before they participated in the study. The study was conducted in accordance
19
20 128 with the Declaration of Helsinki, and the protocol was approved by the Ethics Committee of
21
22 129 Zhongshan Hospital, Fudan University (B2020-027).

22 130 **Statistical Analysis**

23
24 131 Excel (Microsoft Office Professional Plus 2010) was used to establish the database, and SAS
25
26 132 (Version 9.4) was used for data processing and analysis. Continuous variables were presented as
27
28 133 mean±standard deviation($\bar{x} \pm SD$) and categorical variables as frequency (percentage). Kruskal-
29
30 134 Wallis test was used as a univariate analysis to compare the different subgroups' knowledge,
31
32 135 attitude, and behavior scores. Subsequently, three multiple linear regression models were tested to
33
34 136 identify which variables significantly influenced knowledge, attitude and behavior respectively.
35
36 137 The factors which had statistical significance in the single-factor analysis were taken as the
37
38 138 predictors in the multiple linear regression analysis. Categorical variables, such as region, were
39
40 139 entered as dummy variables; ranked variables, such as education level and professional title, were
41
42 140 entered as ordinal variables; all significance tests were two-sided. The P-Values of univariate
43
44 141 analysis<0.1 and multiple linear regression analysis<0.05 were considered statistically significant.

43 142 **Patient and public involvement**

44
45 143 The public was not involved in this research's design, conduct, reporting, or dissemination plans.
46
47 144

48 145 **Results**

49 146 **Characteristics of participants**

50
51 147 1,018 GPs were invited to participate in the survey, and 996 questionnaires were collected, with a
52
53 148 response rate of 97.84% (996/1018). Among the 996 questionnaires, 989 questionnaires were valid,
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55 149 with a quality conformity rate of 99.30% (989/996). There were 279 males and 710 females, and
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150 the average age was 39.18, ranging from 23 to 59. Bachelor's degree and above accounted for
 151 88.47% (Table 1) .

152 **Table 1 The score of Knowledge, Attitude and Behavior regarding COVID-19 of GPs**

Characteristics	Number of participants	Knowledge score ($\bar{x} \pm SD$)	Attitude score (\bar{x})	Behaviour score ($\bar{x} \pm SD$)
Total	989(100)	6.14±1.42	13.59±4.42	7.82±1.53
Region				
Urban area	336(33.97)	6.09±1.46	13.63±4.26	7.64±1.60
Urban-rural fringe	396(40.04)	6.20±1.40	14.04±4.29	8.14±1.35
Rural area	257(25.99)	6.12±1.42	12.85±4.74	7.57±1.60
χ^2		1.288	10.975	28.570
P		0.525	0.004	<.001
Gender				
Male	279(28.21)	5.90±1.41	12.89±4.89	7.49±1.71
Female	710(71.79)	6.24±1.42	13.87±4.20	7.95±1.43
χ^2		11.548	9.400	14.710
P		<.001	0.002	<.001
Age (year)				
≤29	131(13.25)	6.23±1.40	12.96±4.27	8.13±1.46
30~39	414(41.86)	6.22±1.39	13.87±4.32	7.84±1.49
40~49	327(33.06)	6.08±1.49	13.98±4.31	7.80±1.54
≥50	117(11.83)	5.96±1.39	12.21±4.94	7.47±1.62
χ^2		4.757	15.274	11.976
P		0.191	0.002	0.008
Education				
College degree and Bachelor degree	114(11.53)	5.90±1.42	12.55±4.54	7.67±1.71
Master degree or	736(74.42)	6.15±1.42	13.72±4.42	7.85±1.50
	139(14.05)	6.31±1.44	13.73±4.27	7.78±1.53
χ^2		5.172	6.290	0.590
P		0.075	0.043	0.745
Years of work				
< 5	83(8.39)	6.29±1.49	12.96±4.32	8.14±1.62
5~9	202(20.42)	6.09±1.40	13.91±4.36	7.95±1.45
10~19	317(32.05)	6.29±1.34	13.72±4.22	7.81±1.46
≥20	387(39.13)	6.03±1.48	13.45±4.63	7.69±1.59
χ^2		7.773	3.333	9.209
P		0.051	0.343	0.027
Professional title				
Resident	227(22.95)	6.03±1.41	13.37±4.56	7.91±1.56
Attending physician	591(59.76)	6.16±1.42	13.90±4.26	7.80±1.51
Associate chief physician or above	171(17.29)	6.25±1.44	12.81±4.71	7.79±1.55
χ^2		1.759	9.153	1.979
P		0.415	0.010	0.372
Marriage				
Unmarried	195(19.72)	6.06±1.38	12.71±4.44	7.76±1.67
Married	794(80.28)	6.17±1.43	13.81±4.40	7.84±1.49
χ^2		0.963	8.763	0.009

<i>P</i>	0.327	0.003	0.926
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153 Abbreviation: SD=Standard Deviation

154 Knowledge and behavior scores of GPs regarding COVID-19

155 The correct response rate of the 989 GPs of each question on knowledge was 25.58%-97.88%
 156 (Table 2). The average knowledge score was 6.14±1.42 (Table 1). Among them, the correct
 157 response rate of 'Which of the following objects or conditions can kill Novel Coronavirus?' was
 158 the lowest, accounting for 25.58%. The correct response rate of 'What are the transmission routes
 159 of Novel Coronavirus' was the second lowest, accounting for 29.63% (Table 2).

160 The average behavior score was 7.82±1.53 (Table 1). The correct response rate of the 989 GPs
 161 of each behavior question was 51.77-97.07% (Table 2). Among them, the correct response rate of
 162 'Do your hands touch the external surface of the face mask after you put it on?', 'What is your
 163 step to remove a disposable surgical mask?', 'When you wear a disposable surgical mask, how
 164 to fit it entirely to the face?', 'Have you taken the initiative to publicize the "six-step hand-
 165 washing method" since the COVID-19 outbreak' was the lowest, accounting for 51.77%, 58.54%,
 166 63.70%, and 64.00%, respectively (Table 2).

167 Table 2 The Correct Response Rate of GPs on Knowledge and Behavior regarding COVID- 168 19 (N=989)

Questions	n (%)
Knowledge	
1.Which of the following objects or conditions can kill Novel Coronavirus?	253(25.58)
2.What is the transmission route of Novel Coronavirus?	293(29.63)
3.What kind of face mask should you wear when you make home visits to quarantined residents?	302(30.54)
4.Does disposable surgical mask need to be replaced if it is wet or dirty?	318(32.15)
5.What do you think is the minimum social safe distance between people ?	686(69.36)
6.What is the appropriate replacement time of disposable surgical masks?	769(77.76)
7.Do you know the steps of "six-step hand-washing method"?	806(81.50)

8.What kind of face mask should you wear in community clinics during pandemic period?	808(81.70)
9.Do you know what kind of face mask has the effect of preventing Novel Coronavirus?	874(88.37)
10.How long should close contacts be quarantined?	968(97.88)
Behavior	
1.Do your hands touch the external surface of the face mask after you put it on?	512(51.77)
2.What is your step to remove a disposable surgical mask?	579(58.54)
3.When you wear a disposable surgical mask, how to fit it entirely to the face?	630(63.70)
4.Have you taken the initiative to publicize the "six-step hand-washing method" since the COVID-19 outbreak?	633(64.00)
5.Do your hands touch the external surface of the face mask while removing it?	823(83.22)
6.Have you started using the "six-step hand-washing method" since the COVID-19 outbreak?	853(86.25)
7.Do you wash your hands before putting on a face mask?	899(90.90)
8.Have you increased hand-washing frequency since the COVID-19 outbreak?	913(92.32)
9.When you wear disposable surgical masks, how to recognize the external and inner face mask surface correctly?	933(94.34)
10.When you wear disposable surgical masks, how to recognize the upper and lower edge correctly?	960(97.07)

169

170 Attitude scores of GPs regarding COVID-19

171 The average attitude score of 989 GPs on COVID-19 was 13.59±4.42 (Table 1). 26.29% of the
 172 GPs were very worried that themselves or their family member might get infected by Novel
 173 Coronavirus. 7.58% were very worried that their lives were threatened by COVID-19 (Table 3).

174 Table 3 GPs' Attitude Score Regarding COVID-19 (N=989)

Questions	n (%)	Score
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	Not worried at all	not worried	somewhat worried	quite worried	very worried	
1.Are you worried that yourself or your family member might get infected by Novel Coronavirus?	98(9.91)	159(16.08)	281(28.41)	191(19.31)	260(26.29)	3.36±1.29
2.Are you worried you'll be quarantined if you get infected?	114(11.53)	188(19.01)	338(34.18)	170(17.19)	179(18.10)	3.11±1.24
3.Are you worried that the pandemic might be out of control and the virus will spread widely?	141(14.26)	221(22.35)	341(34.48)	155(15.67)	131(13.25)	2.91±1.21
4.Do you feel COVID-19 threatened your life?	241(24.37)	317(32.05)	258(26.09)	98(9.91)	75(7.58)	2.44±1.18
5.Do you suspect that you have been	460(46.51)	366(37.01)	120(12.13)	25(2.53)	18(1.82)	1.76±0.89

infected with	
Novel	
Coronavirus?	
Total	13.59±4.42

175

176 **Univariate analysis of GPs' knowledge, attitude, and behavior towards COVID-19**

177 Univariate analysis showed that male GPs' knowledge score was lower than female GPs' ($P < 0.01$).
 178 GPs with a college education and below and those who had worked for 20 years or longer had the
 179 lowest knowledge score ($P < 0.1$). Female GPs were more worried than male GPs ($P = 0.002$). GPs
 180 who worked in an urban-rural fringe area, aged 40-49, had a master's degree or above, worked as
 181 attending physicians, and married were the most worried ($P < 0.05$). Male GPs had a lower behavior
 182 score ($P < 0.01$). GPs worked in rural areas, aged 50 or above, over 20 years of work had the
 183 lowest behavior score ($P < 0.05$) (Table 1).

184 **Multiple linear regression analysis of GPs' knowledge, attitude, and behavior towards** 185 **COVID-19**

186 Multiple linear regression analysis showed that the knowledge score of male GPs was lower than
 187 that of female GPs ($P = 0.002$). The attitude score of female GPs was higher than that of male GPs
 188 ($P = 0.004$). Married GPs were higher than that unmarried GPs ($P = 0.021$). The behavior score of
 189 GPs in urban areas was lower than that of GPs in urban-rural fringe areas ($P < 0.001$). Male GPs'
 190 behavior score was lower than female GPs' ($P = 0.002$). The higher the knowledge score, the higher
 191 the behavior score ($P < 0.001$) (Table 4).

192 **Table 4 Multiple linear regression on factors associated with Shanghai GPs' knowledge,** 193 **attitude and behaviour score regarding COVID-19**

Variable	Knowledge Score	
	Coefficient (95% CI)	<i>P</i>
Knowledge Score		
Female	0.32 (0.12, 0.52)	0.002
Education Level*	0.15 (-0.01, 0.31)	0.074
Years of work Level*	-0.03 (-0.13, 0.07)	0.532
<i>F</i>	5.474	

<i>P</i>	0.001	
<hr/>		
Attitude Score		
Urban-rural fringe area	0.42 (-0.23, 1.06)	0.203
Rural area	-0.43 (-1.18, 0.32)	0.258
Female	0.90 (0.29, 1.51)	0.004
Age group level*	-0.02 (-0.46, 0.41)	0.913
Education Level*	0.37 (-0.19, 0.92)	0.200
Professional title Level*	-0.20 (-0.73, 0.33)	0.458
Married	0.88 (0.13, 1.63)	0.021
Knowledge Score	0.01 (-0.18, 0.21)	0.890
<i>F</i>	3.340	
<i>P</i>	0.001	
<hr/>		
Behaviour Score		
Urban-rural fringe area	0.44 (0.23, 0.66)	<.001
Rural area	-0.05 (-0.28, 0.18)	0.673
Female	0.32 (0.12, 0.52)	0.002
Age group Level*	-0.12 (-0.31, -0.06)	0.198
Years of work Level*	0.01 (-0.16, 0.17)	0.951
Knowledge Score	0.28 (0.22, 0.34)	<.001
Attitude Score	0.02 (0, 0.04)	0.065
<i>F</i>	19.757	
<i>P</i>	<0.001	

194 * Education Level: 1=College degree and below, 2=Bachelor degree, 3=Master degree or above;

195 *Years of work Level: 1=less than 5, 2=5~9, 3=10~19, 4=greater or equal than 20;

196 *Age group Level: 1=less and equal than 29, 2=30~39, 3=40~49, 5=greater or equal than 50;

197 *Professional title Level: 1=Resident, 2=Attending physician, 3=Associate chief physician or
198 above.

199 Abbreviation: CI=Confidence Interval

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201 Discussion

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3 202 Of the 989 GPs who were our study respondents, their average age was 39.18 years old, among
4
5 203 whom 88.2% were younger than 50, and 88.47% had a bachelor's degree or above, which was a
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7 204 relatively young team with high education level. However, the average score was 6.14 ± 1.42 (range
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9 205 0-10), much lower than that of the online survey of 1,357 medical workers in Henan Province
10
11 206 conducted by Zhang M et al. at the same time[15], which is worrying. GPs are the leading force in
12
13 207 this community pandemic prevention and control campaign against COVID-19 in Shanghai[16].
14
15 208 How can GPs with poor knowledge of COVID-19 lead the community to win the pandemic
16
17 209 prevention and control campaign? GPs needed to master the transmission route of Novel
18
19 210 Coronavirus [17] to protect themselves and to educate the population well. However, the correct
20
21 211 response rate of Shanghai GPs' knowledge of the transmission route was only 29.63%. Feng Xiang
22
23 212 et al. demonstrated the correct response rate of 43.27% in an online survey of 617 medical workers
24
25 213 in Jiangsu Province in early March 2020[18]. Blocking the transmission route is especially
26
27 214 important for infectious diseases. Therefore, it is necessary to strengthen the training of basic
28
29 215 knowledge of infectious diseases. During the pandemic, people must keep a safe social distance of
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31 216 at least one meter [19]. However, only 69.36% of the GPs mastered the social safety distance
32
33 217 during the pandemic [20], which was much lower than the correct response rate of Parikh PA's
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35 218 survey of 744 medical personnel in India in March 2020 [20]. Thus, social safety distance is
36
37 219 another weak point that needs to be focused on in pandemic training. CDC recommends using
38
39 220 medical masks and N95 masks to prevent novel coronavirus [21]. Our study showed that GPs had
40
41 221 a high rate of 88.37% for choosing the correct face masks.

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43 222 Nevertheless, the rate for choosing the correct face mask when making home visits to
44
45 223 quarantined residents was only 30.54%. Many GPs only chose N95 masks on this occasion.
46
47 224 However, when visiting people quarantined at home, the disposable surgical mask or N95 mask is
48
49 225 optional [12]. Compared with disposable surgical masks, N95 respirators are optimized in structure
50
51 226 with core filtration, and their filtering efficiency increased to 95% [22]. Choosing N95 masks may
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53 227 be due to the great fear caused by the pandemic outbreak, and many GPs prefer excessive
54
55 228 protection. Under the circumstances of lacking medical supplies for pandemic prevention, it is
56
57 229 necessary to ensure the safety of GPs and the scientific and rational use of medical supplies.
58
59 230 Disposable surgical masks should be discarded at the interval of 4 hours and should also be
60
231 replaced when they are wet or dirty [11,21]. If the filter layer of a disposable surgical mask absorbs
232 moisture or gets dirty, the filtering function will be reduced or even lost [11]. However, the correct

233 awareness of GPs of the discard interval and occasion was 35.19% and 51.26%, respectively.
234 Therefore, making GPs master the correct discard interval and occasion of disposable surgical
235 masks is essential.

236 Univariate and Multivariate analysis showed that male GPs had lower knowledge scores than
237 female GPs, which was consistent with the results of an online survey of residents around the
238 country on COVID-19 conducted by Qi Y at the end of January 2020.[23] Women tend to be in
239 the center of family life and are usually more nervous about the pandemic [24]. They were more
240 serious about the prevention of the pandemic for the health of themselves and their families and
241 were more willing to follow standardized measures [24].

242 The score of worry of GPs regarding COVID-19 was 13.59 ± 4.42 , which was between not
243 worried and somewhat worried. The proportion of GPs who were somewhat quite or very worried
244 that themselves or their family members might get infected by Novel Coronavirus was 28.41%,
245 19.31%, and 26.29%, respectively. In general, the proportions of GPs with worry were slightly
246 lower than in the studies by Zhang M et al.[15] and Abdel Wahed WY et al.[25], which can
247 indirectly reflect the relatively perfect prevention and control work in Shanghai. For the question,
248 'Do you feel your life threatened by COVID-19?', the proportion of those GPs who were not
249 worried at all and not worried was 56.42%. Furthermore, those who were quite worried and very
250 worried were only 17.49%, which demonstrated that Shanghai GPs had confidence in China's
251 pandemic prevention and control capability, even though they knew the highly contagious nature
252 of Novel Coronavirus. This confidence might also be related to the experience in handling the
253 Severe Acute Respiratory Syndrome pandemic in Shanghai in 2003. Shanghai's pandemic control
254 and prevention capability had improved in the past 17 years [26].

255 Multivariate analysis showed that gender and marriage were the influencing factors of attitude
256 regarding COVID-19 for GPs, which was consistent with the online survey of Zhu Z et al. of 5,062
257 medical workers in Wuhan Tongji Hospital in February 2020 [27]. Female GPs were more anxious
258 in the face of COVID-19. An online survey by Shiyan Yan et al. on 3,088 people in February 2020
259 also showed gender differences in stress [28]. Married people take more responsibility for their
260 families and worry more. Therefore, these GPs should provide appropriate psychological support
261 to reduce their psychological pressure.

262 Medicine is a high-risk profession. If GPs incorrectly wore face masks, they would be at risk of
263 infection [29]. In our study, although 88.37% of the GPs selected the correct type of face mask to

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2
3 264 prevent the invasion of COVID-19, only 63.70% of them knew how to fit a disposable surgical
4 265 mask entirely to the face. The correct percentage of GPs for hands not touching the external surface
5 266 of the face mask while wearing it was only 51.77%, and the percentage of GPs who had mastered
6 267 the correct step to remove a disposable surgical mask was only 58.54%. Therefore, it is necessary
7 268 to emphasize the proper way to wear face masks in detail in GP training. Contact transmission is
8 269 a significant route of COVID-19 transmission. Therefore, hand hygiene is as crucial as wearing
9 270 masks and keeping a safe social distance [30]. Ran L et al. demonstrated that hand hygiene was
10 271 closely related to COVID-19 infection by investigating 72 medical workers in Wuhan in January
11 272 2020 [31,32]. After the outbreak of COVID-19, Shanghai GPs' hand-washing frequency increased
12 273 by 92.32%, and the number of GPs who strictly used the 'six-step hand-washing method' increased
13 274 by 86.25% compared with that before the outbreak[32]. Most GPs performed well in hand hygiene,
14 275 consistent with the survey of 744 medical personnel in India [20].

15 276 Moreover, educating the public is also a social responsibility that GPs should take on their
16 277 initiative. However, only 64.00% of Shanghai GPs actively publicized the "six-step hand-washing
17 278 method" to the public. Therefore, GPs should be aware of educating the public to improve the
18 279 efficiency of pandemic prevention and control.

19 280 The univariate and multivariate analysis showed that the behavior score of male GPs was lower
20 281 than that of female GPs, which was consistent with the survey of 461 medical workers conducted
21 282 by Dimitrios Papagiannis et al. in Greece in February 2020 [33]. Women are better than men in
22 283 knowledge mastery and more nervous than men in attitude. Understandably, they are more
23 284 dedicated to behavior implementation. Our study also showed that the higher the knowledge score,
24 285 the higher the behavior score. It was consistent with the survey of 706 Syrian residents conducted
25 286 by Sanaa Al ahdab et al. in April 2020 [34]. Therefore, there is a need for further training of GPs
26 287 to improve their understanding of the disease and the correct behavior toward pandemic prevention
27 288 in their communities.

28 289

29 290 **Conclusions**

30 291 This is a large-scale cross-sectional survey of GPs' knowledge, attitude, and behavior toward
31 292 COVID-19 in Shanghai, a city with a highly developed economy and high population mobility.
32 293 GPs, as the "health gatekeepers" of the community, are in a critical position in the community grid
33 294 management system. Their knowledge, attitude, and behavior will significantly affect the results

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3 295 of preventing and controlling the pandemic. Based on our survey, GPs in Shanghai had limited
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5 296 knowledge at the beginning of the pandemic; when protective equipment and knowledge of
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7 297 COVID-19 were lacking, their behavior toward COVID-19 needed improvement. When
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9 298 confronted with the sudden breakout of a new emerging contagious disease, it is crucial to train
10
11 299 GPs in the appropriate coping strategies in time. At the same time, we should also care about the
12
13 300 physical and mental health of GPs to build a strong frontline of community prevention and control.
14
15 301 Lessons learned from the current pandemic will help GPs effectively handle any similar future
16
17 302 challenges and possible new pandemics in the future.
18

303 304 **Limitations**

305 The survey has some limitations. The R^2 values were not high for the three multiple regression
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307 models, which suggested that there might be other predictor variables. Further studies are needed
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309 to examine other potential variables which could predict the knowledge, attitude and practice of
310
311 GPs. Although stratified random cluster sampling was adopted, the one-to-one interview could
312
313 not be conducted during the pandemic. Despite providing a necessary reference for the gap in
314
315 knowledge, attitude, and practice of GPs in our study, the extrapolation of conclusions to the
316
317 population was limited. Secondly, as the study was based on a cross-sectional design, a causal
318
319 relationship could not be inferred with certainty. We can do in-depth research in the future.
320

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330

331 332 **Contributors**

333 Jian Wang conceived and designed the study, implemented the research, and helped to draft and
334
335 revise the manuscript. Huiyun Tang implemented the research, conducted data collection, and
336
337 helped to draft the manuscript. Jialiang Fang and Boxiang Tu performed data collection and
338
339

1
2
3 325 statistical analysis. All the authors contributed to the final document and read and approved the
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7 327

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9
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12 330

13
14 331 **Competing interests** None declared.
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16 332

17 333 **Patient and public involvement** The patients and the public were not involved in
18
19 334 the design, conduct, reporting, or dissemination plans of this research.
20
21 335

22 336 **Patient consent for publication** Not reported
23
24 337

25
26 338 **Ethics approval** This study involves human participants. Written consent was obtained from all
27
28 339 respondents before the investigation, which was conducted per the Declaration of Helsinki, and
29
30 340 the Ethics Committee approved the protocol of Zhongshan Hospital, Fudan University (B2020-
31
32 341 027). Participants gave informed consent to participate in the study before taking part.
33
34 342

35 343 **Provenance and peer review** Not commissioned; externally peer-reviewed.
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37 344

38 345 **Data availability statement** Data are available upon reasonable request.
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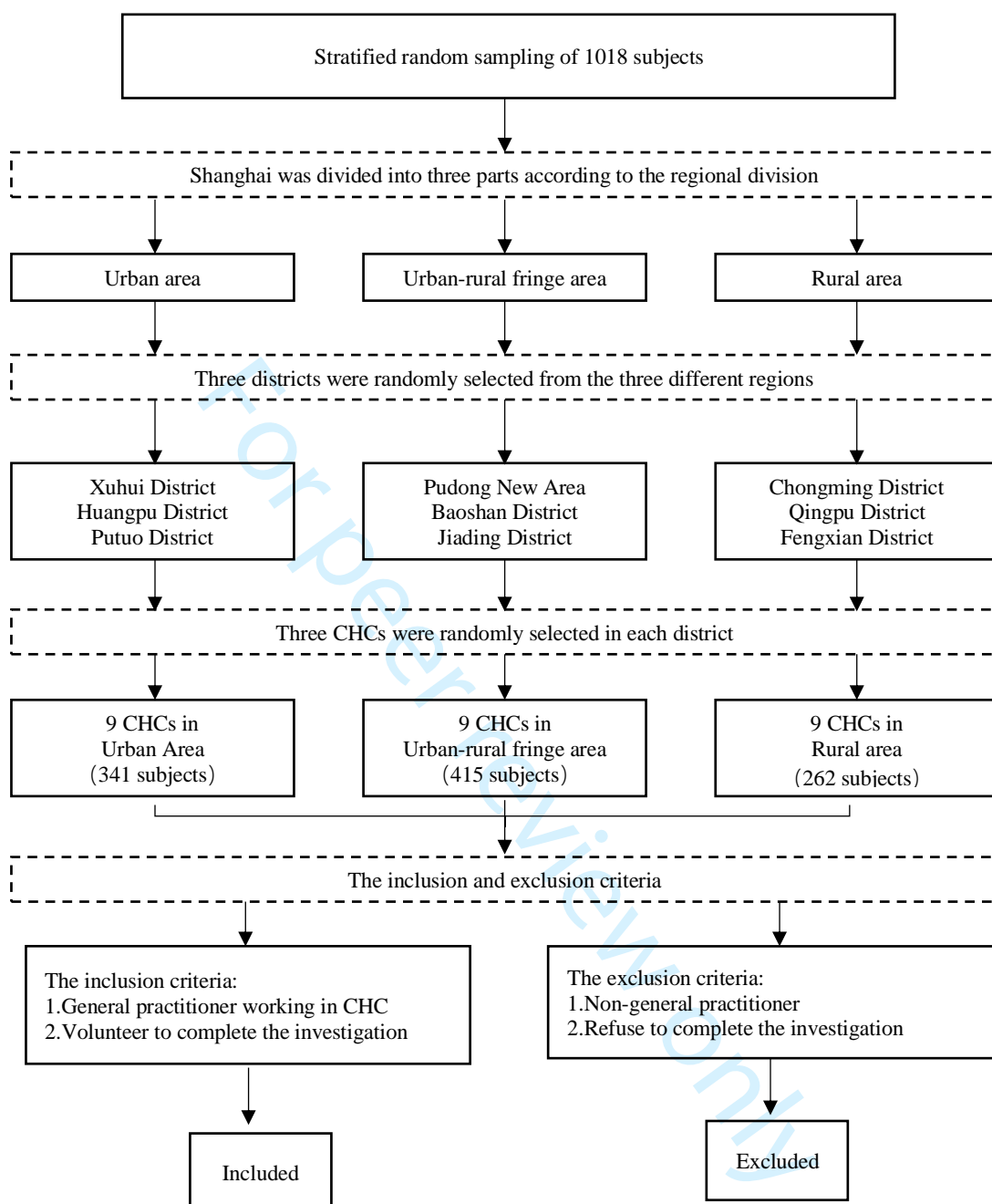
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Fig. 1 Sampling flow chart



STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No.	Recommendation	Page No.	Relevant text from manuscript
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) 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	5	
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6	
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants (b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case	5	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6	
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	7	
Bias	9	Describe any efforts to address potential sources of bias	7	
Study size	10	Explain how the study size was arrived at	7	

Continued on next page

Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7-8
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	7-8
		(b) Describe any methods used to examine subgroups and interactions	7-8
		(c) Explain how missing data were addressed	7-8
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed	7-8
		<i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	7-8
		(e) Describe any sensitivity analyses	7-8
Results			
Participants	13*	(a) 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	8
		(b) Give reasons for non-participation at each stage	8
		(c) Consider use of a flow diagram	8
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8-9
		(b) Indicate number of participants with missing data for each variable of interest	8-9
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	8-9
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	8-9
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	8-9
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	8-9
Main results	16	(a) 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	8-9
		(b) Report category boundaries when continuous variables were categorized	8-9
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	8-9

Continued on next page

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Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	9-18
Discussion			
Key results	18	Summarise key results with reference to study objectives	18
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	18-19
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	18-19
Generalisability	21	Discuss the generalisability (external validity) of the study results	18-19
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	19

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Knowledge, Attitude, and Behaviour of General Practitioners in Shanghai during the Pandemic of COVID-19: A Cross-Sectional Study

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Abstract

Objectives: To understand the knowledge, attitude, and behaviour of general practitioners (GPs) towards COVID-19 and to provide evidence for improved prevention and control measures against the pandemic. **Study design:** A cross-sectional study was conducted with 1018 GPs in Shanghai from 21 February to 2 March 2020 using the WeChat platform. **Methods:** Stratified random cluster sampling was performed according to the regional division of urban, urban-rural fringe, and rural areas. This study used a self-designed mobile questionnaire. The questionnaire collected information on knowledge, attitudes, and behaviours regarding COVID-19 prevention

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3 32 and control. **Results:** A total of 989 questionnaires were declared valid. The average scores of
4 33 GPs' knowledge, attitude, and behaviour towards COVID-19 were 6.14 ± 1.42 (range 0-10),
5 34 13.59 ± 4.42 (range 0-25), 7.82 ± 1.53 (range 0-10), respectively. Multiple linear regression
6 35 analysis showed that the knowledge score of male GPs was lower than that of female GPs
7 36 ($P=0.002$). In addition, the 'attitude' score of female GPs was higher than that of male GPs
8 37 ($P=0.004$). The 'behaviour' score of GPs in urban areas was lower than that of GPs in urban-
9 38 rural fringe areas ($P<0.001$). The higher the knowledge score, the higher the behavioural score
10 39 was observed to be ($P<0.001$). **Conclusions:** The scores of knowledge, attitude, and behaviour of
11 40 Shanghai GPs towards COVID-19 were limited at the beginning of the COVID-19 outbreak. As
12 41 a hopeful measure, the early implementation of proper training programs for GPs in times of
13 42 crisis will contribute to disease control and prevention. Lessons learned from the current
14 43 pandemic will hopefully help GPs handle similar future challenges and potential novel
15 44 pandemics.

16 45 **Keywords:** General practitioner; COVID-19; Knowledge; Attitude; Behaviour
17 46
18 47

19 48 **Strengths and limitations of this study**

- 20 49 ● This is the first large-scale study to examine the knowledge, attitude, and behaviour
21 50 towards COVID-19 among general practitioners in Shanghai, who had become the
22 51 leading force of community pandemic prevention and control procedures at the early
23 52 stage of the pandemic.
- 24 53 ● Stratified random cluster sampling was used to improve the representativeness of the
25 54 sample and minimize selection bias.
- 26 55 ● The cross-sectional nature of this study precludes formal conclusions on causality.
- 27 56 ● Other potential predictor variables, such as factors related to society and culture, could
28 57 be considered in future studies.

29 58 **INTRODUCTION**

30 59 Coronavirus disease (COVID-19) is an emerging infectious disease. Its cases were first
31 60 confirmed in Wuhan, China in December 2019 and were reported nationwide[1]. It rapidly
32 61 engulfed the entire world and became a global pandemic. Up to 20 February 2020, by the launch
33 62 of the first-level response measures for major public health emergencies[2], the cumulative

number of confirmed cases across the country had reached 125,529, and the cumulative number of deaths had reached 5,695[3]. Meanwhile, 2,055 medical workers who had helped to treat COVID-19 were infected[4], mainly due to insufficient knowledge of COVID-19[5].

Shanghai is the largest port city in China, with international trade and shipping centres[6]. Owing to this, the Shanghai municipal government issued regulations on community prevention and control networks[7] as early as on 23 January—the same day Wuhan became socioeconomically inoperative. However, by 20 February 2020, 334 confirmed cases had been reported.

The main force undertaking the task of community pandemic prevention and control was general practitioners (GPs)—the gatekeeper of community residents' health[8]. Nevertheless, there had never been a precedent of GPs being involved in community pandemic prevention. In the face of this emerging infectious disease, did the GPs master the appropriate knowledge field, have high morale and normative behaviour to protect themselves, and educate community residents competently to win the tough fight? According to the literature and theory, knowledge influences behaviour directly or indirectly through attitude. We hypothesised that, in this context, GP's knowledge could predict their attitudes, and their knowledge and attitude could predict their behaviour. To this end, we launched a survey of GPs' knowledge, attitude, and behaviour towards COVID-19 in Shanghai, aiming to find gaps to provide a groundwork for improving the pandemic prevention and control capacity at the grassroots level, enabling fortification of pandemic control measures.

METHODS

Study Design and Population

This cross-sectional survey was conducted between 21st February and 2nd March 2020. As a means to the end, stratified random cluster sampling was performed. According to the regional division of Shanghai, regions were divided into urban, urban-rural fringe, and rural areas[9]. Three districts were randomly selected from each of the three areas, and three community health service centres (CHCs) were randomly selected from each district[10].

According to the formula

$$n = \frac{\mu_{\alpha/2}^2 P (1 - P)}{\delta^2}$$

93 $P=0.0222$, $1-P=0.9778$, $\alpha=0.05$, $\mu_{\alpha/2}=1.96$, $\delta=0.5P=0.0111$,

$$94 \quad n = \frac{1.96^2 \times 0.0222 \times 0.9778}{0.0111^2} = 676.1 \approx 677$$

95 In this, 'n' refers to the required sample size. $\mu_{\alpha/2}$ is the μ value when the cumulative probability
96 from left to right is $1-\alpha/2$ (both sides) in the standard normal distribution. P represents the
97 accuracy rate of all the questions in the pre-survey, where δ is the allowable error. Based on the
98 pre-survey results of 30 respondents ($P=0.0222$, $1-P=0.987$, $\alpha=0.05$), $\mu_{\alpha/2}=1.96$, a 5 percent
99 margin of error was set. Through this, the calculations altered as follows: $\delta=0.5$, $P=0.00715$, and
100 the required sample size was deemed to be at least 677. At a shedding rate of 20%, the total
101 sample size was at least 847. Finally, 1018 on-the-job GPs in the above 27 CHCs were
102 investigated, including 341 GPs in urban areas, 415 GPs in urban-rural fringe areas, and 262 GPs
103 in rural areas (Fig. 1). It must be noted that no incentives were offered to complete the
104 questionnaires.

105 **Measurement Tool**

106 A self-designed questionnaire was used in the survey based on COVID-19 literature published
107 by the World Health Organization and the Chinese Center for Disease Control and Prevention
108 (CDC)[11-14]. The questionnaire was pre-tested on a small sample of 30 GPs from three CHCs,
109 and some questions were adjusted after the pre-survey. The questionnaire collected general
110 information of the respondents such as details regarding region, gender, age, education level,
111 years of work, professional title and marital status. Furthermore, knowledge regarding COVID-
112 19 was tested through six single-choice questions and four multiple-choice questions. For all
113 multiple-choice questions, respondents had to check all the correct items to be judged as correct.
114 Each correctly answered question was scored 1 point, and the total score was 10 points. In
115 addition, the participants' attitude towards the COVID-19 pandemic was assessed through five
116 questions. In answering each question, the extent of concern about COVID-19 was graded as per
117 5 categories with respective scores. The scores were assigned as follows: 1 point for 'not worried
118 at all', 2 for 'not very worried', 3 for 'somewhat worried', 4 for 'quite worried', and 5 for 'very
119 worried'. The total was 25 points. In the end, behaviour towards COVID-19 prevention and
120 control was observed through 10 single-choice questions. Each correctly answered question
121 scored 1 point, and the total score was 10 points. The total Cronbach's alpha coefficient for the
122 questionnaire was 0.844, indicating acceptable internal consistency.

123 **Data Collection**

124 This cross-sectional study was conducted via the WeChat platform. All items in the
125 questionnaire were mandatory. If there were incomplete items, the questionnaire could not be
126 submitted and one IP address could only be used to submit the questionnaire once. Written
127 consent was obtained from all the respondents before they participated in the study. The study
128 was conducted in accordance with the Declaration of Helsinki and the protocol was approved by
129 the Ethics Committee of Zhongshan Hospital, Fudan University (B2020-027).

130 **Statistical Analysis**

131 Excel (Microsoft Office Professional Plus 2010) was used to establish the database, and SAS
132 (version 9.4) was used for data processing and analysis. Continuous variables are presented as
133 mean±standard deviation ($\bar{x}\pm SD$) and categorical variables as frequency (percentage). The
134 Kruskal-Wallis test was used for univariate analysis to compare the different subgroups'
135 knowledge, attitude, and behaviour scores. Subsequently, three multiple linear regression models
136 were tested to identify the variables that significantly influenced knowledge, attitude, and
137 behaviour. The factors that had statistical significance in single-factor analysis were considered
138 predictors in the multiple linear regression analysis. Categorical variables, such as region, were
139 entered as dummy variables; ranked variables, such as education level and professional title,
140 were entered as ordinal variables; and all significance tests were two-sided. P-values of
141 univariate analysis (<0.1) and multiple linear regression analysis (<0.05) were considered
142 statistically significant.

143
144 **PATIENT AND PUBLIC INVOLVEMENT:** The patients and the public were not involved in
145 the design, conduct, reporting, or dissemination plans of this research.

146 147 **RESULTS**

148 **Characteristics of participants**

149 A total of 1,018 GPs were invited to participate in the survey and 996 questionnaires were
150 collected, with a response rate of 97.84% (996/1018). Among the 996 questionnaires, 989 were
151 considered valid with a quality conformity rate of 99.30% (989/996). There were 279 males and
152 710 females with an average age of 39.18 years, ranging from 23-59 years. Bachelor's degree and
153 above accounted for 88.47% (Table 1).

154 **Table 1: The score of Knowledge, Attitude and Behavior regarding COVID-19 of GPs**

Characteristics	Number of participants (%)	Knowledge score ($\bar{x}\pm SD$)	Attitude score ($\bar{x}\pm SD$)	Behaviour score ($\bar{x}\pm SD$)
Total	989(100)	6.14±1.42	13.59±4.42	7.82±1.53
Region				
Urban area	336(33.97)	6.09±1.46	13.63±4.26	7.64±1.60
Urban-rural fringe area	396(40.04)	6.20±1.40	14.04±4.29	8.14±1.35
Rural area	257(25.99)	6.12±1.42	12.85±4.74	7.57±1.60
χ^2		1.288	10.975	28.570
P		0.525	0.004	<.001
Gender				
Male	279(28.21)	5.90±1.41	12.89±4.89	7.49±1.71
Female	710(71.79)	6.24±1.42	13.87±4.20	7.95±1.43
χ^2		11.548	9.400	14.710
P		<.001	0.002	<.001
Age (year)				
≤29	131(13.25)	6.23±1.40	12.96±4.27	8.13±1.46
30~39	414(41.86)	6.22±1.39	13.87±4.32	7.84±1.49
40~49	327(33.06)	6.08±1.49	13.98±4.31	7.80±1.54
≥50	117(11.83)	5.96±1.39	12.21±4.94	7.47±1.62
χ^2		4.757	15.274	11.976
P		0.191	0.002	0.008
Education level				
College degree and below	114(11.53)	5.90±1.42	12.55±4.54	7.67±1.71
Bachelor's degree	736(74.42)	6.15±1.42	13.72±4.42	7.85±1.50
Master's degree or above	139(14.05)	6.31±1.44	13.73±4.27	7.78±1.53
χ^2		5.172	6.290	0.590
P		0.075	0.043	0.745
Years of work				
< 5	83(8.39)	6.29±1.49	12.96±4.32	8.14±1.62
5~9	202(20.42)	6.09±1.40	13.91±4.36	7.95±1.45
10~19	317(32.05)	6.29±1.34	13.72±4.22	7.81±1.46
≥20	387(39.13)	6.03±1.48	13.45±4.63	7.69±1.59
χ^2		7.773	3.333	9.209
P		0.051	0.343	0.027
Professional title				
Resident	227(22.95)	6.03±1.41	13.37±4.56	7.91±1.56
Attending physician	591(59.76)	6.16±1.42	13.90±4.26	7.80±1.51
Associate chief physician	171(17.29)	6.25±1.44	12.81±4.71	7.79±1.55
χ^2		1.759	9.153	1.979
P		0.415	0.010	0.372
Marriage				
Unmarried	195(19.72)	6.06±1.38	12.71±4.44	7.76±1.67

Married	794(80.28)	6.17±1.43	13.81±4.40	7.84±1.49
χ^2		0.963	8.763	0.009
<i>P</i>		0.327	0.003	0.926

Abbreviation: SD=Standard Deviation

Knowledge and behavior scores of GPs regarding COVID-19

The correct response rate of the 989 GPs for each question on knowledge was 25.58%-97.88% (Table 2). The average knowledge score was 6.14±1.42 (Table 1). Among them, the correct response rate for ‘Which of the following objects or conditions can kill the novel coronavirus?’ was the lowest (25.58%). In addition, the correct response rate for ‘What are the transmission routes of novel coronavirus’ was the second lowest, accounting for 29.63% (Table 2).

The average behaviour score was 7.82±1.53 (Table 1). The correct response rate of the 989 GPs for each behaviour question was 51.77-97.07% (Table 2). Among them, the correct response rates for questions that investigated touching of external surface of the masks after wearing it, steps to remove disposable masks, the proper fitting and procedure of wearing disposable masks and the proactive spirit to publicise the ‘six-step hand-washing method’ since the COVID-19 outbreak were highly dissatisfactory and unnerving, accounting for the lowest strata of 51.77%, 58.54%, 63.70% and 64%, respectively (Table 2).

Table 2: The Correct Response Rate of GPs on Knowledge and Behavior regarding COVID-19 (N=989)

Questions	n (%)
Knowledge	
1. Which of the following objects or conditions can kill novel Coronavirus?	253(25.58)
2. What is the transmission route of novel Coronavirus?	293(29.63)
3. What kind of face mask should you wear when you make home visits to quarantined residents?	302(30.54)
4. Does disposable surgical mask need to be replaced if it becomes wet or dirty?	318(32.15)
5. What do you think is the minimum social safe distance between people?	686(69.36)
6. What is the appropriate replacement time of a disposable surgical mask?	769(77.76)
7. Do you know the steps of ‘six-step hand-washing method’?	806(81.50)
8. What kind of face mask should you wear in community clinics during pandemic period?	808(81.70)
9. Do you know what kind of face mask has the effect of preventing novel Coronavirus?	874(88.37)
10. How long should close contacts be quarantined?	968(97.88)
Behavior	

1.Do your hands touch the external surface of the face mask after you put it on?	512(51.77)
2.What is your step to remove a disposable surgical mask?	579(58.54)
3.When you wear a disposable surgical mask, how do you fit it entirely to the face?	630(63.70)
4.Have you taken the initiative to publicize the 'six-step hand-washing method' since the COVID-19 outbreak?	633(64.00)
5.Do your hands touch the external surface of the face mask while removing it?	823(83.22)
6.Have you started using the 'six-step hand-washing method' since the COVID-19	853(86.25)
7.Do you wash your hands before putting on a face mask?	899(90.90)
8.Have you increased hand-washing frequency since the COVID-19 outbreak?	913(92.32)
9.When you wear disposable surgical masks, how to recognize the external and	933(94.34)
10.When you wear disposable surgical masks, how to recognize the upper and	960(97.07)

Attitude scores of GPs regarding COVID-19

The average attitude score of the 989 GPs towards COVID-19 was 13.59±4.42 (Table 1). Of the GPs, 26.29% were very worried that they or their family members might become infected with the novel coronavirus. A total of 7.58% were very worried that their lives would be threatened by COVID-19 (Table 3).

Table 3: GPs' Attitude Score Regarding COVID-19 (N=989)

Questions	n (%)					Score
	Not worried	not	somewhat	quite	very	
1.Are you	98(9.91)	159(16.08)	281(28.41)	191(19.31)	260(26.29)	3.36±1.29
2.Are you	114(11.53)	188(19.01)	338(34.18)	170(17.19)	179(18.10)	3.11±1.24
3.Are you	141(14.26)	221(22.35)	341(34.48)	155(15.67)	131(13.25)	2.91±1.21
4.Do you feel	241(24.37)	317(32.05)	258(26.09)	98(9.91)	75(7.58)	2.44±1.18
5.Do you	460(46.51)	366(37.01)	120(12.13)	25(2.53)	18(1.82)	1.76±0.89
Total						

Univariate analysis of GPs' knowledge, attitude, and behavior towards COVID-19

Univariate analysis showed that the knowledge scores of male GPs were lower than those of female GPs ($P < 0.01$). GPs with a college education and below, along with those who had worked for 20 years or longer, had the lowest knowledge scores ($P < 0.1$). It is interesting to note that the female GPs were more worried than the male GPs ($P = 0.002$). Moreover, GPs who worked in an urban-rural fringe area, aged 40-49, had a master's degree or above, worked as attending physicians, and were married seemed the most worried ($P < 0.05$). Male GPs had lower behavioural scores ($P < 0.01$). Further, GPs who worked in rural areas, aged 50 or above, and boasted of over 20 years of work experience had the lowest behaviour score ($P < 0.05$) (Table 1).

189 Multiple linear regression analysis of GPs' knowledge, attitude, and behavior towards 190 COVID-19

191 Multiple linear regression analysis showed that the knowledge score of male GPs was inferior to
192 female GPs ($P=0.002$). In the same vein, the 'Attitude' score of female GPs was higher than
193 male GPs ($P=0.004$) and the 'behaviour' score of male GPs was also lower than that of female
194 GPs ($P=0.002$). In addition, the number of married GPs was higher than that of unmarried GPs
195 ($P=0.021$). The 'behaviour' score of GPs in urban areas was lower than that of GPs in urban-
196 rural fringe areas ($P<0.001$). It was observed that the higher the knowledge score, the higher the
197 behavior score turned out to be ($P<0.001$) (Table 4).

198 **Table 4: Multiple linear regression on factors associated with Shanghai GPs' knowledge,
199 attitude and behaviour score regarding COVID-19**

Variable	Knowledge Score	
	Coefficient (95% CI)	<i>P</i>
Knowledge Score		
Female	0.32 (0.12, 0.52)	0.002
Education Level*	0.15 (-0.01, 0.31)	0.074
Years of work Level*	-0.03 (-0.13, 0.07)	0.532
<i>F</i>	5.474	
<i>P</i>	0.001	
Attitude Score		
Urban-rural fringe area	0.42 (-0.23, 1.06)	0.203
Rural area	-0.43 (-1.18, 0.32)	0.258
Female	0.90 (0.29, 1.51)	0.004
Age group level*	-0.02 (-0.46, 0.41)	0.913
Education Level*	0.37 (-0.19, 0.92)	0.200
Professional title Level*	-0.20 (-0.73, 0.33)	0.458
Married	0.88 (0.13, 1.63)	0.021
Knowledge Score	0.01 (-0.18, 0.21)	0.890
<i>F</i>	3.340	
<i>P</i>	0.001	
Behaviour Score		
Urban-rural fringe area	0.44 (0.23, 0.66)	<.001
Rural area	-0.05 (-0.28, 0.18)	0.673
Female	0.32 (0.12, 0.52)	0.002
Age group Level*	-0.12 (-0.31, -0.06)	0.198
Years of work Level*	0.01 (-0.16, 0.17)	0.951
Knowledge Score	0.28 (0.22, 0.34)	<.001
Attitude Score	0.02 (0, 0.04)	0.065
<i>F</i>	19.757	
<i>P</i>	<0.001	

200 *Education level: 1= college degree and below, 2= bachelor's degree, 3= master's degree or above

201 * Work level: 1=less than 5, 2=5-9, 3=10-19, 4=greater than or equal to 20;

202 *Age group level: 1=less than or equal to 29, 2=30-39, 3=40-49, 5=greater than or equal to 50

203 *Professional title level: 1= resident, 2= attending physician, 3= associate chief physician or above.

204 Abbreviation: CI=Confidence Interval

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206 DISCUSSION

207 The average age among the 989 GPs was 39.18 years old, among whom 88.2% were younger
208 than 50 years and 88.47% had a bachelor's degree or above, which was a relatively young team
209 with a high education level. However, the average score was 6.14 ± 1.42 (range 0-10), much
210 lower than that of the online survey of 1,357 medical workers in Henan Province conducted by
211 Zhang M et al. at the same time[15], which is worrying. GPs are the leading force in this
212 community pandemic prevention and control campaign against COVID-19 in Shanghai[16].
213 How can GPs with poor knowledge of COVID-19 lead the community to win pandemic
214 prevention and control campaigns? GPs need to master the transmission route of the novel
215 Coronavirus[17] to protect themselves and to educate the population effectively. However, the
216 correct response rate for Shanghai GPs' knowledge of the transmission route was only 29.63%.
217 Xiang et al. demonstrated a correct response rate of 43.27% in an online survey of 617 medical
218 workers in Jiangsu Province in early March 2020[18]. As a preemptive measure, blocking
219 transmission route is particularly advisable against infectious diseases. Therefore, it is necessary
220 to strengthen the basic knowledge of GPs regarding the preventive measures against contagious
221 diseases. During the pandemic, people had to maintain a safe social distance of at least one
222 meter[19]. However, only 69.36% of the GPs mastered the social safety distance during the
223 pandemic, which was painfully much lower than the correct response rate of Parikh PA's survey
224 of 744 medical personnel in India in March 2020[20]. Thus, social safety distance is another
225 disquieting issue that needs to be focused on during pandemic training. The CDC recommends
226 using medical masks and N95 masks to prevent novel coronavirus[21]. Our study showed that
227 GPs had a high rate of 88.37% when choosing correct face masks.

228 Nevertheless, it is quite unsettling that the rate of choosing the correct face mask when making
229 home visits to quarantined residents was only 30.54%. Many GPs chose only N95 masks on this
230 occasion. However, when visiting quarantined people at home, disposable surgical masks or N95
231 masks are optional[12]. Compared with disposable surgical masks, N95 respirators are optimised

232 in structure with core filtration, and their filtering efficiency increases to 95%[22]. The choice of
233 N95 masks may have been propelled by the great fear caused by the pandemic outbreak,
234 whereby many GPs began to prefer excessive protection. Given the lack of medical supplies for
235 pandemic prevention, it is necessary to ensure the safety of GPs and ensure a scientific and
236 rational use of medical supplies. As a precaution and health concern, disposable surgical masks
237 should be discarded at an interval of 4h and replaced when they become drenched or
238 filthy[11,21]. If the filter layer of a disposable surgical mask absorbs moisture or becomes
239 sordid, the filtering effectivity deteriorates or even becomes eliminated[11]. However, the correct
240 awareness of GPs regarding the discard interval and occasion was 35.19% and 51.26%,
241 respectively. Therefore, making GPs master the correct discard interval and the occasion of
242 disposable surgical masks is essential.

243 Further, univariate and multivariate analyses showed that male GPs had lower knowledge
244 scores than female GPs, which was consistent with the results of an online survey of residents
245 around the country on COVID-19 conducted by Qi Y at the end of January 2020[23]. Women
246 tend to be at the centre of family life and are usually more nervous about the pandemic[24]. They
247 were more serious about the prevention of the pandemic for their own and their families' health
248 and were more willing to follow standard measures[24].

249 The score of worrying behaviour regarding COVID-19 was 13.59 ± 4.42 , which was between
250 not worried and somewhat worried. The proportion of GPs who were somewhat quite or very
251 worried that themselves or their family members might get infected by the novel Coronavirus
252 was 28.41%, 19.31%, and 26.29%, respectively. In general, the proportion of worried GPs was
253 slightly lower than that reported by Zhang et al.[15] and Abdel Wahed et al.[25] which indirectly
254 reflected the relatively perfect prevention and control work in Shanghai. For the question, 'Do
255 you feel your life is threatened by COVID-19?', the proportion of GPs who were not worried at
256 all and not worried was 56.42%. Furthermore, only 17.49% of quite worried and very worried
257 GPs demonstrated that Shanghai GPs had confidence in China's pandemic prevention and
258 control capability, even though they knew the highly contagious nature of the novel coronavirus.
259 This confidence may also be related to the experience of handling the severe acute respiratory
260 syndrome pandemic in Shanghai in 2003. Shanghai's pandemic control and prevention
261 capabilities have improved tremendously in the past seventeen years[26].

262 In addition, multivariate analysis showed that gender and marriage were the influencing
263 factors of attitude regarding COVID-19 for GPs, which was consistent with the online survey of
264 Zhu et al. of 5,062 medical workers in Wuhan Tongji Hospital in February 2020[27]
265 Additionally, female GPs were more anxious in the face of COVID-19. Similarly, an online
266 survey by Yan et al., involving 3,088 respondents in February 2020, also depicted gender
267 differences in stress[28]. In another context, married people assume more responsibility towards
268 their families and are disconcerted easily. Therefore, GPs should provide appropriate
269 psychological support to reduce such pressure and mental exhaustion of troubled family
270 members.

271 In fact, being a doctor is considered a high-risk profession. If GPs themselves wore face masks
272 incorrectly, they would be at high risk of infection[29]. In our study, although 88.37% of the GPs
273 selected the correct type of face mask to prevent the invasion of COVID-19, only 63.70% knew
274 how to fit a disposable surgical mask entirely onto the face. The percentage of GPs
275 acknowledging the correct method of hands not touching the external surface of the face mask
276 while wearing it was only 51.77%, and the percentage of GPs who had mastered the correct step
277 to remove a disposable surgical mask was only 58.54%. Therefore, it is necessary to emphasise
278 the proper way to wear face masks in detail during GP training. Furthermore, contact
279 transmission is a significant catalyst of COVID-19 transmission. Therefore, hand hygiene is as
280 crucial as wearing masks and maintaining a safe social distance[30]. To corroborate this, Ran L
281 et al. investigated 72 medical workers in Wuhan in January 2020 and demonstrated that hand
282 hygiene was closely related to COVID-19 infection[31,32]. After the outbreak of COVID-19, the
283 handwashing frequency of Shanghai GPs increased by 92.32%, and the number of GPs who
284 strictly used the six-step hand-washing method increased by 86.25%[32]. Most GPs performed
285 excellently in hand hygiene, which was consistent with the survey of 744 medical personnel in
286 India[20].

287 Moreover, educating the public is also a social responsibility that GPs should undertake.
288 However, only 64.00% of Shanghai GPs actively publicised the 'six-step hand-washing method'.
289 Hence, the GPs should make efforts at educating the public to ameliorate the efficiency of
290 pandemic prevention and control.

291 Univariate and multivariate analyses showed that the behaviour score of male GPs was lower
292 than that of female GPs, which was consistent with the survey of 461 medical workers conducted

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3 293 by Papagiannis et al. in Greece in February 2020[33]. Women seemed profoundly better than
4 294 men in knowledge mastery and more nervous. Understandably, they are more dedicated to the
5 295 implementation of behavioural nuances. Our study also showed that the higher the knowledge
6 296 score, the higher the behavioural score. This was consistent with a survey of 706 Syrian residents
7 297 conducted by Ahdab et al. in April 2020[34]. Therefore, there is a need for further training of
8 298 GPs to improve their understanding of the disease and the correct behaviour towards pandemic
9 299 prevention in their communities.
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17 301 **CONCLUSION**

18 302 This was a large-scale cross-sectional study of GPs' knowledge, attitude, and behaviour towards
19 303 COVID-19 in Shanghai. GPs, as the 'health gatekeepers' of the community, are in a critical
20 304 position in the community grid management system. Their knowledge, attitudes, and behaviours
21 305 significantly affect the prevention and control of the pandemic. Based on our survey, GPs in
22 306 Shanghai had limited knowledge at the beginning of the pandemic. When protective equipment
23 307 and knowledge of COVID-19 were lacking, their behaviour towards COVID-19 needed
24 308 improvement. When confronted with the sudden breakout of a new emerging contagious disease,
25 309 it is crucial to train GPs with appropriate coping strategies. At the same time, we should also
26 310 focus on the physical and mental health of GPs to build a strong frontline for prevention and
27 311 control. In this regard, insights gained from the current pandemic will help GPs in mitigating
28 312 similar challenges or pandemics in the future.
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39 314 **Limitations**

40 315 This study had some limitations. The R^2 values were not high for the three multiple regression
41 316 models, suggesting the presence of other predictor variables. Further studies are needed to
42 317 examine other potential variables which could predict the knowledge, attitudes, and practices of
43 318 GPs. Although stratified random cluster sampling was adopted, one-to-one interviews were not
44 319 conducted during the pandemic. Despite providing a necessary reference for the gap in
45 320 knowledge, attitude, and practice of GPs in our study, the extrapolation of conclusions to the
46 321 population was limited. Second, as the study was based on a cross-sectional design, a causal
47 322 relationship could not be inferred with certainty. Thus, in-depth research is required in the future
48 323 to improve understanding of this subject.
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17 337 **CONTRIBUTORS**18 338
19 339 Jian Wang conceived and designed the study, implemented the research, and helped to draft and
20 340 revise the manuscript. Huiyun Tang implemented the research, conducted the data collection,
21 341 and helped draft the manuscript. Jialiang Fang and Boxiang Tu performed the data collection and
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34 354 **COMPETING INTERESTS:** None declared.
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39 359 **PATIENT CONSENT FOR PUBLICATION:** Not reported
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44 364 **ETHICAL APPROVAL:** This study involved human participants. Written consent was
45 365 obtained from all respondents before the investigation, which was conducted in accordance with
46 366 the Declaration of Helsinki. The Ethics Committee approved the protocol of Zhongshan
47 367 Hospital, Fudan University (B2020-027). The participants provided informed consent to
48 368 participate in the study before participating.
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53 373 **PROVENANCE AND PEER REVIEW:** Not commissioned; externally peer-reviewed.
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58 378 **DATA AVAILABILITY STATEMENT:** Data are available upon reasonable request.
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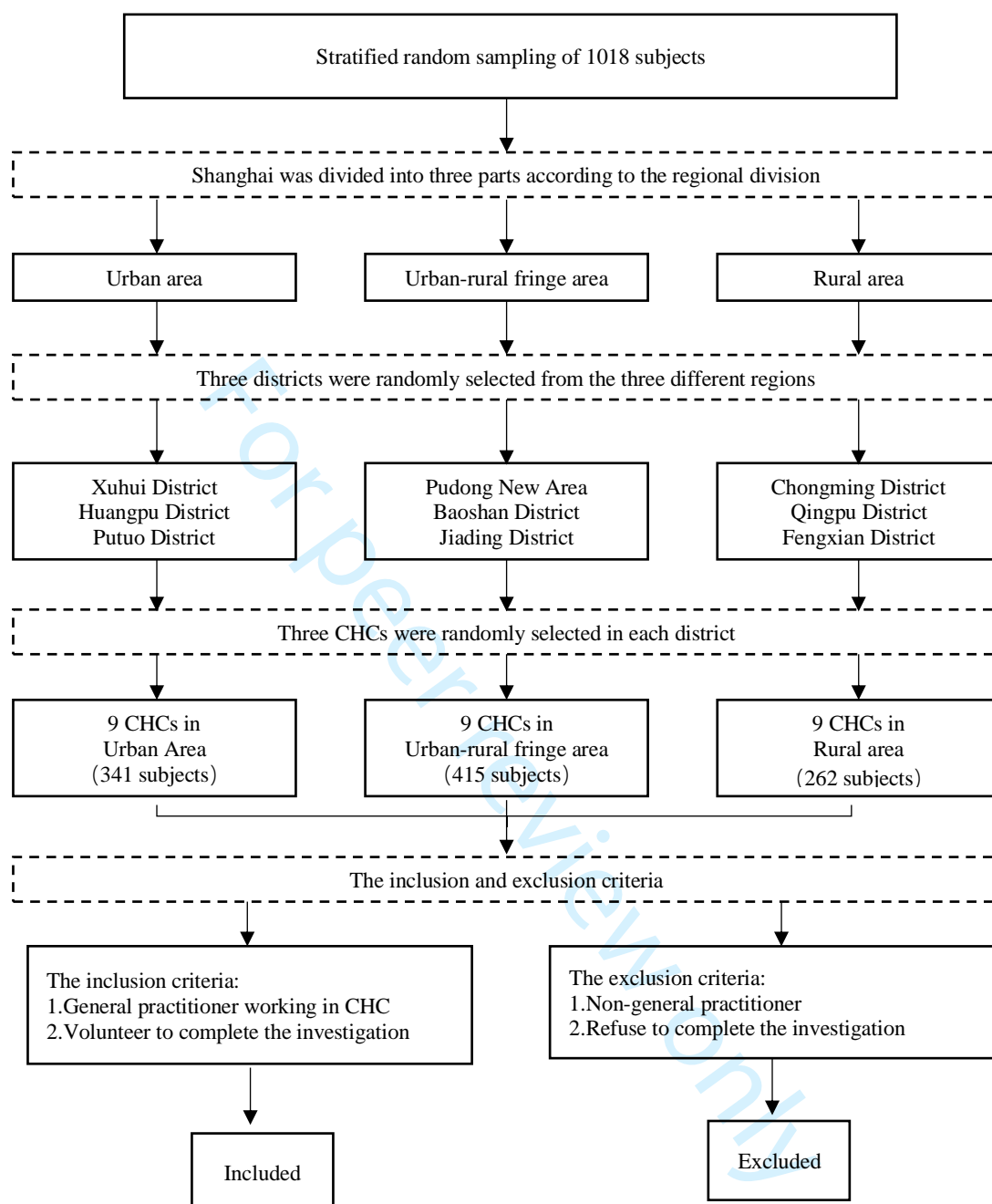
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45 472 Figure Legend:1018 on-the-job GPs in the above 27 CHCs were investigated, including341GPs
46 473 in urban areas, 415 GPs in urban-rural fringe areas, and 262 GPs in rural areas.
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Fig. 1 Sampling flow chart

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No.	Recommendation	Page No.	Relevant text from manuscript
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) 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	5	
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6	
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants (b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case	5	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6	
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	7	
Bias	9	Describe any efforts to address potential sources of bias	7	
Study size	10	Explain how the study size was arrived at	7	

Continued on next page

Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7-8
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	7-8
		(b) Describe any methods used to examine subgroups and interactions	7-8
		(c) Explain how missing data were addressed	7-8
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed	7-8
		(e) <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	7-8
Results			
Participants	13*	(a) 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	8
		(b) Give reasons for non-participation at each stage	8
		(c) Consider use of a flow diagram	8
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8-9
		(b) Indicate number of participants with missing data for each variable of interest	8-9
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	8-9
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	8-9
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	8-9
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	8-9
Main results	16	(a) 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	8-9
		(b) Report category boundaries when continuous variables were categorized	8-9
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	8-9

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Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	9-18
Discussion			
Key results	18	Summarise key results with reference to study objectives	18
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	18-19
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	18-19
Generalisability	21	Discuss the generalisability (external validity) of the study results	18-19
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	19

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.