JMIR Publications
The Leading eHealth Publisher

Knowledge, attitudes, and practices toward COVID-19 among Chinese older adults An Online Cross-Sectional Survey

Ying Chen, Rui Zhou, Boyan Chen, Hao Chen, Ying Li, Zhi Chen, Haihong Zhu, Hongmei Wang

Submitted to: Journal of Medical Internet Research
on: August 21, 2020

Preprint
JMIR Publications

Disclaimer: © The authors. All rights reserved. This is a privileged document currently under peer-review/community review. Authors have provided JMIR Publications with an exclusive license to publish this preprint on it's website for review purposes only. While the final peer-reviewed paper may be licensed under a CC BY license on publication, at this stage authors and publisher expressively prohibit redistribution of this draft paper other than for review purposes.

Table of Contents

Preprint JMIR Publications

Knowledge, attitudes, and practices toward COVID-19 among Chinese older adults?An Online Cross-Sectional Survey

Ying Chen[1*] PhD student; Rui Zhou[1*] PhD student; Boyan Chen[1] MSc student; Hao Chen[1] MSc student; Ying Li[2] MSc; Zhi Chen[3] PhD; Haihong Zhu[3] PhD; Hongmei Wang[4] PhD

[1]Department of Social Medicine of School of Public Health, and Department of Pharmacy of the First Affiliated Hospital Zhejiang University School of Medicine Hangzhou, Zhejiang Province CN
[2]Department of Public Health Xi'an Medical University Xi'an, Shaanxi Province CN
[3]State Key Laboratory for Diagnosis and Treatment of Infectious Diseases, National Clinical Research Center for Infectious Diseases, Collaborative Innovation Center for Diagnosis and Treatment of Infectious Diseases, The First Affiliated Hospital Zhejiang University School of Medicine Hangzhou, Zhejiang Province CN
[4]Department of Social Medicine of School of Public Health, and Department of Pharmacy of the First Affiliated Hospital Zhejiang University School of Medicine Hangzhou, Zhejiang CN
[*]these authors contributed equally

Corresponding Author:
Hongmei Wang PhD
Department of Social Medicine of School of Public Health, and Department of Pharmacy of the First Affiliated Hospital Zhejiang University School of Medicine
Zhejiang University School of Medicine, 866 Yuhangtang Road
Xihu District
Hangzhou, Zhejiang
CN
Phone: +86571-88208222
Fax: 86 571-88206561
Email: rosa@zju.edu.cn

Abstract

Background: The International public health threat of COVID-19 has not yet come to an end. Prevention is of paramount importance to protect the high-risk group of the elderly when specific treatments for COVID-19 are not yet available, despite that, little work has been done to explore factors that promote preventive practices among this population.

Objective: This study aims to investigate the knowledge, attitude, and practice of elderly population in China towards COVID-19 and determine factors that influence the practice of preventive behaviors.

Methods: From February 19 to March 19, 2020, a cross-sectional, internet-based survey was administered to Chinese elderly in all of the 31 provinces in mainland China using a convenience sampling method to assess their knowledge, attitude, and practices (KAP) towards COVID-19. Standard descriptive statistics and hierarchical linear regression analyses were conducted to analyze the data.

Results: A total of 1501 participants responded to the survey, with 1263 valid responses left for further analysis. The overall correct rate on the knowledge questionnaire was 87%, an overall positive attitude towards COVID-19 was found and the mean score of practice was 13.73(SD:1.62, range:5-15). The hierarchical linear regression showed that respondents who were married or in cohabitation, and lived in areas with community-level control measures were more likely to practice preventive behaviors(P<.01). Knowledge(?=0.198, P<.05), perceived susceptibility(?=0.263?P<.001), perceived benefits(?=0.643, P<.001), and self-efficacy in preventing COVID-19(?=0.468, P<.001) were also found to be significantly associated with preventive behaviors.

Conclusions: Most elderly residents had adequate knowledge, positive attitude and proactive practice towards COVID-19. Knowledge and attitude were confirmed to be significantly associated with behavior responses. Our findings have significant implications in enhancing the effectiveness of COVID-19 prevention programs targeting the elderly population, which needs to be continued and strengthened as the epidemic has not yet come to an end. Clinical Trial: An Online Cross-Sectional Survey

(JMIR Preprints 21/08/2020:23729)
DOI: https://doi.org/10.2196/preprints.23729

Preprint Settings

1) Would you like to publish your submitted manuscript as preprint?

✓ **Please make my preprint PDF available to anyone at any time (recommended).**
Please make my preprint PDF available only to logged-in users; I understand that my title and abstract will remain visible to all users.
Only make the preprint title and abstract visible.
No, I do not wish to publish my submitted manuscript as a preprint.

2) If accepted for publication in a JMIR journal, would you like the PDF to be visible to the public?

✓ **Yes, please make my accepted manuscript PDF available to anyone at any time (Recommended).**
Yes, but please make my accepted manuscript PDF available only to logged-in users; I understand that the title and abstract will remain v
Yes, but only make the title and abstract visible (see Important note, above). I understand that if I later pay to participate in <a href="http

Preprint JMIR Publications

Original Manuscript

Preprint
JMIR Publications

Original Paper

Knowledge, attitudes, and practices toward COVID-19 among Chinese older adults：An Online Cross-Sectional Survey

Ying Chen[1*], PhD student; Rui Zhou[1]*, PhD student; Boyan Chen[1], MSc student; Hao Chen[1], MSc student; Ying Li[2], MSc; Zhi Chen[3], PhD; Haihong Zhu[3], PhD; Hongmei Wang[1], PhD

[1] Department of Social Medicine of School of Public Health, and Department of Pharmacy of the First Affiliated Hospital, Zhejiang University School of Medicine, Hangzhou, Zhejiang Province, China

[2] Department of Public Health, Xi'an Medical University, Xi'an, Shaanxi Province, China

[3] State Key Laboratory for Diagnosis and Treatment of Infectious Diseases, National Clinical Research Center for Infectious Diseases, Collaborative Innovation Center for Diagnosis and Treatment of Infectious Diseases, The First Affiliated Hospital, Zhejiang University School of Medicine, Hangzhou, Zhejiang Province, China

*these authors contributed equally

Corresponding Author:

Hongmei Wang, PhD

Department of Social Medicine of School of Public Health, and Department of Pharmacy of the First Affiliated Hospital, Zhejiang University School of Medicine, 866 Yuhangtang Road, Xihu District, Hangzhou, Zhejiang, 310058, China.

Phone: +86-571-88208222

E-mail: rosa@zju.edu.cn.

Preprint JMIR Publications

Knowledge, attitudes, and practices toward COVID-19 among Chinese older adults：An Online Cross-Sectional Survey

Abstract

Background: The International public health threat of COVID-19 has not yet come to an end. Prevention is of paramount importance to protect the high-risk group of the elderly when specific treatments for COVID-19 are not yet available, despite that, little work has been done to explore factors that promote preventive practices among this population.

Objective: This study aims to investigate the knowledge, attitude, and practice of elderly population in China towards COVID-19 and determine factors that influence the practice of preventive behaviors.

Methods: From February 19 to March 19, 2020, a cross-sectional, internet-based survey was administered to Chinese elderly in all of the 31 provinces in mainland China using a convenience sampling method to assess their knowledge, attitude, and practices (KAP) towards COVID-19. Standard descriptive statistics and hierarchical linear regression analyses were conducted to analyze the data.

Results: A total of 1501 participants responded to the survey, with 1263 valid responses left for further analysis. The overall correct rate on the knowledge questionnaire was 87%, an overall positive attitude towards COVID-19 was found and the mean score of practice was 13.73(SD:1.62, range:5-15). The hierarchical linear regression showed that respondents who were married or in cohabitation, and lived in areas with community-level control measures were more likely to practice preventive behaviors(P<.01). Knowledge(β=0.198, P<.05), perceived susceptibility(β=0.263，P<.001), perceived benefits(β=0.643, P<.001), and self-efficacy in preventing COVID-19(β=0.468, P<.001) were also found to be significantly associated with preventive behaviors.

Conclusions: Most elderly residents had adequate knowledge, positive attitude and proactive practice towards COVID-19. Knowledge and attitude were confirmed to be significantly associated with behavior responses. Our findings have significant implications in enhancing the effectiveness of COVID-19 prevention programs targeting the elderly population, which needs to be continued and strengthened as the epidemic has not yet come to an end.

Keywords: COVID-19; Knowledge; Attitude; Practice; Elderly; China

1. Introduction

Coronavirus disease 2019 (COVID-19), first detected in Wuhan, China in December 2019, is an emerging infectious disease caused by a novel coronavirus (SARS-CoV-2).The case crude fatality rate of COVID-19 was 3.7% worldwide(updated August 9, 2020)[1], much lower than that of SARS(9.5%), MERS(34.4%), and H7N9(39.0%)[2], but evidence has shown that this virus is more contagious[3,4]. Considering its extensive spread scope, COVID-19 was declared as a public health emergency of international concern on January 30, 2020[5] and as a pandemic on March 11, 2020[6] by

the World Health Organization(WHO). As of May August 9, 2020, the virus had reached 215 countries and regions, resulting in over 19 million confirmed infections and more than 700,000 deaths[1].

The elderly are especially susceptible to infectious diseases due to decrease in immunity[7], presence of underlying chronic illnesses[8], and cognitive impairment, which caused difficulty in their participating in proper prevention activities[9]. In the case of COVID-19, the elderly are also at significantly higher risk of morbidity and mortality[10-12]. According to an epidemiological study on COVID-19 in China, people aged above 60 made up 31.2% of the 44,672 confirmed cases and 81% of the total number of deaths[13].

Till now, no specific treatment and vaccine for COVID-19 have been available, thus it is of great importance for the elderly to uptake preventive behaviors, which has been proved to be effective in preventing respiratory infectious diseases and controlling transmission[14,15]. It is believed that the transmission route of COVID-19 is human-to-human via respiratory droplets or direct contacts[16], thus effective preventive measures, including hand-washing, mask-wearing, household ventilation and disinfection, reduction of interpersonal contacts by avoiding visiting crowded spaces[17], have been recommended to the elderly by Chinese local authorities.

However, at the early stage of the epidemic, the elderly underestimated the severity of this epidemic as it only affected a relatively small population. They were reluctant to listen to the advice from governments and even their children, supposing that there was no need to practice the suggested COVID-19 preventive behaviors. A recent research also found that compared with younger adults, older men were less worried about COVID-19 and adopted fewer preventive behaviors[18]. Hence, special efforts should be made to enhance elderly people's protection against this new infectious disease.

The adoption of preventive behaviors is largely influenced by knowledge, attitudes, and practices (KAP) towards COVID-19 according to KAP theory[19,20].A good understanding on elderly residents' knowledge, attitude, and preventive practices is significant in providing the needed strategies to be implemented. However, in spite of detection of increased vulnerability in elderly, literature focusing on behavior changes of the elderly under the guidance of KAP theory remained scant. Therefore, the present work is aimed to assess knowledge, attitude and practice of Chinese elderly residents toward COVID-19 and to explore the effect of knowledge, attitude, and other relevant factors on behavior changes.

2. Methods

2.1 Study Design

This cross-sectional study was conducted using an anonymous online questionnaire between February 19 and March 19, 2020. A convenience sampling method was used to recruit participants. Chinese residents aged 60 and above, without intellectual or cognitive impairment, and agreed to participate in our survey were considered eligible. Those who were illiterate or not able to use electronic device can ask others to help them fulfill the questionnaire but it was emphasized that the answers must always reflect their own opinions. The link of the online questionnaire was sent through Wechat (similar to"WhatsApp") and other social media platforms to the contacts of the potential respondents. A brief introduction was presented at the beginning of the survey to inform the respondents of the purpose and content of this study and instruct them to complete the questionnaire. On completion of the questionnaire, the participants would receive a gift worth 1 to 5 RMB.

2.2 Sampling

According to Kendall, multiple regression analysis demands a sample size at least 5 to 10 times the size of the independent variables. The maximum sample size should be 670 cases as 67 independent variables were involved in this study. Returned surveys with unreasonable short answer time, incomplete information or logic problems would be deemed as invalid. The effective sample size estimated for the study was 957 cases with an invalid response rate of 30%. Finally, a total of 1501 questionnaires were returned in the study duration, after excluding 212 invalid questionnaires and 26 participants who reported having never heard about COVID-19, a total of 1263 participants from all of the 31 provinces/municipalities/autonomous regions in mainland China were left for statistical analysis.

2.3 *Measures*

Dependent Variable (Practice of preventive behaviors)

The questionnaire on the practice of COVID-19 preventive behaviors was developed on the basis of the guidelines from the Chinese Center for Disease Control and Prevention (CDC). 5 items were included in this section, involving washing hands frequently, wearing face-masks in public areas, disinfecting and ventilating households, and avoiding visiting crowds（P1-P5）. Answers of "more", "as usual", and "less" were rated as 3, 2, 1 respectively. Therefore the total practice score values from 5 to 15, with higher scores indicating better performance of preventive behaviors.

Independent Variable

Background variables: Socio-demographic characteristics were surveyed in this part, which include gender, age, marital status, education level, household register, and monthly household income per capita. Besides, respondents self-perceived health status, current addresses at the district level, and local community-level control measures (free entry/exit as usual, entry/exit control

exercised, and lockdown) in their residential areas were also surveyed. Provinces of their current addresses were divided into eastern, central, and western region according to National Bureau of Statistics of China, and also categorized into three levels according to number of confirmed COVID-19 cases, provinces with less than 100 cumulative confirmed cases, 100-1000 cases and over 1000 cases rated as low, medium and high-risk area respectively.

COVID-19 related knowledge: Participants' level of knowledge about COVID-19 were assessed by 7 questions (K1-K7): one regarding the province that first reported COVID-19 cases, one regarding the incubation period, one regarding the source of infection, two regarding transmission modes, one regarding susceptible population, and one regarding the vaccine for COVID-19. Answers were judged according to guidelines for clinical management of COVID-19 by the National Health Commission of the People's Republic of China[21]. A correct answer was assigned 1 point and an incorrect/unknown answer was assigned 0 points. The total knowledge score thus ranged from 0 to 7, with a higher score representing a better knowledge of COVID-19.

Attitudes towards COVID-19: Based on the Health Belief Model (HBM) and previous studies, attitude-related factors in our study included constructs of HBM (perceived severity, perceived susceptibility, and perceived benefits), self-efficacy in preventing the disease, and belief in the government to contain the spread of the epidemic(A1-A5). Such factors were found to be significantly associated with the practice of preventive measures in similar studies[22-26]. Perceived severity of COVID-19 was assessed by one item asking the respondents whether they would suffer from more severe symptoms if they unfortunately caught the disease, an answer of 'yes' was coded as '1' while other answers were coded as '0'. One item assessed perceived susceptibility by measuring the degree to which the respondents perceived themselves to be vulnerable to COVID-19, the responses were coded into two groups ((1: High/Very high;0: Low/Very low/ I don't know). Perceived benefits were assessed by three items measuring respondent's belief in the effectiveness of COVID-19 related preventive measures of mask-wearing in public areas, hand-washing, and avoidance of visiting crowded places respectively, answers of 'yes' were considered appropriate (1:Yes;0:Others); the perceived benefits indicator was formed by counting the number of appropriate answers (values of 0 to 3).Respondents' self-efficacy in preventing the disease and confidence in the government to contain the spread of the epidemic were assessed by asking "Are you confident that you can prevent yourself from contracting COVID-19?" and "Do you believe that the government can win the battle against COVID-19?" . Answers of 'yes' were considered positive and given 1 points and 0 points were given for choosing other answers.

2.4 Statistical analysis

Descriptive statistics were used to summarize the background factors and COVID-19 knowledge, attitude, and practice, the results were presented as frequencies (n) and percentages (%) or as means and standard deviation (SD). Associations between background variables and practice score were examined by one-way analysis of variance (ANOVA) or independent sample t-test as appropriate. Multiple linear regression model using statistically significant background variables, scores of knowledge, and factors of attitude as independent variables and scores of preventive practice as outcome variable was performed to identify factors associated with preventive behaviors. Demographic variables of the respondents were entered in the regression model first to control for their effects. Then, score of knowledge was entered in the next block and factors of attitude were simultaneously entered in the last block of the regression. Unstandardized regression coefficients (β) and 95% confidence intervals (CIs) were reported. All statistical analyses were performed in SPSS version 21.0 (IBM Corp, 2012, Armonk, NY, USA), and a *P*-value of <0.05 was considered statistically significant.

2.5 Ethics statement

The study protocol was approved by the Ethics Committee of School of Public Health, Zhejiang University (approval number: ZGL202002-2) before the formal survey. The questionnaire was designed to be anonymous and voluntary, and respondents were informed that submission of the questionnaire implied informed consent. The data were kept confidential and the results did not identify the respondents personally.

3. Results

Background characteristics

Of the 1263 participants, 57.8% completed the questionnaire with the help of others, 54.4% had registered permanent residence in rural areas, the mean age was 69.48 (SD=6.72), over half of the sample were female (55.2%) and approximately three-fourths were married or in cohabitation (74.5%). 586(46.4%) participants had an education level of primary school or below, most (66.8%) respondents had an average household income between 600 and 6000 yuan per month. 564 (44.7%) participants self-reported fair physical health status. 613 (48.5%) respondents lived in eastern region, and nearly half of the participants (46.8%) lived in areas with medium-risk of COVID-19. The majority (83.1%) reported that entry/exit control was exercised in their community/village.

Levels of COVID-19-related knowledge, attitude and practices (Table1-2)

1) Knowledge: The mean knowledge score was 6.06(SD=0.03, range: 1-7), suggesting an overall 87% (6.06/7*100) correct rate on this knowledge test. 85.4% respondents agreed that the main source of infection currently is COVID-19 patients; In terms of modes of transmission, 98.1% thought the COVID-19 can be transmitted by patients' droplets, but less than 80% were aware

that it can also be transmitted through virus-contaminated objects; Around 90% respondents correctly stated that the population is generally susceptible to the virus regardless of age. However, only 64.1% knew that effective vaccines for COVID-19 were not yet available.

2) Attitude: The majority of the elderly (90.3%) believed older people may suffer from more severe symptoms once get infected with COVID-19. Most (85.0%) respondents didn't perceive that the chances for them to contract COVID-19 were high/very high. A substantial proportion (92.1%) of participants had perceived benefits of all three types of preventive measures (i.e., hand-washing, face-mask wearing, and home-staying). Besides, 83.0% were confident in their own abilities in preventing the disease and over 90% respondents believed that government can win the battle against COVID-19.

3) Practices: The mean score of preventive practices toward COVID-19 was 13.73(SD: 1.62, range: 7-15). It is reassuring that more than four-fifths of our participants had increased hand-washing (81.2%) and face-mask wearing in public venues (81.9%) to ensure their safety, in addition, 86.6% of the elderly had reduced their visits to crowded places. However, less participants had increased household ventilation (75.5%) and disinfection (64.6%).

Table 1. Participants' knowledge, attitudes toward COVID-19 (N=1263).

	n(% or mean(SD)
Knowledge item	
K1: The earliest outbreak of COVID-19 in China is in Hubei Province	
Correct	1258(99.6)
Incorrect/Unknown	5(0.4)
K2: The incubation period of COVID-19 is 1-14 days	
Correct	1139(90.2)
Incorrect/Unknown	124(9.8)
K3: Currently the main source of infection is COVID-19 patients	
Correct	1078(85.4)
Incorrect/Unknown	185(14.6)
K4: COVID-19 can be transmitted by patient's droplets	
Correct	1239(98.1)
Incorrect/Unknown	24(1.9)
K5: COVID-19 can be transmitted through touch virus-contaminated surfaces	
Correct	960(76.0)
Incorrect/Unknown	303(24.0)
K6: All age groups can become infected with the new coronavirus	
Correct	1165(92.2)
Incorrect/Unknown	98(7.8)
K7: There is currently no vaccine available that protects against COVID-19	
Correct	809(64.1)
Incorrect/Unknown	454(35.9)
Range of knowledge score	1-7
Mean score	13.73(1.62)
Attitudes item	
A1: perceived severity of COVID-19	
Yes	1141(90.3)

No/ I don't know	122(9.7)
A2: perceived susceptibility of COVID-19	
High/ very high	190(15.0)
Low/Very low/I don't know	1073(85.0)
A3: perceived benefits indicator [a]	
0	6(0.5)
1	26(2.1)
2	68(5.4)
3	1163(92.1)
A4: Self-efficacy in preventing COVID-19	
Yes	1048(83.0)
No/ I don't know	215(17.0)
A5: Confidence in the government to win the battle against COVID-19	
Yes	1160(91.8)
No/ I don't know	103(8.2)

[a] perceived benefits indicator was formed by counting the number of items with "yes" responses in the three basic preventive measures (i.e., handwashing, face-mask wearing, and home-staying).

Table 2. Participants' preventive practice change in Response to COVID-19(N=1263).

Practice [a]	More	Less	As usual
P1: wearing face mask in public venues	1035(81.9%)	60(4.8%)	168(13.3%)
P2: washing hands	1025(81.2%)	12(1.0%)	226(17.9%)
P3: household ventilation	956(75.5%)	66(5.2%)	241(19.1%)
P4: home disinfection	816(64.6%)	38(3.0%)	409(32.4%)
P5: avoidance of visiting crowds	1094(86.6%)	37(2.9%)	132(10.5%)
Range of practice score		7-15	
Mean score		13.73(1.62)	

[a] For each specific behavior assessed, n (%) are presented to describe the participants who indicated that they had made the behavioral change in the past week. Questions were answered using the following scale: 1=less, 2 = as usual, and 3 = more. For the total practice score, we calculated how many specific behavior changes each participant endorsed, data are presented as mean (SD).

Demographic factors of preventive practices: univariate analysis (Table 3)

As shown in Table 3, region, marital status, education level, residence registration and monthly household income per capita were significantly associated with preventive practices (all $P<.05$). Participants who lived in western region had significantly lower level of practice than participants from eastern region($P=.013$). Respondents who were married or in cohabitation had significantly better performance of practice($P<.001$). Rural dwellers, and those attended at primary school or below had lower scores of practice (both $P<.001$). Practice score of participants with an average household income less than 600 Yuan per month was significantly lower than those with income higher than 6000 Yuan($P=.018$). Interestingly, a significant association between local community-level control measures and practice score was observed($P<.001$), respondents would uptake more preventive behaviors when epidemic control measures were exercised in their living areas.

Table 3. The demographic variables associated with preventive practice: univariate analysis (N=1263).

Variables [c]	n（%）	Practice scores [a]		
		Mean ± SD	t/F	*P* value
Gender				
Male	566(44.8)	13.71 ± 1.63	0.208	.65
Female	697(55.2)	13.75 ± 1.61		
Ages（years）				
60-69	683(54.1)	13.81±1.61	2.925	.054
70-79	474(37.5)	13.69±1.62		
≥80	106(8.4)	13.42±1.67		
Marital status				
Married/cohabiting	941(74.5)	13.85 ±1.56	18.625	<.001***
Single/divorced/ separated/widowed	322(25.5)	13.40 ±1.74		
Education level				
Primary education or below	586(46.4)	13.50±1.67[i]	8.904	<.001***
Middle school	330(26.1)	13.94±1.57[ii]		
High school	197(15.6)	13.79±1.65[ii]		
College or above	150(11.9)	14.11±1.33[ii]		
Residence registration				
Urban residence	576(45.6)	13.95 ±1.52	20.090	<.001***
Rural residence	687(54.4)	13.55 ±1.68		
Monthly household income per capita（RMB）				
＜600	219(17.3)	13.51±1.78[i]	4.031	.02*
600-6000	844(66.8)	13.74±1.63[i; ii]		
＞6000	200(15.8)	13.96±1.36[ii]		
Self-reported health				
Excellent	57(4.5)	13.72±1.68	0.375	.83
Very good	220(17.4)	13.85±1.58		
Good	378(29.9)	13.68±1.73		
Fair	564(44.7)	13.72±1.57		

Preprint JMIR Publications

Poor	44(3.5)	13.75±1.53		
Region				
Eastern region	613(48.5)	13.86±1.49[i]	4.393	.013*
Central region	183(14.5)	13.72±1.64[i; ii]		
Western region	467(37.0)	13.57±1.77[ii]		
Provincial COVID-19 epidemic level [b]				
Low-risk: <100 cases	146(11.6)	13.73±1.68	1.166	.31
Medium-risk: 100-999 cases	591(46.8)	13.66±1.69		
High-risk: ≥1000 cases	526(41.6)	13.81±1.52		
Local community-level control measures				
entry/exit control exercised	1050(83.1)	13.70 ± 1.63[i]	7.634	<.001***
lockdown	181(14.3)	14.04 ± 1.45[i]		
free entry/exit as usual	32(2.5)	12.91 ± 1.91[ii]		

[a] Values based on independent sample t-test and one-way ANOVA for continuous variables to examine differences between preventive practice and demographic variables (*P<.05, **P <.01, ***P<.001). For categories of variables with significant ANOVA results, multiple comparisons between each 2 categories are done by post hoc analysis (LSD). Within each column, when two means share same superscript (i,ii), it indicates that they were not statistically different (P>.05) from one another.

[b] Provincial COVID-19 epidemic level：The number of cumulative confirmed COVID-19 cases on the survey launch day (i.e., March 20st, 2020) in the province where an individual was staying during the COVID-19 pandemic.

[c] Variables in bold font were finally included in the subsequent multivariable analyses.

Preprint JMIR Publications

Factors associated with practice: multivariable analyses. (Table 4)

Knowledge score and attitude related variables reported in table 1, together with significant background variables were included into the hierarchical linear regression models. In block 1, demographic factors of region, marital status, education level, residence registration, monthly household income per capita and local community-level control measures were entered first, accounting for 4.7% of the variance (R^2=.047, F = 5.575, P< .001). Score of knowledge about COVID-19 was entered into block 2, which contributed an additional 2.9% of the variance (R^2=.076, F = 8.603, P<.001). Finally, factors of attitude towards COVID-19, including perceived severity, perceived susceptibility, perceived benefits, self-efficacy in preventing the disease and confidence in the government were entered in the third block, they were significant in predicting practice even after considering effects of background and knowledge factors and contributed an additional 3.2% of the variance (R^2=.108, F = 18.904, P<.001). The linear regression analysis of the preventive practice was presented in Table 4.

Education level and residence registration were, in general, non-significant, while some significant marital status and control measure differences were noted. Overall, respondents who were married or in cohabitation (vs. single/divorced/ separated/widowed, β=0.355,95%CI=0.150-0.560)and can't leave the house (vs. free entry/exit as usual, β=0.898,95%CI=0.310-1.486) were more likely to have better performance of preventive behaviors(P<.01). After adjusting for background characteristics, we discovered that the elderly with higher knowledge score of COVID-19 have significantly higher level of practice (β=0.198, P<.001). Meanwhile, results showed that three of the five components of attitudes, namely, perceived susceptibility (β=0.263, 95%CI=0.022-0.504), perceived benefits indicator (β=0.643, 95%CI=0.305-0.982) and self-efficacy in preventing the disease(β= 0.468, 95%CI=0.223-0.713) were positively associated with preventive behaviors(all P<.05), but perceived severity and confidence in the government were not significant predictors of preventive behaviors. Among the influencing factors, local community-level control measures, followed by perceived benefits indicator showed greatest impact on practice.

Preprint JMIR Publications

Preprint
JMIR Publications

Table 4. Factors associated with the preventive practice: multivariable analyses.

	Model 1		Model 2		Model 3	
	β (95%CI)	*P* value	β (95%CI)	*P* value	β (95%CI)	*P* value
Block 1: Background characteristics						
Region						
Western region	Ref		Ref		Ref	
Eastern region	0.156(-0.049,0.361)	.14	0.082(-0.121,0.285)	.43	0.085(-0.116,0.286)	.41
Central region	0.087(-0.186,0.360)	.53	0.013(-0.256,0.283)	.92	-0.051(-0.318,-0.217)	.71
Marital status						
Single/divorced/separated/widowed	Ref		Ref		Ref	
Married/cohabiting	0.330(0.120,0.541)	.002**	0.331(0.124,0.538)	.002**	0.355(0.150,0.560)	<.001***
Education level						
Primary education or below	Ref		Ref		Ref	
Middle school	0.244(0.014,0.475)	.04*	0.177(-0.050,0.405)	.13	0.137(-0.088,0.362)	.23
High school	-0.002(-0.293,0.290)	.99	-0.106(-0.396,0.183)	.47	-0.117(-0.402,0.168)	.42
College or above	0.258(-0.078,0.594)	.13	0.123(-0.210,0.457)	.47	0.096(-0.233,0.425)	.57
Residence registration						
Rural residence	Ref		Ref		Ref	
Urban residence	0.243(0.031,0.455)	.02*	0.184(0.025,0.393)	.09	0.122(0.085,0.329)	.25
Monthly household income per capita						
600	Ref		Ref		Ref	
600-6000	0.047(-0.203,0.297)	.71	0.031(-0.215,0.422)	.81	0.018(-0.226,0.261)	.89
6000	0.113(-0.229,0.454)	.52	0.086(-0.251,0.422)	.62	0.067(-0.266,0.399)	.70
Local community-level control measure						
free entry/exit as usual	Ref		Ref		Ref	
entry/exit control exercised	0.671(0.108,1.234)	.02**	0.635(0.081,1.190)	.03*	0.501(-0.049,1.051)	.07
lockdown	1.062(0.460,1.663)	<.001***	1.034(0.441,1.627)	<.001***	0.898(0.310,1.486)	.003**
Block 2: Knowledge			0.270(0.186,0.353)	<.001***	0.198(0.111,0.286)	<.001***
Block 3: Attitude						
Perceived severity					-0.045(-0.350,0.259)	.77

Perceived susceptibility			0.263(0.022,0.504)	.03*
perceived benefits indicator			0.643(0.305,0.982)	<.001***
Self-efficacy in preventing COVID-19			0.468(0.223,0.713)	<.001***
Confidence in the government to win the battle against COVID-19			0.321(-0.014,0.656)	.06
F	5.575***	8.603***	8.904***	
R²	.047	.076	.108	
ΔR²	.047	.029	.032	
Adjusted *R²*	.038	.067	.096	

[a]**P*<.05, ***P* <.01, ****P*<.001

Preprint JMIR Publications

4.Discussion

The elderly, who are particularly vulnerable to acute diseases and their complications, are now greatly threatened by current outbreak of COVID-19. Special effort should therefore be made to promote elderly people to practice the preventive behaviors suggested by the government. An understanding of knowledge, attitude, and practice toward COVID-19, which affect the adoption of related health behaviors, will be a first step to prevent the spread of COVID-19 to the elderly population.

In this study, it was found that Chinese elderly had a good knowledge of COVID-19 with an overall correct rate of 87% on the knowledge questionnaire, which was slightly lower than that of Chinese general population(90%)[27] but much higher than the KAP toward COVID-19 among US residents(80%)[28]. The high correct rate was surprising, as previous studies suggested that knowledge score is negatively related with age[29-31]. However, this finding may be due to overwhelming publicity on COVID-19 through various channels that fit the demands and features of the elderly, like vivid prints, marked banners, and broadcasts in dialect. Two items with the lowest correct rate are worth mentioning. Knowledge about modes of transmission, proved to be a salient factor influencing level of preventive measures[32], should be further improved among elderly people. Meanwhile, the elderly should also be informed that effective vaccine for COVID-19 is not yet available and precautions against the disease is still of great importance.

Attitudes of Chinese elderly residents towards COVID-19 were found to be overall optimistic. Despite the majority (90.3%) perceiving that the elderly would suffer from more severe symptoms once get infected, relatively few respondents (15%) thought that they are at high risk of acquiring this disease. And the majority expressed their confidence in themselves (83%) and the government (91.8%) to defeat COVID-19. This is consistent with studies during the SARS epidemic, which reported 94.7-100% of Chinese residents had confidence that China can win the battle against SARS[33-35]. Such an optimistic attitude could be explained by the unprecedented epidemic control measures the Chinese government took once COVID-19 hit the country and the concerted efforts of people all around China.

In our findings, 64.6-86.6% of our respondents reported practicing these five major preventive behaviors more frequently in the past week. The reason might be that this study was conducted at a time when these preventive measures were highly

emphasized in China. Similar high tendency to adopt these precautionary behaviors during the pandemic have been found in previous studies[36,37]. In particular, more than 80% respondents reported increased hand washing, face-mask wearing and decrease in visiting crowds, indicating that basic protective behaviors against COVID-19 had taken shape among the elderly. The majority of participants avoided going out because the widely governmental propaganda and social media continuously instilled and reinforced their incentives to stay home (e.g. personal safety, good citizenship, and contribution to the control of the national epidemic). And individuals also felt the pressure from the community to adhere to the practice. Hand-washing and face-mask using have long been regarded as significant preventive habits in the daily life of the public ever since they were proved to be efficacious in preventing influenza and SARS[38,39]. Lau et al. observed that hand-washing and face-mask using were commonly practiced during the SARS outbreak[40], and these behaviors have been sustained by a large proportion of the public even after the SARS epidemic subsided in Hong Kong[41]. On the contrary, the effectiveness of household ventilation and disinfection might have been neglected, with fewer participants reporting that they have practiced these two behaviors more in the past week. Researchers argued that habit has great impact on routine behavior– including hygiene behavior–and despite their best intentions, people may find it difficult to implement new measures during a pandemic if they have not previously made these a habit[42,43]. Further education on practicing household ventilation and disinfection is needed, as these two measures are indispensable in preventing against COVID-19.

In line with previous researches[23,44,45], our study also found that individuals' demographic characteristics had significant influence on preventive practice. Linear regression analysis of practice score showed that participants who are married or cohabiting were more likely to report that they had complied with advocated protective practices more frequently, such finding was consistent with similar studies regarding SARS[46,47]. On the one hand, married or cohabiting seniors can receive support from their spouse or partner. Family support has been shown to influence older people's health beliefs and self-care behaviors[48]. The more family support the seniors receive, the more attention they will pay to their own health, accompanied with more willingness to acquire health knowledge and more positive preventive attitudes. On the other hand, according to the HBM model, advice from family members can be regarded as external cues to action, which is also a very important

factor in increasing various preventive behaviors[49].

Besides, community-level control measures were found to be significantly associated with the practice of preventive measures. With COVID-19 rapidly spread from a single city to the entire country, the governmental ‘minimum contact strategy’ were implemented nation-wide, close management and screening of communities and villages to curb COVID-19 was subsequently implemented nationally in China[50]. Although the contribution of community control measures cannot be quantified, our study supported that community-level control measures against COVID-19 were related to significant increases in older adults’ practice of the recommended preventive behaviors. We further confirmed that those who couldn’t leave the house showed higher compliance with suggested preventive measures than those who could move free as usual. According to the socio-ecological model, factors of structural, interpersonal, and personal levels determine health-related behaviors[51]. At the personal level, Chinese elderly held an ethical duty-’filial piety’-to protect others, which facilitated adherence to quarantine. In Wenzel’s study, 'filial piety' suggested the ‘‘right and humane’’ way to act toward one’s family and others in the community and guided the Chinese elderly in their use of strategies against SARS[52]. Meanwhile, environmental manipulation and policies are crucial structural-level factors to promote individuals to practice the desired preventive behaviors. Therefore, personal perceived ethical duty combined with community actions have facilitated China’s response to COVID-19. The mentioned above highlighted the importance of control measures at the community level, which must be considered when planning pandemic control strategies in the future.

Other than background factors, this study also found that knowledge and attitude toward COVID-19 were significant predictors of preventive behaviors. The results were in agreement with the KAP theory[53] and the Information-Motivation Behavioral Skills Model[54]. In accordance with previous findings, this study confirmed that people with adequate knowledge about COVID-19 were more likely to take preventive measures in responses to the pandemic than those who lack such knowledge[45,55], suggesting health education aimed at improving their COVID-19 knowledge plays an important role in promoting preventive practices towards COVID-19. With regard to attitude related factors, our study confirmed the positive correlation between self-efficacy in preventing COVID-19 and the adoption of preventive measures found in previous researches[23,56], but bidirectional effects may exist between these two

variables as it was suggested that on the one hand, perceived self-efficacy can promote the individual to adopt certain behaviors to achieve desired outcomes, and success in performing certain behaviors could further augment perceived self-efficacy on the other[57]. Contrary to previous findings[58-60], our study found that efficacy beliefs of local health authorities did not significantly predict the target COVID-19 preventive behaviors. The belief in governments may not successfully translate into positive behavioral changes at the individual level, besides, the positive relationship between trust in the government and the practice of preventive behaviors can be mediated by levels of perceived self-efficacy[61], a relatively strong linear correlation between confidence in the government and self-efficacy($r=0.335$, $p<0.001$) was also found in the present study.

Some of the items we used to assess respondents' attitude were derived from the Health Belief Model that consists of perceived severity, perceived susceptibility, perceived benefits, and so on[62,63]. Perceived severity was not found to be significantly related with COVID-19 preventive behaviors in this study. Perceived severity was suggested to have relatively low relevance to preventive health behaviors, but could play an important role when individuals have already been diagnosed with certain diseases[64]. A series studies on preventive health behaviors have also reported perceived severity to be insignificant[46,65-68]. Although most of our respondents perceived that they may progress into serious symptoms once they get infected, they have not yet been diagnosed so that relatively few of them thought that they are at high risk of contracting COVID-19. Perceived susceptibility and perceived benefits were found to be predictors of the adoption of preventive measures. Perceived susceptibility has been consistently found to be a salient determinant of participation in preventive measures during an epidemic among both general and elderly population[60,69-71]. Other studies on health-screening[72,73]and exercise behavior[74] also find that perceived susceptibility plays an important role. Meanwhile, when people deem certain preventive health behaviors to be effective in preventing a disease, they would be motivated to engage in these behaviors[47,58,75,76]. Hence, elderly people should be further made aware of their higher susceptibility to COVID-19 and the effectiveness of the officially suggested preventive behaviors. Indeed, communications that highlight perceived susceptibility and simultaneously increase individual's perception of benefits of particular health behaviors in reducing health threat have been proved to be successful in promoting various preventive behaviors[77-79] .

Our study has some limitations. Firstly, no standardized tool for assessing KAP on COVID-19 has been previously validated. We have designed the KAP questionnaire based on the latest official report from the WHO, the Chinese Center for Disease Control and Prevention, and scientific literature, but the depth of the survey may be limited, as we had to quickly conduct our investigation and recruit as large a sample as possible. Secondly, selection bias might exist. Online survey only included those who have access to the internet, and seniors who were infected or had close contacts with confirmed or suspected COVID-19 patients may not want to participate in this survey, thus the generalizability of our findings can be limited. However, internet-based surveys could be the most appropriate method for data collection during an epidemic since it can avoid transmission and fielding the survey offline was not feasible as strict epidemic control measures have been exercised in most parts of the country. Thirdly, this study was cross-sectional, and no casual-effect statements concerning the relationship between targeting variables and performance of preventive behaviors could be made. Fourthly, recall and social desirability bias may exist as only retrospective self-reports of participants were collected.

Despite all the above limitations, this is one of the few studies that assess the knowledge, attitude, and behavior towards COVID-19 among the elderly population in China. Meanwhile, a large number of respondents from all provinces in mainland China was recruited, enabling us to obtain a wide range of participants with various demographic backgrounds. Besides, the investigation was conducted in the stable epidemic period (February 19–March 19,2020) when community-wide COVID-19 prevention activities were launched by local health authorities, thus we can assess how community-level control measures influence personal preventive behaviors. Therefore, our results are of practical significance for the design and implementation of health programs for elderly population in the prevention of COVID-19 and other emerging epidemics.

5.Conclusions

Generally, Chinese elderly in our survey had good knowledge, optimistic attitude, and appropriate practices towards COVID-19 during the pandemic, which is important to limit the spread of the disease. Better practices were found among married /cohabiting seniors and those who were restricted with community-level control measures, suggesting that health education programs should pay more attention to those who are single and can move around freely. In addition, our findings

suggested that good knowledge and appropriate attitude were associated with high level of preventive practices towards COVID-19. Therefore, to promote preventive practices, continued health intervention programs are advised among the elderly to improve their knowledge in certain aspects, including transmission modes and the vaccine of COVID-19, besides, elderly people's perception of their own vulnerability to COVID-19 and the effectiveness of COVID-19 related preventive behaviors should also be further emphasized.

Acknowledgements

We are grateful to all the survey participants.

Authors' Contributions

HM Wang and Z Chen conceived and designed the study. Y Chen and BY Chen assisted in questionnaire design and data collection. H Chen, Y Li and HH Zhu assisted in data collection. Then Y Chen and R Zhou contributed to the statistical analysis and drafted the manuscript; HM Wang, Y Chen and R Zhou finalized the manuscript. All authors have read and agreed to the final version of the manuscript.

Conflicts of Interest

None declared

Preprint JMIR Publications

Reference

1. World Health Organization. Coronavirus disease 2019 (COVID-19) Situation Report-202. https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200809-covid-19-sitrep-202.pdf?sfvrsn=2c7459f6_2. Accessed 2020-8-9.
2. Munster V, Koopmans M, van Doremalen N, van Riel D, de Wit E. A Novel Coronavirus Emerging in China - Key Questions for Impact Assessment. *N Engl J Med.* 2020;382(8):692-694.
3. Zhou T, Liu Q, Yang Z, et al. Preliminary prediction of the basic reproduction number of the Wuhan novel coronavirus 2019-nCoV. 2020;13:3-7.
4. S.A M, A.M A, T A-K, I.M M, D.M H, M I. Novel coronavirus 2019-nCoV:prevalence, biological and clinical characteristics comparison with SARS-CoV and MERS-CoV. *European Review for Medical and Pharmacological Sciences.* 2020;24(4):2012-2019.
5. World Health Organization. 2019-nCoV outbreak is an emergency of international concern. 2020. http://www.euro.who.int/en/health-topics/emergencies/pages/news/news/2020/01/2019-ncov-outbreak-is-an-emergency-of-international-concern. Accessed 2020-01-31.
6. World Health Organization. WHO Director-General's opening remarks at the media briefing on COVID-19-11 March 2020. https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020. Accessed 2020-03-11.
7. Thomas TY, Rajagopalan S. Tuberculosis and Aging: A Global Health Problem. *Clinical Infectious Diseases.* 2001;33(7):1034-1039.
8. Nikolich-Zugich J, Knox KS, Rios CT, Natt B, Bhattacharya D, Fain MJ. SARS-CoV-2 and COVID-19 in older adults: what we may expect regarding pathogenesis, immune responses, and outcomes. *Geroscience.* 2020;42(2):505-514.
9. Banerjee, Debanjan. The impact of Covid-19 pandemic on elderly mental health. *International Journal of Geriatric Psychiatry.* 2020.
10. Liu K, Chen Y, Lin R, Han K. Clinical features of COVID-19 in elderly patients: A comparison with young and middle-aged patients. *J Infect.* 2020;80(6):e14-e18.
11. Onder G, Rezza G, Brusaferro S. Case-Fatality Rate and Characteristics of Patients Dying in Relation to COVID-19 in Italy. *JAMA.* 2020;323(18):1775-1776.
12. Wang D, Hu B, Hu C, et al. Clinical Characteristics of 138 Hospitalized Patients With 2019 Novel Coronavirus-Infected Pneumonia in Wuhan, China. *JAMA.* 2020;323(11):1061-1069.
13. Yanping Z, Lan W. The epidemiological characteristics of an outbreak of 2019 novel coronavirus diseases (COVID-19) in China. *Chin J Epidemiol.* 2020;41.
14. Visentin LM, Bondy SJ, Schwartz BS, Morrison LJ. Use of personal protective equipment during infectious disease outbreak and nonoutbreak conditions: a survey of emergency medical technicians. *Canadian Journal of Emergency Medicine.* 2009;11(1):44-56.
15. WH S, D T, RW Y, TY C, TK N. Effectiveness of precautions against droplets and contact in prevention of nosocomial transmission of severe acute respiratory syndrome (SARS). *Lancet.* 2003;361:1519-1520.
16. Lai CC, Shih TP, Ko WC, Tang HJ, Hsueh PR. Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and coronavirus disease-2019 (COVID-19): The epidemic and the challenges. *Int J Antimicrob Agents.* 2020;55(3):105924.
17. Centers for Disease Control and Prevention. COVID-19 Guidance for Older Adults. https://www.cdc.gov/aging/covid19-guidance.html. Published 2020. Accessed.

18. Barber SJ, Kim H. COVID-19 Worries and Behavior Changes in Older and Younger Men and Women. *J Gerontol B Psychol Sci Soc Sci.* 2020.
19. Ajilore K, Atakiti I, Onyenankeya K. College Students' Knowledge, Attitudes and Adherence to Public Service Announcements on Ebola in Nigeria: Suggestions for Improving Future Ebola Prevention Education Programmes. *Health Education Journal.* 2017;76(6):648-660.
20. Tachfouti N, Slama K, Berraho M, Nejjari C. The impact of knowledge and attitudes on adherence to tuberculosis treatment: a case-control study in a Moroccan region. *The Pan African medical journal.* 2012;12(1):52-52.
21. General Office of the National Health Commission of the People's Republic of China. Guideline for the diagnosis and treatment of 2019 novel coronavirus (2019-nCoV) infected pneumonia (The Third Trial Version). http://www.nhc.gov.cn/yzygj/s7653p/202001/f492c9153ea9437bb587ce2ffcbee1fa.shtml Published 2020. Accessed Feb 16, 2020.
22. Wong C, Tang CS. Practice of habitual and volitional health behaviors to prevent severe acute respiratory syndrome among Chinese adolescents in Hong Kong. *Journal of Adolescent Health.* 2005;36(3):193-200.
23. Jones JH, Salathe M. Early assessment of anxiety and behavioral response to novel swine-origin influenza A(H1N1). *PLoS One.* 2009;4(12):e8032.
24. Wong C-Y, Tang CS-K. Practice of habitual and volitional health behaviors to prevent severe acute respiratory syndrome among Chinese adolescents in Hong Kong. *J Adolesc Health.* 2005;36(3):193-200.
25. Lau J, Yang X, Tsui HY, Pang E, Kim JH. SARS preventive and risk behaviours of Hong Kong air travellers. *Epidemiology and Infection.* 2004;132(4):727-736.
26. Lau JTF, Kim JH, Tsui HY, Griffiths S. Perceptions Related to Bird-to-Human Avian Influenza, Influenza Vaccination, and Use of Face Mask. *Infection.* 2008;36(5):434-443.
27. Zhong B-L, Luo W, Li H-M, et al. Knowledge, attitudes, and practices towards COVID-19 among Chinese residents during the rapid rise period of the COVID-19 outbreak: a quick online cross-sectional survey. *Int J Biol Sci.* 2020;16(10):1745-1752.
28. Clements JM. Knowledge and Behaviors Toward COVID-19 Among US Residents During the Early Days of the Pandemic: Cross-Sectional Online Questionnaire. *JMIR Public Health Surveill.* 2020;6(2):e19161-e19161.
29. Jehn M, Kim Y, Bradley B, Lant T. Community knowledge, risk perception, and preparedness for the 2009 influenza A/H1N1 pandemic. *Journal of Public Health Management and Practice.* 2011;17(5):431-438.
30. Alanzi ME, Albalawi MAH, Kabrah S, Aljehani YT, Okashah AM. Knowledge, Attitudes, And Practices About Mers-Cov Among Algerian Hajj Pilgrims In 2016. *American Journal of Microbiological Research.* 2019;7(4):122-129.
31. Lin Y, Huang L, Nie S, et al. Knowledge, Attitudes and Practices (KAP) related to the Pandemic (H1N1) 2009 among Chinese General Population: a Telephone Survey. *BMC Infectious Diseases.* 2011;11(1):128-128.
32. Lau J, Griffiths SM, Choi KC, Tsui HY. Widespread public misconception in the early phase of the H1N1 influenza epidemic. *Journal of Infection.* 2009;59(2):122-127.
33. X Z, C X, Q C. Prevention and treatment knowledge and attitudes towards SARS of urban residents in Qingdao. *Prev Med Trib.* 2004;10: 407-408.
34. Z L, H G, S Z. Prevention and treatment knowledge towards SARS of urban population in Jinan. *Prev Med Trib.* 2004;10:659-660.
35. Zewen Q. People groups' responses to sars in the community. *Chinese Rural Health Service Administration.* 2003.
36. Zhong BL, Luo W, Li HM, chen y. Knowledge, attitudes, and practices towards COVID-19 among Chinese residents during the rapid rise period of the COVID-19 outbreak: A quick online cross-sectional survey. *Int J Biol Sci.* 2020;16(10):1745–1752.
37. Hao-nan K, Qin X, Ming Y, wei Z. Awareness on knowledge about coronavirus disease 2019 prevention and control among residents in

Chaoyang district of Beijing city. *Chinese Journal of Public Health.* 2020.
38. Fung IC, Cairncross S. Effectiveness of handwashing in preventing SARS: a review. *Trop Med Int Health.* 2006;11(11):1749-1758.
39. De Wandel D, Maes L, Labeau S, Vereecken C, Blot S. Behavioral Determinants of Hand Hygiene Compliance in Intensive Care Units. *American Journal of Critical Care.* 2010;19(3):230-239.
40. Lau J, Yang X, Tsui HY, Pang E. SARS related preventive and risk behaviours practised by Hong Kong-mainland China cross border travellers during the outbreak of the SARS epidemic in Hong Kong. *Journal of Epidemiology and Community Health.* 2004;58(12):988-996.
41. Lau JTF, Yang X, Tsui HY, Kim JH. Impacts of SARS on health-seeking behaviors in general population in Hong Kong. *Preventive Medicine.* 2005;41(2):454-462.
42. Curtis V, Danquah LO, Aunger R. Planned, motivated and habitual hygiene behaviour: an eleven country review. *Health Education Research.* 2009;24(4):655-673.
43. Webb TL, Sheeran P. Does Changing Behavioral Intentions Engender Behavior Change? A Meta-Analysis of the Experimental Evidence. *Psychological Bulletin.* 2006;132(2):249-268.
44. Barr M, Raphael B, Taylor MR, et al. Pandemic influenza in Australia: Using telephone surveys to measure perceptions of threat and willingness to comply. *BMC Infectious Diseases.* 2008;8(1):117-117.
45. Eastwood K, Durrheim DN, Francis JL, et al. Knowledge about pandemic influenza and compliance with containment measures among Australians. *Bulletin of The World Health Organization.* 2009;87(8):588-594.
46. Tang CS, Wong C. Factors influencing the wearing of facemasks to prevent the severe acute respiratory syndrome among adult Chinese in Hong Kong. *Preventive Medicine.* 2004;39(6):1187-1193.
47. Lau JTF, Kim JH, Tsui HY, Griffiths S. Anticipated and current preventive behaviors in response to an anticipated human-to-human H5N1 epidemic in the Hong Kong Chinese general population. *BMC Infectious Diseases.* 2007;7(1):18.
48. Hsu H-Y, Gallinagh R. The relationships between health beliefs and utilization of free health examinations in older people living in a community setting in Taiwan. *Journal of Advanced Nursing.* 2001;35(6):864-873.
49. Lagerlund M, Hedin A, Sparén P, Thurfjell E, Lambe M. Attitudes, Beliefs, and Knowledge as Predictors of Nonattendance in a Swedish Population-Based Mammography Screening Program. *Preventive Medicine.* 2000;31(4):417-428.
50. Huang Y, Wu Q, Wang P, et al. Measures Undertaken in China to Avoid COVID-19 Infection: Internet-Based, Cross-Sectional Survey Study. *J Med Internet Res.* 2020;22(5):e18718.
51. Bronfenbrenner U. Toward an experimental ecology of human development. *American Psychologist.* 1977;32(7):513-531.
52. Wenzel RP, Edmond MB. Managing SARS amidst Uncertainty. *New England Journal of Medicine.* 2003;348(20):1947-1948.
53. Ajilore K, Atakiti I, Onyenankeya K. College students' knowledge, attitudes and adherence to public service announcements on Ebola in Nigeria: Suggestions for improving future Ebola prevention education programmes. *Health Education Journal.* 2017;76(6):648-660.
54. Fisher JD, Fisher WA. Changing AIDS-risk behavior. *Psychological Bulletin.* 1992;111(3):455-474.
55. Leung GM, Quah SR, Ho LM, et al. A tale of two cities: community psychobehavioral surveillance and related impact on outbreak control in Hong Kong and Singapore during the severe acute respiratory syndrome epidemic. *Infection Control and Hospital Epidemiology.* 2004;25(12):1033-1041.
56. Lau JTF, Yang X, Tsui H, Pang E, Kim JH. SARS preventive and risk behaviours of Hong Kong air travellers. *Epidemiology and infection.*

2004;132(4):727-736.
57. Bandura A. Self-efficacy : Toward a Unifying Theory of Behavioral Change. *Psychological Review.* 1977;84(2):191-215.
58. Rubin GJ, Amlôt R, Page L, Wessely S. Public perceptions, anxiety, and behaviour change in relation to the swine flu outbreak: cross sectional telephone survey. *BMJ.* 2009;339:b2651-b2651.
59. Quinn SC, Kumar S, Freimuth VS, Kidwell KM, Musa D. Public Willingness to Take a Vaccine or Drug Under Emergency Use Authorization during the 2009 H1N1 Pandemic. *Biosecurity and Bioterrorism-biodefense Strategy Practice and Science.* 2009;7(3):275-290.
60. Tang CS, Wong CY. Psychosocial factors influencing the practice of preventive behaviors against the severe acute respiratory syndrome among older Chinese in Hong Kong. *J Aging Health.* 2005;17(4):490-506.
61. Liao Q, Cowling B, Lam WT, Ng MW, Fielding R. Situational Awareness and Health Protective Responses to Pandemic Influenza A (H1N1) in Hong Kong: A Cross-Sectional Study. *PLOS ONE.* 2010;5(10):e13350.
62. Fisher J, Fisher W. Theoretical approaches to individual-level change in hiv risk behavior. *Handbook of HIV Prevention.* 2000:3-55.
63. IM R, VJ S, MH B. Social learning theory and the health belief model. *Health Educ Q.* 1988;15:175– 183.
64. Janz NK, Becker MH. The Health Belief Model: A Decade Later. *Health Education & Behavior.* 1984;11(1):1-47.
65. Johansson SE, Sundquist J. Change in lifestyle factors and their influence on health status and all-cause mortality. *International Journal of Epidemiology.* 1999(6):6.
66. Rundall TG, Wheeler JRC. Factors associated with utilization of the swine flu vaccination program among senior citizens in Tompkins County. *Medical Care.* 1979;17(2):191-200.
67. Rosenstock IM. The Health Belief Model and Preventive Health Behavior. *Health Education & Behavior.* 1974;2(4):354-386.
68. Leung GM, Lam TH, Ho L, et al. The impact of community psychological responses on outbreak control for severe acute respiratory syndrome in Hong Kong. *Journal of Epidemiology and Community Health.* 2003;57(11):857-863.
69. Lau J, Griffiths SM, Au DWH, Choi KC. Changes in knowledge, perceptions, preventive behaviours and psychological responses in the pre-community outbreak phase of the H1N1 epidemic. *Epidemiology and Infection.* 2011;139(1):80-90.
70. Wise T, Zbozinek T, Michelini G, Hagan CC. Changes in risk perception and protective behavior during the first week of the COVID-19 pandemic in the United States. *PsyArXiv Preprints.* 2020.
71. Yıldırım M, Geçer E, Akgül Ö. The impacts of vulnerability, perceived risk, and fear on preventive behaviours against COVID-19. *Psychology, Health & Medicine.* 2020:1-9.
72. Jernigan JC, Trauth JM, Nealferguson D, Cartierulrich C. Factors that influence cancer screening in older African American men and women: focus group findings. *Family & Community Health.* 2001;24(3):27-33.
73. Wardle J, Williamson S, Mccaffery K, et al. Increasing attendance at colorectal cancer screening: testing the efficacy of a mailed, psychoeducational intervention in a community sample of older adults. *Health Psychology.* 2003;22(1):99-105.
74. Booth ML, Bauman A, Owen N. Perceived Barriers to Physical Activity among Older Australians. *Journal of Aging and Physical Activity.* 2002;10(3):271-280.
75. Lau JT, Yang X, Tsui HY, Pang E. SARS related preventive and risk behaviours practised by Hong Kong-mainland China cross border travellers during the outbreak of the SARS epidemic in Hong Kong. *J Epidemiol Community Health.* 2004;58(12):988-996.
76. Lau JTF, Yang X, Tsui HYK, J. H. Monitoring community responses to the

SARS epidemic in Hong Kong: From day 10 to day 62. *Journal of Epidemiology and Community Health.* 2003;57:864–870.
77. Klohn LS, Rogers RW. Dimensions of the severity of a health threat: The persuasive effects of visibility, time of onset, and rate of onset on young women's intentions to prevent osteoporosis. *Health Psychology.* 1991;10(5):323-329.
78. Aoun S, Donovan RJ, Johnson L, Egger G. Preventive Care in the Context of Men's Health. *Journal of Health Psychology.* 2002;7(3):243-252.
79. Ronis DL. Conditional health threats: health beliefs, decisions, and behaviors among adults. *Health Psychology.* 1992;11(2):127-134.

Abbreviations

COVID-19: coronavirus disease 2019

KAP: knowledge, attitudes, and practices

SARS-CoV-2: severe acute respiratory syndrome coronavirus 2

SARS: severe acute respiratory syndrome

MERS: middle east respiratory syndrome

H7N9: avian influenza A

WHO: World Health Organization

Preprint JMIR Publications