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Assessing the impact of COVID-19 on middle-aged and older females in China: a comparative study of urban-rural disparities

Xiaoxu Jiang[1] and Jie Gao[1*]

Abstract

Background The impact of COVID-19 has been long-lasting and severe. Middle-aged and older females, as a vulnerable group, need special attention. China is a typical urban-rural dualistic society, and the impact of the urban-rural gap on middle-aged and older females is unknown. The purpose of this study was to explore the influence of COVID-19 on middle-aged and older females in Chinese urban and rural areas.

Methods This study used CHARLS (China Health and Retirement Longitudinal Study) database. A total of 10,063 participants were included in this study (3,680 in urban and 6,383 in rural). The chi-square test and t-test were used to analyze differences between urban and rural participants, and binary logistic regression (forward: conditional) was used to analyze differences in the factors influencing the two groups in terms of mask wearing.

Results During the epidemic, there were significant differences between urban and rural middle-aged and older females in terms of demographic characteristics, prevention knowledge, attitude, identification, isolation, personal activities, mental health, containment measures in residential areas and individual preventive behavior. Rural middle-aged and older females had poorer preventive behavior. Age, marital status, preventive knowledge, calling and messaging, internet contact, containment measures in residential areas were the common influencing factors affecting mask wearing behavior of the participants. The mask-wearing behavior of urban participants was also influenced by the attitude towards government's measures, COVID-19 test and fear.

Conclusions Middle-aged and older females in Chinese urban and rural areas faced different situations during the epidemic and required targeted measures.

Keywords Middle-aged and older females, Urban-rural, COVID-19, CHARLS

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Introduction

In late 2019, Corona Virus Disease 2019 (COVID-19) broke out and spread rapidly, and on March 11, 2020, the World Health Organization considered that the current epidemic could be called a global pandemic [1]. On the other hand, China experiences rapidly aging, according to the latest data from China's National Bureau of Statistics, there are approximately 280 million women over 45 years of age [2]. As people get older, they become weaker, and more attention needs to be paid to this population in a pandemic [3].

Drawing on Gender Role Theory [4–7], women are more vulnerable due to their dual roles as caregivers and income providers. The increased caregiving responsibilities may have exacerbated their psychological stress and limited their access to healthcare resources [8, 9]. This dilemma is exacerbated during a pandemic [10]. Studies in the US and Canada have found that women generally experience unemployment, increased parenting burden, domestic violence and poor mental health due to the pandemic [11, 12]. In China, reports indicated that women's contributions had been overlooked and gender bias had intensified [13], however, many studies have concentrated on the mental health challenges, especially pregnant and professional women [14–16], less attention is paid to other aspects. In fact, older women are worse than younger women, as Hernández's study noted a higher incidence of hypertension, need for invasive mechanical ventilation (IMV), and mortality among middle-aged and older females [17]. Abuse and age discrimination against older women increased worldwide during the epidemic [18], and research in China suggested that this might be related to economic instability and social isolation [19]. Therefore, attention should also be paid to middle-aged and older women.

China has a typical urban-rural dual structure [20]. A grounded theory study revealed that in China, variations in geographical and architectural planning, residents' living habits, cultural literacy, and socio-material conditions between urban and rural areas result in disparities in the spatio-temporal distribution, management priorities, difficulty, and containment strategies of epidemic control [21]. There were differences in knowledge [22], attitudes [23], practices [24], mental health [25, 26] and difficulties encountered [27] by the urban and rural populations. However, few studies have examined the differences between urban and rural female populations.

Masks can reduce the transmission of respiratory particles that carry viral pathogens, thereby decreasing the likelihood of infection per contact [28]. Additionally, masks should be used in conjunction with handwashing and social distancing [29]. Previous studies showed that knowledge, social psychological factors, accessibility, vaccination status, and media influenced mask-wearing behavior significantly [30–33]. Few studies have specifically explored the influencing factors among women.

In summary, there is a reasonable basis to hypothesize that during the pandemic, women may face multidimensional challenges encompassing daily life, mental health, and preventive behavior, with such challenges potentially exhibiting urban-rural disparities. Investigating the middle-aged and older females during the epidemic is of great significance to fill the research gap, reveal the deep impact of gender role on health, and implement precise epidemic prevention measures based on differentiation. Therefore, the purpose of this study was to explore the current situation of middle-aged and older females in urban and rural areas during the pandemic and the factors influencing their preventive behavior.

Materials and methods

Data

CHARLS (China Health and Retirement Longitudinal Study) is a representative longitudinal survey of people aged 45 years and over in mainland China, designed and implemented by the National School of Development (NSD) and the Institute of Social Science Survey (ISSS) at Peking University, with the aim of building a high-quality public micro-database [34]. Its baseline sample used multistage probability sampling. In the first stage, all counties and districts in the country, except Tibet, were ranked according to urban/rural attributes and GDP (Gross Domestic Product) per capita, and then 150 counties or districts were selected with a probability proportional to the population size; in the second stage, within each sampled units, three secondary sampling units (communities in urban areas or villages in rural areas) were randomly selected with a probability proportional to the population size [35]. Therefore, CHARLS is nationally representative. After the sampling process described above, the CHARLS baseline samples were distributed among 450 villages or communities in 28 provinces covering 150 districts and counties. The CHARLS baseline survey started in 2011. Respondents are followed up every two years through face-to-face computer-assisted personal interviews (CAPI).

Round five survey carried out during July-September 2020, in order to timely record the impact of COVID-19 on the lives and health of middle-aged and elderly people in China, it added the information related to the outbreak [36]. Healthcare utilization, work status, disease prevention awareness, individual illness and isolation, personal activities and residence control were collected.

In this study, participants over 45 were defined as middle-aged and older females. Specific inclusion and exclusion standards were as follows: (1) Age ≥ 45 years old in the 2020 survey. (2) Gender is female. (3) The general demographic information such as age, marital status,

urban-rural attributes, work status and medical treatment is complete. (4) No missing values in the COVID-19 module. The specific sample selection process is shown in Fig. 1.

Measurements

Covariant variables

General demographic characteristics

This section includes the participant's age, marital status, work status and healthcare utilization during the pandemic.

Independent variables

Disease prevention knowledge and attitude

This section includes knowledge of seven preventive behaviors and attitude towards government measures.

Identification and isolation

COVID-19 test, infection, quarantine are contained in this part.

Personal activities and mental health

This component is compared to the pre-outbreak period, consisting going out, physical activities (light, moderate, intense), interaction activities (visit others, square dance, calling and messaging, internet contact), and mental health (fear and anxiety).

Residence control during the pandemic

This portion is comprised of five residential control measures: no one is allowed to enter or exit, limit the number of entries and exits for residents, non-residents are

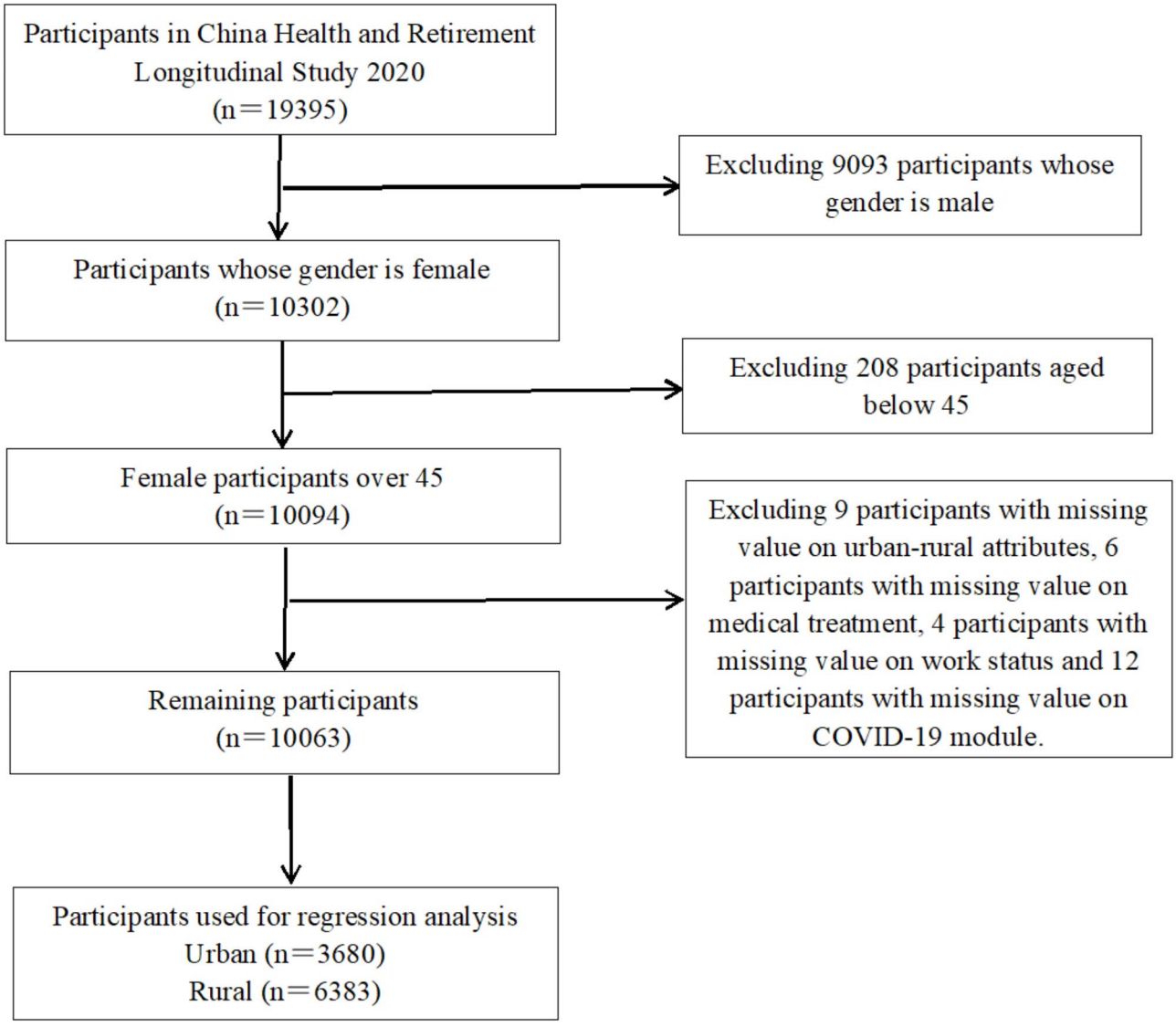

Fig. 1 The flowchart of the sample

not allowed to enter, non-residents are allowed to enter under specific conditions, no restrictions.

Dependent variable

Individual preventive behavior

In this study, the individual preventive behavior is mask-wearing.

Statistical analysis

This study was statistically analyzed using SPSS 26.0 (IBM Corp., Armonk, NY, US), and p value < 0.05 was considered statistically significant. Descriptive analysis (t-test, chi-square test) was used to compare the differences between urban and rural middle-aged and older females on each variable. The binary logistic regression (Forward: Conditional) was used to explore the factors influencing mask wearing behavior.

Results

General demographic characteristics is shown in Table 1. The study included 10,063 participants (Urban:3680, Rural: 6383). The mean ages of urban and rural participants were 61.12 (SD: 9.90) and 61.94 (SD: 10.10), respectively. 68.7% of urban participants were with their spouses, and this proportion was 72% in rural areas. 42.1% of urban and 70.8% of rural participants were still working during the pandemic. Only 15.8% of urban and 11.8% of rural participants reported that medical treatment was delayed. There was a significant difference in general demographic characteristics.

Table 2 shows the participants' disease prevention knowledge and attitude. In urban participants, the knowledge of hand washing, using alcohol and disinfectant, avoid handshaking, wear a mask and glove, avoid travel, avoid gathering, social distance was 86.0%, 80.3%, 73.9%, 93.9%, 80.1%, 88.0%, 81.5%, respectively, while in rural was 73.6%, 65.6%, 60.2%, 84.9%, 69.5%, 77.2%, 71.3%. As for the government's measures, 79.3% of urban and 67.6% of rural participants considered it appropriate. There was a significant difference between urban-rural participants in disease prevention knowledge and attitude.

Table 3 indicates the identification and isolation among participants. 92.3% of urban and 96.6% of rural participants had not taken COVID-19 tests, and no one confirmed. Only 2.3% of urban and 1.4% of rural participants experienced quarantine. There was a significant difference between urban-rural participants in COVID-19 test, COVID-19 confirmed and self-isolation.

The personal activities and mental health are included in Table 4. For urban participants, 75.9% reduced going out, while in rural areas it was 57.9%. The majority of participants in both urban and rural areas showed no change in intense and moderate activities. 59.3% of urban participants and 40.5% of rural participants reported a decrease in light activities. 56.5% of urban participants and 49.0% of rural participants reported a reduction in visits. 76.4% of urban participants and 85.3% of rural participants reported never engaging in dancing. Nearly half of the participants reported no change in calling and messaging. 34.4% of urban participants reported no online communication, compared to 53.9% in rural areas. Nearly half of urban and rural respondents reported no fear or anxiety. There was a significant difference between urban-rural participants except intense activities.

Table 5 presents the containment measures in residential areas. In urban areas, 43.0% of participants reported no one is allowed to enter or exit (rural areas: 59.1%); 59.7% of participants were limited the number of entries and exits (rural areas: 43.8%); 57.7% reported non-residents were not allowed to enter (rural areas: 56.4%); 50.5% indicated non-residents were allowed to enter under specific conditions (rural areas: 37.0%); only 6.7% experienced no restrictions on entry and exit (rural areas: 7.9%). There was a significant difference between participants in this module except non-residents are not allowed to enter.

Table 1 General demographic characteristics about the participants

Variables	Urban ($n=3680$) N(%)	Rural ($n=6383$) N(%)	Total ($n=10063$) N(%)	t/χ^2	P
Age					
Mean ± S. D	61.12 ± 9.90	61.94 ± 10.10	61.64 ± 10.04	-3.934	< 0.001
Marital status					
with a spouse	2528 (68.7)	4593 (72.0)	7121 (70.8)	11.999	0.001
Not with a spouse*	1152 (31.3)	1790 (28.0)	2942 (29.2)		
Working during the pandemic					
No	2131 (57.9)	1861 (29.2)	3992 (39.7)	806.281	< 0.001
Yes	1549 (42.1)	4522 (70.8)	6071 (60.3)		
Medical treatment delayed due to pandemic					
No	3100 (84.2)	5631 (88.2)	8731 (86.8)	32.189	< 0.001
Yes	580 (15.8)	752 (11.8)	1332 (13.2)		

*Not with a spouse: temporary absence, separated, divorced, widowed and never married

Table 2 Disease prevention knowledge and attitude among participants

Variables	Urban (*n* = 3680) *N*(%)	Rural (*n* = 6383) *N*(%)	Total (*n* = 10063) *N*(%)	χ^2	*P*
Hand washing					
No	515 (14.0)	1686 (26.4)	2201 (21.9)	210.690	< 0.001
Yes	3165 (86.0)	4697 (73.6)	7862 (78.1)		
Using alcohol and disinfectant					
No	726 (19.7)	2197 (34.4)	2923 (29.0)	244.452	< 0.001
Yes	2954 (80.3)	4186 (65.6)	7140 (71.0)		
Avoid handshaking					
No	962 (26.1)	2539 (39.8)	3501 (34.8)	191.320	< 0.001
Yes	2718 (73.9)	3844 (60.2)	6562 (65.2)		
Wear a mask and glove					
No	226 (6.1)	962 (15.1)	1188 (11.8)	178.779	< 0.001
Yes	3454 (93.9)	5421 (84.9)	8875 (88.2)		
Avoid travel					
No	733 (19.9)	1949 (30.5)	2682 (26.7)	134.564	< 0.001
Yes	2947 (80.1)	4434 (69.5)	7381 (73.3)		
Avoid gathering					
No	441 (12.0)	1457 (22.8)	1898 (18.9)	179.313	< 0.001
Yes	3239 (88.0)	4926 (77.2)	8165 (81.1)		
Social distance					
No	681 (18.5)	1829 (28.7)	2510 (24.9)	128.421	< 0.001
Yes	2999 (81.5)	4554 (71.3)	7553 (75.1)		
Government's measures					
Stricter than necessary	472 (12.8)	1155 (18.0)	1627 (16.2)	170.902	< 0.001
Satisfied	2920 (79.3)	4312 (67.6)	7232 (71.9)		
Less strict than necessary	137 (3.7)	380 (6.0)	517 (5.1)		
Do not know	151 (4.2)	536 (8.4)	687 (6.8)		

Table 3 Identification and isolation among participants

Variables	Urban (*n* = 3680) *N*(%)	Rural (*n* = 6383) *N*(%)	Total (*n* = 10063) *N*(%)	χ^2	*P*
COVID-19 test					
Yes	273 (7.4)	174 (2.7)	447 (4.4)	127.142	< 0.001
No	3396 (92.3)	6164 (96.6)	9560 (95.0)		
Do not know	11 (0.3)	45 (0.7)	56 (0.6)		
COVID-19 confirmed					
Oneself	0	0	0		
Cohabitant	0	0	0		
Other relatives	1	2	3	0.014	0.907
Acquaintance	12 (0.3)	4 (0.1)	16 (0.2)	10.203	0.001
Self-isolation					
No	3597 (97.7)	6296 (98.6)	9893 (98.3)	11.194	0.001
Yes	83 (2.3)	87 (1.4)	170 (1.7)		

As shown in Tables 6 and 88.6% of urban participants reported wearing masks, compared to 66.7% of rural participants.

Binary logistic regression (Forward: Conditional) was used to analyze the influences affecting mask-wearing behavior in both groups. *P*-values < 0.05 were regarded as statistically significant. All variables in Tables 1, 2, 3, 4, 5 and 6 were included in the regression analysis. Table 7 shows the results of the regression analysis. Age, marital status, wear a mask and glove, calling and messaging, internet contact, limit the number of entries and exits for residents were statistically significantly related to both groups' mask-wearing behavior. Moreover, urban participants' mask-wearing behavior was also statistically significantly related to using alcohol and disinfectant and no one is allowed to enter or exit, rural participants'

Table 4 Personal activities and mental health during the pandemic

Variables	Urban (*n* = 3680) *N*(%)	Rural (*n* = 6383) *N*(%)	Total (*n* = 10063) *N*(%)	χ^2	*P*
Going out					
Increased	28 (0.8)	32 (0.5)	60 (0.6)	343.590	< 0.001
Not changed	858 (23.3)	2655 (41.6)	3513 (34.9)		
Decreased	2794 (75.9)	3696 (57.9)	6490 (64.5)		
Intense activities (such as carrying heavy loads and farming)					
Increased	37 (1.0)	72 (1.1)	109 (1.0)	2.202	0.332
Not changed	2687 (73.0)	4575 (71.7)	7262 (72.2)		
Decreased	956 (26.0)	1736 (27.2)	2692 (26.8)		
Moderate activities (such as mopping floors and brisk walking)					
Increased	181 (4.9)	300 (4.7)	481 (4.8)	42.667	< 0.001
Not changed	2553 (69.4)	4794 (75.1)	7347 (73.0)		
Decreased	946 (25.7)	1289 (20.2)	2235 (22.2)		
Light activities (such as walk)					
Increased	70 (1.9)	146 (2.3)	216 (2.2)	332.568	< 0.001
Not changed	1429 (38.8)	3654 (57.2)	5083 (50.5)		
Decreased	2181 (59.3)	2583 (40.5)	4764 (47.3)		
Visit others					
Increased	7 (0.2)	33 (0.5)	40 (0.4)	163.287	< 0.001
Not changed	485 (13.2)	1493 (23.4)	1978 (19.6)		
Decreased	2082 (56.5)	3126 (49.0)	5208 (51.8)		
Never visit others	1106 (30.1)	1731 (27.1)	2837 (28.2)		
Square dance					
Increased	9 (0.2)	18 (0.3)	27 (0.3)	168.511	< 0.001
Not changed	161 (4.4)	289 (4.5)	450 (4.5)		
Decreased	698 (19.0)	631 (9.9)	1329 (13.2)		
Never danced	2812 (76.4)	5445 (85.3)	8257 (82.0)		
Calling and messaging					
Increased	983 (26.7)	909 (14.2)	1892 (18.8)	350.760	< 0.001
Not changed	1831 (49.8)	3319 (52.1)	5150 (51.2)		
Decreased	502 (13.6)	863 (13.5)	1365 (13.6)		
No device	10 (0.3)	71 (1.1)	81 (0.8)		
Never did	354 (9.6)	1221 (19.1)	1575 (15.6)		
Internet contact					
Increased	905 (24.6)	687 (10.8)	1592 (15.8)	591.533	< 0.001
Not changed	1178 (32.1)	1539 (24.1)	2717 (27.0)		
Decreased	252 (6.8)	367 (5.7)	619 (6.2)		
No device	78 (2.1)	348 (5.5)	426 (4.2)		
Never did	1267 (34.4)	3442 (53.9)	4709 (46.8)		
Fear					
Rarely or never	1944 (52.8)	3358 (52.6)	5302 (52.7)	46.538	< 0.001
Not often	389 (10.6)	557 (8.7)	946 (9.4)		
Sometimes	692 (18.8)	1020 (16.0)	1712 (17.0)		
Often times	619 (16.8)	1357 (21.3)	1976 (19.6)		
Do not know	36 (1.0)	91 (1.4)	127 (1.3)		
Anxiety					
Rarely or never	2104 (57.2)	3612 (56.6)	5716 (56.8)	45.896	< 0.001
Not often	417 (11.3)	615 (9.6)	1032 (10.3)		
Sometimes	680 (18.5)	1041 (16.4)	1721 (17.1)		
Often times	444 (12.0)	998 (15.6)	1442 (14.3)		
Do not know	35 (1.0)	117 (1.8)	152 (1.5)		

Table 5 Containment measures in residential areas during the pandemic

Variables	Urban (*n* = 3680) *N*(%)	Rural (*n* = 6383) *N*(%)	Total (*n* = 10063) *N*(%)	χ^2	*P*
No one is allowed to enter or exit					
No	2099 (57.0)	2611 (40.9)	4710 (46.8)	243.998	< 0.001
Yes	1581 (43.0)	3772 (59.1)	5353 (53.2)		
Limit the number of entries and exits for residents					
No	1483 (40.3)	3590 (56.2)	5073 (50.4)	237.379	< 0.001
Yes	2197 (59.7)	2793 (43.8)	4990 (49.6)		
Non-residents are not allowed to enter					
No	1556 (42.3)	2782 (43.6)	4338 (43.1)	1.613	0.204
Yes	2124 (57.7)	3601 (56.4)	5725 (56.9)		
Non-residents are allowed to enter under specific conditions					
No	1823 (49.5)	4023 (63.0)	5846 (58.1)	174.454	< 0.001
Yes	1857 (50.5)	2360 (37.0)	4217 (41.9)		
No restrictions					
No	3432 (93.3)	5879 (92.1)	9311 (92.5)	4.518	0.034
Yes	248 (6.7)	504 (7.9)	752 (7.5)		

Table 6 Individual preventive behavior of the participants

Variables	Urban (*n* = 3680) *N*(%)	Rural (*n* = 6383) *N*(%)	Total (*n* = 10063) *N*(%)	χ^2	*P*
Mask wearing					
Not always *	419 (11.4)	2128 (33.3)	2547 (25.3)	595.059	< 0.001
Always	3261 (88.6)	4255 (66.7)	7516 (74.7)		

* Not always: sometimes going out without a mask, never wearing one, and never going out at all

mask-wearing behavior was statistically significantly related to government's measures, COVID-19 test and fear.

Discussion

This study used the CHARLS database to explore the impact of the epidemic on urban and rural middle-aged and older females in China, and found that they were different in knowledge, attitude, identification, isolation, personal activities, mental health, containment measures in residential areas and preventive behavior. The factors affecting their preventive behavior also varied.

This study found most participants continued to work during the epidemic, especially in rural areas, this finding confirms that Chinese women play a crucial role as contributors to their family [37]. The knowledge of COVID-19 prevention is worse in rural areas, this is consistent with the findings of chen et al. in Chinese older adults in the early pandemic [38]. On the contrary, this study found that the proportion of participants received the COVID-19 test was extremely low, which was inconsistent with previous studies in China [39]. Previous studies reported that the test rate among the Chinese population was approximately 50% [40, 41], while in this study, it was less than 10%. This might be related to the sampling population and sampling areas, and further verification is needed.

This study reveals that over half of rural participants aged 45 and older do not use the Internet. This finding is inconsistent with the rapid advancement of China's digital infrastructure [42]. Furthermore, the challenge of verifying online information has introduced new complexities [43, 44]. This study found comparable levels of pandemic-related fear and anxiety to those in other Chinese population studies [45]. Rural participants demonstrated more pronounced psychological distress, consistent with existing domestic research [46, 47]. These findings underscore the need to prioritize mental health interventions in rural areas [48].

Notably, the participants' mask wearing behavior in this study was good, which is consistent with other studies [49, 50]. However, Rural participants demonstrated poorer adherence to mask wearing behavior compared to urban. This aligns with Cao's research, he pointed out that the proportion of rural residents taking preventive measures is lower than that of urban residents, women and rural populations failed to take protective measures [22]. Therefore, these groups may benefit from health education and policies. Age, marital status, knowledge, network connections and place of residence control are the factors influencing all participants to wear masks in

Table 7 Binary logistic regression (Forward: Conditional) of factors affecting mask wearing among participants

Variables	Urban			Rural		
	P	OR	95% CI	*P*	OR	95% CI
General demographic characteristics						
Age	< 0.001	1.024	1.011–1.037	< 0.001	1.024	1.017–1.031
Marital status						
with a spouse		1.0			1.0	
Not with a spouse *	< 0.001	1.690	1.334–2.140	0.033	1.155	1.011–1.319
Disease prevention knowledge and attitude						
Using alcohol and disinfectant						
No		1.0				
Yes	0.025	0.724	0.545–0.961			
Wear a mask and glove						
No		1.0			1.0	
Yes	< 0.001	0.359	0.246–0.524	< 0.001	0.455	0.386–0.536
Government's measures						
Stricter than necessary					1.0	
Satisfied				0.021	0.838	0.721–0.974
Less strict than necessary				0.058	1.284	0.991–1.663
Do not know				0.002	1.487	1.154–1.916
Identification and isolation						
COVID-19 test						
Yes					1.0	
No				0.001	2.049	1.327–3.166
Do not Know				0.149	1.876	0.798–4.409
Personal activities and mental health						
Calling and messaging						
Increased		1.0			1.0	
Not changed	0.335	0.826	0.561–1.217	0.048	1.257	1.002–1.578
Decreased	0.328	0.783	0.479–1.278	0.496	1.099	0.837–1.444
No device at home	0.282	2.444	0.480-12.441	0.370	1.307	0.727–2.349
Never did	0.026	1.658	1.061–2.589	< 0.001	1.610	1.251–2.072
Internet contact						
Increased		1.0			1.0	
Not changed	0.300	1.285	0.800-2.064	0.118	1.277	0.940–1.734
Decreased	0.010	2.265	1.216–4.218	0.018	1.610	1.084–2.391
No device at home	0.076	2.012	0.930–4.355	< 0.001	2.338	1.612–3.393
Never did	0.001	2.105	1.333–3.323	< 0.001	1.926	1.432–2.590
Fear						
Rarely or never					1.0	
Not often				0.593	0.943	0.761–1.169
Sometimes				0.003	0.767	0.644–0.915
Often times				0.001	0.769	0.657-0.900
Do not know				0.160	1.509	0.850–2.677
Containment measures in residential areas						
No one is allowed to enter or exit						
No		1.0				
Yes	0.024	1.312	1.037–1.661			
Limit the number of entries and exits for residents						
No		1.0			1.0	
Yes	0.001	0.658	0.520–0.834	< 0.001	0.727	0.644–0.820

* Not with a spouse: temporary absence, separated, divorced, widowed and never married

this study, which is similar to the results of many studies conducted during the epidemic [49, 51, 52]. A nationwide study spanning 31 Chinese provinces revealed that married individuals, respondents with health literacy, and residents in communities implementing containment protocols demonstrated higher compliance with preventive behaviors [38]. Our study did not identify any additional valuable influencing factors for the mask-wearing behavior of the urban participants. Apart from the above-mentioned influencing factors, this study surprisingly found that the mask-wearing behavior of rural participants is also affected by their attitudes towards government measures, COVID-19 testing and fear. Those participants who are satisfied with the measures implemented by the government exhibit better preventive behavior. This is similar to the result of an international study, which confirms the significant role of national identity in guiding group behavior and indicates that the stronger the national identity, the higher the support and compliance with public health measures [53]. Therefore, in the context of the epidemic, national identity may have certain predictive value for people's compliance with preventive behavior.

Implications

This study fills the research gap on the current situation and influencing factors of preventive behaviors among middle-aged and older females in China during the epidemic. Our findings emphasize the importance of paying attention to the health of middle-aged and older females in urban and rural areas and provide an empirical basis for the government to formulate targeted policies and measures for different groups. In response to the pandemic, this study recommends that the Chinese government should strengthen economic support, implement preventive health education programs, facilitate interactive communication, and enforce management of residential areas for middle-aged and older females. What deserves special attention is, for rural middle-aged and elderly females, the government should strengthen the publicity and explanation of prevention knowledge, expand the coverage of COVID-19 tests, and improve the conditions of internet, the measures should be appropriate and satisfactory.

Study strengths and limitations

This study conducted research on middle-aged and older females in China using nationally representative data. It explored the real situations of people during the epidemic and emphasized the significance of paying attention to different groups and different regions (especially rural) when facing public health emergencies.

Despite the advantages, this study has several limitations: Firstly, it was a cross-sectional study, which means that it could not identify the causal relationship between the variables; secondly, the differences in the level of the investigator and memory bias of the respondents may cause bias of the results; thirdly, this survey only asked the mask wearing behavior, further research should expand to other preventive measures; fourthly, the relationships among variables are merely assumed based on experience, lacking causal chains driven by theory, future research should deepen theoretical exploration; fifthly, caution is warranted in generalizing these findings beyond the studied context.

Conclusions

Based on data from the CHARLS survey, this study examined middle-aged and older females in Chinese urban and rural areas during the pandemic. The results indicated that both groups showed differences in demographic characteristics, prevention knowledge, attitude, identification, isolation, personal activities, mental health, containment measures in residential areas, individual preventive behavior and influences affecting preventive behavior. Prevention behavior was poorer among rural middle-aged and older females. More attention should be paid to the knowledge and network conditions of rural middle-aged and older females. During the pandemic, the government should pay attention to the physical and mental health of middle-aged and older females and implement targeted policy between urban and rural areas.

Abbreviations

CHARLS	China health and retirement longitudinal study
COVID-19	Corona virus disease 2019
IMV	Invasive mechanical ventilation
NSD	National school of development at peking university
ISSS	The institute of social science survey at peking university
GDP	Gross domestic product
CAPI	Face-to-face computer-assisted personal interviews

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Author contributions

Conceptualization, validation and supervision—JG, writing, methodology, software, formal analysis and original draft preparation—XJ. All authors have read and agreed to the published version of the manuscript.

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Data availability

The China Health and Retirement Longitudinal Study Database used in this study are available to the public under a Creative Commons license at: https://charls.charlsdata.com/pages/data/111/zh-cn.html.

Declarations

Ethics approval and consent to participate

Ethics approval for the study was granted by the Ethical Review Committee of Peking University. The IRB approval number is IRB00001052-11015. Informed consent was obtained at the time of participation. All methods of this study were performed in accordance with the relevant guidelines and regulations. All experimental protocols were approved by Institutional Review Board at Peking University.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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