Do you take off your mask correctly?a survey study during large-scale COVID-19 nucleic acid detection in China

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Abstract

Background: Guidelines and recommendations from public health authorities related to face masks have been essential for containing the COVID-19 pandemic. We assessed the behavioral differences and correlates of mask usage, mainly mask removal.

Methods: We examined public mask-wearing behavior during on-site COVID-19 nucleic acid detection. We examined 1180 responses to a cross-sectional survey by NingBo of China, completed from April 8 to April 12, 2022. The outcome was face mask usage in public settings and hand hygiene. Descriptive statistics were used to assess public mask-wearing behaviors. A binary logistic regression analysis was performed to identify the risk factors affecting mask-wearing behavior and hand hygiene.

Results: We analyzed data from 1180 participants; 73.2% demonstrated good knowledge regarding face mask use. However, only 53.7% know the correct way to remove a mask; 70.3% maintain hand hygiene after touching the outside of the mask. Health prevention knowledge (odds ratio [OR] = 6.60, 95% confidential interval [CI] = 4.79–9.08, p 0.001; OR = 2.37, 95% CI = 1.79–3.13, p 0.001) and free face mask distribution (OR = 0.71, 95% CI = 0.54–0.94, p = 0.017; OR = 0.49, 95% CI = 0.37–0.64, p 0.001) predicted health prevention behavior (removal during nucleic acid sampling and hand hygiene after touching the outside of the mask).

Conclusions: Most participants used masks during the COVID-19 pandemic; however, mask removal and hand hygiene when touching the outside of the mask were neglected. More attention needs to be paid to details of mask removal and hand hygiene. Local health authorities should consider introducing free distribution of masks.

Key Points

- This was a sizable on-site survey investigation of real-world mask use by the public in China. Everyone used face masks during COVID-19 nucleic acid detection.
- Incorrect mask-wearing behaviors included mask removal and hand hygiene.
- Knowledge and free mask distribution might explain differences in mask-wearing behavior.

Introduction

The COVID-19 pandemic was a global public health crisis. The World Health Organization recommended face coverings or masks in public to manage the crisis. Many countries and regions recommend face masks to control the spread of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the disease that causes COVID-19 [1–5]. Risk assessment studies using population transmission models showed that population-wide mask-wearing could slow the spread of influenza pandemics [6]. Laboratory studies suggested that proper mask using can reduce the spread of aerosol and respiratory droplets of coronaviruses, influenza viruses, and rhinoviruses [7].

The use of masks by the public might be one of the most effective strategies to reduce the spread of COVID-19, as recommended by the National Health Commission of China in guidelines issued on March 18, 2019 [8]. The Chinese government has strongly advocated the widespread use of masks in public places as a source control method. The Chinese generally support the usage of face masks in a public setting as a supplement to hand hygiene and social distancing to slow down or contain the exponential growth of the epidemic [9]. During the uncertain time of a global crisis, one of the most efficient mitigation methods is face coverings or masks, which can play an essential role in COVID-19 disease control[10].

Yet, experts and government health authorities warn that incorrect mask use may increase the risk of infection [11]. Previous studies showed that personal beliefs, individual attitudes, and sociodemographic factors predicted mask-wearing during other health emergencies [12]. Other studies showed that residents may not wash their hands frequently, change masks frequently, or dispose of used masks properly, simply by recording mask usage rates.[13–16]. We were curious about the rate of correct mask usage on a general population scale, mainly whether the rate was related to differences in mask-wearing behavior.

Currently, the epidemic in China is characterized by the coexistence of local sporadic and large-scale aggregation. The National Health and Health Commission continues to guide all localities to promote nucleic acid testing (2019-nCoV) to identify high-risk

individuals. From 2022 April 8 to 12, Zhejiang Ningbo City opened 276 nucleic acid sampling locations and carried out large-scale nucleic acid testing.

COVID-19 can spread through droplets and contact infected persons directly [17]. It survives on surfaces for up to 72 hours; contact with contaminated surfaces with subsequent touching of the face is another possible transmission source [18]. The areas with high population densities may be more at risk, especially in large-scale nucleic acid testing sites. Therefore, we investigated mask-wearing behavior patterns during large-scale nucleic acid testing to identify the factors that might explain differences in mask-wearing behavior.

Methods

Participants

This cross-sectional survey was conducted from April 8 to April 12, 2022. Due to new coronavirus infections in Ningbo, the corresponding area carried out nucleic acid testing for all staff. We collected the data on-site during this period, relying on the authors as medical staff, community workers, volunteers, and a nucleic acid sampler. Participants scanned a QR code of the questionnaire while waiting for nucleic acid sampling. This questionnaire briefly described the purpose, background, procedures, voluntary nature, confidentiality, anonymity, and precautions for completing the questionnaire. People of Chinese nationality over 16 agreed to participate in this study.

Measures

The survey instrument was developed based on the guidelines issued by the World Health Organization [19] and community management of COVID-19 by the National Health Commission of the Peoples Republic of China [20–21]. The questionnaire was modified based on their comments. The final version of the questionnaire was entitled “Investigate residents of health prevention knowledge and behavior during COVID-19 nucleic acid sampling” and consisted of two parts: (1) demographics: age, gender, education, occupation, registered residence, and the unit providing masks; (2) health prevention knowledge and behavior, consisting of 14 items: keeping a safe distance, mask selection, mask-wearing knowledge, the timing of hand hygiene, mask compliance, face mask usage, and hand washing. Items 1–12 concerned knowledge, and items 13 and 14 concerned behavior. The Likert scale assessed the questions with four points (never, occasionally, often, every time) (Table 1). We used binary logistic regression to analyze risk factors for mask-wearing and hand hygiene behaviors. There were eight variables, and the expected sample size was 500.

Table 1
Questionnaire of health prevention knowledge and behavior toward COVID-19

Health prevention knowledge (correct rate, % of the total sample)	Options
1. Do you know the social distancing? (90.8)	Yes/no
2. Do you know the relevant knowledge about wearing masks? (94.3)	Yes/no
3. Do you choose disposable medical masks? (92.3)	Yes/no
4. Do you know the correct way to wear a mask? (85.0)	Yes/no
5. Do you clean hands before wearing a mask? (79.8)	Never/occasionally/often/always
6. Will there be metal bars facing up when the mask is used? (89.7)	Never/occasionally/often/always
7. When using the mask, should the dark color face out? (87.3)	Never/occasionally/often/always
8. Do you wear a mask covering your nose, mouth, and chin? (81.5)	Never/occasionally/often/always
9. When you use a mask, do you hang the mask on your chin? (79.2)	Never/occasionally/often/always
10. Do you expose your mouth or nose when using a mask? (82.6)	Never/occasionally/often/always
11. Do you clean hands after taking off a mask? (82.2)	Never/occasionally/often/always
12. Which side of the mask do your hands touch when taking off the mask? (69.5)	Outside up/outside down/
	Inside down/from the thin straps
Health prevention behavior (correct rate, % of the total sample)	**Options**
13. During the nucleic acid sampling process, how do you take off your mask? (53.7)	Outside up/outside down/
14. Do you perform hand hygiene if you touch the outside of the mask? (70.3)	Inside down/from the thin straps
	Never/occasionally/often/always

Outcome variable definition

The primary outcome was the mask-removal method during nucleic acid sampling, based on the survey question: “outside up, outside down, inside down, and from the thin straps of masks” (Fig. 1). We defined the method of mask removal as a binary variable: 1 if the respondent reported taking off the mask from the thin straps and 0 otherwise.

The secondary outcome was that if you touch the outside of the mask, do you use hand hygiene? Based on the survey question (never; occasionally; often; always). We defined hand hygiene as a binary variable: 1 if the respondent reported often or always, and 0 otherwise.

Statistical analysis

The data was analyzed using SPSS™ for Windows, version 23.0. We used health prevention knowledge as descriptive statistics. Other data were categorical variables expressed as frequencies or percentages. Incorrect and correct responses were scored 0 and 1, respectively. Items 1, 2, 3, and 4 were answered “yes” or “no.” Items 5, 6, 7, 8, and 11 that were answered “occasionally” and “never” were defined as incorrect, while “always” and “often” was defined as correct. Items 9 and 10 were the opposite. For item 12, responses of “from the thin straps” were defined as correct. There were 12 items (Table 1). According to the final score (total of 12 points), ≥ 10 points was regarded as “good,” and < 10 points was regarded as “poor,” which were used as the dependent variable of binary logistic regression analysis. Frequencies of health prevention knowledge answers and behavior of different persons were described, and chi-square tests were performed for behaviors of different populations according to demographic characteristics. One-way analysis of variance was performed with demographic characteristics and health prevention knowledge ($P < 0.05$) as independent variables and health prevention behaviors (items 13 and 14) as outcome variables. Finally, we used a logistic regression model to determine whether individual characteristics and health prevention knowledge levels were related to health prevention behaviors.

Ethical considerations

The study survey was reviewed and approved by the Institutional Review Board of Li Huili Hospital of Ningbo Medical Center (No: KYSB2021SL091). All procedures were performed the relevant guidelines and regulations. A brief introduction explained the background and purpose of the survey. The questionnaire was scanned using the QR code at the site. Each participant received on-site instruction as they completed the survey. We carried out all procedures according to relevant regulations and guidelines.

Results

Descriptive statistics

There were 1180 people participants who completed the survey with no items excluded. Women accounted for 57.2%, and participants aged 35–65 years accounted for 49.5%. Those with bachelor's degrees accounted for 42.6%, and medical staff accounted for 13.5%; 73.2% of the participants demonstrated good knowledge of face mask use (Table 2).

Table 2
Demographic characteristics of the study population participants of the Correlation of hand hygiene after touching the outside of the mask and taking off the mask (N = 1180).

Category	n%	Hand hygiene		χ2	p	Take off mask		χ2	p
		Good Rate	Poor Rate			Good Rate	Poor Rate		
Gender				4.361	0.037			2.474	0.116
Female	675(57.2)	491(59.2)	184(52.6)			376(59.3)	299(54.8)		
Male	505(42.8)	339(40.8)	166(47.4)			258(40.7)	247(45.2)		
Age				2.431	0.297			5.497	0.064
<<35	548(46.4)	375(45.2)	173(49.4)			279(44.0)	269(49.2)		
35–65	584(49.5)	418(50.4)	165(47.4)			333(52.5)	251(46.0)		
>65	48(4.1)	37(4.5)	11(3.1)			22(3.5)	26(4.8)		
Education				14.507	0.002			16.841	0.001
Middle school or below	166(14.1)	137(16.5)	29(8.3)			100(15.8)	66(12.1)		
High school	169(14.3)	111(13.4)	58(16.6)			70(11.0)	99(18.1)		
College	342(29.0)	234(28.2)	108(30.9)			175(27.6)	167(30.6)		
bachelor degree	503(42.6)	328(41.9)	155(44.3)			289(45.6)	214(39.2)		
City/Countryside				4.468	0.035			2.976	0.084
City	649(55)	440(53)	209(59.7)			334(52.7)	315(57.7)		
Countryside	531(45)	390(47)	141(40.3)			300(47.3)	231(42.3)		
Medical staff				0.928	0.335			0.072	0.788
Yes	159(13.5)	117(14.1)	42(12.0)			87(13.7)	72(13.2)		
No	1021(86.5)	713(85.9)	308(88.0)			547(86.3)	474(86.8)		
Free masks distribution				25.298	<0.001			6.182	0.013
Yes	860(72.9)	640(77.1)	220(62.9)			481(75.9)	379(69.4)		
No	320(27.1)	190(22.9)	130(37.1)			153(24.1)	167(30.6)		
Control area				0.101	0.751			20.012	<0.001
Yes	447(37.9)	312(37.6)	135(38.6)			203(32.0)	244(44.7)		
No	733(62.1)	518(62.4)	215(61.4)			431(68.0)	302(55.3)		
Good knowledge				44.353	<0.001			173.092	<0.001
Yes	864(73.2)	654(78.8)	210(60.0)			564(89.0)	300(54.9)		
No	316(26.8)	176(21.2)	140(40.0)			70(11.0)	246(45.1)		

Regarding health prevention knowledge, 90.8% of the participants knew about social distancing, and 92.3% chose disposable medical masks. Regarding prevention behavior, only 53.72% of participants knew the correct way to remove a mask; 70.3% used hand hygiene when touching the outside of the mask (Table 1).

Predictors of health prevention behavior

We performed a univariate analysis of the study population and found that gender, education, urban area residence, and health prevention knowledge were significantly related to hand hygiene when touching the outside of the mask (P<0.05) (Table 2). Education, health prevention knowledge, control area, and receipt of free masks are significantly related to correct mask removal during nucleic acid sampling (P<0.05). Binary logistic regression analysis identified health prevention knowledge and free face mask distribution (Table 3).

Table 3
Binary logistic regression analysis on the influencing factors of health prevention behaviors of mask

Variables	Take off mask		Hand hygiene	
	Odds ratio (95% CI)	P	Odds ratio (95% CI)	P
Good knowledge	6.60 (4.79, 9.08)	<0.001	2.37 (1.79, 3.13)	<0.001
Free face mask distribution	0.71 (0.54, 0.94)	0.017	0.49 (0.37, 0.64)	<0.001

Discussion

As a result of the highly infectious nature of COVID-19 and the ongoing severity of the global epidemic, face masks are ubiquitous in daily life and communication. We assessed the behavioral differences and correlates of mask usage and found that 73.2% of participants with a high level of health prevention knowledge about mask wearing during the large-scale nucleic acid sampling site in China, It was similar to the findings of Tan [9], who found that 73.3% of the participants demonstrated good compliance with face mask use.

Previous studies focused on mask-wearing, especially compliance differences between rural and urban areas [22–23], and selecting different types of face masks [24]. In contrast, we focused on one detail (the mask-removal method during nucleic acid testing). We found that only 53.7% of participants removed masks correctly. Hand hygiene is recommended to reduce the spread of COVID-19 and has been reproducibly found to be effective [25]. We focused on one detail of hand hygiene: We asked, “If you touch the outside of the mask would you perform hand hygiene?” Only 70.3% of participants reported that they perform hand hygiene after touching the outside of the mask. We found that health prevention knowledge and free face mask distribution correlated with these details (health prevention behavior with mask).

Knowledge promotion is a successful health promotion strategy that has altered many health behaviors. The influence of health behavior is often the acquisition of knowledge, regardless of educational background. Even simple, brief, and easily conveyable messages can positively impact behaviors [26]. In our survey, participants with better knowledge showed better behavior regarding mask-wearing. Good mask-wearing habits were linked to how much health education about masks was received. This finding supported the hypothesis proposed by Firouzbakht et al. Knowledge may improve public behaviors and maintain cautious and preventive behavior regarding infectious diseases.

Free mask distribution is another factor affecting health prevention behavior. We found that 72.9% of participants reported that the workplace provided masks to employees. Economic factors are crucial. The residents who bought masks out of their pocket also demonstrated poor mask-wearing behaviors [28]. Participants might consider it a waste to replace and discard masks, and they would not care about the details of wearing masks correctly. Free mask distribution could encourage good mask-wearing behaviors. The finding supported the hypothesis proposed by Fretheim et al., who suggested that free distribution can increase face mask compliance [29].

Conclusions

This study aimed to investigate the behavior of Chinese residents wearing masks during nucleic acid testing. Knowledge and free mask distribution were associated with correct face mask usage. These findings suggest that it is necessary to disseminate knowledge regarding mask removal and hand hygiene. Mask distribution policy is linked to the use of masks. Our findings have implications for the ongoing public health emergencies and health prevention behavior during epidemics of infectious diseases spread by respiratory droplets.

Limitations

The behaviors were self-reported, and the distribution of the study participants occurred in only one city. Finally, the sample size was not insufficiently large.

Declarations

Ethical approval and consent to participate

The Ningbo Medical Center LiHuili Hospital approved the study protocols for collecting and analyzing the survey data (No: KYSB2021SL091).

Informed consent was obtained from all participants. All procedures were performed following the relevant guidelines and regulations.

Consent for publication

Not applicable.

Availability of data and materials

All data generated or analyzed during this study are included in this published article and its supplementary information files.

Competing interest

All other authors declare that they have no competing interests.

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Authors' contributions

JM proposed the study. YZ performed research and wrote the first draft. ZW collected and analyzed the data. All authors contributed to the design and interpretation of the study and to further drafts. JM is the guarantor.

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Figures

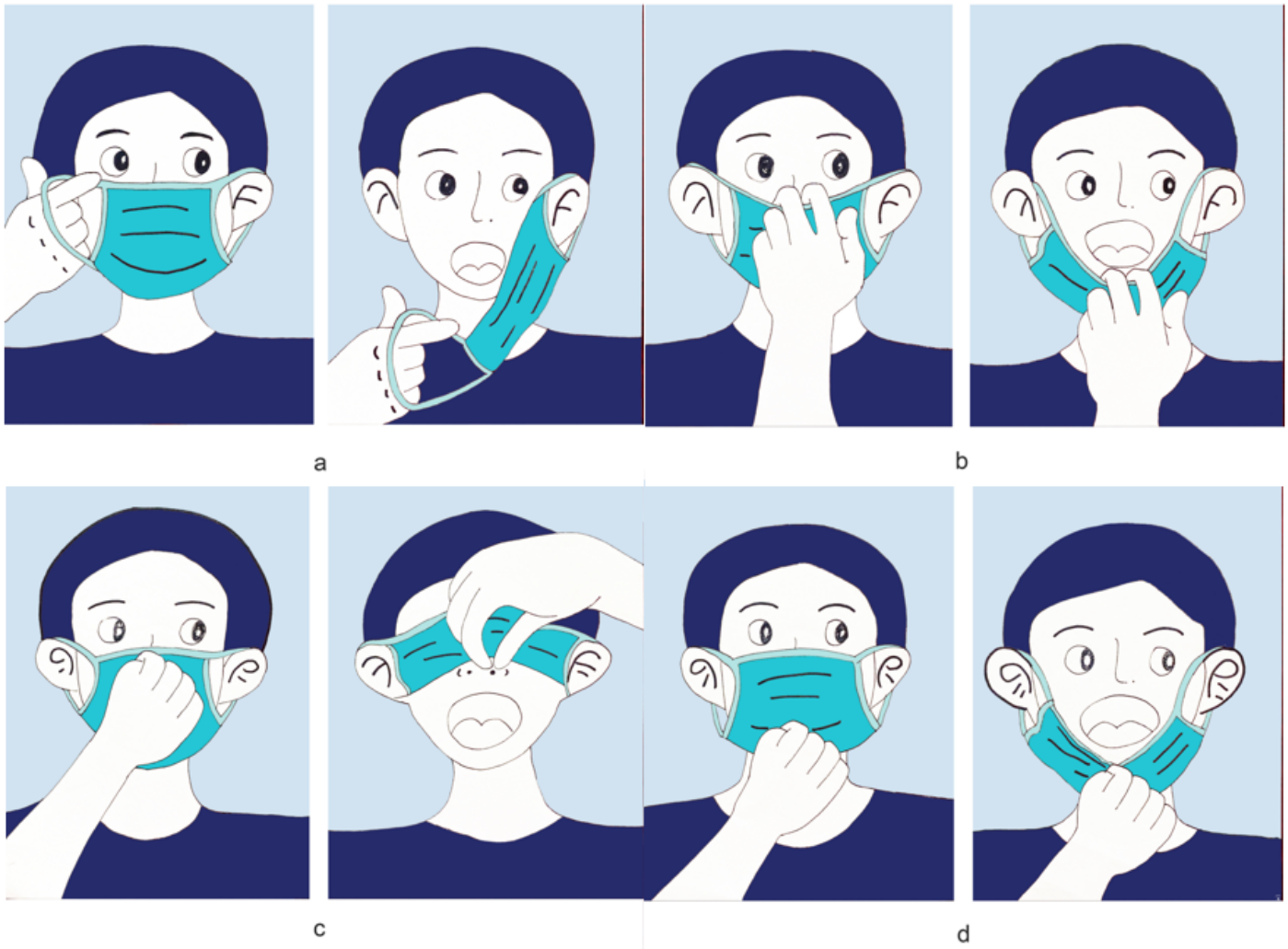

Fig. a was the correct way of taking off masks from the thin strap，account for 53.7%. The wrong behavior of b(13.8%), c(3.7%), and d(28.8%). b taking off masks inside down; c outside up; and d outside down.

Figure 1

A was the correct way of taking off masks from the thin strap. The wrong behavior of b, c and d. b taking off masks inside down; c outside up; and d outside down.

Supplementary Files

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- data1180.xlsx