ORIGINAL ARTICLE

Adherence to preventive behaviours and risk of COVID-19 infection: a case-control study

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ABSTRACT

Aim To investigate the relationship between adherence to preventive behaviors and risk of COVID-19 infection.

Methods In this case-control study, 491 participants were selected through convenience sampling. First, the samples of the case group (COVID-19 patients) were selected, and then the control group was matched with the case group based on age, gender, and occupation. The criteria for diagnosing COVID-19 for the case group were self-reported positive PCR test or lung involvement on a chest CT scan. Descriptive statistics were used to summarize the results, and an odds ratio was calculated to quantify the magnitude of the association using a 95% confidence interval (CI) and a $p<0.05$.

Results The results showed that, compared to those who always wear a mask, the risk of contracting SARS-CoV-2 was 3.153 times higher in those who used no masks (95% CI: 0.953-10.434) and 3.779 times higher in those who used masks occasionally (95% CI:1.929-7.37). The participants who never observed physical distancing and handwashing were 2.25 times more likely to get COVID-19 than those who always observed (95% CI:1.719-4.954; OR=2.258).

Conclusion Participants who fail in following the protective measures, especially wearing a mask regardless of its type, had a higher risk of COVID-19 infection. Therefore, it is recommended to use a mask consistently, especially during the peak of COVID-19 waves.

Key words: handwashing, masks, personal protective equipment, physical distancing

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INTRODUCTION

The new human coronavirus (COVID-19) was initially reported in Wuhan, China, spread rapidly all over the world, and has now become a major public health burden worldwide and an international health concern (1). Although most COVID-19 cases present asymptomatic or with only mild symptoms in many people, it can cause severe and life-threatening illness in people with underlying diseases and the elderly (2). SARS-CoV-2 spreads from an infected person to others through respiratory droplets and aerosols when an infected person breathes, coughs, sneezes, sings, shouts, or talks (3). Although mass vaccination programs have been started since December 2020 in many countries, evidence suggests that inequality in vaccine allocation and delivery among low-income countries remains a major threat to global control of the epidemic (4). Current estimates suggest that the closest time for universal vaccine coverage in all countries of the world will be in 2023 (5). Furthermore, vaccines cannot completely prevent COVID-19 infection and their role in preventing asymptomatic transmission of COVID-19 is still unclear (6). Thus, non-pharmacological interventions, including physical distancing and the use of face masks, will continue to play a key role in reducing the risk of COVID-19 for the present and the future. Since January 2020, WHO has recommended the use of masks as part of a comprehensive control strategy to suppress transmission of SARS-CoV-2 for health workers and the general public, and this advice has been updated regularly (7).

Despite the emphasis on the effectiveness of using a mask, there are conflicting results in the literature on this issue. In Wang's study, the risk of SARS-CoV-2 was reported to be 36.9 times more common in people who used no masks (8), while in two other studies, no significant change in the incidence of colds and flu was reported in people who used a mask and those who did not (9,10). There is also disagreement about the degree of protection of different types of masks. Some evidence has not yet confirmed the difference in protective effectiveness between N95 respirators and surgical masks (11). According to the report of the Ministry of Health, after the fourth wave of COVID-19 in Iran, the rate of compliance with health protocols gradually decreased. The rate of compliance with health protocols in the country was about 77.57% until May 27, which was about 22.66% until June 15 and reached 17.59% by June 12 (12). In late June 2021, the newer variants, the Delta Plus SARS-CoV-2, emerged in the southern provinces and disseminated to other provinces. By mid-August, officials recorded a high fatality rate of 600 daily (13).

Since the decrease in the observance of health protocols for the prevention of COVID-19 in mid-June 2021 coincided with the emergence of newer variants (13), the researchers sought to address the question of how much non-compliance with health protocols in the fifth peak condition could put people at risk for COVID-19.

The aim of this study was to investigate the relationship between adherence to preventive behaviours and COVID-19 infection during the fourth wave peak of COVID-19.

MATERIAL AND METHODS

Study design and participants

The data for this case-control study were collected from September 11 to October 27, 2020. An anonymous online survey was distributed using Google Forms through different social media platforms, asking participants to contribute to the research by completing the questionnaire and sharing it with their social contacts. The participants were asked to respond about their age, gender, and profession, and a brief questionnaire was prepared using the opinions of experts.

We defined a case as a participant aged 13 and older with no history of COVID-19 vaccination, had recently been infected with COVID-19, and not working in health care institution.

A potential control was a participant aged 13 years or older who had no history of COVID-19 vaccination and had not recently been infected with COVID-19. Sex ratio and age range of sample in the control group were considered similar to the case group.

Considering a 17% attrition rate, a sample size of 248 people per group was calculated.

The study was approved by the Ethics Committee of Lorestan University of Medical Sciences ("IR.LUMS.REC.1400.074").

Methods

The questionnaire included several questions about the recent history of COVID-19 and adhe-

rence to protocols including mask use, mask type, number of masks, physical distancing, and hand washing. The answer to the questions was based on a Likert scale (14) with degrees of never, sometimes, often, and always.

The criteria for diagnosing COVID-19 for the case group were a self-reported positive PCR test or lung involvement on a chest CT scan.

Statistical analysis

Descriptive statistics including frequencies, percentages, means, and standard deviations were used to summarize the results, and an odds ratio was calculated to quantify the magnitude of the association using a 95 % confidence interval (CI) and $p<0.05$.

RESULTS

The majority of participants in the case group and the control group were females, 150 (63%) and 174 (69.9%), respectively (p=0.065).

Table 1. Characteristics of the case and control groups

Variable		No (%) of participants in the group		p
		Case	Control	
Gender	Males	92 (38)	75 (30.1)	0.065
	Females	150 (62)	174 (69.9)	
Age (years)	>30	155 (66)	156 (67.2)	0.729
	< 30	80 (34)	76 (32.8)	
Occupation	Unemployed	8 (3.3)	13 (5.2)	0.446
	Worker	12 (5)	5 (2)	
	Employee	46 (19)	40 (16.1)	
	Self-employed	10 (4.1)	10 (4)	
	Housewife	27 (11.2)	35 (14.1)	
	Student	135 (55.8)	143 (57.4)	
	Retired	4 (1.7)	3 (1.2)	

The minimum age of the participants was 13 and the maximum was 84 years. The age of the majority of the participants in the case group and the control group was under 30 years, 155 (66%) and 156 (67.2%), respectively (p>0.729). There was no significant difference between the two groups in terms of occupation (p=0.446) (Table 1).

When the participants were asked about using a mask, 206 (82.7%) in the control group stated that they always used a mask, while only 55 (14.5%) in the case group always used a mask, ($p<0.001$). Also, in the case group, the females used a mask more frequently than the males (p=0.007), but in the control group, there was no significant difference between the males and the females in the frequency of a mask usage (p=0.609). Surgical mask was the most widely used mask type, then a cloth mask, and the least widely used mask was an N95 respirator. There was no significant difference between the two groups in terms of the type of mask used (p=0.312). There was also no significant difference between the two groups in terms of the number of masks used and most of the participants used one mask (p=0.328). In terms of age difference in the use of masks, there was no significant difference between the two age groups of under 30 years and over 30 in both the case and control groups (Table 2).

The results showed that, compared to those who always wear a mask, the risk of contracting SARS-CoV-2 was 3.153 times higher in those who used no masks (95% CI:0.953-10.434) and 3.779 times higher in those who used masks occasionally (95% CI:1.929-7.37) (Table 3).

Table 2. Frequency of preventive behaviour in the case and control groups

Variable	Group		No (%) of participants					p
			Always	Often	Sometimes	Never	Total	
Mask using overall	Case		35 (14.5)	51 (21.1)	35 (14.5)	9 (20.5)	233	<0.001
	Control		206 (82.7)	26 (10.4)	13 (5.2)	4 (1.9)	249	
Gender	Case	males	44 (47.8)	23 (25)	19 (20.7)	6 (6.5)	82	0.007
		females	103 (68.7))	28 (16.07)	16 (10.07)	3 (2)	150	
	Control	males	59 (78.7)	10 (13.3)	4 (5.3)	2 (2.7)	75	0.609
		females	147 (84.5)	16 (9.02)	9 (5.2)	2 (1.1)	174	
Age (years)	Case	<30	96 (61.9)	28(18.1)	23 (14.8)	8 (5.2)	155 (100)	0.192
		≥30	50 (62.5)	21 (26.3)	8 (10)	1(1.3)	80 (100)	
	Control	<30	131 (84)	20 (12.8)	4 (2.6)	1 (0.6)	156	0.235
		≥30	65 (85.5)	5 (6.6)	5 (6.6)	1 (1.3)	76 (100)	
Physical distancing and handwashing	Case		123 (50.8)	54 (22.3)	46 (19)	19 (7.9)	242	0.018
	Control		151 (60.6)	58 (23.3)	24 (9.6)	16 (6.4)	249	
			Surgical mask	N-95 respirator	Cloth mask			
Type of mask	Case		152 (65.2)	34 (16.6)	47 (20.2)		242	0.312
	Control		175 (71.4)	32 (13.1)	38 (15.5)		245	
			One		Two			
Number of mask	Case		156 (67.2)		76 (38.2)		232	0.328
	Control		153 (63)		90 (37)		242	

Table 3. Frequency of preventive behaviour and the incidence rate of COVID-19

Variable	Group	No (%) of participants					Odds ratio (95% CI)	p
		Always	Often	Sometimes	Never	Total		
Mask using	Case	147 (94.2)			9 (5.8)	156	3.153 (0.953-10.434)	<0.001
	Control	206 (98.1)			4 (1.9)	210		
	Case	147 (80.8)		35 (19.2)		182	3.779 (1.929-7.37)	<0.001
	Control	206 (94.1)		13 (5.9)		210		
	Case	147 (74.2)	51 (25.8)			198	2.749 (1.638-4.612)	<0.001
	Control	206 (88.8)	26 (11.2)			210		
Physical distancing and handwashing	Case	123 (86.6)			19 (13.4)	142	2.258 (1.719-4.954)	0.039
	Control	151 (90.4)			16 (9.4)	167		
	Case	123 (72.8)		46 (27.2)		169	2.535 (1.36-4.07)	<0.001
	Control	151 (86.3)		24 (13.7)		175		
	Case	123 (63.5)	54 (30.5)			177	1.143 (0.736-1.776)	0.552
	Control	151 (72.2)	58 (27.8)			209		

In response to a question about contact precautions including physical distancing and hand washing (Table 2), the results showed a significant difference in the frequency distribution of contact precautions in the case and control groups (p=0.018). In the case group, 123 (50.8%) always observed physical distancing and hand washing, compared to the control group 151(60.6%).

Also, in terms of age and gender, there was no significant difference in terms of physical distancing and hand washing between the case and control groups (p>0.05). To calculate the odds ratio of COVID-19 infection, the participants who always used the mask were considered as the reference group, and the odds ratio of COVID-19 incidence in the participants who occasionally or often used a mask as well as in those who had never used a mask were calculated.

In terms of physical distancing and hand washing, the risk of getting COVID-19 in those who never observed was twice as high as those who always observed these measures (95% CI=1.719-4.954; OR=2.15). Also, the risk of getting the infection was 2.25 times higher in those who occasionally observed physical distancing and hand washing (95% CI=1.36-4.07; OR=2.353) (Table 3).

The results also showed that the participants who never used a mask and did not observe physical distancing and hand washing were 4.52 times more likely to get COVID-19 than those who always used these three measures (95% CI=2.122-9.627; OR=4.520) (Table 4).

Table 4. Frequency of all preventive behaviour and the incidence rate of COVID-19

Variable		No (%) of participants in the group			Odds ratio (95% CI)	p
		Case	Control	Total		
Observing all preventing measures	Yes	97 (41.5)	137 (58.5)	234	4.52 (2.122-9.627)	<0.001
	No	32 (76.2)	10 (23.8)	42		

DISCUSSION

The results of this study indicated that 82% of the people in the control group and 14% in the case group always used a mask, and the most widely used mask type in both groups was a surgical mask and a cloth mask, respectively. There was no significant difference between the two groups in terms of the type of mask used. The research focused on aerosol exposure has found that all types of masks are at least somewhat effective in protecting the wearer. Van der Sande et al. found that "all types of masks reduced aerosol exposure, relatively stable over time, unaffected by duration of wear or type of activity," and concluded that "any type of general mask use is likely to decrease viral exposure and infection risk on a population level, despite imperfect fit and imperfect adherence" (15,16). Similar to our study Bartaszko et al. showed that a surgical mask is as effective as an N95 respirator in preventing viral respiratory infections in healthcare personnel during routine care (17). Cheng et al. also showed that the use of any type of mask can reduce the risk of transmission of COVID-19 (18). However, other studies have denied the effect of using a surgical mask in the prevention of viral respiratory diseases (19).

Our results showed that the people who had never used a mask were more than 3 times more likely to get COVID-19 than the people who always wore a mask. Findings from most studies showed that the use of masks is effective in preventing flu-like viral infections (20). In Wang et al. study, the risk of contracting SARS-CoV-2 was 36.9

times higher in the healthcare workers who used no masks than in those who used N95 respirators, which is relatively similar to the results of our study (21). Despite these findings, two studies observed no significant change in controlling influenza (22) or common cold between people who use face masks and those who do not (10); also, the results of our study also showed that the risk of COVID-19 in the people who did not follow hand hygiene and physical distancing was more than doubled. The result of a recent systematic review showed horizontal projection of respiratory droplets beyond 2 m for particles up to 60 μm (23). Another study suggested that SARS-CoV-2 could spread beyond 1-2 m in a concentrated packet through coughs or sneezes (24). Similar to our study a systematic review showed physical distancing of <1 m could result in a transmission risk of 12.8%, compared with 2.6% at distances ≥1 m (25).

In our study people who do not always use a mask, and do not observe physical distancing and handwashing, had 4.5 times greater risk of getting infected with COVID-19. Consistent with our study, Aiello in a clinical trial study showed that the use of a face mask and hand hygiene reduces the risk of influenza transmission (26).

The results of this study showed that the risk of getting COVID-19 infection in people who do not always follow preventative measures is high. This finding may be related to the time of the study because the data collection was done at the peak of the fourth wave of COVID-19. In conclusion, the results of this study show that people who fail in following the protective measures, especially wearing a mask regardless of its type, have a higher risk of COVID-19 infection. The results suggest that the continuous use of a mask potentially minimizes the risk of infection during the waves of COVID-19.

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TRANSPARENCY DECLARATION

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