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Associations between Wearing Masks, Hand Washing, and the Risk of COVID-19 Contraction: A Case-Control Study in the Northwest of Iran

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Abstract

Background: Scientists believe that the new coronavirus causing COVID-19 is airborne. It has been approved that wearing masks and hand washing prevent the spread of COVID-19. This study aimed to evaluate the association between wearing facemasks, hand washing, and COVID-19 contraction in the population of Tabriz, Iran.
Materials & Methods: In this analytical study, necessary information was collected via four online multi-optional questionnaires on sociodemographic characteristics, the COVID-19 virus, mask-wearing behaviors, and hand hygiene habits among 360 individuals (120 cases and 240 controls). Based on data normality, quantitative variables were reported as mean ± standard deviation or the median (min-max). In addition, the relationship between qualitative variables was evaluated by the Fisher's exact test, and correlations were assessed by the Spearman's test.
Results: Elderly individuals and their care seekers had fewer potentials for exposure to COVID-19 ($p = 0.010$), but healthcare workers were at a higher risk of contracting the virus than other occupations ($p = 0.002$). In addition, smokers were at a lower risk of the disease than other healthy people ($p = 0.009$). Furthermore, the incidence of COVID-19 was significantly higher among individuals not wearing facemasks than others ($p = 0.007$).
Conclusions: we concluded that wearing a facemask was more effective than hand washing and antiseptics in preventing the incidence of COVID-19 contraction; thus, people not wearing facemasks were at a higher risk of the viral infection.

Keywords: COVID-19, Gloves, Hand Hygiene, Mask, Viral Infection

Introduction

In December 2019, a new coronavirus (Severe Acute Respiratory Syndrome Coronavirus-2) (SARS-CoV2) was discovered in Wuhan, China, which caused novel coronavirus disease 2019 (COVID-19) [1]. Due to its high virulence rate and rapid spread, the World Health Organization

(WHO) considered it a pandemic health threat [1-3]. From the beginning of the pandemic until February 2022, 6,543,837 confirmed cases were identified in Iran, of whom 132,745 cases died [4]. Although no virus particles were found 2-5 meters away from patients' beds in the ICU in the study by Seyyed Mahdi et al [5], most studies demonstrated that human-to-human transmission of the virus occurred through droplets, or it was airborne [6, 7]. There are two alternatives for dealing with the virus and preventing the incidence of the virus-induced infection. The first one is pharmaceutical methods, like vaccines or drugs, and the second one is non-pharmaceutical interventions [8]. Wearing masks and hand hygiene are the two proven ways, as non-pharmaceutical interventions, for appropriately preventing the virus spread [9-11]. Given that COVID-19 is still unknown and there are many unanswered questions, it is necessary to investigate this issue more accurately [12]. Since the use of vaccines and definitive drugs is not agreed upon by some individuals suspicious of their efficacy, it seems that the use of non-pharmaceutical methods is more logical [13]. However, European countries still keep employing preventive protocols, including wearing face masks and hand washing to control the incidence of COVID-19 [14].

Wearing facemasks and hand washing, as preventive methods, have reduced the incidence of the disease in some countries, like Singapore and South Korea [15]. Evidence shows that facemasks not only prevent viral infections by reducing virus particles, but they also induce immunity among individuals [16]. In contrast, in countries, such as Iran and Italy in which these protocols were not strictly observed, no reduction occurred in the incidence of the disease [17]. In a study by Peyrony et al, it was observed that SARS-CoV2 remained on light switches, door knobs, or closets in the hospital [18]; therefore, it is necessary to use disinfectants to prevent COVID-19 contraction. However, some people refused to regularly follow the protocols of wearing masks and hand washing for asymptomatic, political, medical, or other reasons [19]. There were similar studies in the literature review on the relationship between personal hygiene protocols of COVID-19 and prevention of COVID-19 contraction or mortality (20, 21). Nevertheless, to our knowledge, no study was found to have been conducted among the population of Tabriz, Iran. In this context, this study aimed to determine the role of hand washing and wearing facemasks in preventing COVID-19 contraction and its relationship with other factors among the population of Tabriz, Iran.

Materials and Methods

Data collection for this descriptive non-interventional study was performed from July 22, 2020 to August 20, 2020. To this end, a total of 360 people (120 cases and 240 controls) who participated in the study were selected via non-randomized convenient sampling. The sample size was determined via G-power software, where p = 0.95, d = 0.405, α-error = 0.05, and allocation ratio N2/N1= 2. These individuals received and completed the questionnaire in person, by phone, or online. The inclusion criteria were having a history of periodic care by the health centers of Tabriz, Iran, and being willing to participate in the study. On the other side, the exclusion criteria were incomplete questionnaires, treatment staff, and unwillingness to participate in the study. This study was approved by the Ethics Committee of Tabriz University of Medical Sciences (Ethics Code: IR.TBZMED.REC.1399.116).

During this study, some individuals were employed for collecting the required information via a questionnaire that contained multi-optional questions. In addition, the individuals were free to select one of the options for each question. The questionnaire utilized in this study consisted of four parts. The first part included sociodemographic characteristics, including age, gender, education, occupation, smoking habits, history of underlying diseases, and caring for a child under 7 or a person over 60 years old; the second part included information on COVID-19, whether they or anyone around them had been infected with the disease, and the current status of infected acquaintances; the third part included mask-wearing behaviors, such as whether they wore facemasks, the type of the masks, reuse of the masks, washing the masks, and the reason for not wearing them; and the fourth part included hand washing habits, such as carrying disinfectants outdoors and regularly washing hands after coming home. It is worth noting that the questionnaires utilized were designed by professors at Tabriz University of Medical Sciences, whose reliability and validity were determined at the beginning of the study based on calculations in a study by Firouzbakht et al [22].

Data analysis was performed by SPSS 19.0. In addition, data distribution of quantitative variables was controlled in terms of normality by the Shapiro-Wilk test. The results obtained were reported as mean ± standard deviation or the median (min-max) for normal or non-normal data

distribution, respectively. In addition, after determining frequencies of qualitative variables, the relationship between them was evaluated by the Fisher's exact test. Additionally, correlations were assessed by the Spearman's test, and p-values were considered significant at 0.05.

Results

A total of 360 individuals were included in this study, of whom 120 cases had a history of COVID-19 contraction, yet 240 individuals had not experienced COVID-19. The mean ages of individuals with and without COVID-19 were 43 ± 13 and 44 ± 15 years old, respectively. In addition, distributions of demographic and clinical parameters, including gender, education, and COVID-19 contraction were similar among the groups assessed (Table 1).

Table 1. Participants' demographic information

Variables		COVID-19				P-value
		No		Yes		
		Count	%	Count	%	
Gender	**Men**	123	51.2%	67	55.8%	0.435
	Women	117	48.8%	53	44.2%	
Education	**Illiterate**	11	4.6%	0	0%	0.04
	Lower than high school diploma	52	21.7%	27	22.5%	
	High school diploma	53	22.1%	32	26.7%	
	Undergraduate	87	36.3%	35	29.2%	
	Graduate and higher	37	15.4%	26	21.7%	
Occupation	**Jobless**	14	5.8%	7	5.8%	0.092
	Housewives	54	22.5%	31	25.8%	
	Clerks	57	23.8%	23	19.2%	
	Students	11	4.6%	8	6.7%	
	Health workers	5	2.1%	11	9.2%	
	Retired	32	13.3%	11	9.2%	
	Self-employed	62	25.8%	28	23.3%	
	Workers	5	2.1%	1	0.8%	
Family members	**Care seekers**	122	50.8%	71	59.2%	0.061
	Older than 60	45	18.8%	15	12.5%	
	Younger than 7	48	20%	29	24.2%	
	Both	25	10.4%	5	4.2%	

Results obtained from the Fisher's exact test; p-value < 0.05 was considered statistically significant.

Table 2 shows correlations between the presence of underlying diseases and the incidence of COVID-19 contraction among the participants.

In this study, most of the participants suffered from hypertension (n = 40), obesity (n = 30), and diabetes mellitus (n =22). In addition, 9 individuals had respiratory disorders, 8 had cardiovascular diseases, 5 had neurological or psychological problems, 5 had thyroid problems, 2 had allergies, 2 had autoimmune disorders, and one person had chronic kidney disease. However, the frequency of the individuals infected with COVID-19 was not affected by any of the underlying disorders (p > 0.05).

Table 2. History of underlying diseases among the participants

Underlying diseases	COVID-19				P-value
	No		Yes		
	Count	%	Count	%	
Hypertension	40	16.7%	16	13.3%	0.445
Obesity	30	12.5%	16	13.3%	0.867
Diabetes mellitus	22	9.2%	13	10.8%	0.706
Respiratory disorders	9	3.8%	6	5.0%	0.584
Cardiovascular diseases	8	3.3%	8	6.7%	0.177
Others	8	3.3%	7	5.8%	0.273
Neurological/psychological problems	5	2.1%	2	1.7%	1
Thyroid problems	5	2.1%	2	1.7%	1
Allergies	2	0.8%	2	1.7%	0.603
Autoimmune disorders	2	0.8%	1	0.8%	1
Chronic kidney disease	1	0.4%	1	0.8%	1

Results obtained from the Fisher's exact test; p-value < 0.05 was considered statistically significant.

Table 3. Daily behaviors possibly affecting COVID-19 contraction

Related behaviors		COVID-19				P-value*
		No		Yes		
		Count	%	Count	%	
Smoking	No	176	73.3%	111	92.5%	< 0.001
	Second-hand smokers	30	12.5%	3	2.5%	
	Smokers	34	14.2%	6	5.0%	
Using antibacterial sanitizers	Never	17	7.1%	6	5.0%	0.002
	If available	31	12.9%	11	9.2%	
	Always	192	80.0%	103	85.8%	
Hand washing	No	1	0.4%	4	3.3%	0.584
	Yes	239	99.6%	116	96.7%	
Wearing masks	Never	11	4.6%	8	6.7%	0.011
	After COVID-19 incidence	4	1.7%	10	8.3%	
	Always	225	93.8%	102	85.0%	

Results obtained from the Fisher's exact test; p-value < 0.05 was considered statistically significant.

Table 3 shows daily behaviors affecting COVID-19 contraction. Accordingly, it was revealed that the individuals smoking (p < 0.001), using antibacterial sanitizers (p = 0.002), and wearing facemasks (p = 0.011) were at a low risk of COVID-19 contraction. Although the incidence of COVID-19 contraction was reduced among individuals washing their hands, the difference observed was not statistically significant (p = 0.584).

In addition, observations of personal protection against COVID-19 contraction were compared among the individuals with different genders, education levels, occupations, and family members. The results showed that education remarkably determined if the individuals wore a facemask (p = 0.016); gender and occupation were significantly effective in determining the frequency of hand washing (p = 0.033 and 0.028, respectively); and education and occupation significantly affected the use of antibacterial sanitizers among the individuals (p = 0.001 and 0.02, respectively). However, having a care seeker, a male elder, or a baby did not statistically affect protective behaviors among the individuals (p > 0.05) (Table 4).

Table 4. Observations of personal protection against COVID-19 contraction among the general population

Parameters		Wearing masks			P-value	Hand washing		P-value	Using antibacterial sanitizers			P-value
		Never	After the pandemic	Always		No	Yes		Never	If available	Always	
Gender	Male	11	10	169	0.309	5	185	0.033	11	27	152	0.277
	Female	8	4	158		0	170		12	15	153	
Education	Illiterate	3	0	8	0.016	0	11	0.177	3	1	7	0.001
	Lower than high school diploma	7	5	67		1	78		12	3	64	
	High school diploma	6	4	75		0	85		1	13	71	
	Undergraduate	2	4	116		1	121		4	17	101	
	Graduate and higher	1	1	61		3	60		3	8	52	
Occupation	Jobless	3	0	18	0.343	1	20	0.028	2	0	19	0.02
	Housewives	3	3	79		0	85		9	5	71	
	Clerks	2	2	76		1	79		1	11	68	
	Students	0	0	19		2	17		0	1	18	
	Health workers	1	2	13		0	16		1	2	13	
	Retired	2	5	39		1	42		1	5	37	
	Self-employed	7	0	78		0	90		8	16	66	
	Workers	1	14	5		0	6		1	2	3	
Family members	Care seekers	9	6	178	0.363	3	190	0.357	14	18	161	0.736
	Older than 60	4	1	55		2	58		3	7	50	
	Younger than7	6	5	66		0	77		5	12	60	
	Both	0	2	28		0	30		1	5	24	

Results obtained from the Fisher's exact test; p-value < 0.05 was considered statistically significant.

Table 5 shows the effect of underlying diseases on personal hygiene. The results obtained showed that patients with cardiovascular diseases and a history of COVID-19 contraction wore facemasks more frequently than the others (p = 0.021 and 0.044, respectively). In addition, individuals with a history of COVID-19 contraction and neurological/psychological problems used more antibacterial sanitizers (p = 0.002 and 0.046, respectively); however, none of the two patients with chronic kidney disease used antibacterial sanitizers (p = 0.003). Nevertheless, other underlying diseases had no effect on observations of personal protection against COVID-19 contraction (p > 0.05).

Table 5. Observations of personal protection against COVID-19 contraction among individuals with underlying diseases

Underlying diseases	Wearing masks			P-value	Hand washing		P-value	Using antibacterial sanitizers			P-value
	Never	After the pandemic	Always		No	Yes		Never	If available	Always	
Hypertension	3	3	50	0.744	0	56	1	5	8	43	0.448
Obesity	1	4	41	0.107	1	45	0.497	1	6	39	0.508
Diabetes mellitus	2	2	31	0.711	1	34	0.402	2	3	30	0.936
Respiratory disorders	2	1	12	0.193	0	15	1	1	2	12	0.872
Cardiovascular diseases	1	3	12	0.021	1	15	0.204	1	0	15	0.316
Others	1	0	14	0.769	2	13	0.015	0	2	13	0.755
Neurological/ psychological problems	1	0	6	0.489	0	7	1	2	1	4	0.046
Thyroid problems	0	1	6	0.279	0	7	1	0	0	7	0.749
Allergies	1	0	3	0.317	0	4	1	0	1	3	0.541
Autoimmune disorders	0	0	3	1	0	3	1	0	1	2	0.441
Chronic kidney disease	0	0	2	1	0	2	1	2	0	0	0.003
COVID-19 history	11	11	152	0.044	1	173	0.373	3	23	148	0.002

Results obtained from the Fisher's exact test; p-value < 0.05 was considered statistically significant.

The results of the study were divided into the following two categories:

1. Associations between demographic findings and COVID-19 contraction: The individuals never wearing a mask were older than other groups. In addition, illiterate people were significantly less likely to wear a mask, and people with lower education levels used hand sanitizers less frequently. The risk of COVID-19 was significantly higher in the infected people's acquaintances. Those who had an elderly person (> 65 years) at home and cared for them were significantly less likely to contract COVID-19 (p = 0.010). Smokers had a lower risk of contracting the virus than healthy people (p = 0.009). Besides, health workers were at a higher risk of contracting the virus than other employees (p = 0.002). People with underlying neuropsychological diseases and chronic kidney disease (CKD) used hand sanitizers less frequently. In addition, the use of hand sanitizers was lower among those not having been infected with the virus. The frequency of hand washing and wearing masks was lower in people with underlying cardiovascular diseases as well. Furthermore, the frequency of wearing masks was higher in the non-affected group, while it was higher after contracting the disease in the affected group.

2. Associations between different behaviors and COVID-19 contraction: The use of surgical masks was associated with a higher risk of contracting COVID-19 than cloth masks (p = 0.003). In addition, there was no significant relationship between mask washing behaviors, mask reuse, and the frequency of mask washing with contracting COVID-19.

The main reason for not wearing a mask in the infected people was the lack of trust in the effectiveness of masks; however, in healthy people who did not wear a mask, the feeling of shortness of breath and intolerance to masks were mentioned as the main reasons. The incidence of

COVID-19 was significantly higher among those who had not been wearing masks at least for a period of time (p = 0.007).

The highest and lowest rates of regular hand washing after getting home were observed among women and students, respectively. Besides, failure to wash hands after getting home was more significantly common in people infected with the virus than in others. In the meantime, those who did not use hand sanitizers used masks less frequently.

Discussion

Airborne transmission is considered the main method of COVID-19 contraction [23]. Therefore, wearing a mask reduces the risk of the viral infection. This study aimed to determine risk factors for COVID-19 contraction and the way personal behaviors inhibit COVID-19 contraction.

In this study, an inverse relationship was found between contracting the virus and smoking, which was consistent with a study by Tsigaris et al [24]. However, as mentioned in that study, the association does not assign a therapeutic and prophylactic role to smoking in COVID-19 [24]. Simons et al observed that novice smokers were less exposed to SARS-CoV-2 contraction than professional smokers experiencing severe COVID-19 and even death [25]. In addition, ecological research among European Union countries revealed that frequent smoking led to a lower COVID-19 contraction rate. This might be justified by the downregulation of the angiotensin-converting enzyme (ACE-2) via nicotine [26]. Miyara et al observed severe COVID-19 among ambulatory and hospitalized heavy smokers. They believed that nicotine and nicotinic receptors could be involved in the pathways of viral infections, so this issue could be investigated in an experimental study for more confirmation [27]. In fact, although some studies confirm that smoking may protect people against COVID-19 contraction or at least reduce severity of the disease, toxic effects of nicotine on health should be carefully investigated [28]. Controversially, other studies have reported higher rates of COVID-19 severity and mortality due to COVID-19 among smokers [29, 30]. However, scientists do not advise using nicotine to prevent COVID-19 or to decrease its severity [31].

The lower incidence of COVID-19 among individuals living with the elderly in our study may confirm that they were more adherent to protective protocols for the fear of contracting the disease. COVID-19 is more severe and deadly in elder patients due to their weak immune system and alterations in the ACE-2 receptor, which require more self-protection [32]. Nevertheless, it was observed that the rate of wearing facemasks decreased in elder individuals because there were lower rates of employment at older ages, so they were not required to leave home.

By a decrease in wearing masks, an increase was observed in the COVID-19 incidence among people of low level jobs and low literacy levels. According to Rollston et al, unfavorable conditions at home, less frequent use of healthy foods, inappropriate access to health services, and inability to buy personal protective equipment lead to the possibility and complications of disease transmission [33].

There was no significant difference between the effectiveness of surgical masks and cloth masks. Thus, due to the global shortage of disposable masks and the evidence implying that they are almost equally effective, it is appropriate to use cloth masks and wash them daily [34].

Although the severity of COVID-19 was higher among people with cardiovascular diseases in our study, people with cardiovascular diseases were less likely to wash their hands and wear masks [35]. COVID-19 is associated with several cardiovascular complications that increase the overall mortality rate [36]. This makes it even more important for cardiovascular disease patients to follow hand hygiene and mask-wearing guidelines.

In this study, health care workers were more likely to contract SARS-CoV-2. Proper use of personal protective equipment and adherence to other infection control measures are effective in reducing the incidence of COVID-19 among healthcare providers [37]. The association between hand-washing habits and the incidence of COVID-19 contraction mainly depends on the places where the patients commute. According to Goldman's study, wearing gloves and disinfecting surfaces seem to be reasonable in hospital settings, while in the general population with low virus loads on surfaces, transmission through the surface does not appear to be serious [38]. Zare et al studied COVID-19 contraction in Shahroud County and concluded that COVID-19 re-contraction would be preventable by wearing masks and social distancing [39]. Two studies reported that 50% of the Iranian population did not exhibit approved preventive behaviors of hand washing as well as wearing masks and gloves [40, 41]. Shiraly et al reported that wearing masks prevented touching mucosal zones of the face and infection transmission [41].

Shamsalinia et al reported that among Iranians, women and healthcare workers considered these behaviors excessive, and that all people accepted the rules against COVID-19 contraction only for the

first two months [42]. Consistent with these results, the present study showed that among women, housewives were more involved with COVID-19 than other occupations. Suen et al reported that females had higher compliance with hand washing requirements. In this study, being female was considered an effective factor in improving hand washing knowledge [43]. Several studies have shown that healthcare workers are more prone to contract COVID-19, and that there are more preventive strategies for them to be adopted [42, 44, 45]. Sabetian et al observed that in hospitals of the Fars Province, Iran, healthcare workers were more prone to contract COVID-19, with an incidence rate of 5.62% [45]. A systematic review by Fouladi Dehaghi et al revealed that in addition to wearing N95 respiratory masks, it is important to frequently wash hands and use disinfectants to prevent COVID-19 contraction among healthcare workers [46]. In their study in the hospitals of Birjand City, Iran, Zangoue et al reported that although healthcare workers were more exposed to COVID-19 contraction due to their occupational conditions, the prevalence of antibodies against infections, including COVID-19, was very low due to not fully meeting protective protocols, according to seroconversion studies [47]. In another study by Nasrabadi et al, it was reported that masks were the most frequently used tool against COVID-19 contraction, yet the use of face shields was not prevalent among healthcare workers in surgical wards of Tehran hospitals, Iran [48].

The results of this study could help epidemiologists plan for giving necessary training to the population. However, this study had some limitations. Accordingly, our study was based on a limited number of patients, and the individuals included in this study either had not contracted the disease or had recovered from it after contraction. In addition, severely ill patients and patients who died were not included in this study. Another limitation of the study was recalling behaviors, such as wearing face masks and hand washing at the time of contraction (at least two weeks before acquiring the disease), which caused time bias that could confuse the results. In future studies, it is recommended to evaluate how individuals consider social distancing during their COVID-19 contraction period. In addition, it is important to determine how some people keep following protocols like the beginning days of contraction.

Conclusion

In conclusion, this study found that wearing masks, among protective behaviors, was more effective in preventing COVID-19 contraction than hand washing and using antiseptics. In addition, those who did not wear masks were at a higher risk of COVID-19 contraction. Behaviors, such as reusing masks and washing surgical masks, did not affect the contraction risk. Moreover, this study showed that wearing masks, washing hands, and using disinfectants would significantly depend on individuals' occupation, education, and underlying diseases.

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