ORIGINAL ARTICLE

# Investigating Adherence to Public Health Preventive Instructions in COVID-19 Patients: A Cross-sectional Population-based Study

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## Abstract

**Background:** The COVID-19 pandemic has proven to be a major threat to public health in the present century. In this situation, adherence to preventive behaviors seriously impacts the prevention of viral diseases. The present study aims to investigate adherence to public health preventive instructions in patients infected with COVID-19 before contracting the disease.

**Methods:** This cross-sectional study was carried out from November 2020 to March 2021 in Fars province. 3242 patients infected with COVID-19 were selected via multistage sampling. Data were collected using a demographic information form and a researcher-made questionnaire. The collected data were analyzed by Stata v. 14 using the chi-square test. $P<0.05$ was considered statistically significant.

**Results:** The average age of participants was 38.45±13.07 years. 48.80% had a high rate, 47.90% had a moderate rate, and only 3.30% had a low compliance rate with COVID-19 preventive instructions. The patients' main reason for not following preventive behaviors was having to be present in busy places (41.1%). There was a significant correlation between the participants' age, gender, place of residence, occupation, education, history of underlying diseases ($P\leq0.001$), marital status ($P=0.041$), and use of masks with a rate of adherence to preventive behaviors($P\leq0.001$). In the random forest, the job represents 36.75% compliance with COVID-19 preventive guidelines.

**Conclusion:** Therefore, by raising public awareness, healthcare policymakers and administrators can enhance the public's observance of the COVID-19 prevention instructions and consequently control the spread of the infection and improve public health during the current crisis caused by the pandemic.

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**Keywords:** Coronavirus, COVID-19 pandemic, Preventive behaviors, Preventive instructions, Public health

## Introduction

So far, the COVID-19 pandemic has been the greatest threat to human health in the present century.[1,2] The best and most effective way to fight novel viral diseases when there is a shortage of medical equipment and limited

access to vaccines is prevention and breaking the chain of transmission.[3, 4] Accordingly, WHO and CDC have introduced certain prevention guidelines, which include: social distancing and avoiding crowded areas, wearing face masks, maintaining hand hygiene, not touching one's nose, eyes and mouth in public, allowing for ventilation by keeping windows open and using proper air conditioning, and practicing home isolation in case of having mild symptoms of infection and visiting a medical center in case of severe symptoms.[5-7] Since viral diseases are highly infectious and can affect extensive areas quickly, the public must observe public health instructions.[8]

Concerning COVID-19, caused by the little-known SARS-COV-2,[9] the public must follow the public health instructions recommended by WHO and CDC.[5-7] As the incubation period of COVID-19 is long, the infected may be asymptomatic at first.[3] Moreover, the number of viruses transmitted by asymptomatic and symptomatic individuals infected with COVID-19 is equal.[10] Thus, to prevent the spread of COVID-19 by asymptomatic individuals and consequently reduce the mortality rate of the infection and its adverse economic effects, it is necessary that all individuals wear a mask in large crowds.[11] Studies show that the practice of wearing cloth masks by women in Islamic countries has resulted in fewer cases of infection in those countries.[12] According to Hans Kluge, the regional director for Europe at WHO, if 95% of people wore masks, quarantine would not be necessary.[13] Studies also show that the respiratory droplets of those infected with COVID-19 can reach as far as two meters. Therefore, practicing social distancing in large crowds can decrease the transmission and mortality rate of COVID-19.[14, 15] Since the onset of COVID-19, countries which were quicker to impose social distancing have been more successful in breaking the chain of transmission. By outlawing social gatherings, China and Italy were able to significantly control the spread of COVID-19.[16] On the other hand, the countries which were dilatory in imposing full observance of preventive behaviors at the onset of the pandemic suffered a more extensive spread of the infection and consequently faced a worse crisis in providing healthcare services.[17]

For health instructions to be followed, public awareness should be raised through education. Studies in Iran, India, Saudi Arabia, and China show high public awareness regarding the nature of COVID-19, how it is transmitted, and the prevention instructions.[18-20] However, studies report poor adherence to the entire instructions recommended by healthcare systems. According to some studies, lack of commitment to ethical principles and distrust of authorities are among the reasons which preclude long-term compliance with the prevention instructions.[21, 22] On the other hand, a study in Iran shows that social support, economic status, and the beliefs of friends and family can affect an individual's compliance with the instructions.[23] Over the past 100 years, Science Magazine has reported different results regarding the experiences of individuals with the Spanish flu. According to this journal, one of the barriers to individuals' compliance with health instructions is of the lack of attention by the infected for the hazards the infection can cause them and the people around them.[24] Until March 7, 2020, Iran ranked 15 in the world with 1,715,162 cases of infection and ranked 11 in terms of mortality with 60,928 deaths. Accordingly, the present study aims to investigate adherence to public health preventive instructions in patients infected with COVID-19 before contracting the disease.

## Methods

### *Study Design*

The present cross-sectional study was conducted on 3,242 patients infected with COVID-19 in Fars (the most populated province in the south of Iran) from November 2020 to March 2021.

### *Sampling Procedure and Participants*

The required sample size was determined based on a previous study,[25] using the following formula ($n=Z^2 * P (1-P)/d2$), and considering a confidence interval of 95%, a margin of error of 0.01, and P=0.48. Finally the sample size of 1982 was obtained.

Given a design effect of 2.5, the authors set sample size at 3000 participants. The participants were selected via cluster sampling: initially, Fars was divided into clusters (36 towns); subsequently, of the 10 towns with the highest cases of COVID-19 infection, 5 towns (clusters) were selected through simple random sampling. Eventually, from each cluster, subjects were selected from the available lists of COVID-19 patients via random sampling (random number table). After obtaining an ethics code and the permission of the Department of Research at Shiraz University of Medical Sciences, the researchers received a list of the names and phone numbers of individuals infected with COVID-19 from the body of COVID-19 prevention of the province. Data were collected through phone interviews with the participants. If a participant did not respond or contact could not be made (for three times), the next random number would be used. The inclusion criteria were: submitting one's informed consent via SMS, being a resident of the town in question, being over 18 years old, and being infected with COVID-19. For a definite COVID-19 diagnosis, the subjects should have positive CT scan and screening (RT-PCR) test results and be under treatment. The interviewees who did not answer all the questions or hung up were excluded.

*Measurement and Data Collection Tools*

In order to design the questionnaire, literature review[25, 26] and COVID-19 prevention guidelines recommended by WHO and CDC[27, 28] and the comments of a panel of experts, consisting of infectious disease specialists, community health nurses, and epidemiologists, were used. The final version of the questionnaire was comprised of 15 items. The validity of the questionnaire was measured in terms of its face and content validity. To assess the face validity of the questionnaire, the researchers used the quantitative approach of item impact with the help of 10 experts (infectious disease specialists, public health professionals, and epidemiologists). The impact score of one of the items was smaller than 1.5, while the other 14 items gained impact scores above 1.5. Thus, the item with the smallest impact score was omitted at the end of the face validity evaluation. To assess content validity qualitatively, the researchers interviewed 10 experts (infectious disease specialists, public health professionals, and epidemiologists) and asked them to evaluate the items in terms of syntax and significance. The quantitative content validity of the questionnaire was measured using the two indexes of content validity ratio (CVR) and content validity index (CVI). Finally, 10 experts were asked to determine the CVRs of the items. Based on the Lawshe table, items whose CVR is more than 0.62 are considered satisfactory.[29] At this stage, 4 items (2, 9, 10, 14) were omitted. Next, the CVIs of the items were measured in terms of simplicity, clarity, specificity, and relevance on a 4-point Likert scale using Waltz and Bausell's CVI.[30] The CVI of the questionnaire was found to be at the satisfactory level of 0.97. Next, the instrument's scale-level content validity index/averaging calculation method (S-CVI/Ave) was measured and found to be 0.93, which was a satisfactory value.

The questionnaire reliability was verified with a Cronbach's alpha of 0.811 in a pilot study with a sample size of 500 subjects in the province of Fars. Thus, the questionnaire can be used as a valid and reliable instrument in other studies. The final draft of the questionnaire consisted of 10 items scored on a 5-point Likert scale: never=1, rarely=2, sometimes=3, frequently=4, and always=5. The score range was between 10 and 50. A score of 10 to 20 indicates poor compliance, 21 to 35 indicates moderate compliance, and 36 to 50 indicates high compliance with COVID-19 prevention guidelines (the cut-off point was performed based on the interquartile range (IQR) of the outcome variable).

The present questionnaire consists of two parts: part one deals with the respondents' clinical-demographic characteristics, and part two addresses the extent of their compliance with COVID-19 preventive behaviors and their reasons for not complying with certain behaviors. The demographics questions address age, gender, marital status, education, occupation, and history of underlying diseases. The two clinical questions concern usage of masks and the type of masks used. In the present study, the extent of compliance with preventive behaviors was a dependent variable, whereas; age, gender, marital status, education, occupation, history of underlying diseases, usage of masks, and type of masks were independent variables. Three trained interviewers collected data according to a common guideline. For quality control, the research team monitored the collection and extraction of data, the entrance of data into the software, and data analysis. The collected data were analyzed in STATA V.14.1. P-values smaller than 0.05 were considered statistically significant.

*Data Analysis*

The descriptive statistics of frequency, percentage, mean, and standard deviation were used to describe the normal qualitative and quantitative data. Differences between the sub-groups were compared via the Chi-square test. The normality of all quantitative variables was examined with the Kolmogorov-Smirnov test, histograms, and box plots. The Random Forrest method was used to determine the most important variables in compliance with COVID-19 preventive guidelines. Random Forrest is one of the machine learning methods which was run through using R version 4.1.2 software and flip Multivariate package.

*Ethical Consideration*

Permission to conduct the study was obtained from the ethics committee of Shiraz University of Medical Sciences (ethical code IR.SUMS.REC.1399.856). Before initiating the research, study participants were informed of the study objectives, and the participants were also ensured of data confidentiality and the right to withdraw from the study at any stage.

## Results

The average age of the 3242 patients who participated in the study was 38.45±13.07 years. Most participants were female and married, had a bachelor's degree, resided in urban areas, and were employed in the public sector. Table 1 shows the frequency distribution of the demographic characteristics of the study population and the relationship between the participants' demographic and clinical characteristics. (It is noteworthy that 221 people withdrew from the study).

Figure 1 shows the compliance level of the patients before being infected. Of the 3242 patients infected with COVID-19, 48.80% had high compliance, 47.90% had moderate compliance, and only 3.30% had poor compliance with preventive behaviors.

**Table 1:** The relationship between the participants' demographic and clinical characteristics and the extent of their compliance with preventive behaviors

| Variables | Category | Frequency (%) n=3242 | P value | Chi-square values |
|---|---|---|---|---|
| Age (years) | 18-30 | 1046 (32.3%) | ≤0.001 | 87.975 |
| | 31-39 | 971 (30%) | | |
| | 40-49 | 620 (19.1%) | | |
| | ≥50 | 605 (18.7 %) | | |
| Gender | Male | 1235 (38.1%) | ≤0.001 | 66.639 |
| | Female | 2007 (61.9%) | | |
| Place of residence | Urban | 2959 (91.3%) | ≤ 0.001 | 28.058 |
| | Rural | 283 (8.7%) | | |
| Marital status | Single | 950 (29.3%) | 0.041 | 6.385 |
| | Married | 2292 (70.7%) | | |
| Education | Below diploma | 593 (18.3%) | ≤0.001 | 360.974 |
| | Diploma and associate degree | 933 (28.8%) | | |
| | Bachelor's | 1419(43.8%) | | |
| | Postgraduate | 297 (9.2%) | | |
| Occupation | Unemployed | 1168 (36%) | ≤0.001 | 463.913 |
| | Public sector | 1181 (36.4 %) | | |
| | Private sector | 746 (23%) | | |
| | Retired | 147 (4.5%) | ≤0.001 | 523.765 |
| History of underlying diseases | Yes | 737 (22.7%) | | |
| | No | 2505 (77.3%) | | |
| Use of face masks | Yes | 2943 (90.8%) | ≤0.001 | 538.816 |
| | No | 299 (9.2%) | | |
| Type of face mask | Homemade cloth mask | 231 (7.1%) | ≤0.001 | 52.684 |
| | Medical mask | 2802 (86.4%) | | |
| | Mask with filter N95 | 209 (6.4%) | | |

*Chi-square test

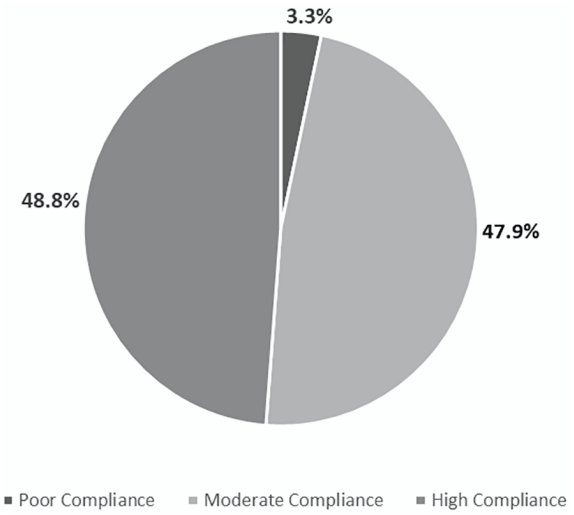


**Figure 1:** Level of compliance of the infected patients with COVID-19 preventive behaviors

Table 2 shows the frequency distribution and percentage of the patients' compliance with COVID-19 preventive behaviors.

Figure 2 shows the excuses of the infected for not fully complying with COVID-19 preventive behaviors. Being compelled to be present in crowded places was the most common excuse of the patients for their poor compliance with preventive behaviors.

In the random forest, the job represents 36.75% compliance with COVID-19 preventive guidelines and is the most important variable based on mean decrease GINI. After this variable, education with 26.81% and then age with 10.21% are in the second and third place in terms of importance (Figure 3. Random Forest compliance with COVID-19 preventive guidelines).

## Discussion

The rapid spread of the COVID-19 pandemic has created widespread fear across the globe and adversely affected most social, educational, and even medical activites.[26] It is essential that the public follow the prevention guidelines recommended by WHO to reduce the negative impact of the infection.[31, 32] The extent of public compliance with the protocols introduced by WHO depends on the public's perception of the significance of complying with the protocols in controlling the spread of COVID-19.[26]

The present study's findings show that the rate of compliance with COVID-19 preventive guidelines among the infected was at a high level. Similar studies report high public compliance in Congo,[25] but low levels of public compliance in Ethiopia.[26] The inconsistencies in the research results can be attributed to differences in the times of the studies: at the onset of the pandemic, due to low public awareness, compliance with the guidelines was unsatisfactory.[26] In the present study, the knowledge and attitude of individuals were found to affect the extent of their compliance with the protocols, which corroborates previous findings about the significance of having knowledge about the infection.[18] Also, the patients

**Table 2:** Frequency and distribution of the participants' responses to the items of the compliance with COVID-19 preventive behaviors questionnaire

| Group | | | | N Total: 3242 n (%) | | |
|---|---|---|---|---|---|---|
| **Item** | **Question** | **Always** | **Often** | **Sometimes** | **Rarely** | **Never** |
| 1 | Washing hands with soap and water for at least 20 seconds after touching a surface | 1436 (44.3%) | 867 (26.7%) | 383 (11.8%) | 251 (7.7%) | 305 (9.4 %) |
| 2 | Using a disinfectant containing at least 60% alcohol to disinfect one's hands after touching a surface | 1002 (46.9%) | 447 (20.9%) | 332 (15.5%) | 220 (10.3%) | 135 (6.3%) |
| 3 | Wearing a mask before leaving home | 2512 (77.5%) | 386 (11.9%) | 202 (6.2%) | 115 (3.5%) | 27 (8%) |
| 4 | Proper use of a mask (fitting the mask on one's face, seeing that the mask is not dirty with respiratory droplets and is not moist, and not damaging the physical structure of the mask) | 1972 (60.8%) | 618 (19.1%) | 315 (9.7%) | 171 (5.3%) | 166 (5.1%) |
| 5 | Maintaining a distance of at least 2 meters with other people outdoors | 727 (22.4%) | 923 (28.5%) | 654 (20.2%) | 481 (14.8%) | 457 (14.1%) |
| 6 | Maintaining a distance of at least 2 meters with one's family members at home | 308 (9.5%) | 335 (10.3%) | 317 (9.8%) | 601 (18.5%) | 1681 (51.9%) |
| 7 | Avoiding crowded places and events, including weddings, funerals, family reunions, and team sports | 1403 (43.3%) | 820 (15.1%) | 489 (10%) | 32 (6.4%) | 207 (10%) |
| 8 | Not touching one's face, eyes, nose, and mouth with unwashed hands | 1273 (38.2%) | 973 (30%) | 624 (19.2%) | 272 (8.4%) | 136 (4.2%) |
| 9 | Exercising self-quarantine in case of having symptoms similar to those of COVID-19 | 2335 (72%) | 500 (15.4%) | 218 (6.7%) | 133 (4.1%) | 56 (1.7%) |
| 10 | Leaving windows open at the home, workplace, and inside vehicles | 1126 (34.7%) | 921 (28.4%) | 672 (20.7%) | 299 (9.2%) | 224 (6.9%) |

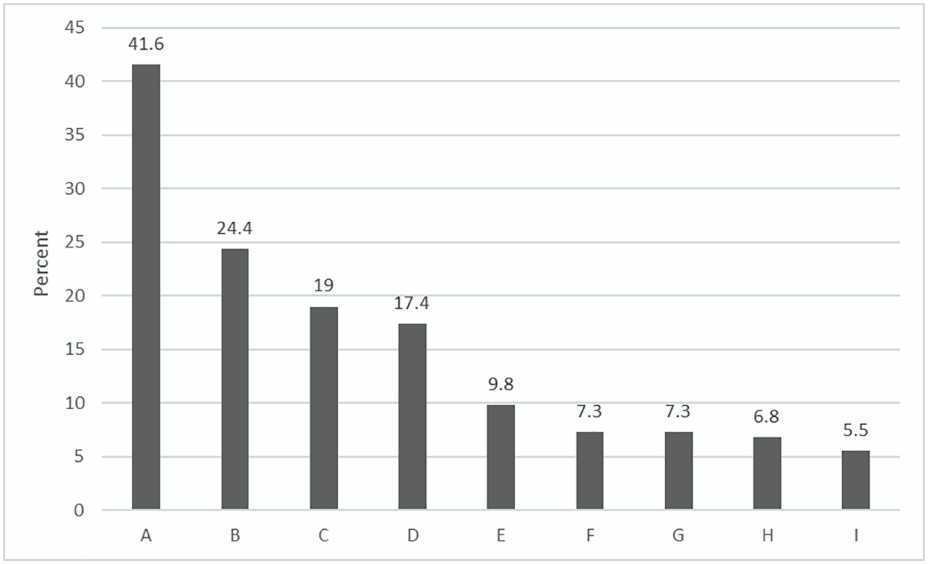


**Figure 2:** Percentage of the participants' excuses for Moderate and poor compliance with COVID-19 preventive behaviors. (A: Being compelled to be present in a crowded place, B: Getting tired of complying with prevention instructions, C: Underestimating the seriousness of the infection, D: Having difficulty complying with the prevention protocols at work, E: Not being aware of the risks of the infection, F: Believing that one has already been infected and cannot be infected again, G: Believing in God's will, H: Not being able to afford personal protection equipment, I: Not trusting scientific findings)

interviewed in the present study had high compliance regarding wearing masks. Similarly, previous studies report that in many societies, most people wear masks. The availability of masks and increased awareness about the significance of wearing masks account for similar results in different studies.[8, 33]

Unlike previous studies, the present study focused on individuals infected with COVID-19 to investigate the rate of compliance of this group with the prevention protocols prior to their infection. Despite maximum compliance with the protocols, all subjects had been infected. The results showed that social distancing and wearing masks are essential to preventing the transmission of the infection. Even though the subjects had worn masks and washed their hands regularly, they were infected due to being present in crowded places and not practicing social distancing. Previous studies with more varied samples report similar results.[25, 26, 34] These findings can contradict the claim of the regional director for Europe at WHO, Hans Kluge, that if people wear masks, quarantine will not be necessary.[13] Failure to comply with one

Random Forest: Compliance with COVID-19 preventive guidelines

Correct predictions (based on out-of-bag sample): 69.8% (1: 7.143%; 2: 56.73%; 3: 82.22%)

| | 1 | 2 | 3 | MeanDecreaseAccuracy | Importance (MeanDecreaseGini) |
|---|---|---|---|---|---|
| Job | 0.037 | 0.066 | 0.131 | 0.100 | 59.61 |
| Education | 0.026 | 0.008 | 0.075 | 0.044 | 43.48 |
| Age | 0.043 | 0.017 | 0.003 | 0.009 | 16.57 |
| Gender | 0.051 | -0.001 | 0.021 | 0.011 | 7.26 |
| Tobacco : | 0.062 | 0.001 | 0.007 | 0.005 | 5.42 |
| Marital statuse | 0.006 | 0.007 | 0.000 | 0.003 | 5.26 |
| Hypertension | -0.005 | 0.005 | 0.003 | 0.004 | 4.38 |
| Diabetes | 0.004 | 0.000 | 0.000 | 0.000 | 3.76 |
| Thyroid disease | 0.001 | -0.001 | 0.000 | -0.001 | 3.29 |
| Asthma | 0.000 | -0.001 | 0.003 | 0.002 | 2.82 |
| Cardiovascular disease | -0.001 | -0.002 | 0.002 | 0.000 | 2.72 |
| Renal disease | -0.001 | 0.000 | 0.002 | 0.001 | 2.18 |
| Digestive disease | 0.000 | -0.002 | 0.002 | 0.000 | 1.97 |
| Cancer | 0.000 | 0.000 | 0.001 | 0.000 | 1.76 |
| Immune system defects | 0.000 | -0.001 | -0.001 | -0.001 | 1.69 |

**Figure 3:** Random Forest compliance with COVID-19 preventive guidelines. 1) Low compliance with COVID-19 preventive guidelines, 2) moderate compliance with COVID-19 preventive guidelines, 3) high compliance with COVID-19 preventive guidelines.

of the COVID-19 prevention guidelines can result in one's infection. If an individual wears masks but also visits crowded areas, he/she is likely to get infected. Therefore, it can be concluded that the public must comply with all the guidelines.

Studies list various reasons why the public does not fully comply with COVID-19 prevention guidelines. For example, in Congo, where people have already experienced an Ebola epidemic, it is generally believed that hand hygiene is much more important than social distancing in preventing the spread of COVID-19.[25] It appears that past experiences have made people feel overconfident and caused them to underestimate the significance of the new protocols. Thus, governments should increase public awareness about the differences between previous and current infections. As breaking the chain of transmission is vital when not much information is available about how an emerging disease spreads, healthcare authorities should initially earn the public's trust and provide systematic education.[22] In the present study, the majority of the infected stated that due to their unsatisfactory financial and occupational conditions, they had to be present in crowds and could not exercise social distancing. They also mentioned that the long-term imposition of restrictions had made them absent in society. The study of Al-Hasan et al. shows that if governments appreciate the despair and fear of their people regarding their financial status and job security following the limitations, people will be more inclined to comply with the prevention protocols fully.[34] If people are provided with emotional support and their financial issues are addressed, they will be more likely to avoid crowded areas and encourage each other to tolerate the limitations and avoid crowds. Thus, sources of public information and educational media can play a significant role in controlling the spread of the infection.

According to an article by Nature, a futuristic model shows that most scientists expect the virus, which causes COVID-19 to become endemic, but poses less threat over time.[35] Thus, it is conceivable that the current limitations will need to be prolonged. Therefore, Healthcare authorities and spokespeople should implement policies that guarantee maximum public compliance with social distancing. The results of previous studies show that the best policy is earning the public's trust.[21, 22] According to the results of the Random Forrest analysis in the present study, the most important variables are job, education, and age. Therefore, healthcare policymakers and administrators can enhance the public's observance of the COVID-19 prevention instructions and consequently control the spread of the infection by paying attention to these three variables.

### *Strength and Limitations of Study*

It is the first study with a large sample size that compares preventive behaviors in patients with COVID-19 in Fars province. Compared to previous similar studies, one of the strengths of the present study is its use of a reliable and valid questionnaire. Another strength of the present study is that data were collected through interviews. The responses of the infected to the items on the questionnaire were recorded in interviews. This approach allowed the entire population, even the semi-literate, to participate in the study. Moreover, it enabled the researchers to discover all the facts surrounding the patients' infection by asking additional questions when necessary—when respondents complete a questionnaire on a self-report basis, they may provide biased answers and hide certain facts. A limitation of this study is that the simultaneity of exposure and outcome (lack of temporal sequence) hinders explaining the causal relationship.

## Conclusion

In the present study, more than half of the patients infected

with COVID-19 had moderate and poor compliance with the prevention guidelines prior to their infection and less than half reported high compliance with the guidelines. The most common excuses of the infected for not fully complying with preventive behaviors were being present in crowded places and tired of observing the protocols for a long time. Therefore, the authorities must constantly stress the significance of social distancing in the media in a systematic and up-to-date manner. Even though there are limited vaccine supplies in many countries now, even if the vaccine proves to be a definite cure for COVID-19 and the virus does not mutate significantly, vaccination of entire populations will take a long time. The present study's findings can prove useful in dealing with other possible pandemics in the future. This study suggests that a self-report questionnaire should be used to collect data instead of telephone interviews in future research. It is also recommended to conduct this research at the national level.

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