

# CoVID-19 symptoms analysis of deceased and recovered cases using Chi-square test

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**Abstract.** – This paper aims to show the relationship between COVID-19 symptoms and patients' status including recovered and deceased cases. The study uses different CoVID-19 patients' information from different countries, the dataset contains 13174 patients with 730 as recovered and 34 cases as deceased. The Chi-square test is adopted with asymptotic significance level to show the strength of each symptom on recovered and deceased cases independently. The study found that the recovered cases are associated with different symptoms based on the patient history, where the deceased cases showed that high fever is not responsible for increasing the number of deceased cases. In addition, the use of symptoms will not give evidence of the patients' status, and therefore gender, age, reason of infection and patients' province are more dominant in determining the status of patients.

*Key Words:*

Epidemiology, Symptoms, Infection, Chi-square.

## Introduction

The Centers for Disease Control and Prevention (CDC) has indicated that CoVID-19 patients have a range of symptoms reported from different hospitals. Symptoms of COVID-19 patients appear between 2 to 14 days from the date of infection. The symptoms may range from mild to extremely dangerous based on the age, sex and province and the reason of infection<sup>1,2</sup>. Based on the CDC, CoVID-19 patients may have different symptoms mainly fever or chills, cough, shortness of breath or difficulty breathing, fatigue, muscle/body aches, headache, new loss of taste/smell, nausea/vomiting, diarrhea, sore throat and congestion/runny nose. In addition, the CoVID-19 patient may have in some emergency cases other symptoms including trouble breathing, inability to wake and bluish face.

So far, different researchers recorded the most clinical and biological characteristics of CoVID-19 patients in all over the world. The studies have reported different information of CoVID-19 patients including the initial symptoms, incubation periods, treatment protocols and degrees of illness. They showed that different symptoms may be associated to recovered and deceased<sup>1-3</sup>. In addition, other researchers showed that deceased and recovered cases may be affected from the different weather conditions including high or low temperature, humidity, pressure, short-wave irradiation<sup>4,5</sup>. The aim of this research is to study the effect of symptoms on deceased and recovered CoVID-19 patients in different countries by using Chi-square test. Chi-square test is used to find the relationship between deceased/recovered and CoVID-19 symptoms.

## Methodology

This research aims to analyze the relationships between symptoms of CoVID-19's patients and recovered and deceased cases from different countries. The study considered 28 symptoms of different patients admitted to the hospitals including high fever (more than 38°C), low fever (less than 38°C), cough, pneumonitis, chills, chest, sore throat, fatigue, no symptoms, pneumonia, discomfort, nausea, diarrhea, runny nose, weak, headache, dry, dyspnea, myalgia, malaise, anorexia, muscle pain, pharynx, vomiting, nasal problem, difficulty in breathing, joint pain, and sputum. The data are collected from Korea Centers for Disease Control and Prevention (KCDC) from 4<sup>th</sup> of January until 1<sup>th</sup> of March. The data contain information on 13175 cases from all over the world. Not all the symptoms are recorded for all patients and several missing information is found, therefore in the analysis of symptoms only the valid data are recorded for each symptom.

To study the symptoms of CoVID-19 patients, statistical analysis and Chi-square test are considered. The tests used a relationship between the deceased, non-deceased, recovered, non-recovered cases to understand the presence or absence of symptoms in the selected patients. A Chi-square test ( $\chi^2$ ) is used to study the relationship between two variables in a contingency table. The test is highly recommended to understand a relationship between categorical variables, where to review the symptoms of CoVID-19 patients against recovered and deceased cases, a cross-tabulation method is used. The cross-tabulation method is recommended to be used between independent and dependent variables, to understand the movement of dependent variable.

### Results

Table I shows the analysis of CoVID-19 symptoms, recovered and deceased cases. The total number of samples in the whole dataset is 13174 patients. The number of recovered and deceased patients reached 730 and 34 cases, respectively. Symptoms vary depending on the patient's condition, as the analysis showed that most of the symptoms of CoVID-19 were recorded as having low fever and coughing on the other hand, cases of high temperatures are rarely recorded in CoVID-19 patients. The remaining symptoms of CoVID-19 patients range from 6 to 34 cases in the entire dataset.

The analysis of symptoms of the deceased cases showed that low fever, cough, chills, sore

throat, fatigue, runny nose and muscle pain are the only symptoms that were recorded with the deceased cases as shown in Table II. The ratios of symptoms detected in the deceased are 8.8%, 8.8%, 2.9%, 5.9%, 2.9%, 2.9% and 2.9% of the total number of deaths, respectively. While other symptoms are not reported to death cases based on the available information. To validate the impact of the symptoms in the death cases, Chi-square test is used. The results found that low fever, cough, chills, sore throat, fatigue, runny nose and muscle pain are statistically significant with deceased cases with Chi-square function and  $p$ -value from 6 to 54 and from 0.000 to 0.010, respectively.

The symptoms' analysis of the recovered cases showed that all the studied symptoms except asymptomatic were reported with the recovered cases as shown in Table II. Low fever, cough, sore throat, fatigue are the most symptoms associated with the recovered cases, the ratios of symptoms detected in the recovered are 30%, 17%, 3%, and 3% of the total number of recovered, respectively. While other symptoms are found with recovered cases with percentage less than 2% of the total number of recovered cases. To validate the impact of the symptoms in the recovered cases, Chi-square test is used. The results found that all the reported symptoms are statistically significant with recovered cases with Chi-square function and  $p$ -value from 5 to 2749 and from 0.000 to 0.019, respectively.

Finally, the deceased cases showed fewer symptoms and were found with a lower fever only or with other symptoms (such as coughs, chills,

**Table I.** Symptoms analysis of COVID-19 patients.

| Symptom      | Mean  | Sum | Symptom              | Mean  | Sum |
|--------------|-------|-----|----------------------|-------|-----|
| High Fever   | .0026 | 34  | Headache             | .0013 | 17  |
| Low Fever    | .0228 | 300 | Dry                  | .0008 | 11  |
| Cough        | .0137 | 180 | Dyspnea              | .0007 | 9   |
| Pneumonitis  | .0014 | 19  | Myalgia              | .0005 | 7   |
| Chills       | .0012 | 16  | Malaise              | .0010 | 13  |
| Chest Pain   | .0010 | 13  | Anorexia             | .0002 | 3   |
| Sore Throat  | .0028 | 37  | Muscle Pain          | .0012 | 16  |
| Fatigue      | .0022 | 29  | Pharynx              | .0005 | 6   |
| Asymptomatic | .0005 | 6   | Vomiting             | .0004 | 5   |
| Pneumonia    | .0013 | 17  | Nasal Problem        | .0003 | 4   |
| Discomfort   | .0008 | 10  | Difficulty Breathing | .0008 | 11  |
| Nausea       | .0005 | 7   | Joint Pain           | .0005 | 6   |
| Diarrhea     | .0006 | 8   | Sputum               | .0007 | 9   |
| Runny Nose   | .0011 | 15  | Deceased             | .0026 | 34  |
| Weak         | .0009 | 12  | Recovered            | .0554 | 730 |

**Table II.** The symptoms analysis of COVID-19 pandemic virus based on deceased and recovered cases.

| Symptoms                | Not founding %<br>within<br>Deceased/<br>Recovered | Founding %<br>within<br>Deceased/<br>Recovered | Pearson<br>Chi-square<br>Deceased/<br>Recovered | Asymptotic<br>Significance<br>Deceased/<br>Recovered |
|-------------------------|--|--|---|--|
| High fever              | 100/99.3   | -/7  | .088/5.47                                       | .766/019   |
| Low fever               | 91.2/69.6  | 8.8/30.4                                       | 6.564/2749                                      | .010/000   |
| Cough                   | 91.2/82.7  | 8.8/17.3                                       | 14.066/1448                                     | .000/000   |
| Pneumonitis             | 100/98.2   | 0.0/1.8  | .049/144  | .824/000   |
| Chills                  | 97.1/98.4  | 2.9/1.6  | 22.343/148                                      | .000/000   |
| Chest_pain              | 100/98.8   | 0.0/1.2  | .034/101  | .854/000   |
| Sore Throat             | 94.1/97  | 5.9/3.0  | 38.190/206                                      | .000/000   |
| Fatigue                 | 97.1/96.7  | 2.9/3.3  | 11.491/331                                      | .001/000   |
| Asymptomatic            | 100/100  | 0/0.0  | .016/0.352                                      | .901/553   |
| Pneumonia               | 100/98.2   | 0/1.8  | .044/164  | .834/000   |
| Discomfort              | 100/98.6   | 0/1.4  | .026/171  | .872/000   |
| Nausea                  | 100/99.2   | 0/0.8  | .018/86   | .893/000   |
| Diarrhea                | 100/98.6   | 0/1.1  | .021/136  | .886/000   |
| Runny nose              | 97.1/98.6  | 2.9/1.6  | 23.959/159                                      | .000/000   |
| Weak                    | 100/98.6   | 0/1.6  | .031/205  | .860/000   |
| Headache                | 100/98.5   | 0/1.5  | .044/114  | .834/000   |
| Dry                     | 100/98.5   | 0/1.5  | .028/188  | .866/000   |
| Dyspnea                 | 100/99.5   | 0/0.5  | .023/26   | .879/000   |
| Myalgia                 | 97.1/99.2  | 2.9/0.8  | .54/86  | .000/000   |
| Malaise                 | 100/99.6   | 0/0.4  | .034/8  | .854/006   |
| Anorexia                | 100/99.7   | 0/0.3  | .008/21   | .93/0.000  |
| Muscle pain             | 100/97.9   | 0/2.1  | .041/238  | .839/0.000   |
| Pharynx                 | 100/99.2   | 0/0  | .016/102  | .901/0.000   |
| Vomiting                | 100/99.5   | 0/5  | .013/53   | .909/0.000   |
| Nasal<br>Problem        | 100/99.6   | 0/4  | .010/37   | .919/000   |
| Difficulty<br>Breathing | 100/99   | 0/1  | .028/71%  | .866/000   |
| Joint_pain              | 100/99.6   | 0/4  | .016/23   | .901/000   |
| Sputum                  | 100/99   | 0/1  | .023/90   | .879/000   |

sore throat, fatigue, rhinorrhea, and muscle pain), where recovered cases were found with low and high fever with various symptoms that combined together. The results showed that the deceased cases were not associated with high fever and difficulty breathing and it is highly connected with age, sex and provinces as shown in<sup>1,2</sup>. This study adopted using different patients' symptoms to understand the relationship between symptoms and two cases including deceased and recovered cases. These results are in line with the conclusion that the symptoms only cannot determine the status of the patients, therefore age, gender and infected reasons are dominant to determine the status (i.e., death or recovered) of the patient. The results are in line with finding of the China Center for Disease Control, which found that the CoVID-19 death rate is dominant for the patients over 80 years.

## Conclusions

This research focused on understanding the relationship of the patient's status (i.e., recovered and death) and the symptoms. The study adopted 28 symptoms of different patients in different places all over the world. The main symptoms are low fever, high fever, cough, sore throat, fatigue. After discussing the obtained results, it was found that patient symptoms cannot be used to predict the patient's status, and additional information is required on medical history, gender, age and reason of infection. As a future study, extra artificial intelligence models should be used to verify the obtained results.

## Conflict of Interest

The Authors declare that they have no conflict of interests.

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