Original Article

TANAFFOS

Time-Dependent Changes in COVID-19 Severity Based on the Information of Patients Referring to Masih Daneshvari Hospital, Tehran, Iran

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Background: Coronavirus disease 2019 (COVID-19) is a newly emerged disease with many unknown facets, so both the treatment and the cause of spreading this disease have remained mysterious so far.

Materials and Methods: Based on the information of 4372 patients with COVID-19 referring to Dr. Masih Daneshvari Hospital in Tehran, the time-dependent changes in COVID-19 severity were investigated in this study using correlation analysis.

Results: According to the results of this study, on average 154.80 patients were infected with mild to moderate COVID-19, and 39.06 were infected with severe COVID-19. The results of this study also indicated a descending trend in the number of patients with mild to moderate COVID-19 (r=-0.40, P-value=0.004) and an ascending trend in the number of patients with severe COVID-19 (r=0.43, P-value=0.003) overtime on a daily basis so that almost two patients were removed from those with mild to moderate COVID-19 and one was added to the patients with severe COVID-19 on average per day.

Conclusion: Based on the current study results, it is concluded that COVID-19 severity will not be constant over time, and there is a probability of COVID-19 becoming more aggressive. Therefore, by the lack of timely control of the disease over time, we will witness an increased number of patients with severe COVID-19 and an increased number of hospitalizations in the intensive care unit (ICU) ward.

Keywords: Coronavirus disease 2019; Disease severity; Time-dependent changes; Trend; Correlation analysis

INTRODUCTION

The coronavirus disease 2019 (COVID-19) is an acute respiratory infection caused by a new virus from the coronavirus family (1). By spreading in many countries across the world, this disease has currently led to the infection and death of millions of people (2,3). The most prevalent and severe manifestation of this disease is pneumonia, and this group of patients will usually experience clinical symptoms five days after the onset of

their disease (4,5). Cough, shortness of breath, muscle pain, sputum production, and sore throat are common symptoms of this disease, and loss of sense of taste and smell are also its less common symptoms (6). Although no specific treatment has been provided for COVID-19 so far, it seems that efforts to produce a vaccine are promising (7-9). Success in treating this disease and the functioning of vaccines require that the changes in COVID-19 severity be constant over time (2, 7, 10). Any change in COVID-19

severity leads to inducing sudden changes in factors such as the contagion speed and the disease aggressiveness. For example, the increased COVID-19 severity will lead to an increased number of patients with COVID-19 over time, particularly the severe and acute types of this disease. Therefore, an essential issue before assessing the functioning of vaccines or common treatments for COVID-19 is to assess the time-dependent changes in the disease severity (2, 7, 10). Most of the COVID-19 studies have been established based on the hypothesis of constant COVID-19 severity over time (5, 7, 10,11). The results of most of these studies have revealed that about 85% of patients with confirmed COVID-19 experience mild to moderate disease, and about 15% experience severe disease (5, 11). It is relatively too optimistic to assume that COVID-19 severity is constant over time and can induce an obscure understanding of the disease and patients' treatment process. If the hypothesis of constant COVID-19 severity over time is not true and COVID-19 severity changes over time, the resultant estimates about this disease will also be time-dependent, and the epidemic control will be consequently much harder than the expectation. The constant or aggressive functioning of COVID-19 over time is a matter that is of particular importance in deciding on the disease treatment and control and also in estimating the medical and therapeutic equipment essential for patient care because by becoming COVID-19 more aggressive over time, we will witness an increased percentage of patients with severe disease, an increased percentage of patient hospitalization, particularly in the intensive care unit (ICU) ward, and an increased mortality rate of patients. Investigating time-dependent changes in the disease severity in patients with COVID-19 indeed will allow for assessing the constant or aggressive functioning of COVID-19 severity during the epidemic on the one hand and will provide the possibility of estimating the medical equipment necessary for patient care and treatment on the other hand, naturally culminating in increasing the efficiency of hospitals and treatment centers to provide services to patients with COVID-19. One of the methods used to examine time-dependent changes in COVID-19 severity is the investigation of the trend in disease severity over time so that the changes in the number of patients with mild to moderate and also those with severe COVID-19 can reveal the presence of a correlation between the disease severity and time.

Hence, the present study was designed and implemented to investigate and understand the changes in COVID-19 severity over time based on the information of patients referring to Masih Daneshvari Hospital in Tehran.

MATERIALS AND METHODS

The time-dependent changes in COVID-19 severity were investigated based on the information of 4372 patients with COVID-19 referred to Dr. Masih Daneshvari Hospital in Tehran during the epidemic. In the present study, COVID-19 severity was determined considering a clinician's opinion and the information recorded in patients' files. According to this information, the daily trends of the number of patients with mild to moderate and those with severe COVID-19 referring to Dr. Masih Daneshvari Hospital in Tehran during the epidemic were assessed. Correlation analysis was also used to investigate the time-dependent changes in COVID-19 severity during the epidemic. Moreover, in this study, a significance level of 5% was considered, and STATA software version 14 was used for data analysis.

RESULTS

According to the results of this study, within 50 days after the onset of the epidemic, on average, about 154.80 patients were infected with mild to moderate, and about 39.06 were infected with severe COVID-19 on a daily basis (Table 1). The maximum daily number of patients registered in Dr. Masih Daneshvari Hospital in Tehran was about 200 patients for mild to moderate and about 49 for severe COVID-19 (Table 1). Most of the patients were infected with mild to moderate COVID-19. Assessing the trend of the number of patients with mild to moderate COVID-19 indicates that although many variations can be

observed in the number of patients over time, the number of patients with mild to moderate disease has reduced over time. The correlation coefficient between the daily number of patients with mild to moderate COVID-19 and time also demonstrates a descending trend in the number of patients with mild to moderate COVID-19 (r=-0.40, P-value=0.004) over time. Examining the daily trend of the number of patients with severe COVID-19 also reveals that the number of these patients increases in Dr. Masih Daneshvari Hospital in Tehran over time so that the correlation coefficient between the daily number of patients with severe COVID-19 and time indicates the existence of an ascending trend over time (r=0.43, P-value=0.002). Therefore, after some time since the onset of the COVID-19 epidemic, the daily number of patients with mild to moderate COVID-19 shows a descending trend, and that of patients with severe COVID-19 denotes an ascending trend (Figure 1). Moreover, the results of this study demonstrate that, on average, almost two patients are removed from patients with mild to moderate COVID-19, and one patient is added to patients with severe COVID-19 on a daily basis.
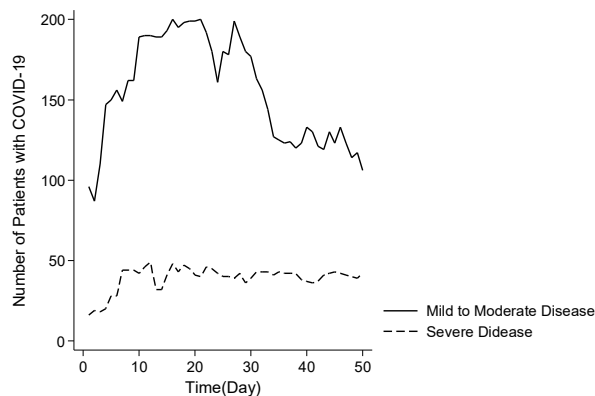

Figure 1. Time-dependent changes of severity in COVID-19 patients

Table 1. Severity of COVID-19 in under study patients based on registered daily number

Number of patients (Daily registered)	Mean	Standard deviation	Minimum	Maximum
Mild to moderate	154.80	33.45	87	200
Severe	39.06	7.54	16	49

DISCUSSION

COVID-19 is a newly emerged disease with many unknown facets, so both the treatment and the cause of spreading this disease have remained mysterious so far (5, 12). By taking health actions and imposing broad restrictions, different countries are attempting to control the COVID-19 epidemic on the one hand, and by assessing different medicines and treatment methods, they are trying to find a treatment or discover a vaccine for COVID-19 on the other hand (4, 5, 7, 13). Thus, since the onset of the COVID-19 outbreak, scholars and researchers have examined a wide variety of medicines and treatment methods to treat this disease (7, 10, 14,15). Of course, the treatment methods and medicines used to treat patients with COVID-19 are still in the experimental stage, and in most cases, their efficiency has not been confirmed by the World Health Organization (WHO) as an effective medicine or method to treat patients with COVID-19 (7, 10, 14, 16). However, an essential issue before assessing patient treatment or discovery of a vaccine is to investigate the changes in the disease severity over time and to estimate the medical and treatment equipment necessary for hospitalization and care of these patients (2, 7, 10). Assuming COVID-19 severity to be constant over time can induce an obscure understanding of this disease. The existence of an ascending trend in the daily number of patients with severe COVID-19 can indicate that COVID-19 is getting more aggressive over time. The issue that the disease severity and subsequently the percentage of patients with mild to moderate and also those with severe COVID-19 is constant over time or changes as time passes is an issue investigated in no study so far (5, 7, 10,11). Numerous studies with the assumption of COVID-19 severity being constant over time have indicated that about 80-85% of patients with COVID-19 will experience mild to moderate, and about 15-20% will experience severe and acute disease symptoms (4,5, 11). Most patients recover without therapeutic interventions with home quarantine, but a part of the patients must be hospitalized in the general ward or the ICU ward due to underlying diseases

and also severe and acute types of this disease (7, 10, 17). Therefore, understanding the constant or variable COVID-19 severity over time requires investigating the daily trend of the number of patients with mild to moderate and severe COVID-19. Therefore, the time-dependent changes in COVID-19 severity were investigated in this study based on the information of patients referring to Masih Daneshvari Hospital in Tehran. According to the study results, most of the patients were infected with mild to moderate COVID-19, so on average, within 50 days after the onset of the epidemic, about 154.80 patients were infected with mild to moderate, and about 39.06 patients were infected with severe COVID-19. The results of this study also demonstrate that the daily trend of the number of patients with mild to moderate COVID-19 within 50 days after the onset of the epidemic is not uniform, so in the first 20 days after the epidemic, the number of patients with mild to moderate disease has an ascending trend and in the next 30 days a descending trend. The correlation analysis results also show a generally descending trend in the number of patients with mild to moderate COVID-19 within 50 days after the onset of the epidemic. Furthermore, assessing the daily trend of the number of patients with severe COVID-19 also reveals an ascending trend until about 10 days after the onset of the epidemic. After this time, the trend of the number of patients with severe COVID-19 is almost uniform. Examining the results of the correlation analysis of the number of patients with severe COVID-19 with time also indicates that although the number of patients with severe COVID-19 is almost uniform after 10 days, overall, the number of patients with severe COVID-19 is increasing over time. Although the correlation between the number of patients with mild to moderate and severe COVID-19 on a daily bases may not be much remarkable, these results reveal that COVID-19 severity will not be constant over time, and it is probable that COVID-19 becomes more aggressive so that based on the results of this study, on average, two patients are removed from the number of patients with mild to moderate COVID-19 per day, and one patient is added to

the number of patients with severe COVID-19 instead. Hence, passing the time after the onset of the epidemic and its lack of timely control, we will witness an increased number of patients infected with acute and severe types of this disease and an increased percentage of patient hospitalization, particularly in the ICU ward.

CONCLUSION

In conclusion, it is worth mentioning that investigating the daily trend of the number of patients with mild to moderate and severe COVID-19 will allow for assessing the disease severity and the constant or aggressive functioning of COVID-19 overtime on the one hand and will also provide the healthcare authorities with the possibility of estimating the therapeutic equipment necessary for COVID-19 patient care, on the other hand.

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