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SHORT-TERM FORECASTS OF THE COVID-19 EPIDEMIC IN TURKEY: MARCH 16–28, 2020

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Abstract

The trend of COVID-19 and its reproductive number should be well examined because the transmission potential of novel coronavirus can reach high values. In this study the early stage of COVID-19 in Turkey between March 16 and March 28, 2020 was examined. Generalized Logistic growth model, Richards Model, and sub-exponential growth models were compared to estimate the trend of disease. Results showed that the reproductive number was between 2.00 and 2.45 at interested period. The best fitting model has been determines as sub-exponential growth model with scaling of growth parameter of 0.91.

Keywords: COVID-19, Reproductive number, Growth curve, Turkey

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1. Introduction

The first case of novel coronavirus determined with onset of symptoms of pneumonia with unknown etiology in Wuhan City, Hubei Province, China at December 08, 2019. China reported a cluster of cases of pneumonia with unknown etiology in Wuhan to WHO at December 31, 2019 with 27 cases and no deaths. Chinese scientists identified the pathogen as a novel coronavirus at January 07, 2020. WHO declared a "public health emergency of international concern" at January 30, 2020 with 7736 confirmed cases and 170 deaths in China and 82 confirmed cases with no death outside of China. Within a short time at February 20, 2020 in China confirmed cases reached to 74675 with 2121 deaths when these outside of China reached to 1073 confirmed cases with 8 deaths (Wu and McGoogan, 2020).

Early cases of the COVID-19, cause of the severe acute respiratory syndrome, have been linked to a live animal seafood market in Wuhan, pointing to a zoonotic origin of the epidemic. However, human-to-human transmission has driven its rapid spread in the strongly interconnected human world community (Roosa et al., 2020a; Bianconi et al., 2020; Jung et al., 2020). Tian et al., (2020) argued that the COVID-19 infection was generally susceptible, and with a relatively low fatality rate. The measures to prevent transmission was very successful at early stage, COVID-19 infection should be focused on early isolation of patients and quarantine for close contacts in families and communities. While the transmission potential of novel coronavirus can reach high values the epidemiological features of COVID-19 are still unclear (Roosa et al., 2020b).

The first confirmed case reported at March 11, 2020 and the first death reported at March 16, 2020 with 47 confirmed cases in Turkey. The Ministry of Internal Affairs announced that venues such as schools, mosques, cinema, concert hall, wedding hall, cafe, coffee shop, massage hall, and gym will be closed temporarily at March 16, 2020. It was announced that the activities of the barber, hairdresser and beauty centers will be stopped at March 21, 2020. After ten days of first death at March 26, 2020 the number of confirmed cases reached to 3629 and deaths reached to 75.

The basic reproduction number is a central concept in infectious disease epidemiology, indicating the risk of an infectious agent with respect to epidemic spread (Liu et al., 2020). The important value in evaluating the effectiveness of quarantine and isolation is the reproductive number R, which is the expected number of secondary infectious cases resulting from an average infectious case once the epidemic is in progress. With R < 1, there is no epidemic. For R > 1, there is an epidemic. The larger the reproductive number, the more virulent the epidemic (Lipsitch et al., 2003).

Modelling the disease outbreak is also essential informative tool for epidemics to understand the course of the disease. Generalized Logistic growth model, Richards Model, and sub-exponential growth model (Roosa et al., 2020b) which have each been previously used to forecast outbreaks due to different infectious diseases were used to modelling in this study.

2. Material and Method

The used data obtained from the daily reports of confirmed COVID-19 patients released by Turkey Ministry of Health.

To estimate the reproductive number R,

$$R = \frac{kb}{v+m+w}(1-q)$$

was used. Where; k is the mean number of contacts per day someone from infectious-undetected, b is the probability that a contact between person in infectious-undetected, v is the per capita recovery rate, m is the per capita death rate, w is the fraction per day of those in infectious-undetected who are detected and isolated and thus transferred to category infectious-isolated and q is the fraction per day of individuals in susceptible who have had exposure to COVID-19 that go into quarantine (Lipsitch et al., 2003).

The generalized logistic growth model (GLM) extends the simple logistic growth model with a scaling of growth parameter p that accommodates sub-exponential growth patterns. The GLM is defined by the differential equation;

$$C'(t) = rC(t)^p\left(1-\frac{C(t)}{K}\right)$$

where $C(t)$ is the cumulative cases at time t, r is the early growth rate, p is the scaling of growth parameter, and K is the carrying capacity and final epidemic size. Values of p = 1 correspond to exponential growth, p = 0 represents constant growth, and $0 < p < 1$ defines sub-exponential growth (Roosa, 2020b; Viboud et al., 2016; Roosa et al., 2019).

The Richards model extends the simple logistic growth model through a scaling parameter (a) which measures the deviation from the symmetric simple logistic curve;

$$C'(t) = rC(t)\left(1-\left(\frac{C(t)}{K}\right)^a\right)$$

where $C(t)$ represents the cumulative case count at time t, r is the growth rate, K is the final epidemic size, and a is a scaling parameter (Roosa, 2020b; Richards, 1959; Wang et al., 2012).

3. Results and Discussion

The reproductive number (R) of COVID-19 in Turkey at early stage of pandemic between March 16 and March 28, 2020 had a waving structure even if there were some decreasing attempt (Figure 1).

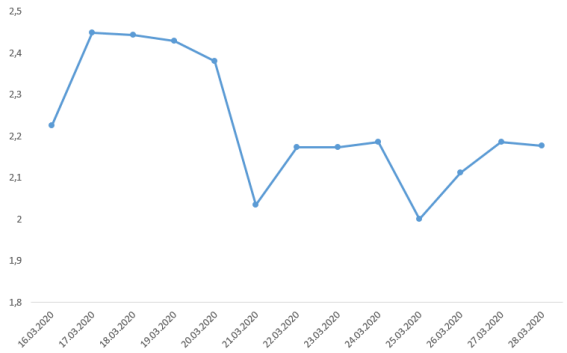

Figure 1. Reproductive number of COVID-19 in Turkey between March 16 and March 28, 2020.

This decreasing may be caused by closing of some venues such as schools, mosques, cinema, concert hall, wedding hall, cafe, coffee shop, massage hall, and gyms. Some increasing points may be occurred the people's reactions to the semi-curfew. It may be interpreted as people did not understand the seriousness of the event. The waving shape of graph was usual because that shape was observed the early stage of COVID-19 in China (Wu and McGoogan, 2020).

To understand the shape of COVID-19 trend, growth curve models (Generalized Logistic growth model, Richards Model, and sub-exponential growth model) were compared (Figure 2). For sub-exponential growth model, many values of p (scaling of growth parameter) were examined and best fitting value was used as (p=0.91).

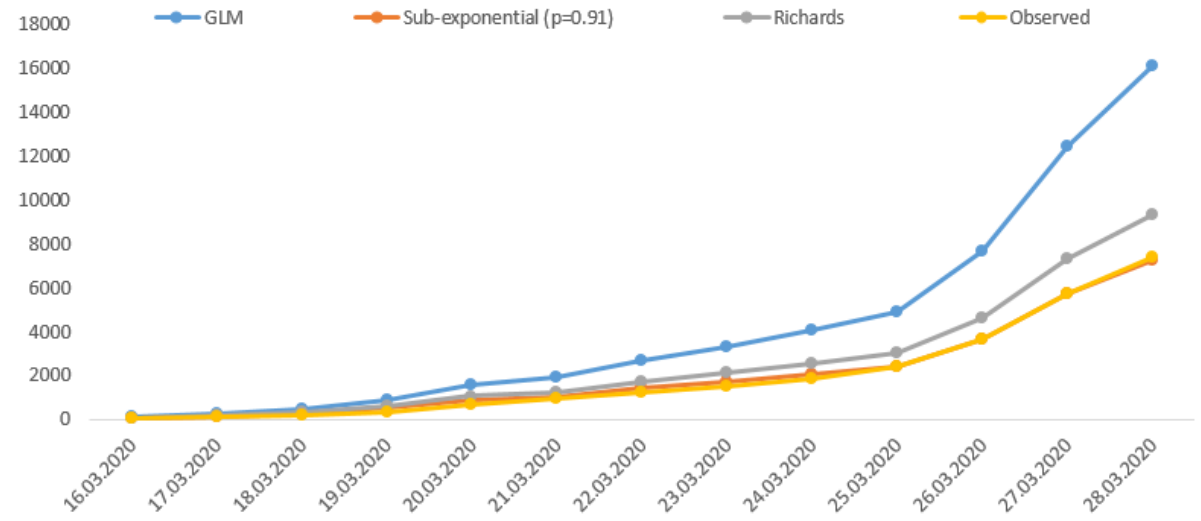

Figure 2. Estimated growth models for COVID-19.

According to the results the best fitting model has been determines as sub-exponential growth model with scaling of growth parameter of 0.91. Sub-exponential growth model was estimated the COVID-19 growth case almost exactly. At the last part of graph the estimations of sub-exponential growth model can be supposed as exact.

To compare the models regression analysis was applied to the models to get comparison criteria such as coefficient of determination, Root Mean Square Error (RMSE) and AIC (Tunç and Enöz, 2018) (Table 1).

Table 1. Comparison criteria for used models

Model	Adj R^2	RMSE	AIC
Generalized Logistic	0.999	3464.96	107.96
Sub-exponential	0.999	135.26	65.79
Richards	0.999	832.55	89.42

Even if all models had yield of 0.999 coefficient of determination. The minimum Root Mean Square Error (RMSE) and minimum AIC values were obtained from sub-exponential growth model as expected from the graph. Sub-exponential growth model was found as the best fitted model by some other researchers (Viboud et al., 2016; Roosa et al., 2020a; Roosa et al., 2020b).

4. Conclusion

The reproductive number (R) of COVID-19 in Turkey was found within the literature declaration which is between 2.2 and 2.68 as seen in Figure 1 (Liu et al., 2020; Jung et al., 2020). The reproductive number of the last stage of interested period was lower than from the other countries. The best estimation method was found as sub-exponential growth model with scaling of growth parameter of 0.91. These results showed that the people should continue to obey the restrictions to avoid COVID-19.

Conflict of interest

The authors declare that there is no conflict of interest.

References

Bianconi A, Marcelli A, Campi G, Perali A. 2020. Ostwald growth rate in controlled Covid-19 epidemic spreading as in arrested growth in quantum complex matter. arXiv:2003.08868.

Jung S, Akhmetzhanov AR, Hayashi K, Linton NM, Yang Y, Yuan B, Kobayashi T, Kinoshita R, Nishiura H. 2020. Real-time estimation of the risk of death from novel coronavirus (COVID-19) Infection: Inference using exported cases. J Clin Med, 9: 523, DOI: 10.3390/jcm9020523.

Lipsitch M, Cohen T, Cooper B, Robins JM, Ma S, James L, Gopalakrishna G, Chew SK, Tan CC, Samore MH, et al. 2003. Transmission dynamics and control of severe acute respiratory syndrome. Science, 300: 1966–1970.

Liu Y, Gayle AA, Wilder-Smith A, Rocklöv J. 2020. The reproductive number of COVID-19 is higher compared to SARS coronavirus. J Travel Med, 2020: 1–4, DOI: 10.1093/jtm/taaa02.

Richards F. 1959. A flexible growth function for empirical use. J Exp Bot, 10: 290–301.

Roosa K, Luo R, Chowell G. 2019. Comparative assessment of parameter estimation methods in the presence of overdispersion: A simulation study. Math Biosci Eng, 16: 4299–4313.

Roosa K, Lee Y, Luo R, Kirpich A, Rothenberg R, Hyman JM, Yan P, Chowell G. 2020a. Real-time forecasts of the COVID-19 epidemic in China from February 5th to February 24th, 2020. Infect Disease Modell, 5: 256e263. DOI: 10.1016/j.idm.2020.02.002.

Roosa K, Lee Y, Luo R, Kirpich A, Rothenberg R, Hyman JM, Yan P, Chowell G. 2020b. Short-term forecasts of the COVID-19 epidemic in Guangdong and Zhejiang, China: February 13–23, 2020. J Clin Med, 9: 596, DOI:10.3390/jcm9020596.

Tian S, Hu N, Lou J, Chen K, Kang X, Xiang Z, Chen H, Wang D, Liu N, Liu D, Chen G, Zhang Y, Li D, Li J, Lian H, Niu S, Zhang L, Zhang J. 2020. Characteristics of COVID-19 infection in Beijing. J Infect, 80: 401–406, DOI: 10.1016/j.jinf.2020.02.018.

Tunç T, Enöz S. 2018. Analysis of job satisfaction levels of police

with structural eqution modeling: the case of Samsun. BSJ Eng Sci, 1(4): 134-139.

Viboud C, Simonsen L, Chowell G. 2016. A generalized-growth model to characterize the early ascending phase of infectious disease outbreaks. Epidemics, 15: 27–37.

Wang X-S, Wu J, Yang Y. 2012. Richards model revisited: Validation by and application to infection dynamics. J Theor Biol, 313: 12–19.

Wu Z, McGoogan JM. 2020. Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China. JAMA, DOI: 10.1001/jama.2020.2648.