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ORIGINAL RESEARCH PAPER

The effect of coronavirus restrictions on air quality and exiting daily traffic

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ABSTRACT

BACKGROUND AND OBJECTIVES: This research attempted to analyze the negative and positive aspects of Coronavirus: its effect on air quality and traffic volume. The sample city of this research was Tehran and transportation behavior toward the Coronavirus and minor quarantines in specific.

METHODS: Six indices were considered for Tehran city in two consecutive years (in quarantine period): carbon mono-oxide, nitrogen dioxide, sulfur dioxide, particulate matters, air quality index, and daily traffic volume, which depart from Tehran city to other destinations. Daily traffic volume changes were examined for four roads separately, and total departed trips were also investigated. This comparison was made graphically and statistically by using the regression model and one-way t-test.

FINDINGS: Results showed that from 20th February to 19th March, the average of produced CO, NO2, and PM10 decreased in 2020 compared to 2019, but other indices related to air pollution were increased in 2020. The average daily traffic in existing roads of Tehran City was declined significantly in 2020. Regression models and a one-way t-test showed that the growth rate of emission production was higher in 2019 compared to 2020. Also, this rate for daily traffic volume was higher from March 20 to April 19 of 2020 compared to 2020.

CONCLUSION: The regression model on indices showed valuable results. For instance, the O3 emission slope in the second month reduced from 0.6 to 0.5; however, the exiting traffic of Tehran city reduced by 47 percent that indicates the higher resident population of Tehran city compare to the last year.

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INTRODUCTION

Coronavirus is a big family encompassing usual cold to intense and dangerous diseases like MERS Coronavirus and SARS Coronavirus. SARS- Cov 2 was initially observed in Wuhan city in China on 31st December 2019, and it was called "Covid-19" (Haas *et al.,* 2020; Lee and Ong, 2020; Li *et al.,* 2020a). In the following, this virus was reported in some other countries. In Iran, after several negative tests given on suspicious people, two positive results were reported regarding two patients in Qom province on 19th February 2020. Then, positive results of Covid-19 tests were reported first from the nearby provinces to Qom, and subsequently, from all provinces of the country. The government attempted to prevent Coronavirus from spreading by closing academic places, reducing present employee numbers, closing some guilds, and prohibition of inter-province transportation (Abdi,2020; Amlashi *et al*., 2020; Behzadifar *et al*., 2020; Tran *et al*., 2020). The statistics by the time of this article (July 2020) showed more than 12 million and 250 thousand patients and 550 thousand and 12 thousand death all over the world and in Iran, respectively (Worldometers, 2020). On the other hand, each year, many people all over the world die due to air pollution (Nunes and Hernandez, 2020; Rojas-Rueda *et al*., 2012; Wadud and Waitz, 2011). Tehran, as the capital city of Iran and a metropolis, is not an exception, and according to available data, air pollution is the main reason for 4000 deaths in Tehran city (Hadian *et al*., 2020; Tehran times, 2019). Some primary causes of air pollution in Tehran city include industrial, production and vehicle pollution production, and so on, from which vehicle is the primary source of air pollution in Tehran city (Heger and Sarraf, 2018; Hosseini and Shahbazi, 2016; Vafa-Arani *et al*., 2014). Due to the limitations of human-based activities actions resulting from Coronavirus and quarantine, the reports indicate the positive effect of Coronavirus on air pollution in some countries (Isaifan, 2020; Gupta *et al*., 2020). One of the main challenges of this research is the effect of this virus on the air quality of Tehran city, which will be analyzed in the next sections. Another view is about traffic volume. In Iran, during the New Year holidays, which begin in late March, there are many leisure trips from Tehran city to other cities, especially to northern Iran (Vahdati *et al.,* 2014). However, travel restrictions because of the Coronavirus epidemic in the current year affect traffic volume and air pollution, which is examined in this study.

Quarantine, Air Pollution, and transportation engineering

Many factors affect the air quality of a city. Coronavirus and quarantine effects on air quality are some of these factors analyzed recently. Many studies have considered air quality in various cities and countries, which will be described later. Most of these studies have considered quarantine effect only on pollution and compared the air quality of the quarantine period to the same period last year. Bao and Zhang (2020) used a baseline regression model on 44 northern cities of China to predict the air quality index. Their prediction was with the help of variables like air quality index in the past, lockdown, and human, and the results showed the vital role of human activities on air pollution. Another study by Dantas *et al*., (2020) is investigated the effect of partial quarantine on air pollution graphically by using the data of Rio de Janeiro in Brazil. Their results showed an improvement in air pollution indices. Gupta *et al*., (2020), the same as Dantas *et al.,* (2020), made a graphical comparison on China and the USA. The results were similar to Dantas *et al* (2020) and some other cases (Kerimary *et al*., 2020; Li *et al*., 2020b; Mahato *et al*., 2020; Masum and Pal., 2020; Otmani *et al*., 2020; Quere *et al*., 2020; Sharma *et al*., 2020; Sicard *et al*., 2020). Some studies analyzed the effect of Coronavirus and quarantine on the economy as well as the environment. The results of environment indices were promising; however, the effect of Coronavirus on the economy showed significant differences in retail, grocery, pharmacy, and industry (Caraka *et al*., 2020). Also, the article of Haghani *et al*., (2020) is useful for accessing more comprehensive information regarding published articles about Coronavirus, particularly in safety sciences like medicine safety, food safety, blood safety, and patient transport. Also, in quarantine time, urban and suburban transportation is affected by the Coronavirus epidemic. Roads and cities experience low traffic volume and high traffic speed. Some studies around the world investigated on pandemic and transportation engineering. For example, in the United States in stay-at-home areas, average daily travel distance declined from 8.0 to 1.6 km in late March 2020 (Glanz *et al.,* 2020). Traffic jams

have disappeared in San Francisco and Los Angeles. Also, traffic speed on D.C.-area roads on quarantine Tuesdays moved an average 38 percent faster than on a typical Tuesday. By Wednesday morning, Chicago's traffic speeds were 77 percent higher than usual, and this percentage for Los Angeles equals to 53 percent. On Wednesday, Metro ridership had declined by 84 percent and by 63 percent on buses (Shaver, 2020).

Contribution

Based on the presented literature review, many studies have been published in different countries during Coronavirus spreading, from which Iran is not an exception. Studies performed about Iran dealt with Coronavirus's effect on people's lives, most of which have considered it based on medical aspects (Ahmadi *et al.*, 2020; Behzadifar *et al.*, 2020). However, the shortage of transportation studies and in specific, studies regarding the coronavirus effect on air pollution and traffic volume is actually realized. Based on these points, this research attempts to consider corona spreading effect on air pollution and traffic volume in Tehran city according to six indices. These six indexes are collected from February 20 to April 19 in 2019 and 2020, and their values are compared for these years. The current study has been carried out in Tehran city in 2020.

MATERIALS AND METHODS

Study area

Tehran city, as the capital city of Iran, is located in the northern part of this country- with almost 8.5 million populations (Edrisi and Askari, 2020; Maghmoumi *et al.*, 2020). This population reaches 12.5 million in daylight, due to daily transportation for work and business goals. Seventeen million vehicle trips are reported each day, and due to air pollution made by these trips, people breathe polluted air in most days of the year (Nourzadeh *et al.*, 2019). On the other hand, due to its geographical position -located between the Alborz Mountains, it seems impractical to remove the polluted air (Heger and Sarraf, 2018). The location of Tehran is presented in Fig. 1.

Data selection and methodology

The present research data include Carbon Monoxide, Sulfur Dioxide, Nitrogen Dioxide, Particulate Matters, Air Quality Index, and the Daily vehicle traffic of Tehran province. These data are provided through the website of the Air Pollution Control System, and the toll stations loop detectors (AQMS, 2020; RMTO, 2020). However, the primary purpose is to compare the trend and measure of these data in the quarantine period, February 20 to April 19 in 2019 and 2020 to the same period of the previous year. The research stages include 1- data collection 2- preparation and drawing charts 3- optical analysis of results and charts 4- statistical comparison of indices. Carbon mono-oxide (CO) is a very harmful gas for the human, produced by vehicles, light, and heat equipment. Nitrogen dioxide (NO_2) is produced by the combustion of fossil fuels, while vehicle traffic is the primary source producing NO_2. Each year 4.6 million people die due to nitrogen dioxide emissions. The primary source of sulfur dioxide (SO_2) involves industrial, mineral, and powerhouse actions, causing acid rains. Particulate matters (PM) are pollutants made of solid and liquid matters, having natural and human made sources. Air quality index (AQI) is a computable measure whose main merit includes air quality awareness of vulnerable groups, and the method of protection against it (Gupta *et al.*, 2020). Air pollution-related data are provided using the website of the Air Pollution Control System of Iran. Loop detectors collect daily traffic volumes. These loop detectors are installed on exit roads of Tehran city, in toll stations. Data includes 60 days, from February 20 to April 19 in 2019 and 2020. The reason for selecting this period is the approved first positive Coronavirus test at this period. In this period, closed academic places such as schools and universities, remote working of several employees and clerks, and closing the guilds because of epidemic coincide with the Persian new-year holidays. Paying insufficient attention to these matters will misguide researchers and bring the wrong results.

RESULTS AND DISCUSSION

Graphical comparison

In this study, the effect of Coronavirus and quarantine on air pollution and daily traffic volume analyzed, by comparing corresponding values for February 20 to April 19 of 2019 and 2020. Table 1 shows the average of produced emission and the average daily traffic volume for these periods of 2019 and 2020.

Table 1 indicates that only the average of produced CO, NO_2, and PM_{10} decrease in 2020, which

Table 1: The average of produced emission and the average daily traffic volume

Indices	Type of indices	Units	Average in 2019	Average in 2020
CO	Produced emission	ppm	29.3	29.1
O_3	Produced emission	ppm	22.7	35.8
NO_2	Produced emission	ppm	57.2	49.3
SO_2	Produced emission	ppm	22.6	24.9
PM_{10}	Produced emission	$\mu g/m^3$	40.2	39.0
$PM_{2.5}$	Produced emission	$\mu g/m^3$	57.9	66.2
Index	Air quality index	-	57.9	66.7
Saveh	Daily traffic volume	veh/hr	67359	36921
Pardis	Daily traffic volume	veh/hr	17923	21357
Qom	Daily traffic volume	veh/hr	62819	13322
Karaj	Daily traffic volume	veh/hr	93673	55310
Total	Daily traffic volume	veh/hr	228000	121414

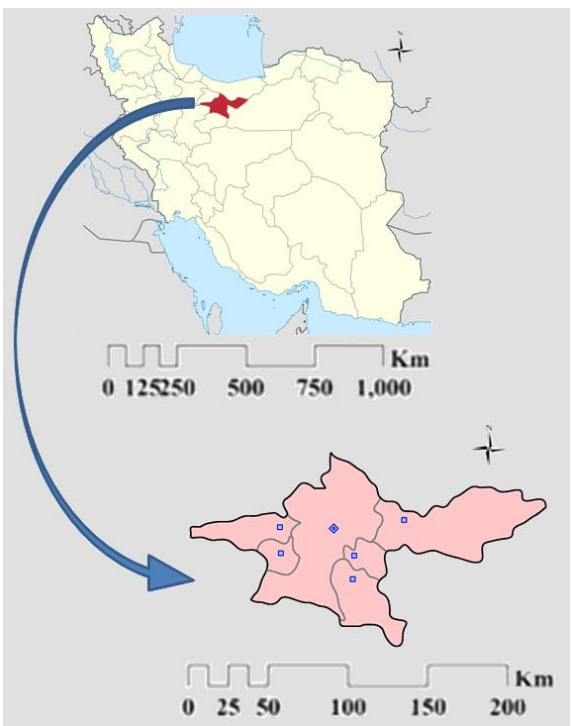

Fig. 1: Geographical location of the study area in Tehran, Iran

this increase seems to be insignificant. On the other hand, the average daily traffic except for those to Saveh is declined drastically in 2020. Figs. 2 and 3 show the trend of air pollution production and daily traffic volume. Based on these graphs, there is no apparent difference between air pollution production in 2019 and 2020. However, daily traffic volume is affected by the Coronavirus epidemic significantly.

Statistical comparison

Another critical point to be considered is to find the general trend of changes and employing another method for comparing indices for different years statistically. For this purpose, the linear regression analysis is used as Eq. 1:

$$y_t = \beta_0 + \beta_1 * y_{t-1} + \varepsilon \quad (1)$$

This regression investigates the relationship between the amount of each parameter in day t and previous day t-1. If the coefficient of y_{t-1} (β_1) has a positive sign the trend of indices is growing in that period. β_0 is the intercept, and ε is the error term of the regression model. Regression models are calibrated for each parameter for the year 2019 and 2020 separately. Higher β_1 means a higher growth rate. To compare β_1s statistically, the one-way t-test is employed (Eq. 2).

$$t = \frac{\beta_{1,2019} - \beta_{1,2020}}{\sqrt{\frac{\left(se_{1,2019}\right)^2 + \left(se_{1,2020}\right)^2}{n}}} \quad (2)$$

Where $\beta_{1,2019}$ and $\beta_{1,2020}$ are regression

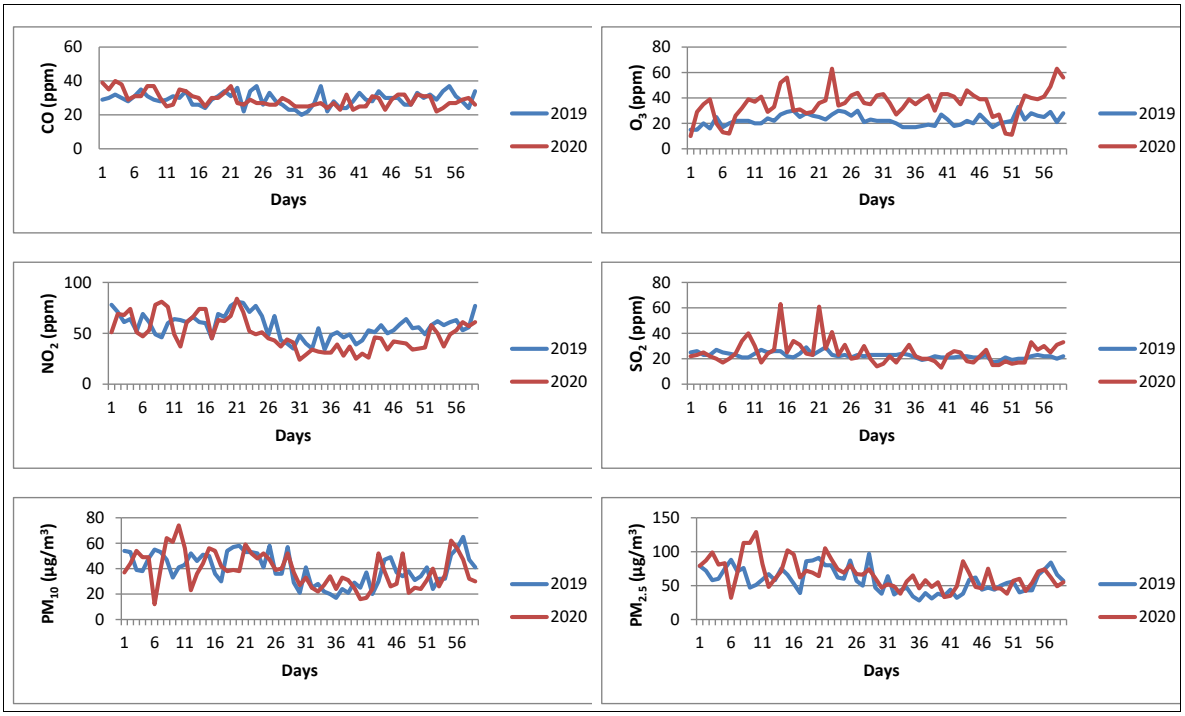

Fig. 2: Trend of air pollution production and daily traffic volume (A)

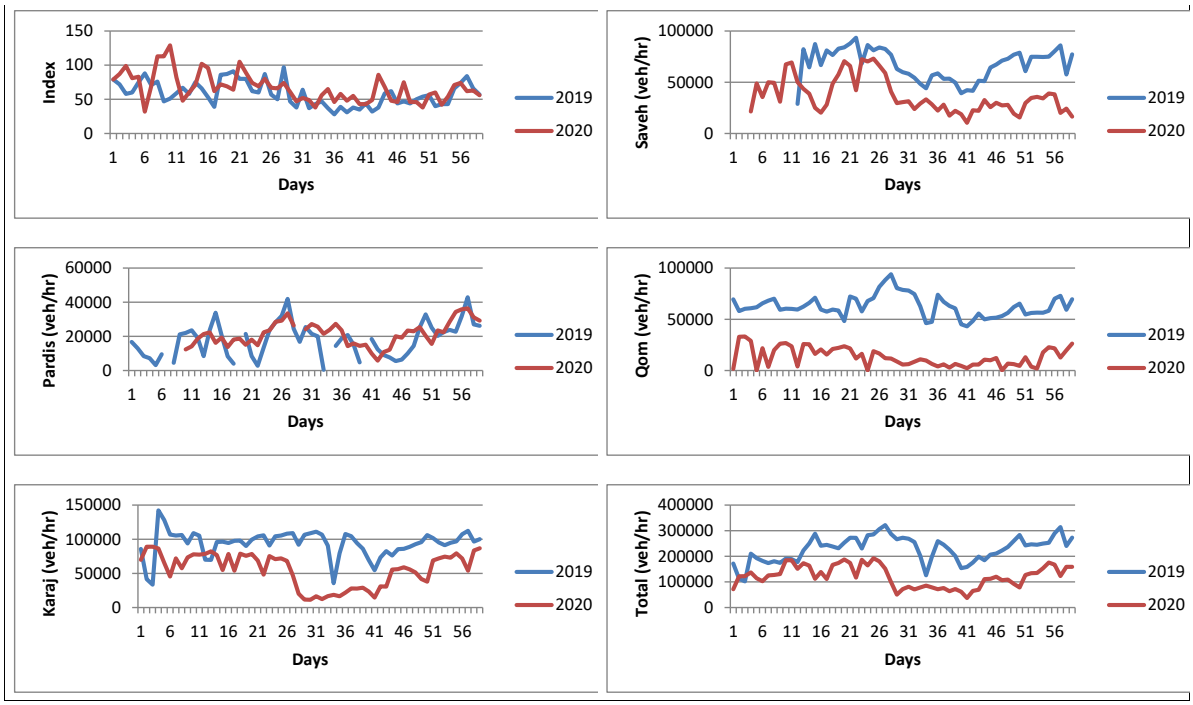

Fig. 3: Trend of air pollution production and daily traffic volume (B)

Table 2: Statistical comparison by using the regression model and one-way t-test

Indices	Period	First-year β_0	First-year β_1 (t)	Second-year β_0	Second-year β_1 (t)	One way t-state	P-value
CO	First month	34 (5.8)	0 (0.7)	15.7 (2.8)	0.5 (2.8)	-12.5	8.327325e-13
CO	Second month	19.6 (3.8)	0.3 (1.7)	25.5 (5)	0.1 (0.4)	5.3	1.616313e-05
O_3	First month	14.6 (3.6)	0.3 (1.9)	11 (2)	0.7 (5)	-9	5.646415e-10
O_3	Second month	9.7 (2.6)	0.6 (3.7)	18 (3.1)	0.5 (2.9)	2.4	0.02573682
NO_2	First month	39.3 (3.1)	0.4 (1.9)	30.5 (2.7)	0.5 (2.7)	-2.2	0.04028434
NO_2	Second month	23.3 (2.5)	0.6 (3.1)	14 (2.2)	0.7 (4.2)	-2.3	0.03091777
SO_2	First month	18.4 (3.9)	0.2 (1.2)	28 (4.7)	0 (0.1)	4.2	0.0003853051
SO_2	Second month	11.6 (3.3)	0.5 (2.8)	12.2 (3.2)	0.4 (2.5)	0.4	0.3604773
PM_{10}	First month	38.9 (4.1)	0.2 (0.9)	34.5 (3.8)	0.3 (1.4)	-1.5	0.3604773
PM_{10}	Second month	16.1 (3)	0.5 (3.5)	20.4 (3.6)	0.4 (2.2)	4	0.0005751396
$PM_{2.5}$	First month	57.4 (4)	0.2 (0.8)	51.7 (3.4)	0.4 (1.9)	-3.4	0.002427118
$PM_{2.5}$	Second month	28.2 (4)	0.4 (2.9)	43.2 (4.4)	0.2 (1.1)	5.1	2.247563e-05
Index	First month	57.4 (4)	0.2 (0.8)	51.7 (3.4)	0.4 (1.9)	-3.4	0.002427118
Index	Second month	28.5 (4)	0.4 (2.9)	45.4 (4.6)	0.2 (1)	5.6	5.831283e-06
Saveh	First month	90173.9 (8.4)	0 (0.9)	26121.3 (2.9)	0.5 (2.9)	-15	9.580514e-15
Saveh	Second month	16509.7 (2.1)	0.7 (5.8)	13931.4 (3.1)	0.5 (2.9)	7.5	3.26434e-08
Pardis	First month	6758.5 (1.9)	0.6 (3.4)	6585.5 (1.9)	0.7 (4.2)	-2.4	0.02767826
Pardis	Second month	3741.2 (1)	0.8 (4.5)	3301.7 (1.4)	0.9 (8.2)	-2.6	0.01612949
Qom	First month	15474.1 (1.3)	0.8 (4.2)	17395 (4.5)	0 (0.2)	14.9	1.292032e-14
Qom	Second month	22730.5 (3.2)	0.6 (5.3)	3272.9 (1.9)	0.7 (4)	-1.7	0.0951005
Karaj	First month	66410.7 (3.6)	0.3 (1.7)	48954 (3.4)	0.3 (1.4)	0.4	0.3672489
Karaj	Second month	43057.9 (2.9)	0.5 (3.4)	4524.9 (1.1)	0.9 (11.2)	-12.8	1.206325e-13
SUM	First month	41648.2 (1.6)	0.8 (7.3)	75566.7 (3.6)	0.5 (3.5)	10	1.547252e-10
SUM	Second month	72898.8 (0.7)	0.7 (5.2)	15314.6 (1.3)	0.9 (7.9)	-5.8	3.15942e-06

coefficients of y_{t-1} for 2019 and 2019, respectively. se is the standard errors, and n is the number of observations.

Table 2 shows the results.

To interpret the results of Table 1, for example, regression models for O_3 in the second month show that the slope of growing O_3 production in 2019 is 0.6 and in 2020 is 0.5. P-value indicates that by 97.5% level of confidence, the slope of increasing O_3 production in 2019 is higher than in 2020. Based on table 1, the slope of the Co-first month, O_3-first month, NO_2-first month, NO_2-second month, PM_{10}-first month, $PM_{2.5}$-First month, Index-first month, Saveh-first month, Pardis-first month, Pardis-second month, Qom-second month, Karaj-second month and sum-second month are higher in 2020 compared to 2019. The results showed that the emission production rate is higher in the first month of 2020 compared to the same period in 2019. Also, the results showed that the daily traffic volume growth rate is higher in the second month of 2020 compared to the same time period in 2019. Estimated P-value for SO2-second month, PM_{10}-first month, and Karaj-first month are higher than 0.36, which means the difference between the slope of growth of these indices in 2020 and 2019 is insignificant and similar pattern have been observed.

CONCLUSION

Coronavirus is probably the most dangerous virus in the 21st century, affecting all countries around the world. This virus has brought economic damages to the governments and companies and made millions of people unemployed, besides endangering millions of lives around the globe. Up to now, no cure has been reported for this virus, and quarantine is the only available solution. Quarantine application in various countries- by restricting human actions- has improved the biological condition of the earth. This research has considered quarantine effects on the Tehran city air pollution level and daily traffic volume. This research has compared behavioral differences in air pollution and daily traffic volume in this year and the same period of last year. By using the mentioned points in this research, we can compare these parameters for attractive destinations of Tehran city residents in the Persian new-year holidays, for the same periods in this year and the previous year.

Results show that there is no difference between air pollution production in 2019 and 2020, but the Coronavirus epidemic affects daily traffic. The growing rate of emission production is higher in 2019 compared to 2020 for the second month. Also, the growing rate of daily traffic volume is higher in the first month of 2020 compared to 2020.

AUTHOR CONTRIBUTIONS

Moghadami, M. performed the literature review and analyzed and interpreted the results with the help of Rasaizadi, A. Rasaizadi, A. analyzed and interpreted the data and prepared the manuscript with the help of Askari, M. and Askari, M. designed and led the research and prepared the manuscript text and manuscript edition.

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CONFLICT OF INTEREST

The author declares that there is no conflict of interest regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancy have been completely observed by the authors.

ABBREVIATIONS

AQI	Air Quality Index
CO	Carbon mono-oxide
COVID-19	COrona VIrus Disease 2019
MERS	Middle East respiratory syndrome
NO_2	Nitrogen dioxide
O_3	Ozone
PM	Particulate matters
$PM_{2.5}$	Particulate matter less than 2.5 microns in diameter
PM_{10}	Particulate matter less than 10 microns in diameter
PPM	Parts per million
SARS	Severe Acute Respiratory Syndrome
SO_2	Sulfur dioxide
veh/hr	Vehicle per hour
$\mu g/m^3$	Micrograms per cubic meter

REFERENCES

Abdi, M., (2020). Coronavirus disease 2019 (COVID-19) outbreak in Iran: Actions and problems. Infect. Con. Hosp. Epid., 41(6): 754-755 **(2 pages)**.

Ahmadi, M.; Sharifi, A.; Dorosti, S.; Ghoushchi, S.J.; Ghanbari, N., (2020). Investigation of effective climatology parameters on COVID-19 outbreak in Iran. Sci. Total Environ., 729: 138705 **(7 pages)**.

Amlashi, F.I.; Gilani, N.; Besharat, S., (2020). Does local or national quarantine may save more lives in Iran during COVID-19 Epidemic? Iran J. Public Health., 49: 125-126 **(2 pages)**.

AQMS, (2020). Air Pollution Monitoring System Online.

Bao, R.; Zhang, A., (2020). Does lockdown reduce air pollution? Evidence from 44 cities in northern China. Sci. Total Environ., 731: 139052 **(12 pages)**.

Behzadifar, M.; Ghanbari, M.K.; Bakhtiari, A.; Behzadifar, M.; Bragazzi, N.L., (2020). Ensuring adequate health financing to prevent and control the COVID-19 in Iran. Int. J. Eq. Health., 19: 1-4 **(4 pages)**.

Caraka, R.E.; Lee, Y.; Kurniawan, R.; Herliansyah, R.; Kaban, P.A.; Nasutation, B.I.; Gio, P.U.; Chen, R.C.; Toharudin, T.; Pardamean, B., (2020). Impact of COVID-19 large scale restriction on environment and economy in Indonesia. Global J. Environ. Sci. Manage., 6(SI): 65-84 **(20 pages).**

Dantas, G.; Siciliano, B.; Franca, B.B.; Silva, C.M.D.; Arbilla, G., (2020). The impact of COVID-19 partial lockdown on the air quality of the city of Rio de Janeiro, Brazil. Sci. Tot. Environ., 729: 139085 **(10 pages)**.

Edrisi, A.; Askari, M., (2020). Multi-objective location model of earthquake shelters. Int. J. Hum. Capital Urban Manage, 5(1): 19-26 **(8 pages)**.

Glanz, J.; Carey, B.; Holder, J.; Watkins, D.; Valentino-DeVries, J.; Rojas, R.; Leather, L., (2020). Where America didn't stay home even as the virus spread. The New York Times.

Gupta, N.; Tomar, A.; Kumar, V., (2020). The effect of COVID-19 lockdown on the air environment in India. Global J. Environ. Sci. Manage., 6(SI): 31-40 **(10 pages).**

Haas, M.D.; Faber, R.; Hamersma, M., (2020). How COVID-19 and the Dutch' intelligent lockdown' change activities, work and travel behaviour: Evidence from longitudinal data in the Netherlands. Transp. Res Interdiscip. Perspectives, 6: 100150 **(11 pages)**.

Haghani, M.; Bliemer, M.C.J.; Goerlandt, F.; Li, J., (2020). The scientific literature on Coronaviruses, COVID-19 and its associated safety-related research dimensions: A scientometric analysis and scoping review. Safety Sci., 129: 104806 **(18 pages)**.

Hadian, M.; Raeissi, P.; Khalilabad, T.H., (2020). The economic burden of mortality and morbidity due to air pollution in Tehran, Iran: a systematic review. Air Qual. Atmos. Hlth., 13: 1001-1011 (**11 pages**).

Heger, M.; Sarraf, M., (2018). Air Pollution in Tehran: Health Costs, Sources, and Policies. Environment and Natural Resources Global Practice Discussion Paper; No. 6. World Bank, Washington, DC., World Bank **(38 pages)**.

Hosseini, V.; Shahbazi, H., (2016). Urban Air Pollution in Iran. Iran Stud. UK, 49(6): 1029-1046 (**18 pages**).

Isaifan, R.J., (2020). The dramatic impact of Coronavirus outbreak on air quality: Has it saved as much as it has killed so far? Global J. Environ. Sci. Manage., 6(3): 275-288 **(14 pages).**

Kerimray, A.; Baimatova, N.; Ibragimova, O.P.; Bukenov, B.; Kenessov, B.; Plotitisyn, P.; Karaca, F., (2020). Assessing air quality changes in large cities during COVID-19 lockdowns: The impacts of traffic-free urban conditions in Almaty, Kazakhstan. Sci. Total Environ., 730: 139179 **(8 pages)**.

Lee, W.C.; Ong, C.Y., (2020). Overview of rapid mitigating strategies in Singapore during the COVID-19 pandemic. Publ. Health, 185: 15-17 **(3 pages)**.

Li, J.; Nguyen, T.H.H.; Coca-Stefaniak, J.A., (2020a). Coronavirus impacts on post-pandemic planned travel behaviours. Ann. Tourism Res., **(6 pages)**.

Li, R.; Azari, M.; Wang, Y.; Zhang, X.; Liu, Z.; Zhu, Y.; Zhang, K.; Xue, S.; Ooi, M.C.G.; Zhang, D.; Chan, A., (2020b). Air quality changes during the COVID-19 lockdown over the Yangtze River Delta Region: An insight into the impact of human activity pattern changes on air pollution variation. Sci. Total Environ., 732: 139282 **(11 pages)**.

Maghmoumi, A.; Marashi, F.; Houshfar, E., (2020). Environmental and economic assessment of sustainable municipal solid waste management strategies in Iran. Sustainable Cities Soc., 59: 102161 **(7 pages)**.

Mahato, S.; Pal, S.; Ghosh, K.G., (2020). Effect of lockdown amid COVID-19 pandemic on air quality of the megacity Delhi, India. Sci. Total Environ., 730: 139086 **(23 pages)**.

Masum, M.H.; Pal., S.K., (2020). Statistical evaluation of selected air quality parameters influenced by COVID-19 lockdown. Global J. Environ. Sci. Manage., 6(SI): 85-94 **(10 pages).**

Nourzadeh, D.; Mortazavi, P.; Ghalandarzadeh, A.; Takada, S.; Ahmadi, M., (2019). Performance assessment of the Greater Tehran Area buried gas distribution pipeline network under liquefaction. Soil Dyn. Earth. Eng., 124: 16-34 **(19 pages)**.

Nunes, A.; Hernandez, K.D., (2020). Autonomous taxis and public health: High cost or high opportunity cost? Transport. Res. A-Pol., 138: 28-36 (**9 pages**).

Otmani, A.; Benchrif, A.; Tahri, M.; Bounakhla, M.; Chakir, E.M.; Bouch, M.E.; Krombi, M., (2020). Impact of Covid-19 lockdown on PM10, SO2 and NO2 concentrations in Salé City (Morocco). Sci. Total Environ., 735: 139541 **(5 pages)**.

Quéré, C.L.; Jackson, R.B.; Jones, M.W.; Smith, A.J.P.; Abernethy, S.; Andrew, R.M.; De-Gol, A.J.; Willis, D.R.; Shan, Y.; Canadell, J.G.; Friedlingstein, P.; Creutzig, F.; Peters, G.P., (2020). Temporary reduction in daily global CO2 emissions during the COVID-19 forced confinement. Nat. Climate Change **(8 pages)**.

RMTO, (2020) Road Maintenance and Transportation Organization.

Rojas-Rueda, D.; Nazelle, A.D.; Teixido, O.; Nieuwenhuijsen, M.J., (2012). Replacing car trips by increasing bike and public transport in the greater Barcelona metropolitan area: A health impact assessment study. Environ. Int., 49: 100-109 (**10 pages**).

Sharma, S.; Zhang, M.; Anshika, Gao, J.; Zhang, H.; Kota, S.H., (2020). Effect of restricted emissions during COVID-19 on air quality in India. Sci. Total Environ., 728: 138878 **(8 pages)**.

Sicard, P.; Marco, A.D.; Agathokleous, E.; Feng, Z.; Xu, X.; Paoletti, E.; Rodriguez, J.J.D.; Calatayud, V., (2020). Amplified ozone pollution in cities during the COVID-19 lockdown. Sci. Total Environ., 735: 139542 **(10 pages)**.

Shaver, K., (2020). As coronavirus precautions take hold, large US cities see rush hour traffic jams vanish.

Tehran Times, (2019) Air pollution responsible for over 4,000 deaths annually in Tehran.

Tran, T.T.; Pham, L.T.; Ngo, Q.X., (2020). Forecasting epidemic spread of SARS-CoV-2 using ARIMA model (Case study: Iran). Global J. Environ. Sci. Manage., 6(SI): 1-10 **(10 pages).**

Vafa-Arani, H.; Jahani, S.; Dashti, H.; Heydari, J.; Moazen, S., (2014). A system dynamics modeling for urban air pollution: A case study of Tehran, Iran. Transport. Res. D-tr. E., 31: 21-36 (**16 pages**).

Vahdati, S.S.; GhafarZad, A.; Rahmani, F.; Panahi, F.; Rad, A.O., (2014). Patterns of road traffic accidents in North West of Iran during 2013 New Year Holidays: complications and casualties. Bull. Emergency Trauma, 2(2): 82 **(4 pages)**.

Wadud, Z.; Waitz, I.A., (2011). Comparison of Air Quality–Related Mortality Impacts of Different Transportation Modes in the United States. Transport. Res. Rec., 2233(1): 99-109 (**11 pages**).

Worldometers (2020). COVID-19 Coronavirus Pandemic.

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