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Influence of mobility restrictions on air quality in the historic center of Cuenca city and its inference on the Covid-19 rate infections

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ABSTRACT

At the end of 2019 in Wuhan China city, the outbreak of the virus called SARS-CoV 2 was originated, which later became a pandemic. In Ecuador, patient zero arrived on February 14, 2020 and the first mobility restriction imposed by the Government occurred on Tuesday, March 17 of the same year. Throughout the confinement, vehicle mobility restrictions have been modified by government entities depending on the number of infected people. This article presents an air quality study in the historic center of Cuenca city as consequence of mobility changes caused by Covid-19, where a comparison of concentration levels of polluting gases of the first semester of 2018, 2019 and 2020 is made, that allow differentiating and identifying the influence of vehicular flow on air quality. It can also be verified how the decrease in vehicle mobility restrictions influenced the increase in the rate of daily infections. For the study, air quality data published by the public mobility company of the city of Cuenca (EMOV EP) and the communications issued by the Emergency Operations Committee (COE), before and during the confinement, were collected. The acquisition, classification, analysis and interpretation of the data obtained through machine learning techniques was carried out. It can be concluded that while mobility restrictions were more severe, air quality improved and infections rate of decrease. Obtaining that polluting gases such as NO2 and CO produced by vehicular traffic show correlations of 61% and 60% respectively, which means that after 15 days of lifting the restrictive measures, the pollutants increased as well as the number of infected.

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1. Introduction

In December 2019 in Wuhan China, the outbreak of a new coronavirus originated, which was assigned the name of Covid-19 [1]. On January 22, 2020, the World Health Organization (WHO) issued a statement affirming human-to-human transmission. On March 11, the World Helath Organization (WHO) declared Covid-19 a pandemic. In Ecuador, patient zero from Spain arrived on February 14, 2020 [2], causing the disease to begin to spread in the country, with which the Ecuadorian government declared the first restrictions on Tuesday, March 17 of the same year [3]. In order to reduce speed of spread of the disease, certain restrictions were implemented, such as: the prohibition of mobility of interprovincial transport and national and international flights. In addition to the closure of places where more than 30 people are grouped for being a focus of spread of the virus [4]. The pandemic has produced a decrease in air pollution [5] due to the isolation of people in their homes and low social interaction. This has been arranged with 2 states of exception, through 4 executive decrees of the Ecuadorian state, in order to control the speed of virus spread [6].

In Cuenca city, the first contagion was reported on March 14, 2020, according to the health coordination in zone 6, with a case from Spain that presented mild respiratory symptoms such as cough and high fever. In Cuenca, from March 14 to August 31, 2020, 4445 confirmed cases of Covid-19 were registered [7].

This work seeks the relationship between polluting emissions generated by mobile sources and their influence on the increase in coronavirus cases. Pollutants such as nitrogen dioxide are obtained from the burning of fossil resources [8] and particulate matter such as PM2.5 is caused by the emanation of vehicles

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powered by internal combustion engines [9]. Vehicle fleet is a direct cause of generation of gases such as carbon monoxide responsible for negative health effects, alterations in blood flow and heart rhythm [10]. In the city of Cuenca, vehicles generate emissions of polluting gases to the environment, producing: 60% carbon monoxide (CO), 43% tropospheric ozone (O_3), 43% nitrogen oxide (NO), 27% dioxide of nitrogen (NO_2), 42% of nitric oxide (NO_X), 11% of sulfur dioxide (SO_2) and 18% of particulate matter smaller than 2.5 μm (PM2.5) [3].

1.1. Related work

Most of environmental pollution is generated by vehicles, which cause environmental and health repercussions [11]. Z. Chen et al. [12] carried out a study by means of statistical regressions and determined that during the pandemic the air quality improved due to mobility restrictions, especially due to the non-circulation of private vehicles, but these are temporary improvements subject to change and development of each city. Razzaq et al [13] In an investigation carried out in the 10 states most affected by the pandemic in the United States, it confirms a dependence between COVID 19 and pollutant emissions through measurements of O_3 at the ground level, as it is considered a precursor pollutant for the development of chronic lung diseases. It was found that the increase in mobility restrictions reduces O_3 temporarily. Zhang et al [14], propose that a short term exposure to particulate matter (PM2.5, PM10) and NO_2 contributes to an increase in the daily occurrence of cases, therefore a decrease in contamination can delay the spread of the virus. Mostafa et al [15] use Egypt as a case study, during times of restriction, diesel and gasoline consumption were reduced by 25% and 9% respectively. Factors such as noise pollution decreased by 75% and gases such as NO_2 were reduced by 15%. Liu et al. [16] compares data on pollutant emissions before, during and after restrictions imposed in the state of California. During confinement, gases such as CO were drastically reduced, while gases such as NO_2 and PM2.5 suffered slight reductions, but when the restrictive stockings were released, the pollutant emission values were very similar to previous periods. Magazzino et al [5] carried out a study on the 3 most important cities in France and the effect that the emission of particulate material generated by vehicles has on human health. With Machine Learning techniques and ANNs they relate the emission of particulate material and respiratory affectations. People exposed to these compounds are more prone to developing complicated COVID-19 symptoms. The study confirms a direct relationship between the emission of particulate matter and the increase in COVID-19 cases.

2. Material and methods

This section describes the data acquisition process used to estimate the number of polluting gas emissions and COVID-19 positive people. The information processing method to present the results is described later.

2.1. Pollutant gas emissions data

Polluting gas emissions data in the historic center of Cuenca city were taken from the air quality monitoring network. This network has twenty surveillance points distributed throughout the city. The Municipality (MUN) was the selected station to collect information which records in real time the concentrations of O_3, NO_2, SO_2, CO, $PM_{2.5}$ and particulate matter less than 10 μm (PM10) [12]. All stations record the amount of polluting gas emissions per minute and generate the information necessary to characterize the spatial distribution of air pollution, by permanently measuring air quality in different areas of the city. [3]. Measurement methods and sensors incorporated in the Cuenca Air Quality Monitoring automatic network are shown in Table 1.

2.2. Data of daily Covid-19 infected

The data taken for the analysis of daily infections was taken from the National Service for Risk and Emergency Management within the Situation Reports and Infographics section Covid-19 since February 29, 2020, which as coordinating entity of the emergencies and disasters in the country, presents the consolidated information from the Ministry of Public Health (MSP) on the national emergency due to Covid-19 that began in March 2020. The Reports and Infographics were generated on a daily basis [7].

2.3. Information processing

For data processing, a multivariate analysis was used using Pearson's correlation coefficient method, which allows the results to be visualized in a graphic way between two variables. Pearson's correlation coefficient is the main measure of linear association between two quantitative variables that allows obtaining the most accurate possible results of the correlation between polluting gases and the number of people infected by Covid-19.

3. Results

3.1. Correlation between vehicular traffic and polluting gases

The influence of vehicular traffic on air quality is determined by Pearson's correlation coefficient. The scatter plot in Fig. 1. contains the seven polluting gases: CO, O_3, NO_X, NO_2, NO, SO_2, PM2.5 and vehicular traffic. The correlation between vehicular traffic and CO is 0.60, vehicular traffic and NO is 0.43, vehicular traffic and NO_X is 0.42, and vehicular traffic and O_3 is 0.43. Table 2 shows the correlation between vehicular traffic and polluting gases.

3.2. Correlation between pollutant gases and meteorological variables

Table 3 shows the relationship between meteorological variables and polluting gases.

For establishment of pollutant emissions database in the historic center of the city of Cuenca, information is organized in matrices provided by the public company EMOV. The matrix incorporates data on polluting gases, such as: Carbon Monoxide (CO), Tropospheric Ozone (O_3), Nitrogen dioxide (NO_2), Sulfur dioxide (SO_2) and Particulate matter less than 2.5 μm (PM2.5).

Averages of CO, O3, NO2, SO2 Y PM2.5 according to the traffic light periods in Cuenca canton. According to the bulletins issued by the Cuenca mayor's office in a declaration to the National COE during the period from January to August 2020 in the city of

Table 1
Sensors used in the automatic station for the polluting gases monitoring.

Pollutant	Method	Brand/Model
Carbon monoxide (CO)	Non-dispersive infrared radiation absorption USEPA	Teledyne. M300E
Sulfur dioxide (SO_2)	UV fluorescence USEPA	Teledyne. M100E
Nitrogen dioxide (NO_2)	Nitrogen Dioxide Chemiluminescence USEPA	Teledyne. M200E
Fine Particulate Material (PM2.5)	Beta ray attenuation USEPA	Met One BAM-1020
Ozone (O_3)	Ultraviolet radiation absorption USEPA	Teledyne. M400E

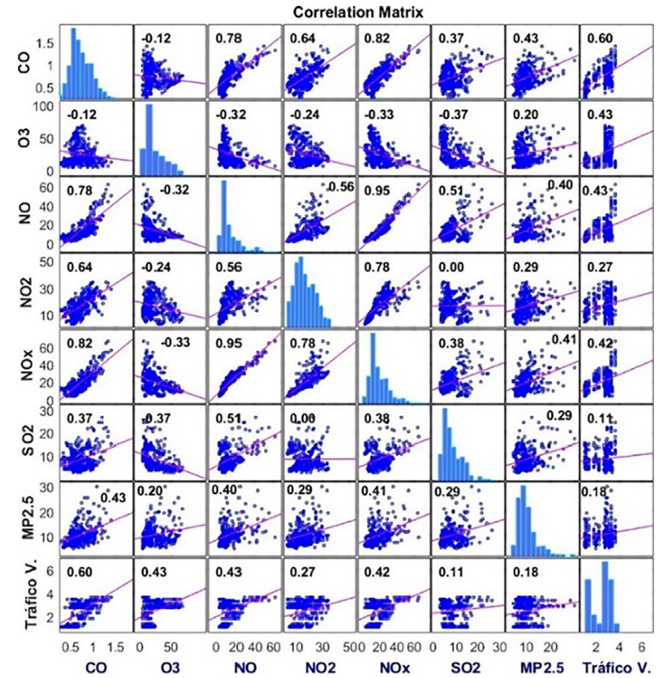

Fig 1. Scatter charts and correlation values between vehicular traffic and polluting gases.

Table 2
Sensors used in the automatic station for the polluting gases monitoring.

Presentation of the Correlation	Results
Very weak correlation (0,00 a 0,19)	Traffic V. vs SO_2 (0.11) y Tráfico V. vs PM2.5 (0.18)
Weak correlation (0.20 a 0.39)	Traffic V. vs NO_2 (0.27)
Moderate correlation (0.40 a 0.69)	Traffic V. vs CO (0.60), Traffic V. vs NO (0.43), Traffic V. vs NO_X (0.42)
Strong correlation (0.70 a 0.89)	CO vs NO_X (0.82), CO vs NO (0.82), NO_2 vs NO_X (0.78)
Very strong correlation (0.90 a 1.00)	NO vs NOX (0.95)

Table 3
Sensors used in the automatic station for the polluting gases monitoring.

Correlation presentation	Results
Very weak correlation (0,00 a 0,19)	T.A vs CO (-0.10), PA vs CO (0.07), H.R vs CO (0.04), V.V vs CO (0.07), P.A vs O3 (0.13), T.A vs NO2 (-0.14), P.A vs NO2 (-0.15), V.V vs NO2 (-0.08), P.A vs NOX (0.09), V.V vs NOX (-0.19), T.A vs PM2.5 (-0.16), H.R vs PM2.5 (0.06), R.S vs PM2.5 (0.12), V.V vs PM2.5 (-0.15)
Weak correlation (0.20 a 0.39)	R.S vs CO (-0.21), T.A vs NO (-0.36), P.A vs NO (0.20), H.R vs NO (0.39), R.S vs NO (-0.25), V.V vs NO (-0.22), H.R vs NO2 (0.21), R.S vs NO2 (-0.36), T.A vs NOX (- 0.32), H.R vs NOX (0.37), R.S vs NOX (-0.31), H.R vs SO2 (0.39), R.S vs SO2 (-0.25), V.V vs SO2 (-0.38).
Moderate correlation (0.40 a 0.69)	V.V vs O3 (0.49), T.A vs SO2 (-0.53), P.A vs SO2 (0.54), P.A vs PM2.5 (0.40)
Strong correlation (0.70 a 0.89)	T.A vs O3 (0.78), H.R vs O3 (-0.83
Very strong correlation (0.90 a 1.00)	R.S vs O3 (0.90)

Cuenca, the following traffic lights were proposed as shown in Table 4.

The days in these time periods were averaged for each gas analysed between the years 2020, 2019 and 2018, taking into account that in the years 2019 and 2018 there were no mobility restrictions in order to make a comparison between levels of contamination of different gases generated. In Fig. 3, the CO averages are established for each period of time in which the curfew schedule and traffic lights changed in the canton of Cuenca, in which the patterns drawn during the 24 h are observed. hours of the day.

In Table 5, results of the total sum of carbon monoxide for each period of time of the three specified years are presented, which will allow comparing the levels of contamination between them, identifying the effectiveness of the vehicle mobility restrictions proposed in the year 2020. Fig. 2 show the effectiveness of the proposed restrictions according to the pollutant levels expelled into the atmosphere for CO. For the period without traffic light 1, the lowest levels of contamination are obtained due to the appearance of the first restrictions on the mobility of vehicles and pedestrians, allowing only mobility for exceptional cases (health, safety, emergencies, etc.). In this study, the process carried out with carbon monoxide is replicated for the remaining gases.

3.3. Average growth of polluting gases

According to traffic lights in 2020. In Fig. 3. the behavior or growth of the different polluting gases is represented, based on the progressive summation of the areas and shows the average of the polluting gases for each phase of confinement within a scale of 0 to 24 h. It should be noted that the traffic light contains different curfew times imposed by the cantonal COE of the city of Cuenca. Next, Table 6 presents the results of the confinement phases that caused the greatest and least impact on contamination, verifying the effectiveness of the mobility restriction corresponding to each period of time.

4. Discussion

The following section shows the averages of the polluting gases for each period of time during traffic lights for the year 2020, while for the years 2018 and 2019 these same periods of time were averaged in order to obtain a comparison of the behavior of the levels of polluting gases between these years. In the following figures, two vertical lines are drawn that identify the beginning (EC) and the end of the curfew (SC).

4.1. No restrictions (January 1 to March 16, 2020), No traffic light (January 1 to March 17, 2020)

In Fig. 4. the behavior of polluting gases can be seen during the unrestricted period that was from January 1 to March 16; In this period of time, no restrictions of any kind were yet in place, since the coronavirus pandemic had not yet started in the country, and the behavior of the polluting gases during the period without traffic light 1. During this period of confinement, the first restrictions on the mobility of vehicles and pedestrians began to be implemented, allowing only mobility for the acquisition of basic necessities and medicines. Vehicle restriction was applied as follows: on Monday, Wednesday, Friday and Sunday vehicles with an odd license plate circulated, in the same way on Tuesday, Thursday and Saturday vehicles with an even and zero license plate circulated, as a consequence of this restriction the Pollutant levels during this period of the year 2020 were affected, for CO, NO_2 y SO_2 levels are the lowest compared to the previous two years and for the PM2.5 maintains a lower profile. In the case of O_3, a consider-

Table 4
Traffic lights in canton of Cuenca.

Traffic light color	Start date	End date	Curfew	Place
Without restrictions	January 1st	March 16	–	TE
No traffic light 1	March 17	March 20	21:00 a 5:00	TE
No traffic light 2	March 21	March 24	19:00 a 5:00	TE
No traffic light 3	March 25	April 12	14:00 a 5:00	TE
Red	April 13	May 24	14:00 a 5:00	Cuenca
Yellow 1	May 25	June 30	21:00 a 5:00	Cuenca
Yellow 2	July 1st	July 30	23:00 a 5:00	Cuenca
Yellow 3	July 31	August 31	M to T 21:00 a 5:00,F to S 19:00 a 5:00	Cuenca

Table 5
Traffic lights in Cuenca canton

Traffic light	Year	CO total sum(mg/m3)	Traffic light	Year	CO total sum(mg/m3)
Without restrictions	2018	18.2819	Red traffic light	2018	15.9841
	2019	35.3406		2019	16.1288
	2020	13.2587		2020	9.5579
No traffic light 1	2018	18.9913	Yellow traffic light 1	2018	17.8169
	2019	11.5654		2019	18.8529
	2020	7.4779		2020	15.4912
No traffic light 2	2018	22.7402	Yellow traffic light 2	2018	18.1508
	2019	16.6248		2019	17.7408
	2020	7.7538		2020	19.8205
No traffic light 3	2018	19.4370	Yellow traffic light 3	2018	19.1589
	2019	8.3518		2019	20.3857
	2020	13.3521		2020	20.4924

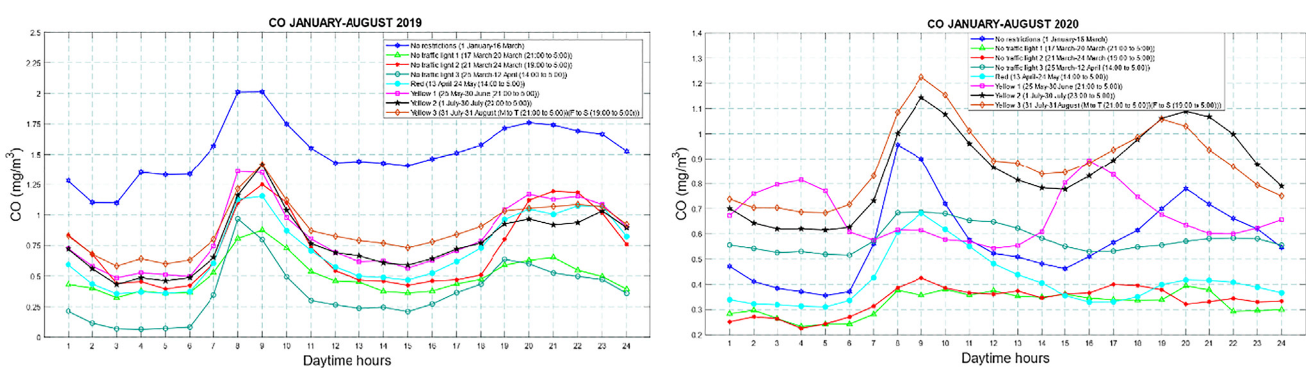

Fig 2. CO from January to August 2018.

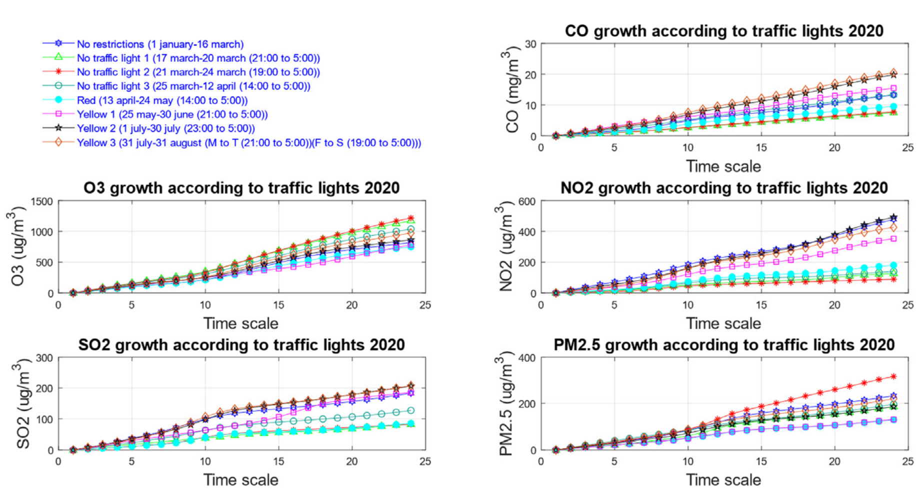

Fig 3. Polluting gases growth according to traffic lights 2020.

Table 6
Traffic lights in Cuenca canton

Polluting gases	Higher growth	Minor growth
CO	Yellow 3	No traffic light and No traffic light 2
O3	No traffic light 2	Red and Yellow 1
NO2	Unrestricted and Yellow 2	No traffic light and No traffic light 2
SO2	Yellow 2 and Yellow 2	No traffic light and red
PM2.5	No traffic light 2	Red and Yellow 1

able change is not observed compared to the years 2018 and 2019 as this is not a gas directly dependent on vehicle mobilization.

4.2. No traffic light 2 (March 21 to March 24). No traffic light 3 (March 25 to April 12).

In Fig. 5. polluting gases behavior is observed during the period Without traffic light 2; During this period of confinement, the vehicle mobility restrictions are maintained as in the previous period, however, the curfew schedule was modified beginning at 7:00p. m. and ending at 5:00 a.m. As a result of the measurement, the CO, NO_2 gases have few fluctuations with a linear trend, while for PM2.5 between the window (EC-SC) high levels are reached. The behaviour of polluting gases is observed during the period without traffic light 3. During this period there were three vehicle mobility restrictions, until March 27 the same vehicle restriction implemented in the two previous periods was in force, later it was implemented a second restriction. From March 28 to April 5, according to the last digit of the plate: Monday and Friday (1, 2, 3),

4.3. Red traffic light (April 13 to May 24, 2020). Yellow traffic light 1 (May 25 to June 30, 2020).

In Fig. 6. the behavior of polluting gases is observed during the red traffic light period, because as of April 13 a traffic light system was implemented throughout the country. The Cuenca canton began the restriction with a red traffic light. The vehicular restriction remains the same as the last one implemented in the previous period. The levels of CO, NO_2, SO_2 and PM2.5 corresponding to the year 2020 are below the years 2018 and 2019, proving to be more effective in increasing the isolation time of people. The behavior of the polluting gases is observed during the period of yellow traffic light 1. During this period of confinement, two vehicle mobility restrictions were implemented, the first one from May 25 to May 31 according to the last digit of the plate: Monday (1, 2, 7), Tuesday (3, 4, 5, 8), Wednesday (5, 6, 9), Thursday (6, 7, 8, 0), Friday (9, 0, 1), Saturdays (2, 3, 4) and Sundays no private vehicle circulated. The second restriction was implemented from June 1 to June 30, where vehicles circulated as follows: plates with the last odd digit circulate on Monday, Wednesday and Friday, plates with the last even digit circulate on Tuesday,

4.4. Yellow traffic light 2 (July 1 to July 30, 2020). Yellow traffic light 3

In Fig. 7. the behaviour of the polluting gases during the yellow traffic light period 2 is observed. During this period, vehicles with the last digit of the odd plate circulated on Monday, Wednesday, Friday and Sunday 5 and 19, while that for vehicles with the last digit on the plate for Tuesday, Thursday, Saturday and Sundays 12 and 26. Taxis, mixed transport and light cargo circulated every day, institutional transport circulated without restriction, urban transport it circulated with 50% of its capacity. The levels of SO_2,

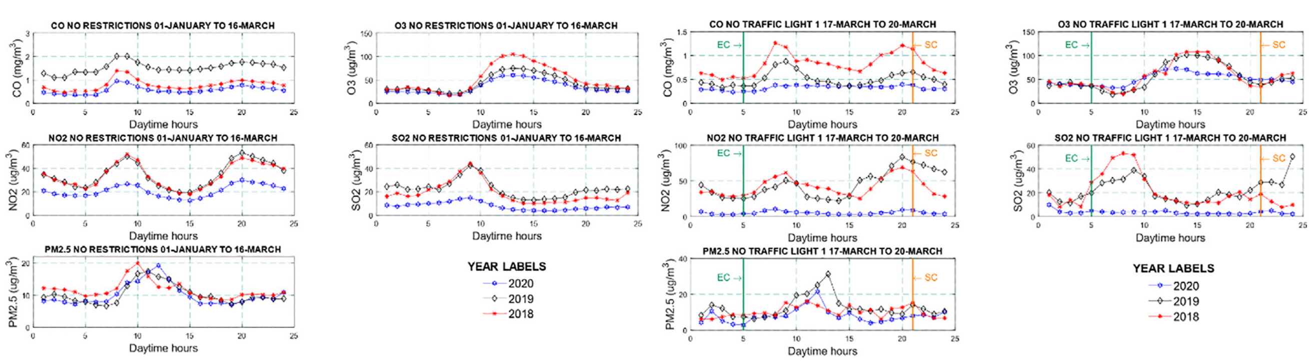

Fig 4. No restriction period; Traffic light 1.

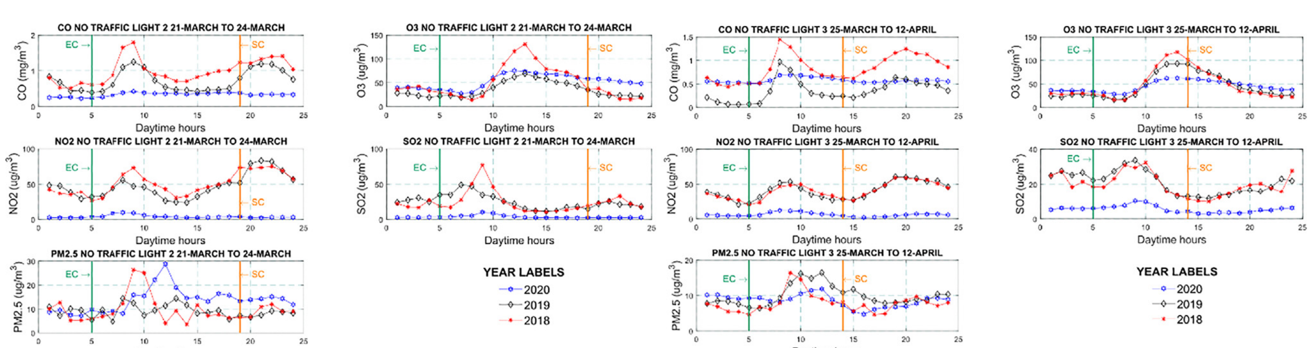

Fig 5. No traffic light 2; No traffic light 3 period.

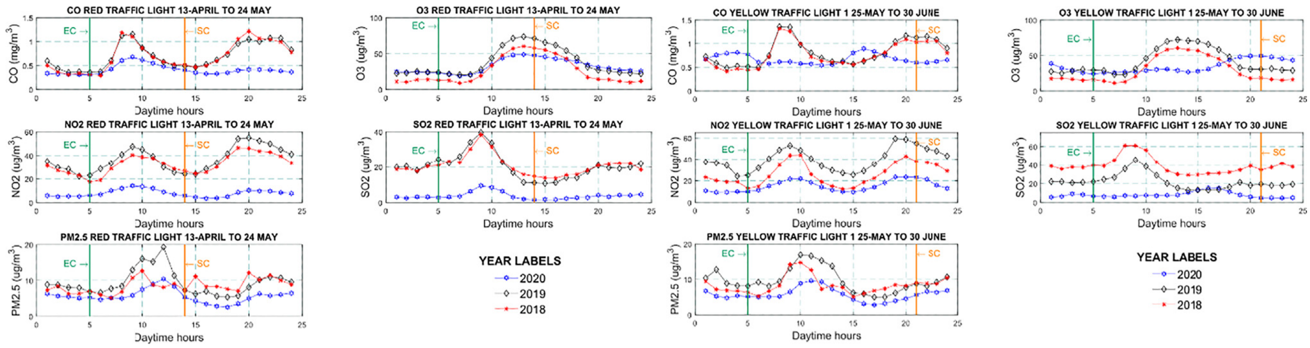

Fig 6. Red traffic light period; Yellow traffic light 1. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

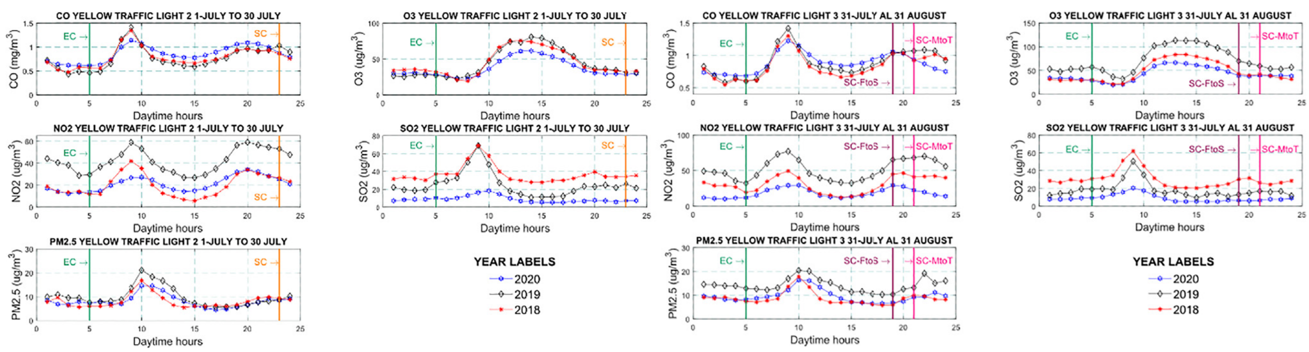

Fig 7. Yellow traffic light 2 period; Yellow traffic light 3 period. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

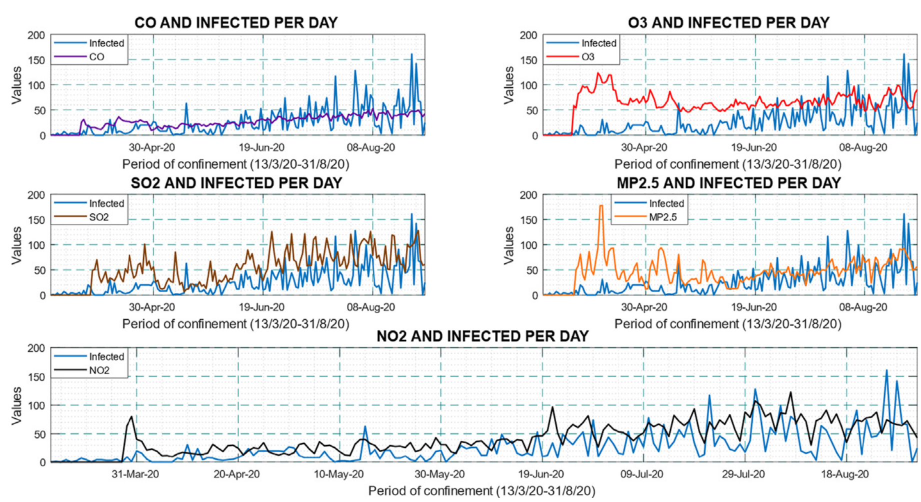

Fig 8. Polluting gases and infected per day.

NO_2 and PM2.5 for the year 2020 remain below the years 2018 and 2019. The behavior of the polluting gases during the yellow traffic light period 3 is observed. The restriction of vehicular mobility for this period allowed the circulation with the last digit of the odd plate on Monday, Wednesday, Friday and Sunday 2, 16 and 30, while for vehicles with the last digit of the license plate on Tuesdays, Thursdays, Saturdays and Sundays 9 and 23. The CO levels for 2020 can be seen to be similar to the years 2018 and 2019, the levels of NO_2 and SO_2 for the year 2020 remain below the years 2018 and 2019, the levels of PM2.5 in the year 2020 are between 2018 and 2019.

5. Results and discussion.

5.1. Determination coefficient R^2 between vehicular traffic and polluting gases

According to the WHO, the time that elapses between exposure to Covid-19 and the moment when symptoms begin is usually around 5 or 6 days, but can vary between 1 and 14 days. In Fig. 8. the graph between the daily infected and the polluting gases and the number of days displaced is observed, where the maximum coefficient of determination R^2 is obtained. The similarities

Table 7
Determination coefficient R2 compared with the days of polluting gases displacement.

Polluting gases	Adjusted R-square	Displacement days
CO	0.4084	14
NO2	0.3747	15
SO2	0.2736	19
PM2.5	0.1121	15

Table 8
Correlation between polluting gases and daily infections

Correlation presentation	Results
Very weak correlation (0,00 a 0,19)	O3 vs Daily infected (0.14)
Weak correlation (0.20 a 0.39)	PM2.5 vs Daily infected (0.27), O3 vs NO2 (0.33), O3 vs SO2 (0.36), NO2 vs PM2.5 (0.38), SO2 vs PM2.5 (0.32)
Moderate correlation (0.40 a 0.69)	CO vs Daily infected (0.60), NO2 vs Daily infected (0.61), SO2 vs Daily infected (0.53), CO vs O3 (0.47), CO vs PM2.5 (0.46), O3 vs PM2.5 (0.67), NO2 vs SO2 (0.62)
Strong correlation (0.70 a 0.89)	CO vs NO2 (0.80), CO vs SO2 (0.71)
Very strong correlation (0.90 a 1.00)	–

between the curves drawn are also observed to subsequently obtain a Pearson correlation coefficient that would indicate the influence force that polluting gases have on those infected daily. In Table 7, the displaced days and their maximum coefficient of determination are displayed.

5.2. Matrix of pollutant gases and daily contaminated

Thus, the maximum values obtained from this specified Pearson correlation between infected daily and polluting gases is the following: 0.61 between infected and NO_2, 0.60 between infected and CO, 0.53 between infected and SO2, 0.27 between those infected and PM2.5 and 0.14 between those infected and O_3. Table 8 shows the correlation that exists between polluting gases and those infected daily.

6. Conclusions

In the historic center of the city of Cuenca, Ecuador, during the period January-August of 2020, the total sum of carbon monoxide for restriction without traffic light 1 is 7.4779 mg/m^3 and the number of infected is 13. This period has the lowest levels of contamination due to the appearance of the coronavirus health emergency, and the first restrictions on the mobility of vehicles and pedestrians, allowing mobility only with the carrying of a safe-conduct, for purposes such as: the acquisition of first rate products need, medications and medical care cases. For the period of no traffic light 2 is 7.7538 mg/m^3 and the number of infected is 11, during this period the vehicle restrictions remained the same, while there were changes in the curfew. It should be noted that this period has low levels of CO and it is because it was still in the first 8 days of confinement decreed by the National Government; For the period of no traffic light 3 it is 13.3521 mg/m^3 and the number of infected is 133, with which it can be mentioned that the contamination levels increased in relation to the previous periods, during this period three vehicle mobility restrictions were applied the same one that allowed to go out less frequently due to the fact that the contagions nationwide were increasing and the curfew hours were the most rigorous, being this from 2:00p.m. to 5:00 a.m. for the red traffic light period it is 9.5579 mg/m^3 and the number of infected is 519, during this period of confinement it begins with the cantonal traffic light imposed by the National Government fulfilling a curfew schedule equal to the previous one in order to contain the spread of Covid-19; for the period of yellow traffic light 1 it is 15.4912 mg/m^3 and the number of infected is 899, for the period of yellow traffic light 2 it is 19.8205 mg/m^3 and the number of infected is 1228, for the period of yellow traffic light 3 it is of 20.4924 mg/m^3 and the number of infected in 1662, during the periods of yellow traffic lights the curfew hours were changed, making them more flexible and allowing the reactivation of vehicular mobility in the country and consequently the levels of contamination are high compared to all previous periods of traffic light.

The growth of the average of the polluting gases according to the confinement phases that caused the greatest pollution: CO (yellow 3), NO_2 (No restrictions, yellow 2), SO_2 (yellow 2 and yellow 3), PM2.5 (No traffic light 2) , while those that caused the least pollution are: CO, NO2 (Without traffic light 1 and Without traffic light 2), SO_2 (Without traffic light 1 and Red traffic light), PM2.5 (Red traffic light and Yellow 1), implying the effectiveness of the mobility restriction corresponding to each period of time.

Days later, the number of infected increased after there was an increase in contamination levels as a result of a greater force of variability: For CO (14 days), NO_2 (15 días), SO2 (19 days), PM2.5 (15 days). These values are within the range of 0 to 20 days from infection to symptoms.

The greatest correlation force existing between polluting gases and the number of daily infected is NO_2 with 61%, followed by CO with 60% correlation, which means that on an average of 15 days after having increased levels pollutants produced by vehicular traffic, also increased the number of infected.

CRediT authorship contribution statement

Néstor Diego Rivera Campoverde: Conceptualization, Writing - original draft. **Paúl Andrés Molina Campoverde:** Supervision, Methodology, Software, Validation. **Gina Pamela Novillo Quirola:** Writing - review & editing. **William Fernando Ortiz Valverde:** Software, Visualization, Investigation. **Bryan Michael Serrano Ortiz:** Data curation, Investigation.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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