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Correlation between the exposure to long-term PM2.5 concentration and COVID-19 pandemic in Iran





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Introduction: COVID-19 in Iran





Introduction

October 2020

• Non-uniform distribution of the pandemic in Iran



Reference: https://en.irna.ir/photo/83713855/Iran-s-corona-virus-toll-update-March-14202



Introduction

• Long-term exposure to pollution is understood as an

influencing factor in extent of the disease.

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October 2020

COVID-19 PM2.5 A national study on long-term exposure to air pollution and COVID-19 mortality in the United States

Reference:

1- Wu, X., Nethery, R.C., Sabath, M.B., Braun, D. and Dominici, F., 2020. Air pollution and COVID-19 mortality in the United States: strengths and limitations of an ecological regression analysis. Science Advances (in press).

2- Exposure to air pollution and COVID-19 mortality in the United States. Xiao Wu, Rachel C. Nethery, Benjamin M. Sabath, Danielle Braun, Francesca Dominici. medRxiv 2020.04.05.20054502; doi: https://doi.org/10.1101/2020.04.05.20054502







Introduction: Air Pollution in Iran



Reference: http://maps.who.int/airpollution/



Introduction: Air Pollution in Iran

3-Year Annual PM2.5 Concentration



Reference: Hassanvand M.S., et al., 2020





Methodology

- To check statistically significant correlation between the long-term exposure to higher PM2.5 concentrations with higher rates of:
 - No. Death (number of death cases per 10⁵ inhabitants)
 - No. Hospitalization (number of serious (hospitalized) cases per 10⁵ inhabitants)
 - Death ratio (percentage of death cases per hospitalized cases)
- 31 provinces in Iran are studied in a cross-section analysis
- Three-year-average concentration of PM2.5 in the capital of the provinces is used in the analysis.
- Official weekly COVID-19 statistics in provinces is used in the analysis.





Results

 No statistically meaningful correlation was seen between the three-yearaverage concentration of PM2.5 and the three indexes of COVID-19.



Results: All Provinces



• Due to lack of normal distribution of data, we have applied Spearman and Kendall

correlation tests as an observer 3-Year Annual PM2.5 correlation with COVID-19 in Iran.

	Spearman Correlation Coefficient (rho Value)	Significance (p-value)	Kendall Correlation Coefficient (Kendall's tau-b)	Significance (p-value)
3-Year Annual PM2.5 - No. Hospitalized	0.168	0.365	0.133	0.299
3-Year Annual PM2.5 - No. Death	0.117	0.528	0.088	0.496

- We find that 3-Year Annual PM2.5 have a non-significant correlation for No. Hospitalized and No. Death in the provinces in both Spearman and Kendall correlation.
- However, the magnitude of correlation coefficients are higher in the Spearman correlation test.





Provinces with high natural PM2.5 concentrations

3-Year Annual PM2.5 Concentration







Provinces with high natural PM2.5 concentrations

• Outliers are provinces with highest frequencies of dust storms.

Results

October 2020

• The high concentration of PM2.5 in these regions is from natural dust.



Reference: Alizadeh-Choobari, O., Ghafarian, P. and Owlad, E. (2016), Temporal variations in the frequency and concentration of dust events over Iran based on surface observations. Int. J. Climatol., 36: 2050-2062. doi:10.1002/joc.4479





Results: Provinces with PM2.5 < $30 \mu g/m^3$

 Statistically significant <u>positive</u> and <u>moderate</u> correlation among long-term exposure to pollution and COVID-19 hospitalization and death rates are observed for the provinces with PM2.5 < 30 μg/m³.

	Spearman Correlation Coefficient (rho Value)	Significance (p-value)	Kendall Correlation Coefficient (Kendall's tau-b)	Significance (p-value)
3-Year Annual PM2.5 - No. Hospitalized	0.530	0.013	0.405	0.01
3-Year Annual PM2.5 - No. Death	0.4347	0.048	0.3158	0.049



Discussion

- Omitting the provinces with PM2.5 concentrations more than 30 µg/m³, results in statistically significant positive and moderate correlation among long-term exposure to PM2.5 concentrations and COVID-19 death rates in Iran, as shown in other studies.
- What is different in the provinces with PM2.5 < 30 μ g/m³:
 - Exposure to high concentration of PM2.5 from natural dust with different chemical composition from anthropogenic PM2.5 emissions,
 - While in other provinces anthropogenic emission (mainly from mobile sources) is the main source of PM2.5.





Discussion

- Due to lack of access to data of potential confounding factors, we consider just the existence of meaningful correlation between exposure to PM2.5 and No. death and hospitalization.
 - Level of access to health care systems
 - Level of access to affordable COVID-19 tests
 - Meteorological conditions
 - State of public awareness and engagement of the local communities
 - Age, sex, smoking, previous disease of hospitalized persons,

• ...

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• Access to more detailed air quality reports and COVID-19 statistics can increase the number of sample and therefore will result in more significant outcome.





Conclusion

- This research work studies the hypothesis that COVID-19 mortality rate increases with exposure to long-term PM2.5 pollution.
- We could not find any significant correlation for No. Hospitalized and No. Death with 3-Year Annual PM2.5 in the provinces with PM2.5 concentrations in the rage of 30-45 µg/m³.
- However, we found a positive and moderate significant correlation for No. Hospitalized and No. Death with 3-Year Annual PM2.5 in the provinces with PM2.5 concentrations less than 30 μg/m³.





Thank you for your attention!

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