Journal of Air Pollution and Health (Summer 2018); 3(3): 147-154

Original Article

Available online at http://japh.tums.ac.ir

The effect of the increase in periodic technical inspection intervals from two to five years on vehicles emission

Kazem Naddafi[1,2], Mohammad Sadegh Hassanvand[2], Seyed Yaser Hashemi[1], Faramarz Azimi[1,]*

[1] *Department of Environmental Health Engineering, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran*
[2] *Center for Air Pollution Research (CAPR), Institute for Environmental Research (IER), Tehran University of Medical Sciences, Tehran, Iran*

ARTICLE INFORMATION

Article Chronology:
Received 20 July 2018
Revised 20 August 2018
Accepted 10 September 2018
Published 29 September 2018

Keywords:
Air pollution; Periodic technical inspection; Emission; Tehran

CORRESPONDING AUTHOR:

fazimi_lums@yahoo.com
Tel: (+98 21) 88954914
Fax: (+98 21) 88950188

ABSTRACT:

Introduction: Most vehicles with over 20 years of age have low combustion efficiency by no catalytic converters. One of the most important ways to control and reduce emissions from vehicles is to conduct periodic technical inspection (PTI). According to the regulations of each country, the frequency of periodic technical inspection is different and is determined by the quality of air.

Materials and methods: Data of light vehicles, which had been tested in 2010, was collected from Tehran vehicle technical inspection bureau. Collected information of data on vehicles manufactured from 2004 to 2008 including Pride, Peugeot 206, Peugeot 405, Peugeot Pars, Samand and Roa. About 248865 and 236084 vehicles were studied for HC and CO emissions, respectively.

Results: According to results one vehicle among every 6 Roa, every 14 Pride, every 22 Peugeot 405, every 40 Peugeot 206, every 125 Samand and every 111 Peugeot Pars, which were referred to technical inspection centers for first time, two years after manufacture, had higher pollutants emission compared to the permitted standards.

Conclusion: The results showed that if the periodic technical inspection intervals of vehicles increase from two years to more than two years, for example to five years, about 17.5 % of Peugeot 405 and 10.8 % of pride will be recorded for CO emissions higher than standard rate. Also, about 62 % of new vehicles will have higher levels of HC emissions, which can cause air pollution and an increase in the concentration of pollutants and eventually cause serious harm to public health.

Introduction

Air pollutants are one of the most important environmental risks by adverse health effects in developing countries. The severity of these effects varies depending on the type of pollutant (solids or gases), exposure duration and exposure frequency [1, 2]. The health effects of airborne pollutants have been shown in various studies, and many of these studies have been done in Tehran and have shown the importance of air pollution

Please cite this article as: Naddafi K, Hassanvand MS, Hashemi SY, Azimi F. The effect of the increase in periodic technical inspection intervals from two to five years on vehicles emission. Journal of Air Pollution and Health. 2018; 3(3): 147-154

[3-7]. Along with the development of industrial cities the air pollution will increase. In Tehran and some other industrial cities, the main sources of air pollutants include vehicles, industrial and household sources [8, 9]. In Tehran, about 80 – 85 % of the major air pollutants such as PM_{10}, NO_2, O_3 and CO are caused by mobile resources [10 - 12]. Several studies have been done on the management of air pollution in Tehran, which consider the contribution of vehicles and their lifetime on the emission of air pollutants. In a comprehensive study on the sources of air pollutants emission and the contribution of each of sources in Tehran, 90 % of the total mass of pollutants released from mobile resources and 10 % of the total mass of pollutants is due to stationary resources. The share of mobile resources in the emission of CO, HC, NOx and PM in Tehran was 98.7 %, 70 %, 67.5 %, and 83.2 % respectively. the study shows a very significant and impressive contribution of vehicles in emissions of air pollutants [13]. Most of the vehicles in Tehran are over 20 years of age, low combustion efficiency and no catalytic converters. Also, the lack of up - to - date standards for consumed fuel is another factor in increasing the emissions of air pollutants from vehicles, therefore, every effort to control and reduce air pollutants and improve air quality in different regions of Iran should be focused on mobile resources mainly [14 - 16]. According to a study, about 4.2 million vehicles were registered in Tehran, of which 70 % are personal vehicles and the rests are motorcycles and public vehicles and the amount of pollutants released in high traffic was 87.5, 7, 12, 0.4 and 1 ton / h, for CO, NOx, VOC, SOx and PM, respectively. It has been shown that by implementing the fuel quality control program, the emissions of CO, NOx, VOC, SOx and PM in a high traffic are reduced about 20.3 %, 14.4 %, 3.2 %, 93.2 %, and 3 % respectively [17]. One of the most important ways to control and reduce emissions from vehicles is to conduct periodic technical inspection. According to the regulations of each country, the frequency of periodic technical inspection is different and is determined by the quality of the air. In this study, the effect of the increase in periodic technical inspection intervals from two to five years on vehicles emission has been investigated and its scientific data is provided.

Materials and methods

This study was designed to investigate the effect of the increase in periodic technical inspection intervals from two to five years on vehicles pollutants emission. At first by referring to the head office of Tehran motor vehicle inspection, information about the amount of light vehicles were referred to the technical inspection centers in 2010 was collected. Collected information included data on vehicles manufactured from2004 to 2008 included Pride, Peugeot 206, Peugeot 405, Peugeot Pars, Samand and Roa. In Tables 1 and 2, the number and type of analyzed vehicles which were referred to Tehran technical inspection centers in 2010 to measure HC and CO, sorted by model and year of manufacture.

In order to determine the relationship between the manufacture year and the amount of CO and HC emissions, it is necessary to calculate the percentage of vehicles whose emissions exceed standard limits, then, depending on the year of manufacture, their relationship is determined. Therefore, at this stage, the vehicles emission compared to standards for HC and CO in the technical in-

spection centers and the percentage of vehicles whose emissions exceeded standard limits were determined according to vehicle type and year of manufacture. Then, to determine the increase in pollutants emissions followed by the increase in periodic technical inspection intervals from two to more than two years, the following steps were taken:

1- Determination of the percentage of vehicles manufactured in 2008 with the higher emissions of HC and CO compared to the standards, for each type of vehicle.

2- Calculation the percentage of vehicles produced before 2008 (years 2004, 2005, 2006, and 2007) with the higher HC and CO emissions in comparison with the standard limits. Finally, the average values were taken for each vehicle over the years and considered as the annual average number of vehicles which emissions exceeded the standard limits. In other words, the annual average number indicates an annual average percentage of vehicles which emissions exceed the standard limits after two years from the manufacture of vehicles.

3- Finally, the following equation was used to estimate the effect of increase in periodic technical inspection intervals from two to more than two years:

$$A_n = B_2 + (C_a \times (n-2)) \quad (1)$$

Which, A_n is percentage of vehicles with HC and CO emissions higher than standard limits recorded in technical inspection centers after the year n. B_2 is average percentage of vehicles with HC and CO emissions higher than standard limits recorded in technical inspection centers after two years of manufacture.

Table 1. The number and type of analyzed vehicles by year of manufacture for HC emission

Production Year	Type of vehicles					
	Peugeot Pars	Samand	Peugeot 206	Pride	Peugeot 405	Roa
2004	2701	7199	9907	21310	5630	-
2005	3883	5578	9827	24429	8903	-
2006	4779	5483	7786	28130	7339	2406
2007	4702	1434	4565	22118	7679	5106
2008	3988	1823	3442	30502	5403	3813

Table 2. The number and type of analyzed vehicles by year of manufacture for CO emission

Production Year	Type of vehicles					
	Peugeot Pars	Samand	Peugeot 206	Pride	Peugeot 405	Roa
2004	2631	7204	9675	21195	5630	-
2005	3853	5584	9470	24201	8903	-
2006	4724	5488	7498	27535	7339	2406
2007	4521	1435	4259	21354	7679	5106
2008	2246	1823	3172	21937	5403	3813

-Missed data

Results and discussions

Percentage of vehicles with emissions of HC and CO higher than standard limits

The results of the percentage of vehicles with HC and CO emissions exceeded the standard limits of HC (250 ppm) and CO (2.5 %) in different years were presented in Tables 1 and 2. A remarkable point in these tables is that there is an annual average for 2004 to 2007 which represents the annual average percentage of worked vehicles were referred to the technical inspection centers in 2008 and according to the law, they should be referred to these centers every year. Because vehicles manufactured in 2008 were referred to technical inspection centers after two years, the values for this year are different with the values obtained for other years (2004 to 2007) so it should be considered separately in analysis.

As shown in Tables 3 and 4, HC emissions are higher than CO in vehicles which were referred to technical inspection centers every year. Also, approximately one vehicle from every 7 Roa, every 16 Pride and Peugeot 405, every 30 Peugeot 206 and every 42 Samand and Peugeot Pars, which were referred to technical inspection centers every year, had higher pollutants emission level.

Table 3. Percentage of vehicles with HC emissions higher than standard limits

Production Year	Type of vehicles					
	Peugeot Pars	Samand	Peugeot 206	Pride	Peugeot 405	Roa
2004	4.5	3.1	2.7	13.7	9.1	-
2005	2.7	2.2	3	3.5	5.9	-
2006	1.7	3.7	2.8	4.6	4.8	8.8
2007	0.8	0.8	5.1	3.2	5	21.9
Average annual	2.4	2.4	3.4	6.3	6.2	15.4
2008	0.8	0.9	2.5	7.2	4.6	16.4

* Vehicles annual average manufactured from 2004 to 2007, which refereed technical inspection centers every year.
** Vehicles annual average manufactured in 2008, first visited by technical inspection centers in 2010.
- Missed data

Table 4. Percentage of vehicles with CO emissions higher than standard limits

Production Year	Type of vehicles					
	Peugeot Pars	Samand	Peugeot 206	Pride	Peugeot 405	Roa
2004	1.7	1.9	0.6	7.8	4.5	-
2005	0.9	1.9	2.7	1.1	2.9	-
2006	2.9	1.9	2.8	1.5	2.6	4.5
2007	1.4	0.6	1.9	1	5.8	2.2
Average annual	1.7	1.6	2	2.9	3.9	3.4
2008	6.0	0.4	0.7	2.1	5.8	1

* Vehicles annual average manufactured from 2004 to 2007, which refereed technical inspection centers every year.
** Vehicles annual Average manufactured in 2008, first visited by technical inspection centers in 2010.
- Missed data

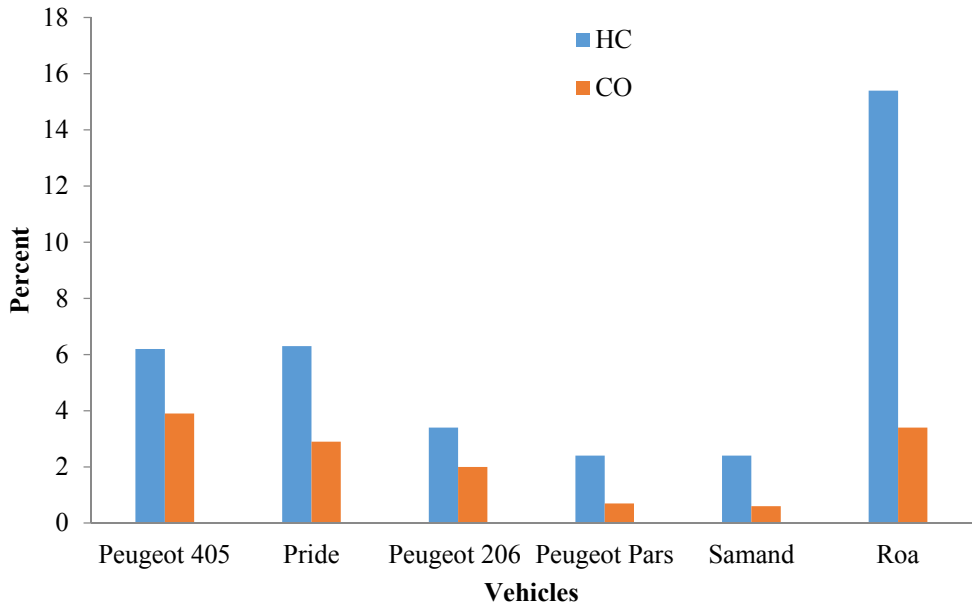

Fig. 1. Comparison of the annual average percentage of vehicles which were referred to technical inspection centers every year, with the emissions exceeded standard limits.

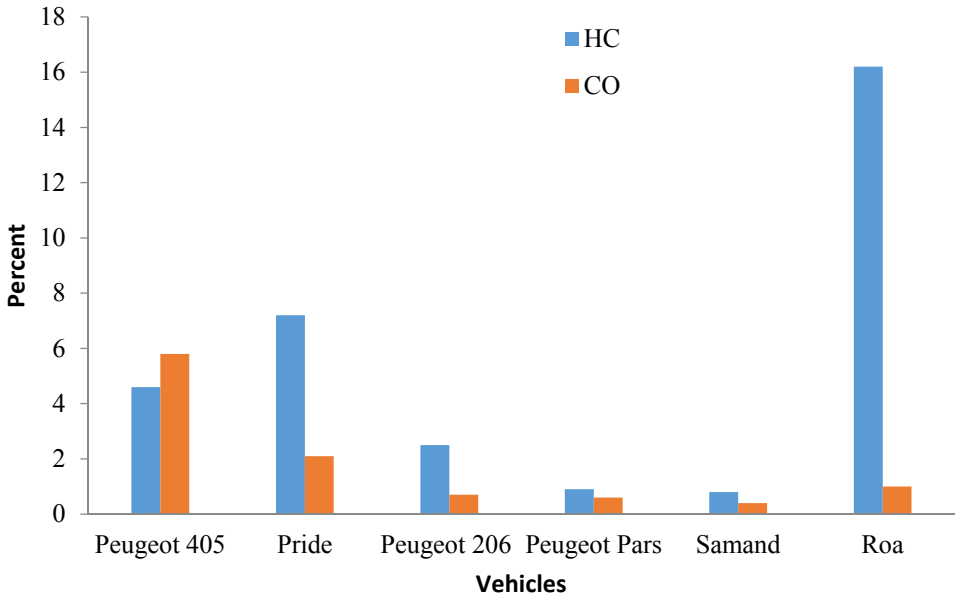

Fig. 2. Comparison of the annual average percentage of new vehicles were referred to technical inspection centers for 1st time in 2010, with emissions exceeded standard limits.

As shown in Tables 3 and 4 and Fig. 1, HC emissions are higher than CO in vehicles which were referred to technical inspection centers every year. Also, approximately one vehicle from every 7 Roa, every 16 Pride and Peugeot 405, every 30 Peugeot 206 and every 42 Samand and Peugeot Pars, which were referred to technical inspection centers every year, had higher pollutants emission level.

As shown in Fig. 2, most of vehicles which were referred to technical inspection centers in 2010 for first time with the HC emissions higher than standard limits, were Roa, Peugeot 405 and Pride and the lowest emissions were related to Samand, Peugeot Pars and Peugeot 206. Also most of vehicles which were referred to technical inspection centers in 2010 for first time with the CO emissions higher than standard limits were Peugeot 405, Pride and Roa, and the lowest emissions were related to Samand, Peugeot Pars and Peugeot 206. According to the results, one vehicle in every 6 Roa, every 14 Pride, every 22 Peugeot 405, every 40 Peugeot 206, every 125 Samand and every 111 Peugeot Pars, which were referred to technical inspection centers two years after manufacture for first time, had higher pollutants emission level.

Therefore, as presented in Tables 3 and 4 and Figs. 1 and 2, the most number of vehicles with HC and CO emissions higher than standard limits which were referred to technical inspection centers every year or for the first time were Roa, Pride and Peugeot 405 and the lowest number were Samand, Peugeot Pars and Peugeot 206.

Conclusion

The effect of increase in periodic technical inspection intervals of vehicles from two to more than two years on pollutants emissions

The Eq. (1) was applied to estimate the effect of increase in periodic technical inspection intervals on the concentration of pollutant emissions from vehicles. There is an increasing trend in the number of polluting vehicles if the periodic technical inspection intervals of vehicles increase from two to more than two years. According to the previous regulation, vehicles were obligated to refer a technical inspection center after two years which caused vehicles with emissions exceed the standard limits were repaired. By enforcing the regulation of increase in periodic technical inspection intervals, vehicles are not checked and regulated for the engine up to five years. So the traffic of vehicles emitting air pollutants higher than standard limit would be increase. In Tables 4 and 5, the effect of increase in periodic technical inspection intervals on the amount of HC and CO emissions from vehicles has been calculated.

As shown in Table 5, if the periodic technical inspection intervals of vehicles increase from two years to more than two years, for example, to five years, about 17.5 % of Peugeot 405 and 10.8% of Pride will have higher CO emissions than standard limits which can exacerbate air pollution and increase the level of pollutants and ultimately cause serious effects on community health.

Table 5. Average percentage of vehicles with CO emission higher than standard limits referring to technical inspection centers in different years

Interval time of referring to technical examination centers after production	The average percentages of vehicles with CO emission higher than standard limits					
	Roa	Samand	Peugeot Pars	Peugeot 206	Pride	Peugeot 405
Two years after production	1	0.4	0.6	0.7	2.1	5.8
Three years after production	4.4	2	2.3	2.7	5.0	9.7
Four years after production	7.8	3.6	4.0	4.7	7.9	13.6
Five years after production	11.2	5.2	5.7	6.7	10.8	17.5

Table 6. Average percentages of vehicles with HC emission higher than standard limits referring to technical inspection centers in different years

Interval time of referring to technical examination centers after production	The average estimated percentage of vehicles with HC emissions higher than standard					
	Roa	Samand	Peugeot Pars	Peugeot 206	Pride	Peugeot 405
Two years after production	16/2	0/8	0/9	2/5	7/2	4/6
Three years after production	31/6	3/2	3/3	5/9	13/5	10/8
Four years after production	47/0	5/6	5/7	9/3	19/8	17/0
Five years after production	62/4	8/0	8/1	12/7	26/1	23/2

According to Table 6 while periodic technical inspection intervals for vehicles increase from two years to more than two years, the percentage of vehicles with HC emission higher than standard limits will increase significantly. In this case, about 62 % of Roa will have higher emissions of HC compared to the standard limits.

There were some limitations in this study which could be considered and omitted for the next studies. Also, the expression of limitations can help researchers to make better decisions when using this results. The limitations of this study were as follows:

- Lack of access to data of technical inspection centers of vehicles in different years. In this study, it was processed only the data from the technical centers which were accepted in the tests in 2010.
- Lack of access to the data of vehicle technical inspection centers in other cities. In this study, only Tehran city data has been analyzed.
- The data accuracy of the concentration of pollutants measured in the technical inspection centers.

Financial supports

This study was funded by Tehran University of Medical Sciences (grant number # 19040-46-03-91) at the Center for Air Pollution Research.

Competing interests

The authors declare that there is no conflict of interest

Acknowledgements

The authors are grateful to head office of Tehran Motor Vehicle Inspection for providing data.

Ethical considerations

All of the ethical issues have been completely observed by the authors.

References

1. Faridi S, Shamsipour M, Krzyzanowski M, Künzli N, Amini H, Azimi F, et al. Long-term trends and health impact of PM2.5 and O3 in Tehran, Iran, 2006–2015. Environment international, 2018. 114: 37-49.
2. Atash, F. The deterioration of urban environments in developing countries: Mitigating the air pollution crisis in Tehran, Iran. Cities, 2007. 24(6): 399-409.
3. Hassanvand MS, Naddafi K, Kashani K, Faridi S, Künzli N, Nabizadeh R, et al. Short-term effects of particle size fractions on circulating biomarkers of inflammation in a panel of elderly subjects and healthy young adults. Environmental pollution. 2017. 223: 695-704.
4. Hassanvand M.S, Naddafi K, Faridi S, Nabizadeh R, Sowlat MH, MomenihaF, et al. Characterization of PAHs and metals in indoor/outdoor PM10/PM2. 5/PM1 in a retirement home and a school dormitory. Science of the Total Environment, 2015. 527: 100-10.
5. Hoseini M, Yunesian M, Nabizadeh R, Yaghmaeian K, Ahmadkhaniha R, Rastkari N, et al.Characterization and risk assessment of polycyclic aromatic hydrocarbons (PAHs) in urban atmospheric Particulate of Teh-

ran, Iran. Environmental Science and Pollution Research, 2016. 23(2): 1820-1832.
6. Naddafi K, Sowlat MH, Safari M, Integrated assessment of air pollution in Tehran, over the period from September 2008 to September 2009. Iranian journal of public health, 2012. 41(2): 77.
7. Heger M, Sarraf M. Air Pollution in Tehran: Health Costs, Sources, and Policies. World Bank ; 2018.
8. Seifi M, Niazi S, Johnson G, Nodehi V, Yunesian M. Exposure to ambient air pollution and risk of childhood cancers: A population-based study in Tehran, Iran. Science of The Total Environment, 2019. 646: 105-110.
9. Taghvaee S, Sowlat MH, Mousavi AH, Hassanvand MS, Yunesian M, Naddafi K, et al. Source apportionment of ambient $PM_{2.5}$ in two locations in central Tehran using the Positive Matrix Factorization (PMF) model. Science of The Total Environment, 2018. 628-629: 672-686.
10. Naddafi K, Hassanvand M.S, Faridi S, Nabizadeh R, Yunesian M, MomenihaF, et al, Health impact assessment of air pollution in megacity of Tehran, Iran. Iranian journal of environmental health science & engineering, 2012. 9(1): 28.
11. Azizi M.H., Impact of traffic-related air pollution on public health: a real challenge. Archives of Iranian medicine, 2011. 14(2): 139.
12. Alizadeh-Choobari O, Bidokhti AA, Ghafarian P, Najafi M. Temporal and spatial variations of particulate matter and gaseous pollutants in the urban area of Tehran. Atmospheric Environment, 2016. 141: 443-453.
13. Bayat R, Torkian A, Najafi M, Askariyeh MH, Arhami M, editors. Source apportionment of Tehran's air pollution by emissions inventory. International emission inventory conference of EPA; 2012: EPA Tampa, FL, USA.
14 Halek F, Kavouci A, Montehaie H. Role of motor-vehicles and trend of air borne particulate in the Great Tehran area, Iran. International journal of environmental health research, 2004. 14(4): 307-313.
15. Ghadiri Z, Rashidi Y, Broomandi P. Evaluation Euro IV of effectiveness in transportation systems of Tehran on air quality: Application of IVE model. Pollution, 2017. 3(4): 639-653.
16. Mohammadiha , Malakooti H, Esfahanian V. Development of reduction scenarios for criteria air pollutants emission in Tehran Traffic Sector, Iran. Science of The Total Environment, 2018. 622: 17-28.
17. Shahbaz H, Reyhanian M, Hosseini V, Afshin A. The relative contributions of mobile sources to air pollutant emissions in Tehran, Iran: an emission inventory approach. Emission Control Science and Technology, 2016. 2(1): 44-56.