Journal of Environmental Sciences Studies

Journal home page: www.jess.ir

POTENTIAL ECOLOGICAL RISK OF METALS EMITTED FROM TRAFFIC ON THE LEAVES OF TREES IN TEHRAN, IRAN

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Received: (August - 27- 2021)
Accepted: (October – 09- 2021)

Abstract

The purpose of the current study was to investigate the effect of fuel quality on the contamination and potential ecological risk of metals in high-traffic areas. To this end, the leaves of street-side trees in Tehran were used as particle collectors. The concentration of Pb, Cd and Zn decreased but the concentration of Co and Cu increased in 2014 compared with 2012. The potential ecological risk of metals, Cd, Co, Cu, Ni, Pb, and Zn, decreased by %43 in 2014 compared to 2012. Despite the improvement of fuel quality in 2014, there was yet the moderate likelihood of potential ecological risk of metals in the study sites. It was revealed that the wear and tear of interior and exterior parts of vehicles remained significant, especially after the high-risk period of 2012. As conclusion, natural factors and air conditioning exacerbated the contamination of metal at local levels in Tehran. The purpose of the current study was to investigate the effect of fuel quality on the contamination and potential ecological risk of metals in high-traffic areas. To this end, the leaves of street-side trees in Tehran were used as particle collectors.

Keywords

Potential Ecological Risk; Traffic-emitted metals; leaves of street-side trees; Tehran

Introduction

The particles of dusts in streets contain high concentrations of a variety of metals and are considered as the main challenges of urban environmental contamination (Yu et al. 2014; Zheng et al. 2015; Han et al. 2017.Chen et al.,2021). Metals are toxic, resist to biodegradation and accumulate in the food chain and adipose tissues of living organisms (Yu et al. 2014; Zheng et al. 2015; Suryawanshi et al. 2016; Han et al. 2017). Exposure to metals results in chronic and acute injuries to the living organisms (Naddafi et al. 2012; Kermani et al. 2016; Kamani et al, 2017). With respect to the fact that people are constantly exposed to air pollution in urban areas, air pollutants can easily enter the body and cause adverse effects on human health in the short and long runs (Kermani et al. 2016; Suryawanshi et al. 2016. Arden Pope et al.,2020). Various diseases of nervous and digestive systems, cardiovascular diseases, behavioral disorders and endocrine changes are all caused in human by exposure to metal pollutants (Yu et al. 2014; Kermani et al. 2016; Han et al. 2017) . Dealing with such problems necessitates a comprehensive investigation into air quality, air pollution dispersion models, quantitative and qualitative assessment of pollutants and their sources of emission to air (Naddafi et al. 2012; Herath et al. 2016. Men et al., 2018; Hou et al., 2019). In order to determine and estimate the toxicity and detrimental effects of metals on urban ecology as well as their health risks on the residents of these areas, there is a need to examine the chemical forms, quantity, emission pattern and toxicity of metal pollutants and identify their potential sources and risks. The assessment of potential ecological risks of metals against the health of living creatures provides the community health planners with a powerful tool for processing and analyzing ecological information (Zhao and Li 2013; Han et al. 2017. Zhao et al., 2019. Chen et al.,2021). The potential ecological risks of metals in environment, through the analysis of Contaminatio factor (Cf), Modified degree of contamination (mDf), Pollution load index (PLI), potential ecological risk index (RI) indices, have been considered in by researchers in several studies (Muller 1979; Thomilson et al.1980; Salmanzadeh et al. 2015; Xu et al. 2015; Yu et al. 2014; Yuan et al. 2014; Hakanson 1980; Herath et al. 2016; Han et al. 2017). Despite the importance of quantitative and qualitative assessment of air pollutants in urban areas and compound characteristics of air for developing strong models, little attention has been given to investigation of the composition of pollutants, particularly metals, in Tehran of Iran; thus, only a few limited studies can be found in this regard (Naddafi et al. 2012; Kermani et al. 2016). Tehran, the largest city of Iran, is considered as one of the most populous cities in the world (Naddafi et al. 2012). It deals with many problems like high population and high vehicle traffice volume. Tehran is also the most industrial city of Iran. Many industries including power plants, refineries, furnaces and chemical-metallurgical plants are located around Tehran (Kermani et al. 2016; Ghaemi et al. 2016). Air pollution is a serious problem in Tehran (Halimi et al.2016). Several research in Iran has studied air pollution in Tehran concentrating on CO, Nox, Sox and O3 pollutants, suspending particles, air quality index (AQI), detriments of air pollution, and air pollution emission models regardless of considering metal pollutants, identifying their emission sources and defining the relevant standards (Shamsipour et al. 2013; Noorpoor and Sadri Jahanshahi. 2014; Kermani et al. 2016; Salmanzadeh et al. 2015; Mazloomi et al. 2017; Kamani et al. 2017. Ali-Taleshi et al, 2020). The present study aimed at investigating the effect of potential ecological risk of metals emitted from traffic on Street-side trees within Sep. 2012 and Sep. 2014 based on geochemical indices . The economic and political conditions of Iran during the years 2010-2011 caused foreign countries to refuse to engage in fuel deals with Iran. This forced the country to supply the required fuel of vehicles from domestic petrochemical plants. After that, in the winter of 2013, with the announcement of relevant institutional bodies, including the Department of Environment(DoE)and Ministry of Petroleum(MoP), the fuel quality of the vehicles was improved. It should be recalled that, until the publication of this paper, no official reports on the new content of the fuel distributed by the relevant organizations have been published. The present research investigated the changes in the heavy metal content of the fuel within two time intervals, i.e. Sept. 2012 and Sept. 2014. Since plants function as natural filters, they can decompose the dust particle due to their morphological features (Daylam-jafarabad et al. 2013; Naderizadeh et al. 2016; Chrabąszcz and Mróz. 2017. Hatami-Manesh et al.,2019). In the present study, for the ease of sampling, the leaves of the street-side trees were used as particle collector surfaces. Several studies have accentuated the use of plant's leaves, due to their pervasiveness all over the city, for reducing the costs of sampling (Maher et al. 2008; Naderizadeh et al. 2016; Chrabąszcz, and Mróz. 2017. Hatami-Manesh et al.,2019). Deploying plants is an appropriate alternative to human sampling in order to describe the toxicity and potential risks of metal pollutants since collecting samples from human to assess the effect of metal pollutants on them causes social consequences .

2. Materials and Methods

The city Tehran(35°41′46″N 51°25′23″E) is the capital of Iran. Tehran is at an average height of 1191 meters from the sea level and its maximum temperature is 5.22 ºC and the minimum temperature is 2.11 ºC. The prevailing wind flow in Tehran is the west east direction and most of the industries are in the lands of west of Tehran and suburbs. Tehran's topographical condition is in such a way that north and east of Tehran has blocked with some mountains which act as high barriers that prevent the pollution from exiting (Abdemanafi et al. 2017). In contrast, the west of Tehran, due to the openness of the region, suburb's pollution also enters the city from this direction with the help of winds. The speed of the wind intensely slows down inside the city. Air pollution in a city is depends on the wind pattern and follows its direction and speed. The intensity and rate of pollution increase from east to west and from north to south. Most of Tehran's winds are weak have varying directions and a small portion of the winds blow from west to southwest and northwest and are relatively quicker and can be effective in the transmission of pollutions. All of these topological conditions lead to the increase of pollution in the central regions of Tehran (Abdemanafi et al. 2017). The density of industrial units is higher in the west and southwest of Tehran and approximately 28% of the industries of the entire Tehran province and in other words 7% of the industries of the whole country are in this area (Abdemanafi et al. 2017). Among these industries, there is thermal power stations and refineries of Tehran and construction products workshops such as cement and ceramic and also airport. For the current investigation, two different sites were selected in the center and west of Tehran (Fig. 1).

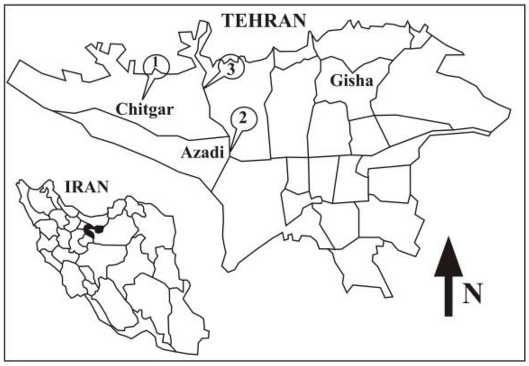

Fig. 1. Sampling sites of urban street in Tehran, Iran (Sept. 2012 and Sept. 2014)

The Site 1 was Azadi Square in the west of Tehran and Site2 was Gisha Bridge (conjunction of Jalal Al Ahmad and Chamran highways) in the center of Tehran. Azadi square is an area with heavy traffic. This area is the closest study station in the present research to the Tehran – Karaj Highway. In this area, presence of wide streets and various walking passages and subsequent to it reduction of the density of business and residential structures have led to a better conditioning and air flow in comparison with the area of site 2 in this region. In site 2, presence of overpass bridges for transportation vehicles and the intersection of the two highways and closeness to the business and residential structures and higher education institutes and offices in this area have led to the increase of the traffic volume and the volume of the pollutants increase and air conditioning reduces. Standards have not yet been set for determining the concentrations of metals in air (pre-industrial background levels) in Tehran and Iran.Therefore, the levels of metal concentrations were determined in one the largest forest parks in west of Tehran i.e. Chitgar Park (control site) and were used as background levels for estimating geochemical indices. Given the application of Chitgar forest park, in this site, traffic of cars in the sampling areas have been very little. The horizontal distance of the sampling place in this site to the Tehran – Karaj Highway (the most traveled highway of Iran) is approximately 1000 meters; nevertheless, due to the location being in the west of Tehran and the large number of small and large industries and special topographical conditions and wind in Tehran, this region is influenced by the consequences of air pollutants. Since a large portion of the particles produced by the traffic of cards in the shortest distance from the source of production of sediment, thus samples of tree leaves in the monitoring site have been collected from inside of the dense coating of the green space of the margin of the passages inside the park.Regarding the pollution emitted from industries in the west and southwest of Tehran, it was indicated that the trends of metal concentrations in sites 1 and 2 were mainly caused by traffic in comparison to the control site (Fig.1). In Table.1 the condition of the air quality indexes and some parameters measured in the reports of Tehran's air quality monitoring organization in the year 2013 have been shown (annual report of Tehran's air quality in the year 2014). In the area of Chitgar Park, there was no active air monitoring station. The closed air pollutant monitoring stations to the site 1 and 2 were 500 meters from the sampling location.

Table.1 Air quality parameters of Tehran in 2014

Parameter	Site.2(Azadi)	Site.3(Gisha)
CO(ppm)	2.08	2.07
SO2 (ppb)	7.62	14.32
NO2 (ppb)	24.36	45.89
PM10(µg/m3)	100.05	93.39
O3 (ppb)	16.91	20.70
PM2.5(µg/m3)	28.39	29.20
benzene (ppb)	0.21	2.49
toluene (ppb)	2.46	11.55
ethylbenzen(ppb)	0.50	0.13
p-xylene(ppb)	2.46	5.19
o-xylene (ppb)	1.08	2.72

In each site, the tree leaves were collected randomly from the leaves of three types of trees sycamore, elm and acacia in the shortest distance from the street. The location of the trees from the street and sunlight and the direction of the wind blow and height from the street level have been considered to be equal. Samples were collected from trees within two time intervals in the late growing season i.e. Sept. 2012 and Sept. 2014. It had been almost one moth that passed the latest rainfall, storm and wind in these sites by two periods. Completely healthy leaves have been collected from the canopy of each tree from the street. With the least touch of hands, the leaves were put into the ice tank and were transferred to the laboratory in the shortest time. 0.5 grams of each sample was put in 12cc of nitric acid in a Teflon polymer coated with aluminum foil for one hour in the room temperature. Then it was put on an asbestos heater with indirect heat. After drying up with paper in a 50cc balloon, it reached its desirable volume and was smoothened with a 42 whatman filter and then it was read in an ICP-MS. For calibration of amounts of element in the reference material was used used to read the concentration levels of cadmium, lead, zinc, nickel, copper and cobalt. Several studies have considered these metals as the main metals emitted from traffic and highlighted their toxicity (Kermani et al. 2016; Maher et al. 2008). The present study used Contaminatio factor (Cf), Modified degree of contamination (mDf), Pollution load index (PLI), potential ecological risk index (RI) indices to determine the likelihood of potential ecological risks of each metal element in the intended sites (Muller 1979; Thomilson et al. 1980; Salmanzadeh et al. 2015; Xu et al. 2015; Yu et al. 2014; Yuan et al. 2014; Hakanson. 1980; Suryawanshi et al. 2016; Herath et al, 2016; Han et al. 2017. Chen et al.,2021).The metal concentrations, determined in Chitgar Park, was used as background value while Aluminum was used as reference metal. The indices of Cf and mCd were used in order to determine and express the environmental contamination status with a particular metal. These indices were calculated by Formula 1.Cd

(Contamination Degree) is an index to measure the severity of total environmental degree of contamination which is obtained by the sum of Cf (Contamination factor) of all metals (Formula 2). Later, in 2005, Abrahim developed mCd (Modified Contamination Degree) (Formula 3). Furthermore, PLI (Pollution Load Index) was measured by Formula 4.

$$Cf = Cn / Cref \quad (1)$$

$$Cd = \sum_i^n Cf \quad (2)$$

$$\sum_i^n Cf/n = m\,Cd \quad (3)$$

$$PLI = \sqrt[n]{Cf1 \times Cf2 \times \ldots \times Cfn} \quad (4)$$

Where, Cn is the measured concentration of the element in the sample tested and Cref is background value of the element. The levels of Cf (Xu et al. 2015) and mCd (Abrahim 2005) and PLI (Thomilson et al. 1980) is Table 2.

Table 2. Levels of Cf and mCd and PLI
Potential ecological risk index(RI) is defined as 5 and 6 formulas (Hakanson,1980) .

mCd	mCd< 1.5	2-4	4-8	8-16	16-32	mCd> 32
mCd grade	Low	Moderate	Considerable	High	Extremely	ultra high
Cf	Cf < 1	1 ≤Cf <3	3 ≤Cf < 6	6 < Cf		
grade Cf	Low	Moderate	strongly	extremely		
PLI	PLI >1	PLI < 1				
PLI grade	polluted	indicatesno pollution				

$$Er = Ti \times Cf \quad (5)$$

$$R = \sum_{i=1}^n Ei \quad (6)$$

Where Er is the potential ecological risk factor of metal i ;Ti the toxic response factor of metal Co = Cu= Ni = Pb = 5,cd=30 and Zn = 1(Xu et al .2015; Shi and Wang .2013; Hakanson.1980). Cf the pollution factor of metal i, Cb the background value of metal i. RI represents the sensitivity of the biological community to the toxic metals and illustrates the potentional ecological risk casused by the overall contamination (Xu et al. 2015; Hakanson 1980). Table 3 shows the grade of ecological risk.

Table 3. Grade of ecological risk
Er, The ecological risk factor of metal i; RI, the ecological risk index.

Er	Ecological risk grade	RI	Ecological risk rade
Er < 15	Low	RI < 50	Low
15 ≤ Er < 30	Moderate	50 ≤ RI < 100	Moderate
30 ≤ Er < 60	Considerable	100 ≤ RI < 200	Considerable
60 ≤ Er < 120	High	200 ≤ Ei	High
120 ≤ Er	Very high		

3. Results & Discussion

Table 4 presents the mean concentration of metal including Cd, Co, Cu, Ni, Pb and Zn in the aforesaid sites during the intended sampling periods (Table 4).

Table 4. The mean concentration of metal (ppm) in the intended sited in Sept. 2012 and Sept. 2014

Location, year/ Heavy	Gisha 2012	Azadi 2012	Gisha 2014	Azadi 2014	Chitgar 2014
Cadmium	4.12	3.94	2.24	1.75	0.72
Cobalt	1.51	1.8	2.63	1.99	0.7
Copper	74.23	66.84	155.2	129.25	63.33
Nickel	7.13	8.3	6.75	8.72	4.17
Lead	406.3	491.04	159.13	128.17	58.17
Zinc	145.05	191.98	111.87	182.2	67.03

Cf is an index to express the environmental degree of contamination with a specific metal and mCd measures the total degree of contamination in environment. These two indices are measures of degree of contamination (Hakanson.1979). Furthermore, PLI(Pollution Load Index) is simple index to measure the quality of the sites (Thomilson et al. 1980). The estimates of PLI and mCd showed that the intended sampling sites were in inappropriate conditions in terms of contamination with Cd, Co, Cu, Ni, Pb and Zn within the investigation periods; the degree of contamination was moderate The comparison of both periods indicated that despite the decreased severity of contamination compared with 2012, the contamination of metals had yet caused potential risks at a moderate level in the intended sites in 2014 (Figs.2 and 3).

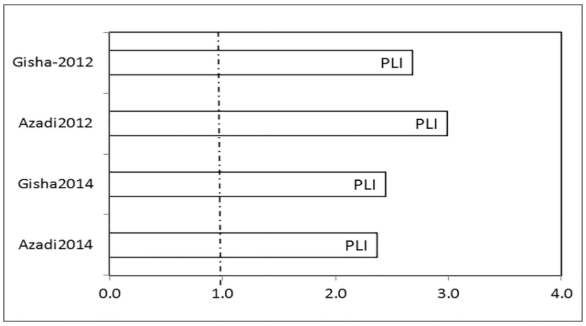

Fig 2. Quality of environment based on PLI

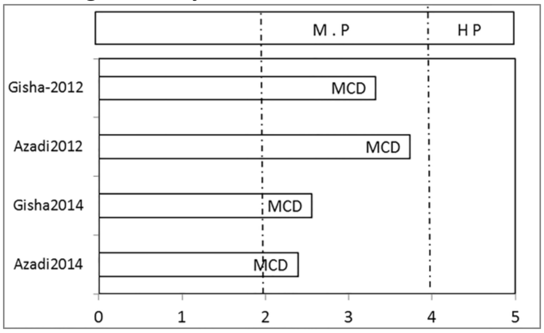

Fig 3. Pollution of environment on mCd

*** L.P= Low polluted. M.P= Moderate polluted. H.P= High polluted**

Comparing Cf (Degree of Contamination) between both periods, it was revealed that Cadmium (strongly polluted level) and Lead (extremely polluted level) respectively aggravated contamination while the degree of contamination of other metals was moderate

On the other hand, the severity of Cf of all metals decreased to a moderate level in 2014; however, Copper exacerbated contamination in 2014 more than 2012. Cobalt had the most severe Cf in 2014(extremely polluted level) (Fig.4).

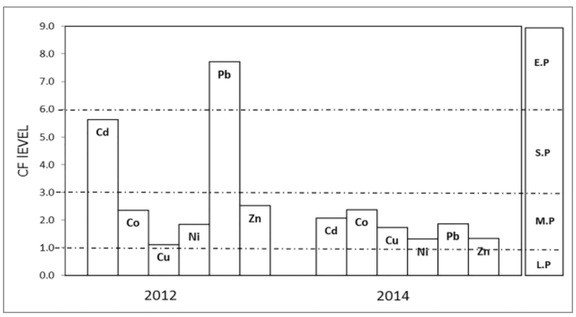

Fig 4. Trends of Cf in 2012 and 2014 in the intended sites

The Modified Contamination Degree of Cd and Pb was severe and more severe in Gisha site in comparison to other metals. In 2014, the degree of contamination of all metals, except for Cd and Co, decreased to a moderate level in Gisha (Fig.5).

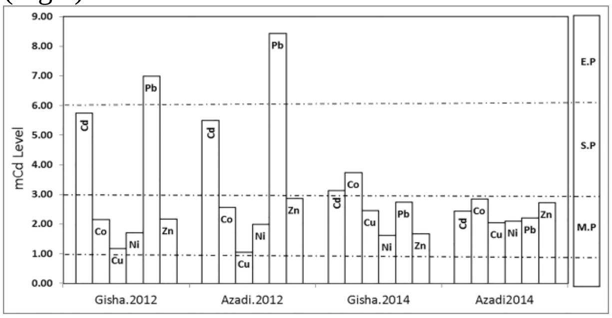

Figure 5: Trends of Cf in 2012 and 2014 in the intended sites

Hakanson,1979 states that the estimation of RI and Er of each metal in different areas along with the quantitative description of the severity of degree of contamination based on geochemical indices can clearly reveal the potential ecological risk of metals and indicate the degree of environmental contamination with metals. The observed value of RI for all elements was respectively 236.4 and 135.06 in 2012 and 2014. The potential ecological risk of Cd, Co, Cu, Ni, Pb and Zn decreased by %43 in 2014 in comparison to 2012. Furthermore, the comparison of RI between both periods indicated that the ecological risk of metals was more severe in Gisha and Azadi in 2012 while it decreased in 2014 even though it yet remained significant. The ratio of RI reduction in Azadi and Gisha was respectively %49 and %37 in 2014 compared with 2012 (Fig. 6).

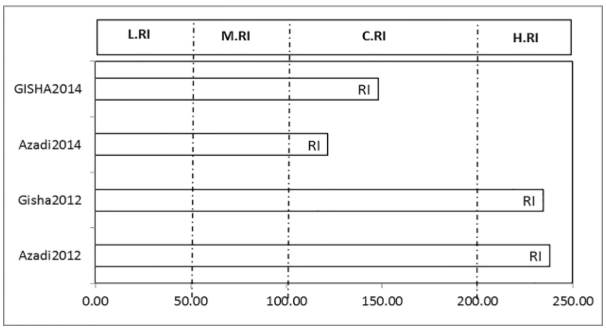

Fig. 6: Potential ecological risk in 2012 and 2014 in the intended sites

The trends of Er of each metal were also estimated in 2012 and 2014 (Table 5). According to the following table, copper and cadmium were considered as the high-risk metals in the intended sites in 2012 whereas their risk decreased in 2014 so that copper was identified as a low-risk metal. In 2014, Cobalt and Cadmium were the high-risk metals in the intended sites; moreover, the degree of contamination and risk level of cobalt took an ascending trend (Table 5).

Table 5. Er from metal in 2012 and 2014

Er.	2012	2014
Cadmium	VH. Er	H. Er
Cobalt	L. Er	M. Er
Copper	L. Er	L. Er
Nickel	L. Er	L. Er
Lead	C. Er	L. Er
Zinc	L. Er	L. Er

VH.Er (Very high) . H.Er(High) . C.Er (Considerable) . M.Er (Moderate). L.Er (Low)

In order to determine the trends of potential risk of each metal in the intended sites and describe and interpret the probable causes of these trends and changes, their degree of contamination was determined in the aforesaid sites and the Er value of metals was compared with each other (Table6).

Table 6. Er from metal in 2012 and 2014 in the intended sites

Er	Gisha 2012	Azadi 2012	Gisha 2014	Azadi 2014
Cadmium	VH.Er (172.5)	VH.Er (164.9)	H.Er (93.8)	H.Er (73.3)
Cobalt	L.Er (10.8)	L.Er (12.8)	M.Er (18.7)	L.Er (14.2)
Copper	L.Er (5.9)	L.Eri (5.3)	L.Er (12.3)	L.Er (10.2)
Nickel	L.Er (8.5)	L.Er (9.9)	L.Er (8.1)	L.Er (10.5)
Lead	C.Er (34.9)	C.Er (42.2)	L.Er (13.7)	L.Er (11.0)
Zinc	L.Er (2.2)	L.Er (2.9)	L.Eri (1.7)	L.Er (2.7)

VH.Er (Very high) . H.Er(High) . C.Er (Considerable) . M.Er (Moderate) . L.Er (Low)

The Er of Nickel remained unaffected within both periods. The wear and tear of automotive parts, motor oil, petrol combustion, the activity of power plants are the sources of Nickel emission into the environment (Victoria et al. 2014; Suryawanshi et al. 2016). Nickel is used to produce alloys for plating tire rims, exterior parts of vehicles, cylinder and pistons of engines to increase their resistance to long-term exposure to heat or high temperature (Victoria et al. 2014; Suryawanshi et al. 2016). According to the results of the present study, the degree and risk of contamination with Nickel was low and it had insignificant fluctuations in the aforesaid sites within the intended periods. vehicle traffic volume, motor oil, tires wear, automotive alloys along with electrical and metallurgical industries are all the emission sources of Zinc into environment (Herath et al. 2016; Victoria et al. 2014 ; Suryawanshi et al. 2016) . In urban environment, the concentration and contamination of Pb, Zn and Cd altogether indicate the critical role of vehicles in the emission particle into air(Suryawanshi et al. 2016). The emissions sources of Lead are fuel hoses of tanks, igniters(Maher et al. 2008; Victoria et al. 2014), wheel balance weights and tires wear are the sources of Lead (Victoria et al. 2014. Sabouhi et al., 2020). The other sources of Lead emission are construction materials, cement, brick, wood and painting (Kermani et al. 2016) as well as erosion of road asphalt and tire wear(Victoria et al. 2014. Gope et al.,2018). Research has shown that the main problem with gasoline and diesel fuels in Iran is their low octane number which increases fuel consumption and contaminants while reduces engine life(Naderi et al. 2013; Ghorbani et al. 2018). These trends of metal concentration were associated with the trends of fuel quality in vehicle . Research has shown that the main problem with gasoline and diesel fuels in Iran is their low octane number which increases fuel consumption and contaminants while reduces engine life (Naderi et al. 2013). Furthermore, since the level of sulfur and gasoline is high in fuels, the efficiency of pollution control catalysts decreases in vehicles (Naderi et al.

2013; Stradling et al. 2016; Ghorbani et al. 2018).In order to improve octane number, some additives are added to fuels which mainly emit toxic and carcinogenic particles to environment; for instance, the compounds such as Tetraethyl Lead (pb (c4h5)) is the most common additive used in fuels and motor oil of vehicles. These compounds have a high level of Lead Oxide which is emitted into air (Stradling et al; 2016) . The carcinogenic property of Cd and Pb has been approved by many scientific studies (Kermani et al; 2016) . The use of Leaded fuels has long been abandoned. Nevertheless, the Lead-free fuels contain other metal compounds which emit particles, like lead, into environment while being exposed to vehicles (Maher et al. 2008; Suryawanshi et al. 2016).Cadmium has a low concentration in the earth's crust; hence, its emission into urban environment is mainly due to human activities. The combustion sources of cadmium are a few. The erosion of construction materials like cement and asphalt as well as the wear of vehicles' parts and batteries are all the emission sources of Cadmium. One of the most important emission sources of Cadmium is the tire wear(Victoria et al. 2014; Herath et al. 2016; Kermani et al. 2016) . Cobalt is emitted from the fuel combustion, aviation industries and erosion of construction materials like ceramic and glass (Han et al. 2017). Probably, two major sources of cobalt in Tehran are the tear of interior parts of vehicles and fuel combustion of industries, located in west of Tehran, and their entrance and emission to the city. The concentration and contamination of cobalt did not have any significant changes in the intended sites within the investigation periods. In other words, its emission levels had a quite similar trend within the research periods. Therefore, it is probable that a majority of cobalt are emitted from the industries located in west of Tehran. The relative increase of cobalt in 2014 might have been influenced by the fluctuations in wind and the emission of a high volume of contaminants into the city . Copper particles are emitted from engine wear, bearings, wear of automotive parts and metals (Han et al. 2017). Copper is also emitted from the corrosion of oil pump and the exposure of grease to vehicle's parts at high temperature and exits from the vehicle exhaust. It is used in spark plug to increase the flammability and is also used as an anti-corrosion on engine surface to reduce the friction between different parts of engine (Herath et al. 2016; Suryawanshi et al. 2016). The major emission sources of copper in urban areas are the particles emitted from industrial lubricants, tire wear and engine wear (Herath et al. 2016). The considerable rise of copper concentration was most probably caused by traffic of vehicles with worn-out interior parts containing remnant sediments. On the other hand, the amount of damage and potential risks of metals was not too worrying even though it was higher in Gisha. Therefore, the highest concentration of Cu in this study could indicate that brake abrasion from frequent brake use and exhaust fumes from fuel combustion in high-rate traffic cause higher Cu concentrations in this area**.**The results of the current study showed that the improvement of fuel quality had a significant effect on the reduction of emitted contaminant compounds in air.Kermani et al. (2016), and Salmanzadeh et al. (2015) emphasized the severity of degree of contamination in the central areas of Tehran; they stated that the suspended particles, under 2.5, along with their pertinent metals were caused by traffic in these areas (Ghaemi et al.2016; Kamani et al. 2017). The investigation of probable sources of contaminants in the present study accentuates the fact that in addition to the improvement of fuel, it is necessary to pay considerable attention to fuel consumption and its associated parameters. Parameters including vehicle traffic volume, traffic red light duration, the number of use of brake, the composition of automotive fleet are the factors increasing the wear and tear of vehicles; subsequently, fuel consumption increases in dilapidated automotive fleet (Herath et al. 2016; Hui et al. 2017). Fuel consumption with low octane and high sulfur increases the amount of sediments in fuel pump and combustion chamber; hence, the combustion temperature is disrupted and requires more fuel injection (Naderi et al. 2013;

Stradling et al.2016; Ghorbani et al. 2018). and subsequently, fuel consumption increases. In addition to the wear and tear of interior parts of vehicles, the erosion of automotive alloys as well as tire wear pave the way for the emission of metal elements(Salamanzadeh et al. 2015; Herath et al. 2016). In Tehran, the wear of vehicles and the plenty number of dilapidated vehicles aggravate the contaminants (Salmanzadeh et al. 2015; Naderi et al. 2013; Mazloomi et al, 2017; Kamani et al, 2017). The results of the present study showed that Azadi had more critical conditions due to the traffic of vehicles with a variety of fuel consumption and improper fuel quality in 2012 in comparison to Gisha. On the contrary, once the fuel quality improved in 2014, the contamination aggravated more in Gisha than in Azadi. Kermani et al. (2016), and Salmanzadeh et al. (2015) emphasized the severity of degree of contamination in the central areas of Tehran; they stated that the suspended particles, under 2.5, along with their pertinent metals were caused by traffic in these areas (Ghaemi et al.2016; Kamani et al. 2017. Ali-Taleshi et l., 2020). The frequent number of dilapidated vehicles in Gisha led to emission of metals. Furthermore, climate conditions, decreased air conditioning, and density of buildings in Gisha increased the concentration of contaminants. Almost %70 of winds in Tehran are weak and have varied directions . With respect to the geographical and climate conditions of Tehran, the air pollutants remain for a longer time on the earth. Wind speed is a determinant of dispersion and emission of contaminants. The higher the speed of wind, the more the turbulence of air and the less the concentration of contaminants will be. The decrease of wind speed aggravates the degree of contamination in central areas of Tehran (Shamsipour et al. 2013; Halimi et al.2016).

4. Conclusions

The present study intended to investigate the potential trend of ecological risk of metals, including Cd, Zn, Pb, Co, Ni and Cu, in two high-traffic areas of Azadi Square and Gisha Bridge in Tehran, Iran, within two time intervals i.e. September 2012 and September 2014, using Contaminatio factor (Cf) ,Modified degree of contamination (mDf),Pollution load index (PLI), potential ecological risk index (RI) indices. In general, the purpose of the current study was to investigate the effect of fuel quality on the contamination and potential ecological risk of metals in high-traffic areas. To this end, leaves of street-side tress were used as particle collectors. The results indicated that the improvement of fuel quality reduced the emission of metal pollutants in 2014. These trends had a significant effect on the reduction of potential risks of Lead and Cadmium. According to the results, despite the improvement of fuel quality in 2014, there was yet a moderate likelihood of potential ecological risk of metals in the aforesaid areas. Thus, considerations should be given to not only fuel quality but also fuel consumption. In 2014, copper significantly increase due to the wear and tear of vehicles. It was found that the influential factors on the concentrations of metal pollutants include the mean age of vehicles, wear and tear of vehicles, automotive alloys, and the type of platform of vehicle compatible with fuel. Furthermore, the vehicle traffice volume, frequent use of brake and the composition of automotive fleet have significant effects of the emission of metal pollutants . In 2014, metal rise and the degree of contamination emitted from these metals in environment signified the role of influential factors including wear and tear of vehicles, particularly after the high-risk period of 2012, and the increased wear of the interior parts of vehicles. The other influential factor which should be considered in pollution management is the role of natural factors, such as wind and air conditioning, on the severity or stability of metal pollutants at local levels in Tehran. It seems that in the cases of fuel quality reduction, the degree of contamination becomes more critical in Azadi. Whereas once the fuel quality improves, other factors such as fuel consumption, wear and tear of vehicles, erosion of construction materials and street asphalt as well as climate conditions cause more severe contamination in Gisha. Consequently, in addition to considering fuel quality and consumption in Tehran, the improvement of the fuel of polluting industries should be ensured.

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