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Letter to the Editor

Mortality and morbidity due to exposure to particulate matter related to drying Urmia Lake in the NW Iran

Combination of PM with heavy metals and different constituents related to Urmia Lake and PM from anthropogenic activities has been anticipated to exacerbate health impacts on 3,000,000 inhabitant in this province [1].

AirQ software is a simple, beneficial and user-friendly tool to assess the effects of criteria air pollutants on the exposed population in a specific place and time. This software has been introduced by the WHO European Centre for Environmental Health, Bilthoven Division [2]. Other researchers have applied AirQ software to estimate effect of exposure to different pollutants in Iran [2,3] and other places in the world [4].

This study aimed to evaluate exposure to PM_{10} related to traffic and released by drying of Urmia Lake and impacts on human health in northwest of Iran according to WHO approach using AirQ software. To the best of our knowledge regardless of the significance of salty dust storms on respiratory diseases, this is the first study in term of finding the exposure to PM_{10} originating from drying Urmia Lake and impacts on human health in northwest of Iran.

The Urmia city have 100 Km^2 area and sited in northwest of Iran in longitude of 45 00′ to 45 07′ E and latitude of 37 29′ to 37 34′N. This region has arid-cold winters, temperate springs, hot dry summers and warm autumn's climate. The Urmia population in 2015 are made by 736,224 people, 50.6% men and 49.4% women (Statistical Centre of Iran, 2015). The age pyramid of population is included by 25.7% of 15 years old, 64.68% of 15–64 years old age group and 5.7% of people that are higher than 64 years old. In the age pyramid related to the city of Urmia, the most abundance age group is between 15 and 35 years old that denotes the young population of the city.

The concentrations of PM_{10} from March 2015 to February 2016 were collected from the four online air pollution monitoring (Enviro SA detector) stations situated near to Bahonar, Shaharchi, Azerbaijan, and Motahhari Squares. These monitoring stations are operated by Urmia Department of Environment. The data were filtered by Excel software according to the WHO recommendations. Then, hot and cold seasonal averages, annual averages, and their maximum, as well as annual 98th percentile for PM_{10}, were extracted. The baseline incidence (BI) of the total mortality, mortality attributed to cardiovascular and respiratory diseases were estimated using death and diseases data obtained from health Urmia university of medical sciences. In case of needs for other epidemiological parameters which were not available for the city the WHO calculated values were applied. Finally, these data were entered into AirQ software according to the WHO guideline.

The annual mean of PM_{10} concentrations were 106 $\mu g/m^3$, which was much higher than 20 $\mu g/m^3$ recommended by WHO such as air quality guideline value [5]. The maximum concentration value of PM_{10} gained during the winter which theirs averages were 138 $\mu g/m^3$, 90 days higher than 20 $\mu g/m^3$ and 83 days higher than 50 $\mu g/m^3$. The highest monthly mean of PM_{10} concentration with 147 $\mu g/m^3$ was recorded in March.

The inhabitant's exposure to different ranges of PM_{10} in the Urmia city was determinate. In Table 1 presented the estimate of AirQ model about the effect of PM_{10} on human health for total mortality, cardiovascular mortality, respiratory mortality, hospital admissions for cardiovascular diseases, and hospital admissions due to respiratory diseases. Also the annual BI rate of total mortality in Urmia city was 403.82 per 100,000, the cumulative excess cases for total mortality was 105 in intermediate relative risk situations. The number of excess cases predictable for cardiovascular mortality and respiratory mortality was 105 and 23 cases, respectively. The Table 1 also shows the cases of mortality due to respiratory and cardiovascular diseases in different ranges of PM_{10} concentrations which related to 409 cases (RR = 1.006) of total mortality, attributable proportion (AP) 5.487% (95% CI: 3.726–7.185%) of non-accidental mortality cases, 8.011% (95% CI; 4.615–11.174%) of cardiovascular mortality, and 11.174% (95% CI; 4.615–16.215%) of respiratory mortality was predictable using AirQ program for the PM_{10} concentration higher than WHO guideline. For every 10 $\mu g/m^3$ rise in PM_{10} concentrations, relative risk for total mortality augmented by 0.6%.

After 59 $\mu g/m^3$, all the mortality was increased very fast. For cardiovascular mortality, for every 10 $\mu g/m^3$ increase in PM_{10}, RR increased by 0.9%, and for respiratory mortality, 1.3% increase was observed. More than 92% of short-term effects occurred at the time when PM_{10} concentration was less than 179 $\mu g/m^3$ (the data not showed). The total cases numbers for HA due to cardiovascular and respiratory diseases in relative average risk were 257 and 666 persons, respectively. More than 66% of the persons were associated with the PM_{10} concentrations of less than 119 $\mu g/m^3$.

In a study carried out in Tehran, exposure to PM_{10} concentrations of more than 20 $\mu g/m^3$ was reported as major cause for 4.6% of total non-accidental mortality [6]. In another study in Mashad city with 82.9 $\mu g/m^3$ value of annual mean PM_{10} reported that 4.24% (CI 95%; 2.87–5.58) of non-accidental total mortality, 6.23% (CI 95%; 3.56–8.7) of cardiovascular mortality, and 8.76% (CI85%; 3.56–12.88) of respiratory mortality are associated to PM_{10} concentration [7]. In another study carried out both in urban and industrial area in Tabriz described the total mortality number related to TSP, $PM_{2.5}$, and PM_{10} and these values obtained were 327, 360, and 363 $\mu g/m^3$, respectively [8]. In two urban areas in Northern Italy reported that $PM_{2.5}$ was the main actor for the negative health impacts on inhabitants living in two small cities. The exposure to PM_{10} with the concentration higher than 20 $\mu g/m^3$ in Trieste, a city in the north-east of Italy with about 200,000 population, 52, 28, and 6 cases were assessed for total mortality, cardiovascular mortality, and respiratory mortality, respectively. They resulted that 2.5% of respiratory mortality and 1.8% of cardiovascular cases were associated to the values of higher than 20 $\mu g/m^3$ [9]. The observations derived by these studies based on excess cases are consistence to that of

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Table 1
Baseline incidence (BI), relative risk (RR) with 95% confidence intervals (95% CI), estimated attributable proportion (AP) and number of annual excess cases due to short-term exposure to $PM_{2.5}$ and PM_{10} above 10 μg/m^3.

Health endpoints	Pollutant	BI*	RR (per 10 μg/m^3)	AP percentage (uncertainty range)**	Number of excess cases (uncertainty range)**
Total mortality	PM_{10}	403.82	1.006(1.004–1.008)	5.487(3.726–7.185)	409(278–536)
Cardiovascular mortality	PM_{10}	178.47	1.009(1.005–1.013)	8.011(4.615–11.174)	105(61–146)
Respiratory mortality	PM_{10}	27.62	1.013(1.005–1.020)	11.174(4.615–16.215)	23(10 – 33)
Hospital admissions respiratory disease	PM_{10}	1260	1.008(1.0048–1.0112)	7.185(4.438–9.778)	666(412–907)
Hospital admissions cardiovascular disease	PM_{10}	436	1.009(1.006–1.013)	8.011(5.487–11.174)	257(176–359)

* Crude rate per 100,000 inhabitants per year.
** Obtained using the lower and upper RR values.

our study carried out in Urmia. Together the burning of fossil fuel, also salty dust from Urmia Lake is sources of PM_{10}. Total mortality in Milan (Italy) with 1,308,000 inhabitants, predicted by AirQ model was 677 cases attributable to PM_{10} [10].

In totally, a comparison our result with the other researches could observed that the high rate of mortality is associated to higher mean values of PM_{10} or the number of days with high PM_{10} concentration in the study area due to fuel's burning and also dust from drying Urmia Lake as emerging natural tragedy which it could be treated for population living in some parts of Iran, Turkey, Armenia and Azerbaijan. Furthermore, in coming years, it estimated more than 10 million people will be expose to this salty PM which may be lead to several skin, eye and respiratory diseases.

Conflict of interest statement

The authors declare that there is not conflict of interest.

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