

Environmental Health Problems and Indicators in Tabriz, Iran

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ARTICLE INFO	ABSTRACT
<p>Article type: Original Article</p>	<p>Background: Environmental Health Indicators (EHIs) are the most important criteria for evaluation of efficiency and effectiveness of the activities of the health sector. The operations and situation of the health system can be analyzed through surveying the indicators and comparing them during different times. The present study aimed to study the EHIs of Tabriz, using the common environmental health processes and national EHIs of the Ministry of Health.</p> <p>Method: The required information for determination of EHIs was collected from different sources, including mainly the Environmental Health Department of the Health Center of East Azerbaijan Province, Iran and other organizations.</p> <p>Results: We found some important desirable and undesirable EHIs in Tabriz, including high percentage of households with access to safe and reliable drinking water, high safety in microbiological and chemical quality of drinking water, acceptable level of BOD₅ and COD in the effluent of wastewater treatment plants (WTP), lack of complete municipal wastewater collection and treatment, relatively poor sanitation and health of food markets and public places, undesirable collection, transportation and disposal of municipal solid waste, low EHIs of some school classrooms, unacceptable disposal of medical waste in some hospitals, and finally high level of noise pollution in the city.</p> <p>Conclusion: Considering the poor condition of some EHIs of Tabriz, implementing proper actions for promotion of the indicators especially development of municipal wastewater collection, improvement of solid waste management, environmental health of some schools and mosques, and finally the noise pollution level of the city is recommended.</p>
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Introduction

Evaluation of processes and services provided by the governmental agencies in order to provide reliable data for evidence-based decision making is a key element to increase the knowledge and the links between envi-

ronmental impacts on human health and also human effects on the environment^{1, 2}. According to WHO definition, environmental health addresses all the physical, chemical, and biological factors external to a person, and all

the relevant factors affecting manners. In addition, environmental health includes the evaluation and control of those environmental agents that can potentially affect human health. This aspect of health is targeted towards creating health-supportive environments and preventing disease³. In other words, environmental health includes not only the study of the direct pathological effects of various chemical, physical, and biological factors, but also the effects on health of the wide-spreading physical and social environment, which includes dwelling, land-use and transportation, industry, agriculture and urban development^{3,6}. Environmental health indicators (EHIs) are applied in wide variety of research and decision-making processes in order to measure the health subsequences, to summarize complicated information and to compare policy impacts across locations or time periods. While EHIs can provide a useful means of supplying information, they also can be misused^{1,2}. An EHI generally is defined as: "An explanation of the connection between environment and health, targeted at a subject of particular policy or management concern and presented in a form which facilitates explanation for effective decision making"⁷. There are two principal perspectives to this definition. The first is an EHI which provides information about a scientifically based linkage between environment and health; the second is its relation with policy and management, mentioning monitoring and action⁸. EHIs provide effects of the environment on health. Accordingly, they are based on an understandable correlation between environment and health. Indicators are explanations of evaluations that summarize the specifications of systems or over rid what is occurring in a system. Generally, there are three types of EHIs, including:

- Measures of environmental qualities that have the potential to affect human health.
- Human health effect which is caused by or associated with environmental exposure.

- Activities that place pressures on the environment or/and increase the feasibility of exposure in vulnerable populations⁹. In other words, the uses of environmental health indicators are:

- supporting priority setting for policy-makers; by providing comparative information, feasible policy interventions can be prioritize based on the best available evidence.

- They are powerful communication tools for policy-makers, experts and the public; when confederate with the policy-making process, they can illustrate the effectiveness of environment and health policies, thus facilitating the setting of preferences among competing policies. Environmental health indicators prepare witness that supplements epidemiological information to inform policy development.

- Indicators can be hypothesis - generating tools, as they will be able to identify data gaps as well as areas where there is a marked difference between one area and the national average.

- They identify examples of good practice; it is obvious that the EHI reporting would provide examples of good practice among participating organizations.

- Indicators help monitor global progress by providing a uniform approach to monitoring time trends in regions or countries. This is important if the countries and agencies are to introduce collaborative policies on environment and health.

- They prepare evidence for the potential benefits of policies; they enable the assessment of the potential impact of environment and health policy on the health of the population. Spatial and temporal analysis of the indicators further facilitates this process¹⁰. There are very limited published data about EHIs in Iran. Because of the importance of EHIs for making judgments about condition and health service, which is provided by authorities, the present study was conducted to investigate the EHIs of Tabriz as the center of the East Azerbaijan Province, Iran.

Materials and Methods

Tabriz is the fifth largest city and one of the historical capitals of Iran and the capital of the East Azerbaijan Province, which is, located in the North West of Iran with a population around 1.5 million. This city is the fourth most populous city in Iran after Tehran, Mashhad, and Esfahan, and is a major Iranian heavy industrial and manufacturing center. The environmental health services in Tabriz are provided by the Health Center, and also other organizations such as the Tabriz Municipality and the Water and Wastewater Company. The indicators presented in this report reflect the WHO indicators. There have been a few changes and additions to the original WHO indicators to reflect variation in data availability and other issues specific to Tabriz. These changes are the result of the consultation and feedback received over previous years from various agencies. During the study, common environmental health processes and EHIs of the Ministry of Health and EHIs of WHO European Region were considered. Required information for determination of EHIs were collected from environmental health department of the Health Center of the East Azerbaijan Province and Tabriz Water and Wastewater Company,

Management and Planning Organization, Tabriz Municipality, Tabriz Parks Organization and green spaces, Traffic and Transportation Organizations of Tabriz, East Azerbaijan Accidents and Emergency Medicine Center. Then the EHIs were computed through analyzing the collected raw data. The parameters which were considered to be assessed in this study included drinking water, wastewater treatment and disposal, food distribution markets hygiene, public places sanitation, hospitals & health service providing centers (HSPC), solid waste management, schools, mosques and noise pollution. Since there were no reported measurements for the level of sound pressure, we carried out some measurements in two points of the city simultaneously using two sets of sound level meter. One station was located in the commercial district (Bazar, Rastekuche as the core and the downtown of Tabriz) and the second one was in commercial – residential district (Golbad, next to Madani Hospital) due to proximity to the heart hospital as a sensitive urban area (Fig.1). Measurements were carried out during 30 days (morning, noon, evening) for 30 minutes and totally 180 sound data series were provided in a weight channel period. Statistical analysis was conducted using SPSS version 11.5.

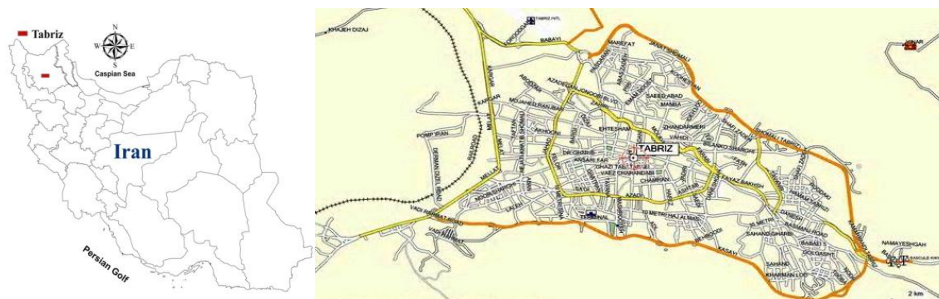


Fig. 1: Location of the sound measurement point on Tabriz map

Results

The results of EHIs are presented as drinking water, wastewater treatment and dis-

posal, food distribution markets hygiene, public places sanitation, hospitals & health service providing centers (HSPC), solid waste management, schools, mosques and noise pollution as following:

Access to drinking water and its quality

In order to assess the quality of the drinking water of Tabriz, a set of samples were daily collected and analyzed for different microbial, chemical and physical parameters. The results of the conducted analysis are presented in Table 1, which shows that more than 99% of the analyzed samples were in accordance with the drinking water standard limits. Furthermore, based on the drinking water quality standard (Coli form bacteria in-

indicator), 99.8% of 5378 microbiologically assessed samples, were safe.

The percent of the households with access to safe and reliable drinking water is shown in Table 2, which is clear that this indicator in both the municipal and provincial areas were higher than the national average. Considering the chemical quality parameters, all of the 32 samples were in accordance with the standard levels.

Table 1: Indicators of water quality in Tabriz comparing to East Azerbaijan Province

Indicator	Tabriz City		Azerbaijan Province	
	Total no.	In accordance with standard	Total no.	In accordance with standard
Microbial test	5378	5372		
Chemical test	32	32		
Heterotrophic Plate Count				
<i>Reservoir</i>	411	407	4710	4698
<i>Distribution network</i>	2245	2239	9014	8938
Residual Chlorine	45864	44753		
Turbidity	16776	16546	64201	58701

Moreover, 99% of the Heterotrophic Bacteria Plate Count (HPC) test conducted in storage reservoirs of Tabriz drinking water was desirable. This rate for the Zanjan province was 99.7%. Assessing the drinking water distribution network showed that 2239 HPC tests among 2245 samples (99.7%) conducted in Tabriz and 8938 tests among 9014 samples (99.1%) conducted in total East Azerbaijan

province were desirable. Considering residual free chlorine analysis, 97.6% of tests conducted annually showed acceptable concentration (0.5-0.8 mg/L).

Finally, the turbidity test conducted by the Water and Sewage Company, 98.6% of Tabriz and 91.4% of East Azerbaijan Province samples were in accordance with the standard limit.

Table 2: Water quality Indicators in Tabriz comparing to East Azerbaijan Province & Iran

Region, years	Country (Iran)		Province		Tabriz City	
	2009	2010	2009	2010	2009	2010
EHI						
Percent of rural households with access to safe and reliable drinking water	95	93.4	99	98.1	99.7	99.7
Percent of rural households that have drinking water supply system	90	89.6	90	89.7	99.5	99.5

Wastewater management

The volume of collected wastewater in Tabriz is 40,093,465 m³ annually; however, 37,198,285 m³ just enters to the Wastewater

Treatment Plant (WTP) of Gharamalek. The average rate of wastewater flow of wastewater treatment plant with an average input for BOD₅ and COD 401 mg/L and 557 mg/L

respectively, is approximately 116,372 m³/d which considering the effluent of WTP, BOD₅ and COD are equal to 36 mg/L and 53 mg/L, respectively.

Food distribution markets hygiene and public places sanitation

Food distribution markets and public places (hotels, motels, inns, guesthouses, pre-schools, kindergartens, passenger buses, bathrooms, swimming pools, saunas and barbers) of Iran are monitored by the health authorities considering 2 aspects: hygiene and sanitation. Hygienic parameters considered for the staff of the mentioned places include the assessment of personal health, hands and clothes hygiene, having health certificate, etc. Sanitation parameters considered for evaluation of the condition of public places buildings included study of floors and walls hygiene, availability of safe water, sewage and solid waste disposal. There were 14587 food distribution markets and 4160 public places in Tabriz which based on the study results, 8326 (Fig. 2a) and 1732 (Fig. 2b) had sanitation benchmark, however, 6202 food distribution markets and 1997 public places were in accordance with proper hygiene criteria. Among the mentioned public places staff, 28041 out of 32411 had a valid health certificate.

Hospitals & Health Service Providing Centers (HSPC)

Among 76 HSPC, 53 centers had good condition considering general health status and environment aspects (Fig. 2c). In addition, all of 25 hospitals of Tabriz had access to safe drinking water and sanitary wastewater collection and disposal system. Eighty eight percent of hospitals had convenient laundry and kitchen in hygienic condition. However, proper medical solid waste management was performed in 19 hospitals.

Solid waste management

At the study period, 216 vehicles for collecting and transporting solid waste were

available in Tabriz, which 124 vehicles were ordinary and just 92 were specific for this purpose. Solid wastes were collected 3 times a day. Unfortunately, final disposal of collected solid wastes was not in good condition and there was considerable pollution in the disposal site (Anakhatoon).

Schools

Considering classroom standards (including area, wall colorings, wall and floor condition etc), in 461 of 614 schools in Tabriz, desired condition was observed (Fig. 2d). Wastewater disposal and solid waste disposal were in good condition in 612 and 605 schools respectively.

Mosques

There were 494 Mosques in Tabriz, which hygienic toilets were observed, in 315 of them. In addition, 288 mosques had suitable bathrooms and 181 of them had unsuitable antechamber.

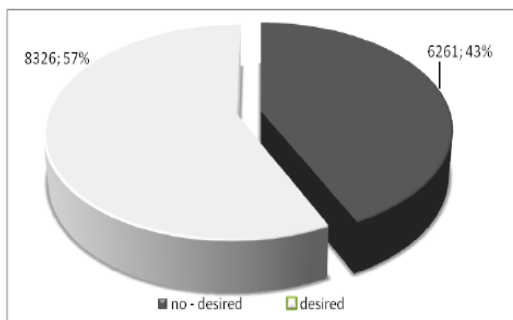
Noise level

Sound pressure levels (SPL) of two studied points are presented in Fig. 3 and Fig. 4. SPL in Raste-kucheh Station (commercial area) during morning, noon and evening periods were 70.3, 71.4, and 70.6 dB, respectively. In Golbad station (commercial – residential area), SPL were measured as 68.9, 70.3, and 69.8 dB for morning, noon and evening, respectively. The average maximum SPL (L_{max}) in Raste-kucheh was measured 84.5, 87.1, and 88.2 dB and in Golbad Station were 85.5, 86.4, and 85.7 dB for morning, noon and evening, respectively.

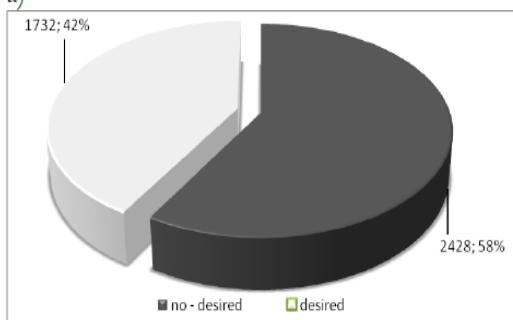
Discussion

World Health Organization defines indicators as "providing environmental health information about the relationship between environment and health based on scientific

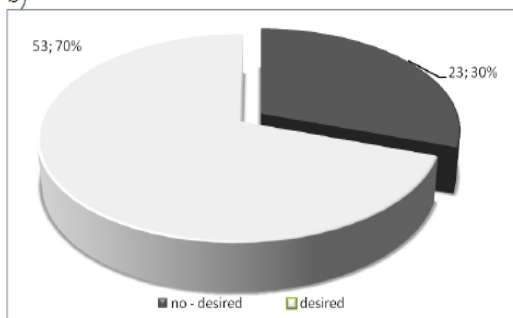
principles"². EHI are the most important criteria for determination of the rate of effici-



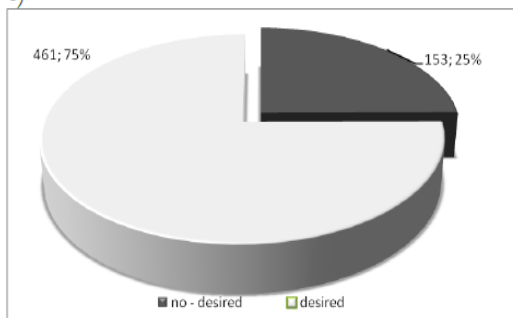
a)



b)



c)



d)

Fig. 2: Condition of some places in Tabriz considering related health criteria, a: Food distribution markets, b: Public places, c: Health

service providing centers, d: School environmental health

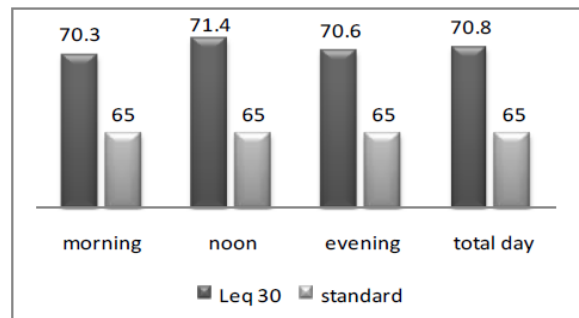


Fig.3: Sound pressure level equal in Rastekuche station, Tabriz

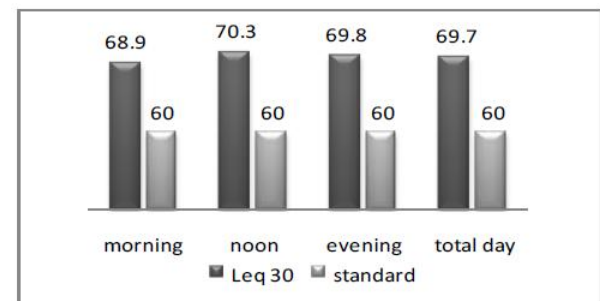


Fig.4: Sound pressure level equal in Golbad Station, Tabriz

ency and effectiveness of activities of the health sector. The operation and situation in the health system could be analyzed through surveying the EHI and with comparing the indicators in different times. Environmental health indicators more often are related with healthy society and its population and they could have important influence on determinates to communicate with health.

Conducted researches have shown that environment could have considerable effects on the human health ^{4, 5, 11, 12} especially in the urban areas or rural communities ^{13, 14}. An environmental health indicator is a gauge of health, economic and social condition, environmental quality, or socio demographics used to help monitor the overall health of the population in a community. For a long time, there has been an increasing demand for EHI,

from agencies and practitioners to help protect and monitor policy on environment and health, from local to international levels⁹⁻¹¹. For example, the following indicators are required:^{2, 14, 17, 18}.

- To monitor and assess the effects of interventions on environmental health;
- To compare different areas or countries in terms of their environmental health status, so as to help goal measure where it is most needed or to help allocate resources;
- To monitor trends in health, resulting from exposures to environmental risk factors, in order to guide Policy;
- To help monitor trends in the condition of the environment, in order to identify and distinguish potential risks to health;
- To help research potential links between environment and health (e.g. as part of epidemiological studies), as a basis for informing health interventions and policy;
- to help enhance knowledge and awareness about environmental health issues across different stakeholder groups (Including policy-makers, health practitioners, industry, the public, and the media)^{1, 15, 16}. Managers of health service provider systems require real health indicators for making suitable decisions and planning for protection of public health. In the meantime, EHIs are very important because of their basic role in health and wellbeing of people.

The Environmental health indicators (EHIs) were piloted and tested in 15 countries in Europe. The detailed methodology for individual indicators were developed by world experts and reviewed at working group meetings involving a wide range of multidisciplinary expertise and several countries. The United States and Canada have recently decided to follow the WHO Europe program.

The present study aimed to investigate EHIs of Tabriz. According to WHO definition, safe drinking water is water with microbial, chemical and physical characteristics that meet WHO guidelines or national standards on drinking water quality. Access to safe

drinking water is defined as the proportion of the people using improved drinking water sources: household connection, public stand-pipe, borehole, protected dug well, protected spring, and rainwater. Available data shows that 1.6 million people die every year from diarrheal diseases (including cholera) which are attributable to lack of access to safe drinking water and basic sanitation and 90% of these are children under five, mostly in developing countries. The MDG target implies a commitment to raise the global drinking water coverage of 77% in 1990 to 88.5% in 2015^{6, 19}.

According to the results of the present study, 99.89 % of water samples were safe in terms of microbial indicators and just 0.11% did not meet WHO drinking water guideline. In a similar study conducted in 2006, this index for Zanjan Province and municipal drinking water network, were 1.7 and 2.1% respectively²⁰. Considering *E. coli* criteria, 0.2% and 0.54% of samples in Tabriz and East Azerbaijan province were not in accordance with the related guideline; this percent was 10.3 in 2006 for Zanjan Province. The desirability indicator of HPC was 99.27% in drinking water storage reservoir and 99.73% in distribution system, which shows the better condition of the distribution network comparing to storage reservoir. In addition, non-compliance with WHO drinking water guidelines for *E. coli* index bacteria indicator in Tabriz was less than the East Azerbaijan province. In the study conducted in Zanjan Province, the desirability indicator of HPC for both of drinking water storage reservoir and distribution network was 99.3%²⁰. For residual chlorine, the desirability indicator in distribution network was 97.62% and nonconformity of the chemical parameters comparing with WHO drinking water guideline was zero. In the Zanjan study, the above percentage was 87.2% in urban areas that shows a better condition in Tabriz²⁰. The desirability indicator of the water turbidity was 98.63% for Tabriz and for entire Eastern-Azerbaijan Province was 91.43% (8.57% nonconformity); which is a

high rate comparing with other studies e.g. Zanjan (5.5%).

Municipal wastewater places a significant pressure on the water environment through the release of loads of organic matter, nutrients, pathogenic microorganisms etc. The principal effect of poor water quality on health is diarrheal disease. A recent estimate of mortality from diarrheal disease attributable to poor water quality, sanitation, and hygiene, suggested that over 13000 children aged less than 14 years die annually in Europe and central Asia due to poor water conditions²¹. Lack of sanitation is the world's biggest cause of infection and unfortunately 2.5 billion people lack access to improved sanitation, including 1.2 billion people who have no facilities at all. About 93% of wastewater transported by sewage collection network in Tabriz is treated, which BOD₅ and COD reduction in treatment process is approximately 91%. Nevertheless, it is estimated that the treated flow is just equal to 48 percent of wastewater generated in Tabriz and the remaining flow is disposed to environment without treatment, which shows a low index of wastewater collection and treatment.

Food distribution markets hygiene and public place sanitation

Food plays a major role in health of community. Exposure to hazardous chemicals especially during growth and development can result in long-term effects on the health of children. The strict regulations and measures applied in a country mean that food is generally safe, but consumption of contaminated food may still present an important route of exposure to chemical hazards²². According to this study, 57.1% of food distribution markets meet acceptable sanitation criteria and 45.52% meet acceptable hygiene criteria, which could be defined as 99.63% acceptable sanitary and hygienic criteria. Moreover, 41.63% of public places were in accordance with sanitation criteria and 48% were in accordance with hygiene criteria, which could be mentioned as

89.64% acceptable sanitary and hygienic criteria. 86.52 percent of food distribution markets and public places workers had medical examination certificate. These results show that food distribution markets and public places in Tabriz require improvement in sanitation and hygiene indicators.

Medical waste, also known as clinical waste, normally refers to waste products, which are produced in healthcare centers, such as hospitals, clinics, doctors' offices, veterinary hospitals and labs. According to the present study, less than 70 percent of health service provider centers (HSPC) had desirable environmental health criteria indicating the necessity of improvement in current condition. The proper solid waste disposal indicator was 76% for hospitals. The solid waste collection interval for municipal wastes was 3 days a week in a considerable part of the city, which seems inadequate and should be improved. In addition, an unhealthy condition of solid waste collection and transportation was observed in more than 57 percent of centers.

Children spend more time at school than anywhere else except home. Schools can have a major effect on children's health, through teaching health and promoting healthy behaviors. The school building and environment should be a safe and healthy place for your child. In the case of schools EHIs, all schools in Tabriz had access to safe drinking water, however in about a quarter of schools' classrooms specially in primary schools, conditions were not desirable; which shows the necessity of more attention and planning by decision makers. Unfortunately, the EHIs for mosques had a decreasing trend comparing to past years, that present requirement for more attention due to their important position in the community.

The word noise comes from the Latin word *nauseas*, meaning seasickness. Noise pollution is excessive, displeasing human, animal or machine-created environmental noise that disrupts the activity or balance of human or animal life. Studies had shown that

the source of most outdoor noise worldwide 23-25 is mainly construction and transportation systems, including motor vehicles noise, aircrafts noise and rail noise. Poor urban planning may give rise to noise pollution, since side-by-side industrial and residential buildings can result in noise pollution in the residential area²⁶.

Measurement of sound index showed that the maximum Equivalent Sound Pressure Level at 30 minutes measured in weighted networks in both points was higher than Iranian outdoor sound standard (Table 3).

Table 3: Outdoor sound standard of Iran in terms of Leq (30min) dB (A)

Type of area	Day time (7am-10pm)	Night time (10pm-7am)
Residential area	55 dB	45 dB
Commercial-residential area	60 dB	50 dB
Commercial area	65 dB	55 dB
Residential-industrial area	70 dB	60 dB
Industrial zone	75 dB	65 dB

Note: (Leq (30min) dB (A) = level equivalent to 30 minutes in duration measured in A weight channel (based on sensitivity of human ear) and its unit is dB.

The mean equivalent sound pressure levels in commercial and residential-commercial areas in Tabriz were 70.77 and 69.67 dB, which were 5.77 and 9.67 dB higher than the standard levels, respectively. According to the results of this study, 100 % of measurements were in higher levels comparing to national standards. ANOVA test showed significant differences between the values of equivalent sound pressure levels (SPL) in the mornings comparing to noon and evenings (*P*-value < 0.05). However, there was no significant difference between the values of Equivalent Sound Pressure Levels in the noontime in comparison to evening (*P*-value =0.24).

In accordance to One-Sample *t*-test, observed total mean sound pressure levels Raste-

kucheh and Golbad stations were 70.63 ± 5.6 dB and 69.98 ± 9.98 dB (*P*-value < 0.001) respectively, which showed significant differences between ESPL values with standard levels at both mentioned stations.

In a similar study performed in Zanjan, the average ESPL (Leq) in residential-commercial areas was 62.17 dB²⁷. Average ESPL(Leq) in Kashan City was reported as 79.7dB^{28, 29}. In a study conducted in Brazil, Leq values were more than 65 dB for 93.3% of the cases and were higher than 75dB in 40.3%. In Italy, Leq was 75dB³⁰. In more large cities of the world, noise pollution is still a social problem and factors like urban planning and traffic engineering have a critical effect on this problem 31-35. According to our results, the problem of noise pollution in Tabriz was largely related to traffic problems and urban context. The present study indicated that in Tabriz, EHIs have different status considering type of indicators. Various parameters related to drinking water in urban water supply systems, schools' EHIs (in terms of drinking water, sewage disposal, solid waste collection and disposal, safety issues), and access to safe drinking water and sanitation in hospitals could be considered as strengths of Tabriz EHIs; however, status was not desirable for other EHIs. Hence, it is necessary to take proper actions to adopt for promotion of indicators. In this context, following suggestions can be considered;

- Wastewater treatment plant of Tabriz should be developed for treatment of all generated wastewater for prevention of more pollution by untreated flow.
- To improve the poor condition of food distribution markets hygiene and public places sanitation, more efforts should be done.
- Medical and infectious solid wastes treatment and disposal in Tabriz hospitals should be improved by adopting reliable and efficient methods and education of staffs.
- Existing vehicles should be replaced by proper solid waste collection vehicles; and

solid waste collection in all parts of the city should be daily.

- Considering the undesirable schools' EHIs including condition of drinking water place, lavatory, toilet, buffet, and finally classrooms condition, , paying special attention to this issues by the authorities are recommended.

- Taking in to account the higher noise pollution at residential-commercial and commercial areas in comparison with standard levels; taking proper planning and actions to reduce the noise level is essential.

Conclusion

According to the present study, the drinking water supplied by the water supply system of Tabriz, was safe in terms of microbiological and chemical quality during the study period. . Therefore, most of the households had access to safe and reliable drinking water. Moreover, BOD₅ and COD levels of the effluent of wastewater treatment plants (WTP) were acceptable.

All Tabriz hospitals had safe drinking water and sanitary wastewater collection system. Food distribution markets and public places in Tabriz should improve their sanitation and hygiene indicators. On the other hand, considering the poor level of some EHIs in Tabriz, it is necessary to take proper actions for promotion of some indicators especially municipal wastewater, solid waste, schools' environmental health, mosques' health, and noise pollution. Therefore, paying more attention and tracking the processes by governmental agencies and others to prepare information for evidence-based decision-making, is essential. Monitoring of the EHIs during a longer period for providing a clear trend of indicators is suggested.

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