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Original Article

Economic Valuation of Air Pollution Health Impacts in the Tehran Area, Iran

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Abstract
Background: Air pollution in Tehran, capital of Iran is responsible for several diverse negative effects. It has been established that air pollution can affect human health. These health effects include increased hospital admissions due to the exacerbation of cardiac and respiratory diseases, as well as symptoms such as headache, cough, eye irritation, nausea, sputum and even death in the most vulnerable individuals. In evaluating any policy that would reduce air pollution, it is useful to compare the policy's costs to its benefits expressed in monetary units.
Methods: Since there is no market available that places value on the benefits of improved air quality, we must undertake non market valuation methods. In this paper we used direct medical cost (DMC), contingent valuation (CV) and value of statistical life (VOSL) approaches and household production model of health. According to this study marginal health damage costs for the following type of pollutants impacts: sulfur dioxide (SO2), nitrogen dioxide (NO2), particulate matter (PM10) and carbon monoxide (CO) are quantified using exposure response functions(ERF) which relate pollutant concentration to the resulting impact on a receptor(health). ERFs for health impacts are derived from epidemiological studies.
Results: Health damage costs has been estimated at 16224 US$ per each unit increase of PM10, 28816 US$ per each unit increase of CO, 1927 US$ per each unit increase of NO2 and 7739 US$ per each unit increase of SO2.
Conclusion: Substituting economic incentives for command and control approach to regulating air quality.

Keywords: *Contingent valuation method, Willingness to pay, Value of statistical life, Cost of illnesses, Household production model, Iran*

Introduction
Environmentalists as well as policy makers are concerned about the air pollution that characterizes urban centers. In these metropolitan areas, the high concentration of human population, traffic, and industrial activity intensifies the concentration of the criteria pollutants and hence increases the environmental risks of exposure. Since a large proportion of the population is exposed to the associated health hazards, increase abatement efforts in cities should yield a higher level of marginal benefit than in rural communities. Health damage cost estimation is a critical element of risk management in urban air pollution. As a risk management strategy, benefit cost analysis can be used to set policy objectives and to select the best available control instrument to achieve these objectives
Environmental economists commonly use the direct medical cost (DMC), contingent valuation (CV) and value of statistical life (VOSL) approaches to value morbidity and mortality linked to environmental changes, such as air pollution increase. The air in Tehran is one of the most polluted airs in the entire world. Because of the air pollution in the Great Tehran area, morbidity, mortality and symptoms emerge. In general, 20% of the total energy of the country is consumed in

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Tehran. Pollutants such as SO_2, NO_2, HC, PM10 and CO are the major air pollutants in Tehran, about 80-85% of which is produced by mobile sources of pollution (1). At the moment, the concentration of these pollutants is higher than the standard level most of the time which means that they have numerous effects on the health of Tehran citizens. These effects can be divided into categorizes from headaches to premature mortality (2).
A number of economic studies have been published in the developed countries to value the health effects of air pollution, but relatively few studies have taken place in countries with significantly lower incomes. This study has been conducted for the first time in Tehran the capital of Iran.
In this paper, we have tried to distinguish the health effect of air pollutants in Tehran, and then estimate the monetary value of these effects by using household production model of health.

Materials and Methods

The theoretical model that provides the setting for this analysis was first articulated by Maler (3). Models that describe what an individual would pay for health improvements associated with air pollution are by now well established in the literature Cropper and Freeman (4). Such a model is reproduces in this paper to provide a framework for interpreting the Willingness to Pay (WTP) estimates obtained in our surveys.
The approach is to allow air pollution to affect the duration of illness in a household production model of health. A marginal change in air pollution will therefore cause a marginal change in the duration of illness. Because there is a one-to-one correspondence between the air pollution and the duration of illness, the questions in the survey are asked to obtain the respondent's valuation of a marginal change in the duration of illness in the willingness to pay. This provides us with a partial indirect estimate of the value of reducing air pollution. This model also identifies the variables on which willingness to pay depends.
A person'd willingness to pay to avoid an air pollution-related illness can be developed in the context of the following household production model. For instance, utility in one period depends not only on acute illness in that period, but also on the stock of acute illness experienced to that date. Thus, the actions a person would take to mitigate illness in one period would also depend on illnesses experienced in the past and on the realization that mitigating illness today would reduce the future disutility of illness. This modeling can be quite sophisticated, yet due to data limitations a simple approach is being followed in this paper.
Individual preferences are represented by a utility given as:

U = U(X, L, I, N; Z) Where

X: Consumption goods
L: Leisure
I: Illness adjusted for its severity
N: Nature of illness
Z: Vector of individual characteristics

Note that I= (D) (S), where D is the disutility that one receives from illness and S is the severity of the illness. Z is a vector of individual characteristics such as health history, age, etc. which affect the disutility received from I and N, as well as the utility received from X and L. The assumption is that the duration of respiratory illness D depends on air pollution P, on the nature of the illness N, and on an exogenous measure of the severity of air pollution E. E indicated how bad a case of N one has before anything is done to relieve one's symptoms. S on the other hand, measures the severity of illness after mitigating behavior, M, which includes medication taken and medical attention received.

I (P, N, M, E) = [D (P, N, E)] [S (M, E)]

The utility function is continuous and non-decreasing in its arguments and strictly quasi-concave in X. However, the utility function is not necessarily quasi-concave in M. Simply there is no compelling reason why quasi-concavity should apply; as indicated above, how the individual feels about is an empirical question. For instance, actions taken to mitigate illness in one period are independent of acute illnesses experienced in the past and are not motivated by the impact of these actions on the future utility.

The individual faces a budget constraint based on disposable income and prices of the market and non-market commodities. The quantity of illness enters the household's budget constraint by influencing the amount of productive time available to work. Specifically, the budget constraint is:
(3) $Y + W (T–L– I)= P_X X + P_M M$ Where
Y; Nonwage income
W; Real wage rate
T; Total time
P; Price
The health production model assumes that the individual allocates nonillness time (T-L-I) between work and leisure activities and income between medicine and other goods to maximize utility, subject to the budget constraint. This yields a set ordinary demand functions for both X and M. If we determine what it would be worth to an individual to reduce air pollution, this would be the amount of money that could be taken away from that individual while reducing pollution and its symptoms and keeping the utility of that individual constant. Thus, the willingness to pay for a change in air pollution is equivalnt to changes in D and the willingness to pay for changes in D. The value of a nonmarginal change in D may be defined using the following pseudoexpenditure function. This is the minimum value of expenditure minus wage income necessary to keep utility at U^0.
(4) $E= Min \{P_X X + P_M M- W (T- L- D. S)+ \lambda [U^0 = U(X, L, D. S, N; Z)]\}$
where, λ is a Lagrangian multiplier. Willingness topay for a marginal change in D may be defined using equation 4 as the expenditure necessary to achieve U^0 at the original duration of illness, D^0, minus the expenditure necessary to achieve U^0 at the new (lower) duration of illness D^1:
$WTP= E (P_X, P_M, Y, W, N, S, Z, D^0, U^0)-E (P_X, P_M, Y, W, N, S, Z, D^1, U^0)$
Equation 5 implies that the willingness to pay is expected to vary with income, price, individual characteristics, the nature of the illness, its severity and D^0 and D^1. Consequently, the willingness to pay can be regressed against all of the above variables.

The Contingent valuation (CV) was utilized in order to place monetary values on symptoms avoidance. CVM plays a major role in research aimed at estimating the value of non- market goods. Basic to the survey technique for valuing nonmarket goods is establishing a hypothetical market in which a commodity/service can be traded. Standard contingent valuation techniques were employed in this study where the total societal WTP to prevent 10 different symptoms were estimated. We also utilized the survey to obtain a monetary value on the individual WTP to prevent a set of symptoms. Finally, we estimated average societal WTP for each symptom independently. Ten symptoms were identified for valuation: Cough, "khelt", shortness of breath, Chest pain, Irregular heartbeat, Vomiting Headache, sore throat, Eye irritation and impatience.
After the questionnaire was prepared and pilot studies were conducted, as the incidence of the minimum index of the symptoms in the study was *P*= 0.02, with a confidence level of 0.95 and at d= 0.005 level of significance, the sample volume was estimated to be 3000. In order that the questionnaires be filled in, all the citizens of Tehran, Eslamshahr and Shahre-Rey were divided into clusters, with each cluster including 450 people. The 450-people clusters were chosen so that there would be enough chance for the selection of people at the age of 18 and above. In the first stage, from among all the 450-people clusters, 60 clusters were randomly selected. These clusters were selected from among the complete list and framework of the blocks that were provided by Iran Statistics Center. The procedure was conducted in such a way that the probability of the selection of the clusters in each block would correspond to the volume of the clusters in each block Proportion Probability Sampling (P.P.S). In the next stage, those who were 18 and above were enlisted. From among them, and by using simple random selection method, 50 people were selected and interviewed.
At the beginning of this study by using simple unit transfer approach with income adjustments (INC present per capital income of each nation);

we can directly transfer the mean WTP_B estimate from US ($5 million) to Iran by following formula. The VOSL[1] is the Willingness to Pay of the people of a society to reduce one case of fatality among those who die.

$WTP_A = WTP_B\,(INC_A/INC_B)^{\alpha}$

The α term is the income elasticity of WTP. The elasticity of 1 will show a higher elasticity compared to 1.5. Similarly, the income elasticity of 1.5 demonstrates a higher elasticity compared to income elasticity of 2.

In order to estimate average direct medical cost (DMC), sufficient numbers of general hospitals were selected based on the ranking of the hospitals (1-3) from among the hospitals that had codification systems (at least one hospital from each group). Then, all the files pertaining to the illnesses caused by Tehran air pollution in 2002 were extracted. After that, 10% of these files were selected, the required information were extracted from the files and registered in the prepared forms. This information included the number of the patient's file, age, sex, the costs of hoteling, cost of drugs, cost of physician, cost of surgery, cost of physiotherapy, cost of consumed materials, duration of hospitalization, type of insurance, job and the total expenditure. In the end, the mean of the total direct costs of each illness in each and every group of hospitals was estimated.

Results

The Iranian VSL are ranging from$12,593 to 250932(US$2002). per life. These values are actually very close to what one recognized as a lower in the developed countries. All of these estimates that converting Exchange rate to purchasing power parity (5) are presented in Table 1. The mean of the direct medical costs are presented in the Table 2. Marginal number of mortality and morbidity (hospitalization) are presented in the Table 3 and 4. Regarding the item of number of deaths, the calculations have been conducted in two different ways: One based on different age groups (under 1, 1-35, 35-65, over 65) and the other without regarding the age groups. Among the illnesses under study, Angina, Arrhythmia, CVA and COPD demonstrated relationships with air pollution in Tehran (Table 4). We remind the reader here again that if we are to obtain the number of incidences pertaining to the air pollution (or the preventable number, in case of the reduction in air pollution) we should first define an obtainable level, and then obtain the results using the presented coefficients and a simple calculation. It is obvious that defining an obtainable level of reduction in air pollution is the responsibility of organizations that are involved in evaluation, planning and administration; and that what is presented in this paper as the number of incidences pertaining to air pollution is an estimation of the number of acute and preventable health problems pertaining to air pollution in three air pollution reduction scenarios (Table 5).

Tables 6-9 are presented mariginal and avarage total annual health damage costs of premature mortality and morbidity caused by air pollution in Tehran.

After 3000 questionnaires which belonged to 60 blocks in Great Tehran Area were filled in, the gathered data were analyzed by SPSS computer software. The results of these analyses are presented in the Tables 10-13.

In order to estimate the total number of symptoms, we should first see how much it is possible to reduce the air pollution, and then, we can calculate the number of occurrences that are avoidable based on this reduction in air pollution. In this report, in order to obtain an estimate of the magnitude of avoidable (and measurable) consequences of air pollution, the Japanese standards were used as the allowable limits for the pollutants. The number of the symptoms was estimated in such a way that in maximum 1% of days the level of pollutants would exceed the Standard Level of Japan. The corresponding Z for each of the above probabilities was extracted from the related standard tables, and was then multiplied by the standard deviation. The result of the multiplication was deducted from the mean of the pollutants in the year 2002, and the resulting fig-

[1] Value of Statistical Life

ure was adopted as the feasible limit of the air pollution reduction. The number of the avoidable symptoms was calculated by multipying the "feasible limit of the air pollution reduction" by the related coefficients for each consequence (6).

Table 1: Income Elasticity Method for the estimation of VOSL (US$2002)

Number	Elasticity	V.S.L.($) PPP	V.S.L. ($) Exchange rate
1	1	893318	250932
2	1.5	200122	56214
3	2	44831	12593

Table 2: The Mean of the Direct Medical Costs based on the type of the Illness in the Hospitals of Tehran (US$2002)

Type of Illness	Cost (dollars)
Unstable angina. Angina Pectoris. Coronary artery disease (CAD). Ischemic heart disease (IHD)	421.83
Arrhythmia, dysrhythmias	1399.86
CVA	1611.66
Chronic obstructive pulmonary obstruction (asthma chronic bronchitis, emphysema, …	598.99

Table 3: Marginal (Per each unit increase in pollutant per day) number of mortality in different age groups and the confidence level of %95 2002(6)

Age Group (yr)	Pollutant	Number of Increased items		
		Upper Limit	Lower Limit	Mean
Mortality in all ages	PM10	0.049	0.007	0.028
	SO_2	0.076	0.016	0.046
Mortality among people aged 30-65	CO	0.204	0.023	0.113
	SO_2	0.029	0.003	0.016
Mortality among people aged over 65	PM10	0.028	0.004	0.016

Table 4: Marginal (per each unit increase in pollutants per day) number of hospitalizations in Tehran with the confidence level of %95 (6)

Illness	Pollutant	Number of increased item		
		Upper Limit	Lower Limit	Mean
Angina	CO	1.09	0.258	0.68
Arrhythmia	PM10	0.046	0.0086	0.027
CVA	NO_2	0.03	0.0023	0.017
COPD	CO	0.52	0.06	0.29

Table 5: Estimation upon Maximum 10% of Days Over standard Level of Japan 2002 (6)

Group	Effect Group	Pollutant	Mean daily effect/unit	Mean Annual Effect	Minimum Annual Effect	Maximum Annual Effect
Death*	All Death	PM10	0.028	786.8378	196.70945	1376.96615
	All Death	SO_2	0.046	228.6798	79.5408	377.8188
	30-65	CO	0.113	397.6018	80.9278	717.7944
	30-65	SO_2	0.016	79.5408	14.9139	144.1677
	Over 65	PM10	0.016	449.6216	112.4054	786.8378
Hospitalization	Angina	CO	0.68	2392.648	900.7616	3835.274
	Arrhythmia	PM10	0.027	758.73645	241.67161	1292.6621
	CVA	NO_2	0.017	356.97365	48.296435	629.9535
	COPD	CO	0.29	1020.394	211.116	1829.672
Telephone survey	Efficacy	PM10	2580	72501483	34283647	111281346
	Nausea	SO_2	575	2858497.5	939575.7	4782390.6
	Eye	SO_2	915	4548739.5	1004202.6	8103219
	Eye	PM10	1940	54516619	16411188.4	92734455
	Headache	SO_2	1430	7108959	2351424.9	11881407
	Headache	PM10	4040	113529454	52830538	174509383.5
	Sputum	NO_2	961	20179510.45	6488521.05	33807504.5
	Cough	NO_2	946	19864533.7	4094697.75	35697365

Table 6: Mariginal (per each unit increase in pollutants per day) health damage costs of premature mortality caused by air pollution in Tehran (US$2002)

Pollutant	Age	Upper Limit	Lower Limit	Mean
SO_2 microgram/m^3	Under 1 year			
	1-30			
	30-65	7277.03	752.80	4014.91
	Over 65			
	All ages	19070.83	4014.91	11542.87
CO_2 miligram/m^3	Under 1 year			
	1-30			
	30-65	51190.13	5771.44	28355.32
	Over 65			
	All ages			
PM10 microgram/m^3	Under 1 year			
	1-30			
	30-65			
	Over 65	7026.09	1003.73	4014.91
	All ages	12295.67	1756.52	7026.10

Table 7: Annual health damage costs of premature mortality caused by air pollution in Tehran based on maximum %1 of days in which the level of pollutants has been higher than the standard level (US$2002)

Pollutant	Age	Upper Limit	Lower Limit	Mean
SO_2	Under 1 year 1-30 30-65 Over 65 All ages	36184394.4	378886.8	19949094
CO	Under 1 year 1-30 30-65 Over 65 All ages	180093896.38	20300398.8	99770563.2
PM10	Under 1 year 1-30 30-65 Over 65 All ages	18947433297.63	2820481.8	112819027.2

Table 8: Marginal (per each unit increase in pollutants per day) health damage costs of hospitalizations caused by air pollution in Tehran ($US2002)

Type of Illness	Pollutant	Lower Limit	Upper Limit	Mean
Unstable angina. Angina Pectoris. Coronary artery disease (CAD). Ischemic heart disease (IHD)	CO	108.83	459.79	286.84
Arrhythmia, dysrhythmias	PM10	12.04	1.25	37.80
CVA	NO_2	3.71	48.35	27.40
Chronic obstructive pulmonary obstruction (asthma chronic bronchitis, emphysema, …	CO	35.94	311.47	173.71

Table 9: Total direct costs of illnesses caused by air pollution in Tehran based on maximum %1 of days in which the level of pollutants has been higher than the Japan standard level (US$2002)

Type of Illness	Pollutant	Lower Limit	Upper Limit	Mean
Unstable angina. Angina Pectoris. Coronary artery disease (CAD). Ischemic heart disease (IHD)	CO	47.5	202.2	126.2
Arrhythmia, dysrhythmias	PM10	42.3	226.3	132.8
CVA	NO_2	9.7	126.9	71.9
Chronic obstructive pulmonary obstruction (asthma, chronic bronchitis, emphysema, …	CO	15.8	137.0	76.4
Total				407.3

Table 10: Socio- economic Data from CV (the standard deviation is mentioned in the parentheses)

Number of observation	3,000
Smokers	25.5%
Male	47.33%
Female	52.7%
Age	37 years (15.5)
Married	71.2%
Education	9.9 years (4.68)
Household size	4.5 persons (17)
Head of household	36.6%
Hours per day out door	5.19 hours (5.33)
Average monthly income	$261($216)
Average monthly expenses	$226

Table 11: Increase number of symptoms for each level of pollutants with average daily symptoms and a confidence level of %95(6)

Symptom	**Pollutant**	**Number Of Increased Occurrence**		
		Upper Limit	**Lower Limit**	**Mean**
Efficacy	Pm10	3.96e+03	1.22e+03	2.58e+03
Nausea	So_2	9.62e+02	1.89e+02	5.75e+02
Eye Irritation	So_2	1.63e+03	2.02e+02	9.15e+02
	Pm10	3.30e+03	5.84e+02	1.94e+03
Sore Throat	No_2	2.39e+03	4.73e+02	1.43e+03
Headache	So_2	2.39e+03	4.73e+02	1.43e+03
	Pm10	6.21e+03	1.88e+03	4.04e+03
Sputum	No_2	1.61e+03	3.09e+02	9.61e+02
Cough	No_2	1.70e+03	1.95e+03	9.46e+02

Table 12: Marginal (per each unit increase in pollutants per day) health damages cost of the symptoms (US$ 2002)

Symptom	**Pollutant**	**Upper Limit**	**Lower Limit**	**Mean**
Efficacy	Pm10	5916.9	1822.9	3854.9
Nausea	So_2	870.1	171.0	520.1
Eye Irritation	So_2	2201.3	230.4	1043.6
	Pm10	3763.8	666.1	2212.7
Headache	So_2	3610.6	714.6	2160.3
	Pm10	9381.5	2840.1	6103.3
Sputum	No_2	1400.0	268.7	835.6
Cough	No_2	5916.9	1822.9	3854.9

Table 13: Total annual health damages cost of the symptoms in Tehran based on Maximum %1 of days when the level of pollutants has exceeded the standard level of Japan (US$ 2002)

Symptom	Pollutant	Upper Limit	Lower Limit	Mean
Efficacy	Pm10	166272828	51225468	108329269
Nausea	So_2	4325774.3	849866.5	2585572.18
Eye Irritation	So_2	9242106.2	1145341	5188052.9
	Pm10	105768051	18717739	62178793.5
Headache	So_2	17949331	3552315	10739557.7
	Pm10	263632634	79811490	171509798
Sputum	No_2	29397020	5642037	17546917.2
Cough	No_2	40158956	4606244	22347278
Total				400425238

Discussion

Increase use of cost benefit analysis (CBA) in the environment quality has increased demand from decision makers for information on the economic value of environmental goods. Policy uses of environmental values include: CBA of projects and policies, environmental costing to calculate the social optimal level of air pollution (and optimal size of e.g. green taxes), green accounting at the national, community and firm level; and calculating compensation payments after a pollution accident.

As knowledge advanced, we have become better able to find solutions for air pollution. Many nations have begun substituting economic incentives for command and control approaches to regulating air quality. Understanding the extent of this progress and analyzing what has been accomplished requires a fairly thorough examination of the facts and some sense of the evolution of policy. This module provides a multi step approach to learning about air quality problems and policy solutions, using economics as an analytical tool. One of these economic tools is valuing health effects of air pollution. Environmental economists use several approaches to value morbidity and mortality changes linked to environmental changes, such as air pollution increase. Numerous studies have been conducted in developed countries. In the United State, as urban smog became more apparent in cities like Los Angeles and Philadelphia, pressure began to mount for public officials to take action. Local communities and some state governments began to enact air quality law. But it was literally decades before the federal government took an active role in what was fast becoming a worldwide problem. Over the past four decades, US air quality control policy has evolved into a comprehensive body of law, with the most recent revisions embodied in the 1990 Clean Air Act Amendments. There is a fair amount of research that evaluates the efficiency of specific air quality economic control provision. Far less prevalent are comprehensive analyses assessing the Clean Air Act in its entirerty. Drawn from the work of other researchers, one such investigation was conducted by Paul Portney, an economist and researcher at resources for the future in Washington, DC. With careful reservations, portny offers a very telling comparison of the social benefit and cost associated with US policy prior to the enactment of the 1990 Clean Air Act Amendments. Beyond the implication of the result, the study illustrates the practical value of benefit cost analysis. Portney's analysis derives from the work of two other researchers, Michael Hazilla and Raymond J Kobb. These researchers use a model of the US economy to estimate how prices and income change with the implementation of policy aimed at air quality (7).

In a Bangkok, Thailand study, chestnut et al. (8) found that the WTP for avoiding a respiratory illness day actually exceeds what would be predicted following a simple national income adjustment, suggesting that health may be viewed as a basic necessity and "that those with lower incomes may be willing to pay a higher share of that income to protect their health." Alberini and Krupnick (9) reached a similar conclusion in a comprehensive health valuation study of three urban areas in Taiwan. More recently, Bowland and Begin (10) derived a prediction function for developing countries.

The economic valuation literature linking air pollution to health effects is large. There are two types of literature. The first relates acute episodes of air pollution and the second, a far smaller literature, relates choronic exposure to air pollution. Most of economic valuation literature.like our study, deals with the former, i.e. with acute effects. But it is becoming increasingly clear that the choronic exposure epidemiology is more important, although acute studies still have a role to play. One of the problems with acute studies is that they may tell us number of people symptoms, morbidity and mortality from acute effects but not the period of life that is forshortened. There is a debate as to whether the life period concerned are very short indeed, a matter perhaps of just a few days in OECD countries, or wether what evidence we do have on life foreshortening understates the true effecs. This debate is well rehearsed in the contributions in pears and palmer (11).

In this study except V.S.L we use exposure response functions (Impact pathway approach) for assessing physical impacts and the associated damage costs for pollutants in Tehran. In recent years, environmental economists and policy makers have taken a lot of effort to estimate the value of change in the quality of the environment, and especially in reducing air pollution and its effect on the reduction of mortality in developing countries. One of these efforts is estimating VOSL. Through income elasticity. This elasticity, which Bowled and Beghin estimate to range from 1.52 to 2.269. The estimation of mortality damages in developing economies is a topic of rising importance because many of these economies like Iran are in their environmental transition. Growth, environment trade offs, which were taken for granted, are being reexamined. Adverse environmental aspects of economic growth translate in higher welfare losses in economies with rising incomes. The range of possible application of estimates of mortality valuation is large, especially in the context of mortality related to air pollution. Numerous VSL studies have been conducted in developed countries, including direct surveys to elicit willingness to pay to decrease mortality, but estimates are virtually nonexistent for developing countries. There are few estimates of the VSL for developing countries in the economics literature. Bowland and Bghin conducted a Meta-Analysis of VSL studies from the industrialized nations to derive a VSL prediction equation that could be used for developing countries. This equation accounts for difference in risk, human capital levels, and perhaps more importantly, income between more and less developed nations. We used direct surveys to elicit willingness to pay for Iran and an alternative approach, simple unit transfer approach with income adjustments (12), to transfer value from US to Iran. Transferring economic values to other countries typically relies on a simple scaling based on national per capita output (or income) rations between the study site and policy site (Iran). Such a procedure contains many drawbacks; the most obvious is the implicit assumption that preferences for averted morbidity and mortality are similar between the countries and, further, that they are determined largely by income. Use of such a simple transfer procedure also assumes that the income elasticity of willingness to pay (α-WTP) for improved health (or death avoided) is equal to 1.0 (or that treating it as 1.0 captures all other factors that may influence the WTP). This, of course, ignores the potential importance of other factors. At the current time, we have very little data on how these differences might affect preferences and how these relate to willingness to pay. Some recent valuation studies have begun to address the issue of income and preferences in a developing country.

In conclusion the total daily health damage costs of the air pollution in Great Tehran area per each unit increase of each pollutant has been estimated at 16224 US$ per each unit increase of PM10, 28816 US$ per each unit increase of CO, 1927 US$ per each unit increase of NO2 and 7739 US$ per each unit increase of SO2.

The total annual health damage costs, considering the reduction of pollutants in such a way that the level of pollutants would be higher than the standard level of Japan in maximum %1 of the days in a year has been estimated to be USD 663,776,376. It goes without saying that this figure in this study is the Lower Limit or the minimum estimation of the health effects caused by the air pollution in Tehran. If the indirect effects and chronic effects are added to the above figure, the total costs will become significantly higher. We hope other researchers will conduct such studies, and we also hope that this study will be an effective step in reducing the pollutants that exist in the air of Tehran.

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The authors declare that they have no Conflict of Interests.

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