Impact of Global Air Pollution on Human Health: An Empirical Investigation

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Abstract

Air pollution is major hazard of the world. Due to swift boost in urbanization and industrialization along with the massive volume of traffic over last some decades the air pollution is increasing in both developed and developing countries in the world. There are many cities in the world where exterior air pollution is observed do not satisfy the World Health Organization's principle for adequate pollutant levels. One out of eight of global deaths are the result of air pollution exposure. Aflame fossil fuels discharges CO_2, a heat-trapping gas, into the ambience which is the main reason of change in global climate. This study gets penal data on CO_2 emission, health expenditure and life expectancy of 186 countries. We simply use penal least square which express positive relation of CO_2 emission and health expenditure with 170.59 magnitude and negative impact of CO_2 emission on life expectancy with -0.0472 value of coefficient. The study also provides some grasp suggestions for collective decision to mitigate the pollution.

Introduction

"Air pollution is contamination of the indoor or outdoor environment by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere" (World Health Organization). Due to rapid increase in urbanization and industrialization along with the huge volume of traffic over last some decades the air pollution is increasing in both developed and developing countries in the world. There are many cities in the world where exterior air pollution is observed do not satisfy the World Health Organization's principle for adequate pollutant levels. And people who are living in these cities have faced risks of stroke, lung cancer, heart ailment and severe respiratory diseases and other health problems. Interior air pollution is one more major reason of pitiable health and premature death, principally in developing countries. Major sources of air contamination are traffic, diesel vehicles, bricks making industries, power plants, cooking and heating with solid fuels, woods flames and open burning of municipal waste (UNEP, 2014).

According to WHO (2014) One out of eight of global deaths are the results of air pollution exposure. Low- and middle-income countries in the world had the largest air pollution associated trouble in 2012, with a total of 5.9 million deaths related to both indoor and outdoor air pollution in South-East Asia and Western Pacific Regions, (WHO, 2014). Highly developed nations of the world plus China and India are facing estimated cost of air pollution is US$3.5 trillion per year in the form of lives lost and poorly health. Whereas due to outdoor air pollution, the OECD countries are estimated to have monetary lose of US$1.7 trillion in 2010 (UNEP, 2014). Nowadays, most of the worlds confide on fossil fuels to fulfill their energy requirements. Aflame fossil fuels discharges CO_2, a heat-trapping gas, into the atmosphere which is the main reason of change in global climate.

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From hundreds of years, the concentration of CO_2 in the atmosphere stayed between 200 and 300 parts per million (ppm), which is now up to nearly 400 ppm, and the amount is still rising. CO_2, a greenhouse gases, is trapping heat and causing the climate to change (EPA, 2011). Human influence on the climate system is clear and recent anthropogenic emissions of greenhouse gases are the highest in history.

Recent climate changes have had widespread impacts on human and natural systems. Future climate will depend on committed warming caused by past anthropogenic emissions, as well as future anthropogenic emissions and natural climate variability. By mid-21st century, the magnitude of the projected climate change is substantially affected by the choice of emissions scenario (UNEP, 2014). Limiting climate change will require substantial and sustained reductions of greenhouse gas emissions. Halting global mean temperature rise at any level requires near zero carbon emissions at some point in the future. The WHO provides a guideline for average annual particulate matter in both PM_{10} and $PM_{2.5}$ levels. The Former is 20 µg/m3 annual mean and 50 µg/m3 24-hour mean whereas the latter is 10 µg/m3 annual mean and 25 µg/m3 24-hours mean (WHO, 2005). PM2.5 levels of over 500 micrograms per cubic metre have been measured in Kathmandu, Nepal, (UNEP, 2014).

The main objective of study is to explore some ingredient of air pollution in the world and its effects on health. It also focuses on the causes and effects of air contamination and identifies some global and collective solutions of this toxic waste.

Literature Review

The number of available scientific literature to assess the effects of climate change and adaptation, and vulnerability more than doubled between 2005 and 2010, with particularly relevant publications rapid increases adaptation. And increased authored publications climate change from developing countries, although it still represents a small percentage of the total. (IPCC, 2014)

Shahid and Hussian (2013) conducted an empirical study in “Manchester of Asia” (Faisalabad, Pakistan) to determine the air quality of the city and problems of solid aerosols by using syntax map method. Due to lack of air quality management capabilities air pollution has become a serious problem in the world in general and particularly in developing countries. It is the need of the time to make legislative framework for the protection of environment and implement for the sake of human health.

Anwar, Ahmed and Asghar (2012) carried out a case study in Bahawalpur (Pakistan) in which they investigated links between air pollution and human health. They collected primary and secondary data and used statistical techniques such as regression and correlation. Inhabitants perceive that air quality is fair, major source of air pollution is road traffic and skin allergy and asthma are major diseases due to air pollution in the city and they are less interesting to visit green places.

Khwaja, et al. (2012) carried out a study in Karachi (Pakistan) about Effect of air pollution on daily morbidity and this study covered a period of 12 months (Aug 2008 to Aug 2009). The mean PM2.5 levels in Karachi exceeded the WHO’s 24 hour air quality guideline almost every day and often by a factor of greater than 5-fold. The results show that the extremely elevated concentrations of PM2.5 in Karachi, Pakistan are, as expected, associated with significantly elevated rates of hospital admission, and to a lesser extent, ER visits for cardiovascular disease.

Majid, Madl and Alam (2012) reviewed the metropolitan cities (Karachi, Lahore, Rawalpindi, and Peshawar) of Pakistan. The study conducted to estimate the quantitative relation between exposures and health quality. Environmental pollution in these cities is analyzed in terms of Particulate Matter (PM) and derived particle mass concentrations.

Detected 24 hour averaged PM10 and PM2.5 concentrations in all four cities are up to 6 times higher than the maximum PM concentrations recommended by the WHO guidelines. He suggests that by controlling urban traffic, shifting alternative and efficient means of transports and implementing environmental protection laws we can bring down the pollution.

Qadir (1996) discussed air quality in some cities of Pakistan with respect to transport system. Out of 17 million Ton of petroleum, 7.8 Million Tons (45.88%) and out of 19.35 Million Tons oil, 8.93 million ton (46.2%) is consumed by transport sector only in Pakistan. Due to rapid increase in population, urbanization and industrialization along with high level of consumption of fossil fuels in transport and energy sectors the NOx, CO_2 and hydrocarbon emissions had a great threat for human health. Moreover, Levels of SPM in major cities is about 6 times higher than the World Health Organization's standard. To reduce air pollution, transport planning and flow management in busy roads of cities must establish by authority and new road vehicles should be used instead of old vehicles.

Khan & Zaidi (2005) states that IAP is one of the major risk factors for pneumonia related morbidity and death in children worldwide. Biomass fuel which is being used in four fifths of all households in Pakistan is the major source of IAP when it is burned for cooking, space heating and lighting homes. Few efforts have been undertaken in this regard so far in Pakistan.

Triana , Afzal , Faiz , Ali and Shuja identify the abating urban air pollution from mobile sources in Karachi. In this paper they concentrate of particulate matters like carbon monoxide, sulphur and nitrogen oxides, ozone and other parameters in Pakistan. They used techniques standard valuation to measure the health effects through air pollution. They analyze the availability of data from 2007 to 2010. Finally, they give economically efficient interventions for reducing air pollution.

Gupta, Khan, Silva and Patadia (2013) found atmospheric aerosol loading and surface level particulate matter air quality assessments. They were analyzed for availability of aerosol data from Karachi and Lahore. They suggest that Lahore experience unhealthy air quality on more than 80% days in any given year.

Kampa and Castanas (2008) reviewed briefly by presenting the adverse effects of a number of air pollutants in human health. They categorize the pollutants as Gaseous pollutants, Persistent organic pollutants, heavy metal and particulate matter. They theoretically discussed the link of air pollutants with premature mortality and reduction in life expectancy and recommended that efforts should be intensified by taking the appropriate measures, in order to reduce the possibility of human pollutant exposure.

Shakun et al. (2012) find out the connection between global warming and concentrations of carbon dioxide. They found that temperature is correlated with and generally lags CO_2 during the last deglaciation. The data set compiled in this study contains most published high-resolution (median resolution, 200 yr), well-dated (n 5 636 radiocarbon dates) temperature records from the last deglaciation. They used transient model to evaluate potential physical explanations for the correlations between temperature and CO_2 concentration.

Kurihara and Shirayama (2004) conducted an empirical study in (Japan) to determine the effect of increased atmospheric CO_2 on the early development of the sea urchins and reduce the pH at the ocean surface. This study examined the fertilization and early cleavage to evaluate the impact of elevated CO_2 concentration on fertilization rate, cleavage rate and developmental speed. He found that all tended to decrease with increasing CO_2 concentration. He suggests that both decreased pH and carbonate chemistry affect the early development and implying that increased seawater CO_2 concentration will seriously alter marine ecosystems.

Baumann Talmage and Gobler (2011) found the relation life growth and carbon dioxide. Absorption of anthropogenic carbon dioxide by the world's oceans is causing mankind's other CO_2 problem and ocean acidification. Grown-up fish tolerate short-term exposures to CO_2 levels that those predicted for the next 300 years but potential effects of increased CO_2 on growth and survival during the early life stages of fish remain poorly understood. These findings challenge the belief that ocean acidification will not affect fish populations, because even small changes in early life survival can generate large fluctuations in adult-fish abundance.

Knight and Schor (2014) explore the relationship between economic growth and carbon dioxide emissions over the period 1991–2008 with a balanced data set of 29 high-income countries. They present a variety of models, with particular attention to the difference between territorial emissions and consumption-based (or carbon footprint) emissions, which include the impact of international trade. The effect of economic growth is greater for consumption-based emissions than territorial emissions. They also find that over this period there is some evidence of decoupling between economic growth and territorial emissions, but no evidence of decoupling for consumption-based emissions.

Malik (2012) conducted an empirical study in (Islamabad) Pakistan to determine the global climate change through Greenhouse emissions (GHGs). The study investigate the increasing concentration of GHGs is warming the earth's atmosphere. The major factors contributing to the global climate change include polluted emissions by excessive burning of fossil fuels and deforestation. The study estimated the negative effect of climate change and Pakistan contributes very little effect to the GHG emission. Climate change is estimated to decrease crop yields in Pakistan. The impact of climate change will intensify the existing social inequalities of resource use and intensify social factors leading to instability, conflicts, displacement of people and changes in migration patterns.

Theoretical Link

There is a stronger link between both indoor and outdoor air pollution exposure and cardiovascular diseases such as strokes and ischaemic heart disease, as well as between air pollution and cancer. This is in addition to air pollution's role in the development of respiratory diseases, including acute respiratory infections and chronic obstructive pulmonary diseases. Table 1 provides the percentages of breakdown of deaths attributed to specific diseases caused by indoor and outdoor air pollution in the world.

The new data states that 2.9 billion people living in homes using wood, coal or dung as their primary cooking fuel which supports the evidence about air pollution's role in the improvement of cardiovascular and respiratory diseases (WHO, 2014). Moreover, the carbon cycle, the relation between the Earth's air temperature and the amount of CO_2 in the atmosphere over a long time period, helps us to better recognition of to the greenhouse effects and its role in the earth's climate (EPA U.S, 2011). Recent studies of the deglaciation have shown a strong correlation between the disappearances of ice from glaciated region and carbon dioxide release (Shakun, 20 12).

Figure 1 depicts the sources of air pollution and their effects on ecosystem of the World. Air pollution releases from different sources, for example it discharges from point sources such as Sulphur dioxide and hydrogen fluoride or even non-point sources such as hydrocarbons, carbon monoxide, oxide of nitrogen and others are secondary toxins, e.g. photochemical ozone.

Descriptive Analysis

Table 2 depicts average values of variables along with their maximum and minimum values. It also includes some important standards which are describing the various aspects of data. The average year of life expectancy of the world is 68.24 years in reference period and maximum years of life expectancy globally are 82.93 years (2009) in Japan whereas minimum are 38.11 years (2000) in Sierra Leone. The average spending of the world for health is $775 on each person from 2000 to 2010 as well as the country spends maximum on health is Norway with 8694.291 dollar per capita in 2010, the opposite is Liberia which only spends 4.50 dollar per person in the world. As CO_2 is concern, the world has been facing 4.30 metric tons per capita average emission during the first decade of 21st century. The country destroying to the global ecosystem due to highest level of emission 38.16113 metric ton per capita of this chemical is Trinidad and Tobago in 2010. Its industrial value addition is 62.72% of GDP in respected year. On the other hand, minimum discharge of the gas is made by Afghanistan which only emits 0.016 metric ton per capita in 2002 with 23.7% of GDP industrial value addition in particular year.

Table 1 Air Pollution Caused Deaths

Outdoor Air Pollution		**Indoor Air Pollution**	
Diseases	**Percentage**	**Diseases**	**Percentage**
IHD	40%	IHD	34%
Stroke	40%	Stroke	26%
COPD	11%	COPD	22%
Lung Cancer	6%	Lung Cancer	6%
ALRI	3%	ALRI	12%

Source: WHO

Figure 1

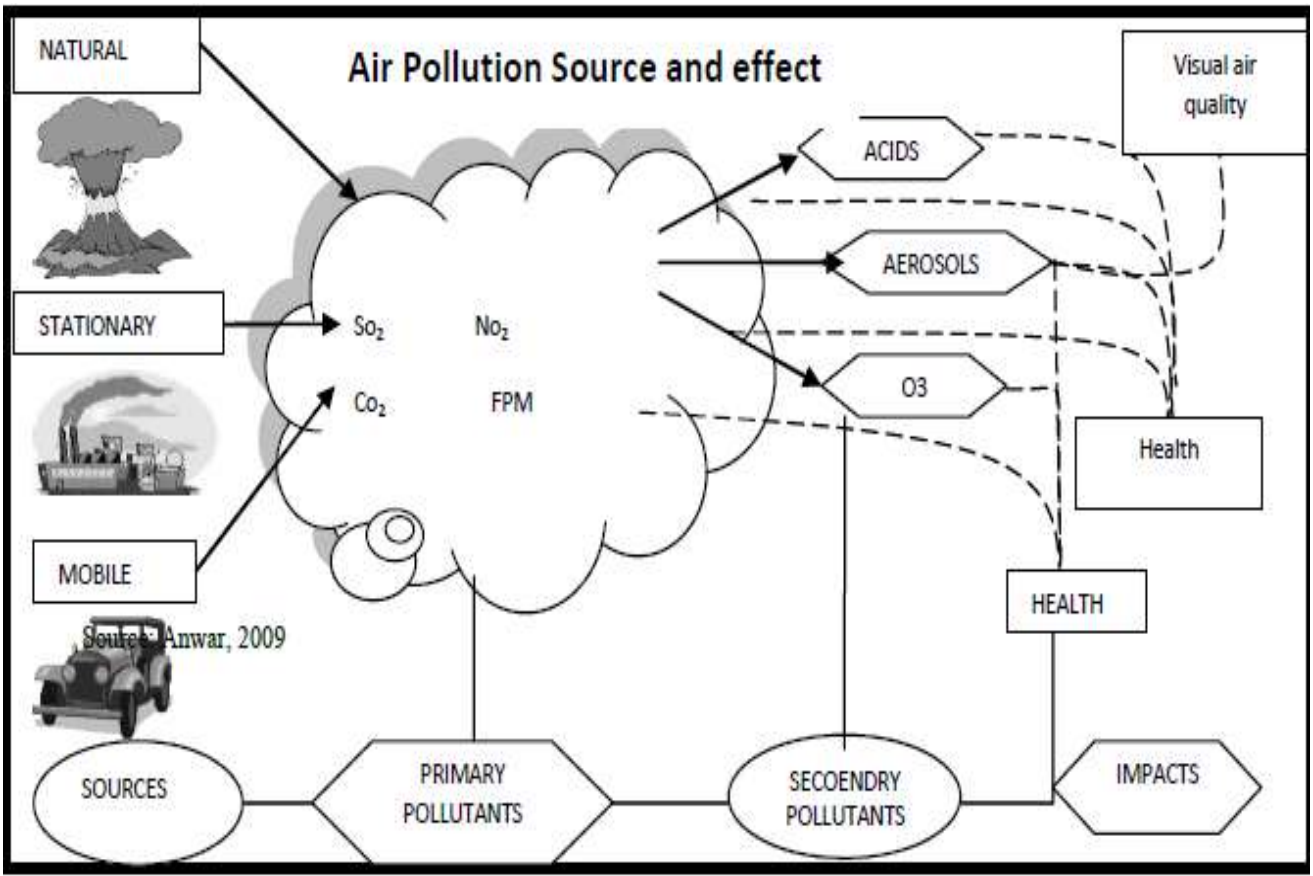

Table 2 Descriptions of Data

	Life Expectancy	Health Expenditures US$	CO2 Metric Tons Per Capita
Mean	68.24123	775.0910	4.302727
Median	70.83817	174.2271	2.351000
Maximum	82.93146	8694.291	38.16113
Minimum	38.11161	4.501224	0.016186
Std. Dev.	9.534034	1453.335	5.076549
Skewness	-0.823067	2.684448	2.175593
Kurtosis	2.805267	10.26808	9.746260
Observations	2046	2046	2046

Methodology

We take data from World Bank on CO_2 emission and some health indicators such as life expectancy and health expenditure. These are penal data of 186 countries from 2000 to 2010. Health expenditures are given in US dollar per capita whereas CO_2 emissions are measured in metric tons per capita.

$$Y_1 = \alpha_0 + \alpha_1 x_i + \mu_1 \quad (1)$$

$$Y_2 = \beta_0 + \beta_1 X_i + \mu_2 \quad (2)$$

$$Y_2 = \beta_0 + \beta_1 X_{it} + \delta_t + C_i + \nu_{it} \quad (3)$$

Y_1 and Y_2 both dependent variables are Health expenditures and life expectancy respectively while X_i is CO2 emission as an explanatory variable.

Table 3

Dependent variables	Independent variables	Coefficients
Health expenditure per capita US$	CO2 emission metric tons per capita	170.59
Life expectancy	CO2 emission metric tons per capita	-0.0472

In both equations we simply use penal least square. In third equation "δ" is time-specific effect and "C" is individual-specific effect, whereas "i" is equal to 186 and "t" is equal to eleven. Due to individual-specific effect and time-specific effect on equation 3 we use correlated random effects Hausman test to detect violation of the random effects modeling assumption that the explanatory variables are orthogonal (unrelated) to the unit effects. We obtain conventional level of significance of the Hausman test and find that there is no correlation between the independent variable(s) and the unit effects because estimated of β_1 in the fixed effects model ($\beta_1 FE$) is asymptotically similar to estimated β_1 in the random effects model ($\beta_1 RE$). Health expenditures are positively related to the CO_2 emission, on the other side, life expectancy is negatively related with regressor. The value of α_1 is 170.59 which mean that each one unit of metric tons of CO_2 emission will cause to increase 170.59 dollar expenditure per capita. The magnitude of β_1 in second equation is -0.0472 which mean that by discharging one metric tons emission per capita life expectancy reduce by 0.045 year.

Conclusion

Living organisms cannot survive without air. Each adult uses 15 kilograms air daily (EPA, 2009). CO_2 emission, no doubt**,** is adversely affecting to the air quality as well as population health and is a hazardous for ecosystem of the world. As data express that life expectancy is being reduced under high level of CO_2 emission. This is not only one dimension phenomenon, because due to high level of emission world climate system is being changed. The UN Framework Convention on Climate Change (UNFCCC) states that mitigation measures bringing about societal benefits should be prioritized (U.N, 1992). So, this climate change threatens the health of human populations worldwide, but particularly in low-income countries. These unpleasant effects on health urge the world to make collective decisions to mitigate emissions and to make policies to protect the ecosystem of the world for next generations. These mitigation policies are not only helpful for population health but also supportive for international health priorities such as Millennium Development Goals and reduction in health inequalities.

Therefore, to reduce the emissions governments should participate actively and industrial countries ought to work according to the principle of Kyoto Protocol "Common but Differentiated Responsibilities". Mitigation policies should focus on household energy, transport, food and agriculture and electricity generation to reduce emission. To address these emissions the world can reduce child mortality from acute respiratory infections, ischaemic heart disease in adults, and other non-communicable diseases. Moreover, there should be improvement of access to affordable and clean energy in middle and low income nations which can further contribute reduction in poverty and risk of climate changed along with better population health. Advanced mechanism used by developed countries should be adopted by low income countries and resources for clean development from high-income to low-income countries should take into account to overcome the health problems of the world. Health professionals can play important role for the awareness about emission and have a crucial role in the design of a low carbon economy. Governments of the nations should make access on data regarding different variables of air pollution locally, particularly in lees developed nations for the purpose of research. Researchers should provide the governments with appropriate empirical analysis on health and emission which are the beneficial for the world.

Finally, if the world community changes their energy system by improving mechanism as well as enhances indoor and outdoor air quality, changes the way of transport sector into less polluted vehicles, manufactures commodities that can be produced with efficient methods that are favorable for environment and consumers reduce demand for polluted goods then many affirmative consequences will be achieved. In addition, these mitigation activities should be significantly large in low income countries which will help to rationally converge mitigation agendas between low income and high income countries.

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