POLICY RESEARCH JOURNAL
ISSN (E): 3006-7030 (P) 3006-7022

Volume 2, Issue 4, 2024

Received: 02 November 2024
Accepted: 02 December 2024
Published: 09 December 2024

WILLINGNESS TO PAY FOR IMPROVED HEALTH DUE TO CLIMATE CHANGE IN LAHORE

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Abstract:

This paper analyzes the Willingness to Pay (WTP) for health in Lahore, Pakistan. Lahore is relatively hotter than norther cities of Pakistan. The study uses the Contingent Valuation method to calculate the willingness to pay for enhanced health program specifically for cardiovascular diseases[5] in Lahore. The study has found inverse relationship between health and Climate Change for Lahore. This study also found that education and WTP for health is positively related. The findings indicate that the people of Lahore are more conscious about their health as they are ready to pay significant amount for improved health program.

Keywords: Climate Change, Temperature, Cardiovascular disease, WTP

INTRODUCTION

All the countries in the world, whether developed or developing, are struggling to achieve sustained economic development to eradicate poverty and to increase the welfare of society. Developing countries face difficult choices in balancing efforts to protect the environment and boosting economic growth. In developing countries like Pakistan, climate change is an additional burden because socioeconomic and ecological systems are already facing pressures caused by rapid population growth, industrialization and economic development.

Human beings are the cause and effect[6] of climate change. The effects of climate change could be linked, directly or indirectly, with the health hazards faced by individuals. Healthy human beings have the capability to overcome the problems caused by climate change; however unhealthy humans face an exacerbation of the problems like workdays loss, absence from school, restrictive activity days etc. Therefore, this study focuses on improved human health due to climate change.

In the first part of study relationship of temperature[7] with the number of patients of cardiovascular disease in Lahore is examined. In the second part our objective is to find out the willingness to pay for improved health. Climate change has the characteristics of a public good and market price is unavailable for evaluation of its impacts (Halsnæset al., 2007). Therefore, in the second part, the contingent valuation method has

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[5] An indicator for the health.
[6] Human beings are cause because they are responsible for emissions of anthropogenic emissions and they are effect because they are facing damages especially health damages through climate change.
[7] An indicator for the Climate Change.

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ISSN (E): 3006-7030 (P) 3006-7022

been applied to calculate the willingness to pay for a health program in Lahore city.

Temperature trends:

According to the World Development Indicators, in 1971, the temperature has increased from 0.2 to 1.0°C from 1971 to 2003. The effects of global climate change can be potentially very detrimental for the next century. The possible aftereffects include regional increases in high-temperature events, outbreaks of diseases affecting human health and safety adversely, especially among poor communities with high population densities. If we review history, top ten warmest years in the history (1880-2014) are between 1998 and 2014(NOAA, 2014). According to IPCC, climate change is likely to have a wide-ranging and mostly adverse impact on human health, accompanied by a significant loss of life.

By 2020, more than half of Asia's urban population will be at great risk from heat waves, pollution and diseases while straining infrastructure (ADB, 2008). One of the major health impacts of climate change is the increase of heart-related diseases especially cardiovascular diseases (McMicheal et al., 2006; Haines and Patz, 2004). The highest death rate in world is 26 percent of total deaths due to cardiovascular diseases in south Asia region (WHO, 2005). IPCC also concludes, "The range of published evidence indicates that the net damage costs of climate change are likely to be significant and to increase over time." (IPCC 2007)

It is further stated that the susceptibility of the human and natural system to climate change varies greatly from region to region (IPCC 2007). As urban areas and the population of urban areas increases, vulnerability to heat-related mortality seems likely to increase in future. More vulnerable regions are temperate latitudes, and regions around the pacific and Indian oceans [Patz, et al.(2005)].

There are several limitations to the available information. Foremost is that most empirical climate-health studies and national assessments of health risks from future climate change have been done in high-income countries. Most epidemiological studies of extreme temperatures have been done in Europe and North America [Basu, (2002); McGeehin, (2001)]. It has been observed that most of the studies have been conducted in Canada, USA and Europe and a couple of studies have taken place in Asia[8]. With respect to Asia, some research on this topic has been conducted in India; however, as far as I know, no study has been carried out in Pakistan. It has also been concluded that most of the effects of climate change are adverse effects. To estimate the health effects associated with climate change in developing countries, policy makers are often forced to extrapolate results from studies conducted in industrialized countries. These extrapolations, however, may be inappropriate.

Objectives of the Study

Following are the major objectives of the study:

1. To analyze the impact of temperature change on health.
2. To calculate the willingness to pay for improved health in Lahore.

Importance of the Study

Climate change is affecting almost every sector of economy such as human health, ecosystem, rainfall, water resource etc. Human beings are the cause and effect of climate change. Therefore human beings need to make an effort to limit climatic changes. Healthy human beings have the capability to overcome the problems caused by climate change; however unhealthy human beings face an exacerbation of the problems linked to climate change. That is why climate change's health impacts analysis has been chosen for this study. Climate change is expected to increase the average temperature. Increased temperature is expected to increase morbidity and mortality especially for cardiovascular patients. It is also expected that climate change will affect the life in developing countries more than in developed ones. (Patz and Kovats 2002).

Most of the studies related to climate change and health have taken place in Europe and USA. They

[8]For detail see the Literature Review of this paper.

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have shown a positive relationship between increased temperature and mortality. It has also been found that most of the mortalities occurred in people with pre-existing cardiovascular disease. It is also evident from most of the studies that people living in urban areas are at greater risk. This is due to the urban heat island effect.[9]

In Europe, abnormally high temperature (3.5C above normal) in the summer of 2003 was associated with over 35000 more deaths than in the same period in previous years (P. S. Stott 2004). Climate change has already caused the deaths of 150000 people in 2000. In 1995, the Chicago heat wave caused 696 more deaths (whitman, 1997)and in 1999 a heat wave caused 119 deaths in Chicago (Palecki, 2001). Adaptation[10] to climate change can reduce the risks. This showed that developed countries are also vulnerable to increased temperature especially laborers who work outdoors.

It is imperative to estimate the health impacts with reference to conditions in Pakistan. Additionally it is essential for Pakistan to initiate research about this important issue so that an estimation of the impact of climate change on health can be carried out. These steps are necessary in order to convey our stance in international debate and convey our subjective point of view; which will eventually lead to legislation of internal policies. If preventive measures are not taken, increased temperature will lead to an increased health cost which will bring about a depletion of human resources. Every country needs mental and medical fitness of its human resources to achieve maximum prosperity and sustainable development.

The reason for choosing cardiovascular disease is that the patients of this disease are increasing and the impacts are very acute. Internationally, Asia has the highest death rate due to cardiovascular diseases (WHO, 2005). In all other diseases we have generally enough time to manage the treatment but not in the case of cardiac related disease. This indicates that the causes of cardiovascular disease need to be tackled urgently.

There is an acute shortage of environmental and health data in developing countries, especially in Pakistan. Due to financial and time constraint, it is very difficult to conduct this study for the whole country. Thus, a survey of Lahore was conducted to collect information. In order to obtain primary data we have chosen Lahore city to study WTP for health, for our analysis. Main reason for choosing Lahore as the subject for this study is that Lahore city is the second largest city and second biggest commercial area of Pakistan and the capital of Punjab province. The oldest and largest hospital of cardiology is situated in Lahore.[11] Another reason for choosing Lahore is that the incidence of cardiovascular disease is increasing in Lahore. The government of Punjab has provided the highest level of facilities for cardiovascular patients in Lahore as compared to other cities.

Literature Review

In 2007, Intergovernmental Panel on Climate Change (IPCC) reached on a consensus that Urban areas are more vulnerable to climate change as compared to surrounding areas. Buildings absorb increased temperature more than trees and green fields. Consequently, people in cities are more at risk as compared to residents of rural areas. As mentioned earlier, in developing countries the research on impacts of climate change is not sufficient, but it is expanding at a high rate.

[9]Inner urban environments, with high thermal mass and low ventilation, absorb and retain heat which amplifies and extends the rise in temperature.

[10](Proper air conditioning in summer, proper heating in cold weather, improved health care facilities, public awareness etc.

[11]There are other cardiology hospitals in Punjab but they are relatively smaller and newer as compared to Lahore's cardiology hospital. There are four more cardiology hospitals in Punjab located at Rawalpindi, Multan, Faisalabad and Wazirabad.

Pakistan's atmospheric environment is very different and it has very different climatic conditions as compared to the rest of the world[12].

Literature on Climate Change and Health

IPCC reports conclude that most of the observed warming over the last 50 years is attributed to human activities and these are likely to continue to change the climate during the 21st century. By 21st century the atmospheric temperature will be in the range of 1.4 – 5.8°C at the end of the 21st century [Albritton (2001)]. Different studies have concluded that IPCC estimates regarding the temperature increase of between 1.4 – 5.8°C in 21st century are likely to be conservative [see Andronova (2002), Knutti(2002), Stott and Kettleborough, (2002)].

Meehl (2004) reveals that the frequency of heat waves has been projected to increase the frequency and duration in Chicago and Paris by the end of the century (2080-2099). Patz and Kovats (2002) have concluded that health effects of climate change affect poorer populations first. In this paper authors have reviewed the major findings of published reports by IPCC, the National Research Council, the World Health Organization and UN Environmental Programs. They found that developed nations are more responsible for the emissions of GHG and climate change but poorer nations are at a higher risk. Andrew, et al. (2000) checked the health status in Africa, Asia and South America. They used secondary data. The health impacts were estimated from the number of people affected. Climate Variability is one of the factors which accounted for up to 26 percent of the anomalies in the case of highland hospitals which needs to be prioritized amongst many factors affecting human health and survival.

Mostly the health impacts of climate change come from temperature and precipitation [Jonathan A. Patz (2002)]. Pattenden (2003) concluded that higher temperature contributes approximately 1-4 percent to the mortality of the elderly in Europe. Stott (2004) reported that more than 35000 deaths in Europe in 2003 were due to the heat wave and it has been estimated that the probability of such events has doubled since preindustrial time. Patz,et al. (2005) have reviewed the climate-health relationships in many regions of the world. They concluded that the effect of heat waves has increased in big cities as compared to villages and small towns. As urban areas and population of urban areas have increased, vulnerability to heat-related mortality seems likely to increase in future. More vulnerable regions are temperate latitudes and regions around the Pacific and Indian oceans. McMicheal,et al. (2006) have focused largely on thermal stress, extreme weather events and infectious diseases.

Eurowinter (1997) concluded that daily deaths increased with falling temperatures in warmer areas. The effect of a cold day is larger in warmer cities then in colder cities. Braga (2002) has concluded that for cardiovascular deaths the hot day effect is five times smaller than the cold day effect. This refers to the fact that a fall in temperature affects cardiovascular patients more than a rise in temperature. They also concluded that the cold temperature effect continues for days, but high temperatures are associated with the actual death or the day before the actual death. In a report by McMichael A. J. et al (2003) it is observed that in South East Asia, change in the temperature in a range of 0 - 1°C is associated with 0 – 0.9 percent of cardiovascular cases and between 1 - 2°C temperature is associated with 0 – 1.3 percent of the cardiovascular cases. A serious side effect of increased temperature is related to premature deaths due to Cardiovascular, cerebrovascular and respiratory diseases Zell, (2004), Patz and A., (2004), McMicheal, et al. (2006) and there are some indirect effects of climate change through air pollution like asthma and allergies; as well as other acute and chronic respiratory disorders and deaths [Haines et al (2000)]. The World Health Organization, WHO, (2005), has suggested that in many temperate countries, death rates during the winter are higher, approximately 10-15 percent than during the

[12]In Pakistan, 12 locations are cooler, 22 are warmer. Globally, 2282 are cooler, 698 are warmer (World Climate 2010).

summer season. Most deaths occur in people who are suffering from preexisting conditions such as cardiovascular and respiratory diseases.

Shannon, et al. (2007), Committee on Environmental Health, USA has tried to determine the main factors that affect children's health. They have concluded that we have to educate people about adverse health effects for children.

The discussion in paragraphs given above revealed that the result is inconclusive. Some studies show a positive relationship between temperature and incidence of cardiovascular disease while others show a negative relationship. Moreover as mentioned earlier that most of the studies have taken place in the developed countries. Thus, there is a need to investigate this subject further especially in developing countries in order to reach a conclusion. Therefore Lahore from Pakistan has been chosen for this study in order to reach a conclusion. Lahore is a relatively hotter area as compare to the northerner areas of Pakistan**.**

Literature on Willingness to Pay

As mentioned earlier the second part of this study is related to the willingness to pay for improvement in the health sector. Thus, the following literature review is also related to the willingness to pay.

Cropper (1981) used the damage function approach to conclude that the willingness to pay is greater for acute illness than the benefits computed. She estimated that the value of a 10 percent reduction in pollution is only $3.60 ignoring the adjustments to pollution and therefore this value is understated. A study was conducted by Anna Alberini et al(1997), the objective of the study was to elicit Willingness to Pay (WTP) to avoid a recurrence of acute illness in Taiwan. Using survey based data for 864 people and applying Contingent valuation method and Log likelihood function the study shows that WTP increased with duration of illness, number of symptoms and with education and income.

In another study Alan, et al. (2002) suggests that value of statistical life through willingness to pay was C$ 3.8 million in 1999 C$, for 1 in 10000 annual risk reduction and C$ 1.2 million for 5 in 10000 annual risk reduction or US$ 3.04 and US$ 0.96 million respectively. They also concluded that willingness to pay for 5 in 10000 risk reduction is C$ 657 and did not change up to age 70 and was around 30 percent lower for persons age 70 and above. Anna (2004) investigated the Willingness to Pay (WTP) for a reduction in probability of dying during the next 10 years in Canada and in USA. She used the survey based data for 930 residents of Hamilton, Canada and 1200 residents from USA. She used the Contingent valuation method and applied Maximum Likelihood technique for estimation. They found that in both countries the results are similar. WTP is significantly greater for persons with high blood pressures than for those without it. Chronic respiratory and cardiovascular diseases have no statistically significant effect on WTP in either country. Alberini (2005) obtained estimates of the Value of a Statistical life in the context of the risk of dying of Cardiovascular and Respiratory illness. They collected primary data from three cities including PRAGUE (N=351), BRNO (N=296) AND OSTRAVA (N=307). They calculated the Value of Statistical Life (VSL) by applying the Maximum Likelihood technique. They concluded that mean VSL of€1.27 million at the current exchange rate is, €2.86 million at the PPP, while median VSL is 18.52 million. Value of Statistical life is higher among rich people and it declines with the age of the respondent. In another study by Anna Alberini (2006) it is concluded that delaying the time of risk reduction of mortality risk significantly reduces the willingness to pay. Respondents between ages 40 – 60 have less willingness to pay today for a risk reduction of mortality which is going to occur at age 70 then willingness to pay for a current risk reduction. In another study Alberini (2006) looked at the WTP for reduced mortality risk by analyzing the latency in the period from 10 years to 30 years. This was a survey based study for 930 residents of Hamilton, Canada and 1200 from USA. They concluded that delaying the time at which the risk reduction of mortality occurs significantly reduces WTP, at least for respondents in the 40-60 age groups.

Haines et al (2000) analyzed direct and indirect health effects of climate change. Based on their

analysis they suggested a change in the housing designs to enhance summer-time cooling, adding greenery to inner cities and early warnings of the weather. McMichael (2003) reviewed the quantitative estimates of the total health impacts due to climate change. He also laid out the steps necessary to further scientific investigation and develops strategies and polices to help societies adapt to climate change. A study by Patz (2004) investigates the impacts of thermal stress, floods and droughts, air pollution, etc. on health. They have concluded that if we make policies related to reducing GHG, efficient use of energy and early warning of climate changes then we can reduce the impacts of climate change on health.

McMicheal (2006) summarized the epidemiological evidence of how climate variations and trends affect health outcomes from some published materials. He concluded that the evidence and anticipation of adverse health effects will indicate priorities for planned adaptive strategies and strengthen the case for pre-emptive policies.

Discussion in literature review revealed that most of the studies are from developed countries like Canada, USA and Europe. Only a few studies have been undertaken in Asia. From Asia, a few studies are available for India but no research has been conducted on this topic in Pakistan (according to my knowledge). It can also be concluded from the above discussion that climate change has adverse direct and indirect health effects. Moreover the discussion concluded that some studies show a positive relationship between temperature and incidence of cardiovascular disease while others show a negative relationship. Most of the studies have been conducted in colder areas whereas some studies are from comparatively hotter areas. Therefore, it is imperative for Pakistan to initiate research on this important issue in order to assess the impacts of climate change on health and realize and suggest appropriate precautionary measures. Therefore, as mentioned earlier, there is a need to investigate this subject further especially in developing countries in order to reach a conclusion. Therefore Lahore from Pakistan has been chosen for this study in order to reach a conclusion. Lahore is a hotter area as compare to the northern areas of Pakistan.

Brief History of Climate Change in Pakistan[13]

In Pakistan, the met data, available from 11 stations, indicates that a cooling of 0.1 to 0.3ºC in rural towns' stations and a warming of 0.7ºC in the stations of cities is observed in the last four decades. In the last three decades, there has been a net decrease in temperature of Badin and Nokundi by 0.3ºC and 1.1ºC respectively whereas in last two decades the temperature of Islamabad has decreased by 0.6ºC. In the last decade, the decrease in temperature of Hyderabad and Jacobabad has observed by 0.2ºC and 0.1ºC respectively. There has also been observed a net increase in temperature in Karachi, Quetta, Gilgit, Peshawar and Lahore 0.7ºC, 0.5ºC, 0.2ºC, 0.3ºC and 0.6ºC respectively. All of these increases have been observed in the last four decades.

The mean maximum temperature also has different patterns. The mean maximum temperature in Badin decreased by 1.4ºC, in Hyderabad decreased by 0.7ºC, and in Jacobabad decreased by 0.3ºC in the last four decades. On the other hand in Karachi an increase of 0.6ºC, Nokkundi by 0.4ºC, Quetta by 0.4ºC, Gilgit by 0.7ºC, Islamabad by 0.4ºC has been observed between 1960 and 1990. In Lahore an increase of 0.2ºC was noted between 1960 and 1990 and a decrease of 0.1ºC was seen in the period between 1960 – 70, Peshawar exhibited an increase of 0.9ºC since four decades.

Based on data, reported in the Economic Survey of Pakistan (various issues), the temperature trends of major cities of Pakistan which shows slight fluctuation of temperature (mean of Maximum) in Pakistan's major cities from 1975 to 2002. While a significant increase in the temperature (mean of minimum) of Pakistan's major cities except for Quetta.

Historical temperature of Pakistan from 1970 to

[13]The figures of Pakistan temperature have been taken from a study by Dr. Mirza Arshad Ali Beg (Former Director General, PCSIR) entitled "Climate Change in Pakistan; is it Related to Global Warming".

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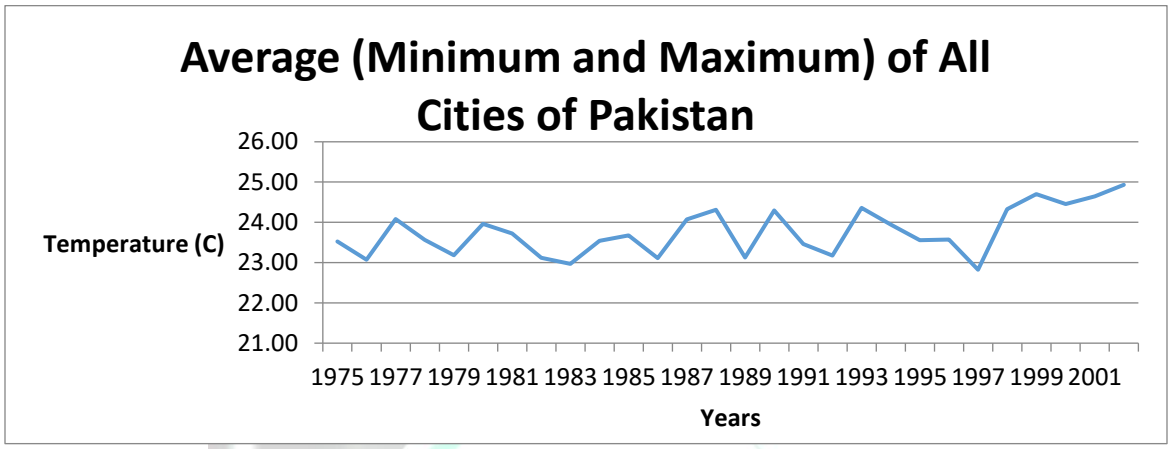
2004 revealed that temperature has changed from 0.2 to 1.0 C°. Figure below clearly shows an upward trend of temperature of Pakistan.

Figure: Average temperature of Pakistan



Data Collection and Methodology

In first section the relationship of temperature with the number of heart patients of cardiovascular disease, an indicator of health, in Lahore is examined. In second section our objective is to find out the willingness to pay for improved health system.

Daily data is required for the first part as the effect of temperature is visible after an interval of three to seven days. The second part of the study is based on the use of the contingent valuation method (CVM). For this purpose a household survey of Lahore city has been conducted. CVM was first proposed by the S. V. Ciriacy-Wantrup in 1947 for evaluation of non-market goods. It was first applied by Davis in 1963 to estimate the value tourist placed for wilderness areas. But it gained popularity in 1989 after the assessment of the Exxon Valdez Oil Spill, which took place on March 24, 1989 in Prince William Sound, Alaska. Economists used the CVM to find the willingness to pay to prevent another oil spill. After this estimation the method is being used worldwide.

A lot of criticism was aimed at this method. In 1993, the National Oceanic and Atmospheric Administration (NOAA) commissioned a Blue Ribbon Panel to look into the criticism. The panel consisted of many experts, including two Nobel prize winners, viz., Kenneth Arrow and Robert Solow. They heard the arguments put forth by advocates and critics of CVM. In their final report, the panel concluded that the CVM can produce reliable results provided researchers meet a high standard of proof.

The primary objective of the study is to calculate willingness to pay for an improved health system. For this purpose two data sets were required. One was related to climate change (temperature) and other was related to health. The data sets were collected from two sources. The First data set was obtained from the meteorological department. The second data set was collected from a household survey in Lahore city to ascertain the willingness to pay for improvement in health services. To compile a second data set, a household survey of Lahore city has been conducted to estimate people's WTP for health. Description of different data sets and their collection procedure is given below.

Meteorological Data[14]

The Meteorological Department Karachi provided

[14]I am thankful to **the Director** of Climatological Data Processing Centre, Karachi for providing me the daily data of temperature for different cities from 1980 to 2008. Daily temperature data is available on payment. For the students they provide limited data sets without any payment. Otherwise everybody have to purchase the data. Due to financial constraints, the

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the Lahore's daily temperature data. This included the maximum and minimum temperature of Lahore city based on a monthly average. Historical temperature of Pakistan revealed that temperature changes from 0.2 to 1.0 C°. The Figure in previous section clearly shows rising trend in Pakistan's temperature.

Survey Area[15] (Lahore City)[16]

Lahore experiences all four seasons. May and June are considered to be the hottest months while December and January are thought to be the coldest months. The temperature of Lahore city ranges from 1.2 °C to 46 °C. Lahore's seasons can be divided into four categories according to the temperature.

Summer	[June – September]
Autumn	[October – November]
Winter	[December – February]
Spring	[March – May]

Lahore is divided into 9 towns and 150 union councils.

Survey Data

A household survey has been conducted to estimate the willingness to pay for improvement in health sector. For this purpose a questionnaire was developed with the consultations of the experts in this field. It took around three months in finalizing the questionnaire. A team of highly qualified and experienced people was formed to conduct the survey[17]. Data authentication is the primary responsibility of this study which is why a highly qualified and experienced data collection team was developed. Due to financial and time constraints a target of 500 questionnaires were set. Out of 500 households only 322 responded returned the completed questionnaires. The number of questionnaires to be delivered in different parts of Lahore was decided according to the population of each of Lahore's towns. Each town has been given weights according to the town's population. As mentioned earlier there are nine towns in Lahore

The number of completed questionnaires received from each town is reported in Table 1.1 below.

Table: 1.1 Numbers of completed questioners from each town

Serial Number	Name of the Town	Number of Completed questionnaire
1	AllamaIqbal	67
2	Aziz Bhatti	15

only data which was provided (without payment) was used in this study i.e. temperature.

[15] Due to time and monetary constraint we have conducted the survey only in Lahore.

[16]The total geographical area of Lahore consists of 1772 sq. km. The river Ravi flows in the west side of the district and it touches the district Sheikhupura on the west. On the South side it touches the Kasur district and Indian border is on the East and North-East side.

[17]There were five members of the survey team who were highly qualified and had a minimum M. Sc level education in Economics/Environmental Economics. One member has an M. Sc Economics; two are doing M. Phil/MS in economics and environmental economics while two other members are PhD candidates in environmental economics.

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3	Data GanjBaksh	32
4	Gulberg	49
5	Nishtar	30
6	Ravi	28
7	Samanabad	34
8	Shalimar	18
9	Wahga	18
	Cantt& DHA	31
	Total	322

Source: Survey conducted by Author

- NOTE: Cantt& DHA are not included in any town and is separately mentioned in Lahore's map.

The average age of the respondent is 30 years. Minimum age of the respondent was 16 years while the maximum age was 76 years. Out of 322 respondents, the numbers of male respondents are 207 while 115 are female. Out of these respondents 148 are married, 169 are unmarried and 3 are divorced

The educational level of the respondents has been reported in Table 1.2.

Table: 1.2 Educational levels of the respondents

Educational Level	Number of Respondents	Percentage Share
Illiterate	15	4.66
Primary	6	1.86
Up to Metric	67	20.81
Up to Intermediate	37	11.49

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Up to Graduation	76	23.60
Up to Masters	108	33.54
Above Masters	13	4.04
Total	322	100.00

Source: Survey conducted by Author

Out of the sample 75 persons are the head while the other relations of respondents to the head of household are reported in Table 1.3. The Table shows that majority of the respondents are either sons, or daughters or brothers. This is expected to improve quality of data significantly.

Table: 1.3Relationships of respondents with the head of the family.

Relationship	Number
Head	75
Brother	16
Cousin	3
Daughter	83
Daughter in Law	7
Husband	3
Sister	6
Son	111
Uncle	3
Wife	15
TOTAL	322

Source: Survey conducted by Author

Respondents were asked about the relationship between temperature and health, namely whether temperature effects health or not? Out of 322 respondents 303 (94 percent) replied that they

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were aware of this relationship while 19 (6 percent) were unaware of the relationship. Among the 245 respondents, 64 (26 percent) respondents replied that there is strong relationship (between cardiovascular disease with the temperature), 78 (32 percent) replied that there is a moderate relationship, 49 (20 percent) replied that there is a weak relationship while the remaining 54 (22 percent) said that there is no relationship between temperature and Cardiovascular disease.

The respondents were then asked if there was any cardiovascular problem in their family. Out of the total respondents, 104 (33 percent) reported positively while the remaining did not have this problem. The respondents were then asked if they would be willing to participate/contribute to any improvement in the health system. Out of total respondents 80 (25 percent) were NOT WILLING TO PAY for improvement in the Health system and 230 (71 percent) were WILLING TO PAY for improvement in the health system. About 12 (4 percent) respondents did not answer this question. Out of 230, who are WILLING TO PAY, 162 (70 percent) reported a positive amount while the remaining said that they were willing to pay but could not specify the amount at the moment.

During the course of the survey, the respondents revealed that they were willing to pay an even higher amount for an improved health system but due to lack of confidence in the government's part, they did not reveal their true willingness to pay. The majority of respondents told us that if they were guaranteed that their money would be appropriated in the right direction then they would pay even more.

Respondents were asked about the mitigating activities and the averting behavior. In mitigating activities, different questions were asked such as number of sick days, travel cost to a hospital, doctor's fees, medicine expenditure, number of days absent from work, wages lost etc. In averting behavior questions such as use of A/C in summer, A/C cars, exhaust fans etc. were asked.

In the last section, respondents were asked about the monthly household income. The respondents were divided according to their household income and thus seven groups were created according to the income range.[18]The income groups of the respondents are shown in Figure 1.1.

[18]Group 1 (income less than Rs. 10000), Group 2(Income between Rs. 10000 – 20000), Group 3 (Income between Rs. 20001 – 30000), Group 4 (Income between 30001-40000), Group 5 (Income between 40001 – 50000), Group 6

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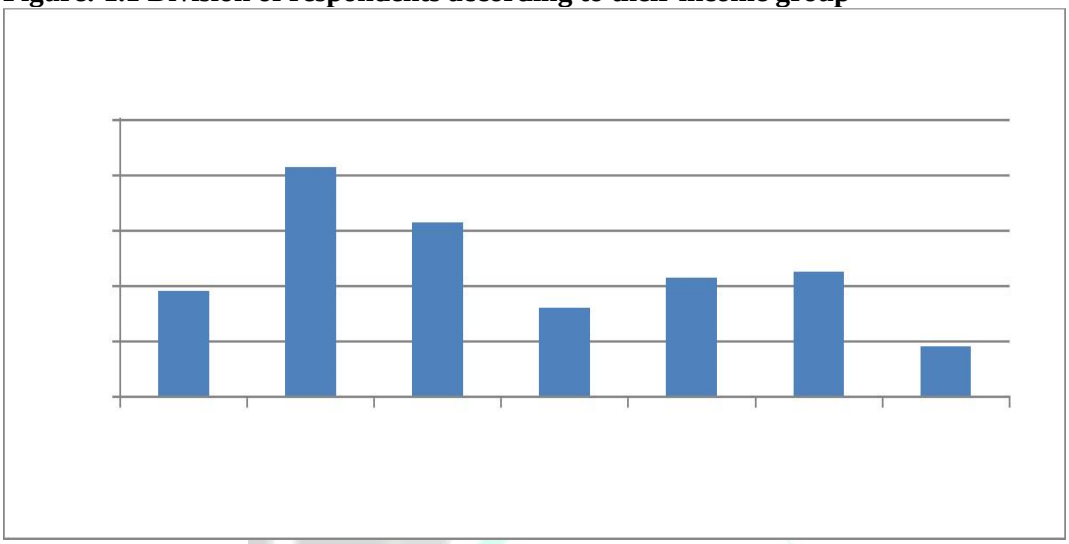
Figure: 1.1 Division of respondents according to their income group



Source: Survey conducted by author

The majority of the respondent's household income is in group 2, Followed by group 3, group 6, group 5, group 1, group 4 and group 7.

Theoretical Model:

The primary objective of this study is to focus on the health sector. We have used the health production function which was originally developed by the Grossman (1972). Then different economists have used the health production function with some variation. For example Cropper (1981) introduced a pollution variable in her model, Harrington and Portney (1987) included the pollution variable to check the willingness to pay for a reduction in pollution etc. In this study climate change (proxied by temperature) variable is used to check the relationship of climate change and health.

Household health production function is implicit in the utility maximizing behavior of an individual and is as follows:

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$U = f\ (X, L, H, A, M)$ ……(1)

Where
X = Consumption of marketed goods
L = Leisure time
H = Number of patients in hospital/no of days of illness
A = Averting behavior
M = Mitigating activities

Household health production function:
$H = f\ (Cc\ (Temp\ (CO_2)), A, M, Z)$…… …..(2)
Where,
H: Work days lost due to morbidity/no of days of illness
Cc = Climate change
Temp = Temperature
CO_2 = Carbon dioxide
Z: Vector of other health indicators and household characteristics

Now substituting equation 2 into 1

$U = f\ (X, L, H\ (Cc\ (Temp\ (CO_2)), A, M, Z), A, M)$……(3)

The individual maximizes utility subject to the following budget constraint:

$Y = w\ (T-L-H)$…… ……..……(4)

Where,
Y = Income
W = Wage rate
(T-L-H) = Time spent at work

$C = X + PaA + Pm\ M$…….(5)

Pa = Price of averting behavior
Pm: Price of mitigating activity
Price of X is numerarie.

Equating the income and cost equations to get the budget constraint:-

$Y = C$ ……..(6)
So
$w\ (T-L-H) = X + PaA + PmM$ ……(7)

The consumer faces the following problem:
$\max U = f\ (X, L, H\ (Cc\ (Temp\ (CO_2)), A, M, Z), A, M)$……(8)
s.t
$w\ (T-L-H) = X + PaA + PmM$……..(9)
By applying the Lagrange Function, demand function for mitigating activities and averting behavior have been obtained.
$£ = f(X, L, H\ (Cc\ (Temp\ (CO_2)), A, M, Z), A, M) + \lambda\ (w\ (T-L-H) - X - PaA - PmM$...(10)
The first order conditions for maximization are as under:-
$Lx = Ux - \lambda = 0$ ..…….……(a)
$L_A = U_H H_A + U_A - \lambda(P_A + WH_A) = 0$…….……..……..(b)
$L_M = U_H H_M + U_M - \lambda(wH_M + P_M) = 0$…….……..……(c)
$L_L = U_L - \lambda w = 0$……(d)
$L\ \lambda = w\ (T-L-H) - X - PaA - PmM = 0$……..……(e)

Rearranging the averting behavior equation (b) yields following utility maximization equation:-
$(U_H H_A + U_A)/\ \lambda = P_A + WH_A$……(11)

The above equation of averting behavior shows that the marginal benefits of averting behavior are equal to the marginal cost of averting behavior. Consumers will continue the averting behavior until the marginal benefit of averting behavior is equal to its marginal cost.
Likewise rearranging the equation for mitigating activities (c) for utility maximization, we get the following:
$(U_H H_M + U_M)/\ \lambda = wH_M + P_M$ ……(12)

The above equation of mitigating activities shows that the marginal benefits of mitigating activities are equal to the marginal cost of mitigating activities. Consumers will continue the mitigating activities until the marginal benefits of mitigating activities are equal to their marginal costs.
First order conditions can be derived for the demand functions for mitigating activities and averting behaviors. The resulting demand functions are as follows.
$M^* = m\ (Pm, W, H, Z)$… …….(13)
$A^* = a\ (Pa, W, H, M, Z)$…… ……..(14)

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Similarly demand functions of all variables of objective function can be obtained.
Substitution of optimal values of all variables into the objective function (utility function) yields the indirect utility function:-
$V = V(P_A, P_M, W, H, M)$…… ……..(15)

The above indirect utility function is non-increasing in prices i.e. if P' >= P, then V'<=V. likewise it is non-decreasing in W i.e. if W'>=W, then V'>=V. It is non-increasing in H and homogeneous of degree zero.
Totally differentiating the indirect utility function:-
$dV = V_{PA}dP_A + V_MdP_M + V_WdW + V_MdM + V_HdH$…….(16)

Taking the total derivative of the mitigating activities, we get:
$dV/dM = V_H(dH/dM) + V_M$……..(17)
Holding utility constant, the marginal value of a change in mitigating activities is given as:

$WTP=dH/dM=- v_{M/H}$…….(18)
At the optimal values, first order condition can be interpreted as the marginal utility of mitigating activities:-
$VM = U_HH_M + U_M - \lambda(wH_M + P_M) = 0$ ……(19)

First order condition for averting behavior is:
$L_A = U_HH_A + U_A - \lambda(P_A + WH_A) = 0$ ……(20)

Rearranging the above equation we get the following:-

Estimation of Willingness to Pay[19] for Health Sector– A Contingent Valuation Approach

The estimated health cost is only part of the total cost; as there are additional costs as well such as productivity loss, cost incurred by the caretaker and psychic cost etc. which are difficult to

$U_H = (\lambda(P_A + WH_A) - U_A)/H_A$……..(21)
Putting the value of U_H (21) into equation 19 and simplifying, we get the following:-

$MWTP = P_A(H_{M/A}) - U_A(H_{M/A})/ \lambda + U_M/ \lambda - P_M$

Where

MWTP = Marginal willingness to pay

The marginal willingness to pay is equal to the difference between the marginal value of averting behavior in joint production function of health incorporating mitigating and averting activities and its marginal utility of averting behavior from joint production function plus the difference between marginal utility from mitigating activities and its value.
If marginal utility of mitigating activity is equal to its value then marginal value and marginal utility of averting behavior in joint production function determine the marginal willingness to pay and if the marginal value of averting behavior in joint production function is equal to its marginal utility then marginal willingness to pay becomes zero.
If marginal value of averting behavior is equal to its marginal utility in joint production function then the difference between marginal utility from mitigating activities and its value determine the marginal willingness to pay.
We have to estimate the health production function and the demand function simultaneously in order to get the marginal willingness to pay.

[19] Basically there are many methods to estimate the willingness to pay. For example. 1. The differences in wages that workers must be paid to take riskier jobs. 2. Examines behaviors where people weigh costs against risks (revealed preference) and this is indirect approach of obtaining the willingness to pay.(as mentioned by reviewer) 3. Contingent valuation surveys where respondents are directly asked how much they are willing to pay (stated preference) and this is direct approach of obtaining the willingness to pay.

I have applied the third approach and in literature many authors have applied the third approach like Anna Alberini et al(1997), Kumar (2001), Alan, et al. (2002), Anna (2004) etc have applied the third approach.

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estimate. For example, psychic cost includes tension, pain, disturbance etc. during the disease. If these costs are high, people will be willing to pay more and vice versa for improved health services. For this purpose people are asked how much they are willing to pay to reduce the total cost. Thus, cost and willingness to pay are assumed to be directly proportional; the higher the cost is, the more the people will be willing to pay. In this section we have asked people how much they are willing to pay for the improvement of Lahore's better health system and applied the contingent valuation method to estimate average WTP of respondents. For estimation purpose, contingent valuation method has been applied i.e. people were directly asked how much they would be willing to pay for better health systems. The data, collected through a household survey, has already been discussed.

Health Sector

An estimate of willingness to pay was made with respect to the health system. Econometric techniques used to remove the heteroscedasticity problem in the regression. The following regression has been estimated for willingness to pay.

$$WTP\_HEALTH\_AMOUNT = \beta_1 + \beta_2*AWARENESS + \beta_3*PHD + \beta_4*MASTER + B_5*GRAD + \beta_6*METRIC + \beta_7*MIDDLE + \beta_8*PRIMARY + \beta_9*MARITAL\ STATUS + \beta_{10}*SEX + \beta_{11}*DOCTOR\_FEE + \beta_{12}*INC\_4 + \beta_{13}*TRAVEL\_COST + \beta_{14}*CVD + U$$

Where

WTP_HEALTH_AMOUNT = Willingness to pay for betterment of health system of Lahore. (Rs)

AWARENESS = Awareness about relationship of climate change with health (yes = 1)

PHD = Doctor of Philosophy

MASTER = Master's degree (16 years of education)

GRAD = Graduation (14 years of education)

METRIC = Metric (10 years of education)

MIDDLE = Middle (8 years of education)

PRIMARY = Primary (5 years of education)

MARITAL_STATUS = If married then 1, other wise 0

SEX = Sex (if male = 1, female =0)

DOCTOR_FEE = Doctor fee

INC_4 = Income group (Rs. 30001 – 40000 per month)

TRAVEL_COST = Travelling cost to hospital

CVD = Have cardiovascular disease (if yes = 1, otherwise = 0)

By estimating the above regression, the residuals are obtained and then the auxiliary regression has been estimated which is suggested by White i.e. regressing the squared residuals on a constant, all explanatory variables, their squared and cross products. The heteroscedasticity problem was found in the test because the p value is less than 0.05. So to remove the problem, instead of simple OLS method, the weighted least squares (WLS) has been applied. By applying the WLS the problem of the heteroscedasticity was also removed. It was necessary to click on the heteroscedasticity consistent coefficient covariance and then choose White in order to resolve the problem posed by heteroscedasticity.

Table 1.4 show that the heteroscedasticity is removed, because the P value is greater than 0.05.

Table 1.4 White heteroscedasticity test:

F-statistic	1.740433	Probability	0.059871
Obs*R-squared	23.57212	Probability	0.072725

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The results of WLS are as follows:-

Table 1.5 Estimated parameters of WTP for improvement of health system (CVM).

Dependent Variable: WTP_HEALTH_AMOUN

Variable(s)	Coefficient	Standard Error	t-Statistic [Prob]
C	-687.8904	250.1930	-2.749439 [0.0074]
AWARENESS	250.3252	184.4585	1.357082 [0.1786]
PHD	563.7971	104.4798	5.396232 [0.0000]
MASTER	458.5887	91.56399	5.008396 [0.0000]
GRAD	700.0148	186.2917	3.757627 [0.0003]
METRIC	422.6713	97.84662	4.319733 [0.0000]
MIDDLE	146.2464	55.42792	2.638497 [0.0100]
PRIMARY	230.3419	111.7232	2.061718 [0.0425
MARITAL_STATUS	127.7981	113.0166	1.130790 [0.2615]
SEX	162.1401	113.6368	1.426827 [0.1575]
DOCTOR_FEE	0.013451	0.078350	0.171684 [0.8641]
INC_4	318.4855	162.4813	1.960137 [0.0535]
TRAVEL_COST	-0.041819	0.017553	-2.382485 [0.0196]
CVD	145.0832	86.46080	1.678023 [0.0972]
R-Squared 0.209661			
D-Watson 1.738634			

The willingness to pay equation in the theoretical model reflects marginal utility from one additional unit of health improvement: the higher willingness to pay shows higher marginal utility from improvement in the health system. In other words any factor affecting the marginal utility from one additional unit of health improvement positively will also affect the willingness to pay positively; increase in the value of such factors will also increase the marginal utility from one additional unit of health improvement and thus will also increase the willingness to pay and vice versa.

The results given above show that education is positively related to the willingness to pay for a better health system especially with respect to cardiovascular related disease. A PhD level person is willing to pay Rs. 564/- more than an illiterate person for a better health system especially for the cardiovascular related health problems. The Postgraduate (16^{th} year of education), graduate (14^{th} year of education), metric (10 years of education), middle (8^{th} years of education) and primary (5^{th} years of education) are willing to pay Rs. 459/-, 700/-, 422/-, 146/-and 230/- respectively more than an illiterate person respectively.

For income, only category four is significant. It means that those people whose income lies between Rs. 30 – 40 thousands are willing to pay Rs. 319/- more than the people whose income is less than 10 thousand per month for improvement in health system. All other income categories, lower and upper, are insignificant.

The cost of travelling to a hospital/doctor is negatively related to the willingness to pay. People have to seek out medical help. Consequently, when their traveling expenditures increase they are less willing to pay for a better health system, conversely they want to bear the expenditure themselves. The last significant variable is CVD. People who have a cardiovascular related disease are willing to pay for better health system especially for a cardiovascular related health system. People who have CVD are willing to pay Rs. 145/- more than those who don't have this disease.

Then we have calculated the total willingness to pay with respect to level of education on the basis

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of students who have completed the specific level of education in Lahore. We have calculated only for the education as this the most important for any nation of the world. Similar calculations can be done with the same method. We have also chosen two levels only for comparison purpose i.e. matric and graduation. Then we have calculated the net WTP for the effect of four years of education i.e. between matric and graduation.

The details are given as follows:-

1. (Number of people who have completed Metric level education) X (Willingness to pay in Rs.) (40812) X (Rs. 423/) = Rs. 17.26/- million per month

Willingness to pay per year = 17.26 X 12 = Rs. 207.12/- million

2. (Number of people who have completed graduation level education) X (Willingness to pay in Rs.) (31069) X (Rs. 700/-) = Rs. 21.75/- million per month Willingness to pay per year = 21.75 X 12 = Rs. 261/- million

Table 1.6 Total WTP for education.

WTP for Education	Metric (10 years Completed)	Graduate (14 years Completed)	Net Effect of 4 Years of Education at Higher level.
Willingness to Pay for year 2010 (Lahore)	207.12 (Million Rs.)	261 (Million Rs.)	53.88 (Million Rs.)
Willingness to Pay for year 2010 (Pakistan)	5451.62 (Million Rs.)	6749.46 (Million Rs.)	1297.84 (Million Rs.)

Source: Calculations based on survey conducted by author

Willingness to pay with respect to remaining education level can be calculated by applying the same methodology.

For income groups, the results show that only category 4 is willing to pay for better health system especially for cardiovascular related diseases in Lahore. The willingness to pay for this group is Rs. 319/- higher as compared to group one. Six income groups have been defined earlier in this paper. Willingness to pay for every category can be calculated with the same method.

Summary of the Results:

From these results it can be concluded that the people of Lahore are more concerned and are willing to pay a much higher amount for the improvements in the health system especially for cardiovascular disease. The Table 1.7 shows a summary of the results of the regressions given below.

It has been concluded that people of Lahore are willing to pay more for improvement in health. Those people who got matriculation (10 years of education) are willing to pay around 207.12 million for health. Those who graduated (14 years of education) are willing to pay around 261 million for health system If we see the difference of four years of education (from matriculation to graduation) then it is concluded that willingness to pay for improvement for health system is 53 million.

Table 1.7 Summary results of WTP

	Health System (Cardiovascular Diseases)
Metric (10 years of Education)	**207.12 (Million Rs.)**

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Graduation (14 years of Education)	**261 (Million Rs.)**
Income Group 4 (Rs. 30001 – 40000 per month)	**2511.12 (Million Rs.)**

Source: Calculations based on survey conducted by author

Conclusions:

In the first part the relationship of temperature with the number of patients of cardiovascular disease, an indicator of health, in Lahore is examined. In the second part our objective is to find out the willingness to pay for improved health system.

The main conclusion is that in Lahore the relationship of cardiovascular disease is inversely related to the Lahore's average temperature. So this is contrary to the findings in developed world. The main difference is that the major studies have been conducted in Europe, Canada and America where cold weather prevails during most of the year[20]. People in these areas are used to live in a cold area so an increase in temperature would lead to cardiovascular complications. Lahore is mostly warm. People living in Lahore are used to warm weather. Consequently, when the weather gets warmer, cardiovascular problems do not increase. For this purpose various doctors, belonging to different hospitals in Lahore, were interviewed; they concurred that in winter there are more cardiovascular patients than in summer.

In the health system, education, income group4 and people who are facing cardiovascular diseases display a positive relation with willingness to pay. However travel cost to hospital/doctor has a negative relationship with the health system especially cardio related health system.

The study also concluded that educated people and middle income class people are willing to pay for improvement in the health system. Education brings awareness to life. People want to live in a healthy and clean environment. Consequently, they are willing to pay for better health system.

The risks of serious impacts of this increase in temperature indicate that there is a dire need to quickly resolve the problem.

Health damages are not associated with private cost (household, firms etc.) therefore the role of public policy is necessary for the solution of the problem. Waiting for economic recovery rather than making a decision now will create more obstacles in future. Therefore main policy is suggested that since the results of the survey indicate that people are willing to pay a huge amount for the health system especially for cardio related disease[21]. The Government should use this opportunity and provide better health services and state of the art technology to the people.

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[20]In Pakistan, 12 locations are cooler, 22 are warmer. Globally, 2282 are cooler, 698 are warmer (World Climate 2010).

[21] See table 7.10

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