ORIGINAL ARTICLE

The Increasing Carbon Dioxide concentration in our atmosphere can damage Human Health as well

SHIRAZ ASLAM[1], MUHAMMAD AKHLAQ[2], M. MUBARIK ALI[3], BILAL HUSSAIN[4], TARIQ KHAN[5], MUHAMMAD T KHAN[6]
[1]Professor of ENT, Doctors Hospital, Lahore.
[2]Professor of ENT. Pak. Red Crescent Medical College, Dina Nath. 03214277281
[3]Associate Professor ENT. Avicenna Medical and Dental College, Lahore. 03314991459
[4]Associate Professor ENT. University of Lahore, Lahore. 0344031162
[5]Senior registrar ENT. University of Lahore.03003040089
[6]Final Year medical student, Lahore Medical & Dental College, Lahore.03214438337
Correspondence to Prof. Shiraz Aslam, Email: shirazfrcs@yahoo.com, Tel. 03008469970

ABSTRACT

Aim: To ascertain CO_2 concentration in the environment in various areas of Lahore.
Study design: A cross sectional survey.
Place and Duration of study: Various areas in Lahore. January 2019.
Methodology: The survey was conducted using a special CO_2 monitor to record the concentration of this gas in the atmosphere in 16 areas randomly selected in Lahore.
Results: In most of the areas the atmospheric CO_2 concentration was more than 1000ppm while two areas which are considered congested showed a level of near or above 2000ppm. Immensely known congested Areas of Lahore (Data Darbar, Kacheri, MAO College and GCU area) have shown higher values of CO_2 concentration. On the contrary, GOR 1, which is not a public thoroughfare, shows much reduced values. However, all the measured values are higher than the Planetary CO_2 concentrations at the moment (412 ppm).
Conclusion: The concentration of CO_2 is risingworld over and Lahore is no exception. This rise is almost totally human created. Therefore, it is imperative that our society as a whole takes charge and makes endevours to reduce this toxic gas back to an acceptable level.
Key words: Carbon Dioxide, Greenhouse Gases, Greenhouse Effect, Environmental Pollutants, Climate Change

INTRODUCTION

Millions of years ago plants and animals were buried under tons of soil. These became fossils and as they contain carbon in huge quantities so when they are burnt by humans as a source of fuel, they release carbon dioxide. Thus, we convert solid carbon into its gaseous form, which is carbon dioxide, by causing deforestation and burning coal. Production of cement is also a large anthropogenic source of carbon dioxide.

At about 5 to 10 Kilometers above the Earth's surface there is a huge collection of carbon dioxide in the Northern hemisphere around the months of April and May. This is because the plants are not actively carrying out photosynthesis at this time of the year. But around the month of July, active photosynthesis of the vegetation below sweeps up this carbon dioxide in a very dramatically visual manner as demonstrated by NASA's visualization studios[1].

According to the Environmental protection agency of the United States, in 2018, carbon dioxide constituted 81% of the total greenhouse gases emissions while methane (10%), nitrous oxide (7%) and fluorinated gases (3%) were the rest[2].

CO_2 is a colorless, odorless and a gas which is heavier than air. It does not support combustion. It can be dissolved in water to form carbonic acid.

It is associated with a number of conditions as enlisted by "*pubchem*", an off shoot of the National Library of Congress in USA. These conditions range from atherosclerosis, cardiovascular diseases to amnesia, memory disorders and learning difficulties[3].

CO_2 is a gas present in the atmosphere in a natural way in a concentration of 250 to 350 ppm. The level of 300 ppm was reached about 350,000 years as a highest since the last 800,000 years. The 2020 average is about 413.46 ppm (December 8th, 2020) according to the Scripps Institution of Oceanography[4].

The projection is to around 700 ppm by 2100.It is also alarming to note that not only the concentration of CO_2 is at a steady rise but the rate of increase is also accelerating.

According to the Scripps CO_2 program, the atmospheric CO_2 has been steadily rising steadily especially after the 1958 industrialization. This is evident from the steep rise in the Keeling curve. This is a daily record of global atmospheric carbon dioxide concentration recorded by the Scripps Institute of Oceanography at UC San Diego. The sensitive apparatus is placed at Mauna Loa Observatory, Hawaii, USA[5].

Prior to 1958 the CO_2 level was around 280 and 300 ppm but after this year the rapid technical developments in industry also resulted in a steep rise in the atmospheric CO_2 concentration from around

In Pakistan the fossil carbon dioxide emissions are due mainly to activities in the power industry and the transport sectors (amounting to about 26% each).

MATERIALS AND METHODS

Some sites in Lahore were randomly selected (16 in number) for measurements of their environmental CO_2 concentration levels. There was no endeavour to choose

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particular sites but a car route convenient to the researchers was selected and sites were randomly selected on this particular route. The measurement was done using a latest CO_2 measuring device (Techno line Weather Station WL1005). The measurement time was chosen to be 5 minutes at each particular site.

The measuring device was placed on the roof of the car for 5 minutes and then the reading was recorded.

RESULTS

The measurements of the CO2 levels from different area in Lahore (Table 1), is indicative of the production of the gas and the rapidity with which it is removed from that particular area.

Some areas of Lahore (Data Darbar, Kacheri, MAO College and GCU area) which are known to be congested both with people and vehicles have shown higher values as expected. These areas have heavy traffic and usually consisting of smoke emittingrickshaws, vans and trucks. The Carbon emissions from these old and ill managed vehicles add to the CO2 concentrations especially in an environment which consist of still air.

Area which is restricted to traffic (GOR 1) , shows a much lower value, although the figure here is higher than a well-ventilated area should show.

Interestingly enough, Jail Road also showed a lower value, presumably due to wider roads and better ventilated thoroughfare.

Table 1

10/1/2019 3:17 PM	**CO_2 ppm**
Jail Road	750
Ferozepur Road	900
Lytton Road	1250
MAO College	1500
Kacheri	1800
G.C.U	1750
Data Darbar	2200
Bhati Gate	1550
Shahalami	1500
Bansanwala Bazar	1150
Gawalmandi	950
Lakshmi	900
Montgomery Road	1000
Shimla Pahari	1150
Davis Road	1200
G.O.R 1	700

DISCUSSION

According to the World Bank, 0.4 metric tons per capita was emitted by Pakistan in the 1060s and which increased to 1 metric ton per capita in 2016. This unit describers the total amount of carbon dioxide produced by the inhabitants of a particular country relevant to its population.

There is fascinating interplay between the value of the brightness of the Sun and carbon dioxide. Although the carbon dioxide was high several million years in the past but the net warming effect of co2 and the Sun light was less. This balance has been sustained for millions of years but now due to excessive deforestation and fossil fuel burning the co2 levels is rising and the increase is accelerating[6].

Carbon dioxide concentrations were high hundreds of millions of years ago, but the net warming effect of CO2 and sunlight was less in other terms the Sun was dimmer than it is now. In addition to this human activity has made things worse by increasing the atmospheric co2 by burning an increasing amount of fossil fuel. Thus, now the change in climatic conditions will be faster and much exaggerated.

Thus the increasing levels of atmospheric CO_2 cause a 'heat trap' effect resulting in an increase in the average temperature of Earth by one degree Celsius. This in turn will have damaging effects on the Planet like melting of world glaciers and a rise in the sea levels and devastating heat waves.

An off shoot of the United Nations is the World Meteorological Organization based at Geneva. The impact on humans is projected and a risk assessment warns of ill effects of the resultant rising temperatures and flood leading to humans being displaced and exposed to diseases and malnutrition. Thus there can be deaths due to heat waves, draughts, and floods.

The "United Nations Framework Convention on Climate Change" stressesupon a definite interplay between the purity of the air we breathe and the prevailing climate at the time. This is evident from the increased number of days a heat wave persists in the area.

The Kyoto Protocol (1997) and the Doha Amendment (2012) set up under the auspices of the United Nations Climate Change arm vies to set up a robust and effective system which can monitor climatic changes and can verify its causes and effects on the environment and finally on humans.

These researchers found that a level above 1000ppm in elementary schools does result in a decline of the decision-making abilities of the school children[7,8]. These researchers also noted that more than 80% of the US schools monitored had a CO2 level greater than 1000ppm while the rest had levels of above 3000ppm[9].

The carbon dioxide dissociation curve of normal human blood describes how the partial pressure of carbon dioxide rises with a rise in the total content of carbon dioxide. The Haldane effect describes how the total content of the carbon dioxide is greater if the oxygen content is low at the same partial pressure of carbon dioxide. Thus there will be an increase in the bicarbonate concentration. In simple terms the Haldane effect describes the ability of the deoxygenated haemoglobin to carry more CO_2 than the oxygenated haemoglobin.

Indirect effect through effect of the greenhouse gases on human nutrients. There is an increase in the carbon dioxide content of food crops resulting in a decrease of both macro and micro nutrients. Thus, a consequent decrease in minerals such as potassium, zinc and iron occurs[10,11].

There can be severe consequential deficiencies in humans in the long run. There can also be a decrease in the concentration of ascorbic acid, rice, wheat and proteins[12].

The effect of increase in atmospheric carbon dioxide, will, unfortunately affect the poorer countries like Pakistan, much more than it might the richer countries as determined by a computer micro-simulation. Carbon-dioxide-induced reductions in iron and zinc concentrations in agricultural

products are a serious consequence. The researchers analyzed the zinc and iron deficiencies in their populations from 2015 to 2050 in more than 100 countries. They described the burden of disease in terms of "disability-adjusted life years" or DALYs for short and postulate that poorer counties like India and Afghanistan will have a disease burden of between 3 and 4 DALYs/10^3, while Pakistan fairs a bit better at 2.5 DALYs/10^3, but never the less the values are disturbing regarding the future of the populations' general health[13].

A raised atmospheric carbon dioxide can affect the human body in various ways. The respiratory system can be affected adversely resulting in a decreased respiratory rate. It can also result in a raised heart rate and blood pressure. The central nervous system effects can be severe, resulting in acidosis and sedation. The kidneys can also be affected resulting in a decrease in the renal output[14].

American researchers have determined that CO2 levels above 1000 ppm measured for about 8 hours do affect the faculty of cognition. The reason of the present study was the same to measure the levels of CO_2 in some parts of Lahore and try to ascertain if the public or personnel on duty or the innocent passers bye are at risk of acquiring ailments due to raised CO2 levels in the environment[15,16].

Inflammation has also been found to be a result of a raised environmental CO_2 concentration. It has been demonstrated that raised CO2 level can activate the neutrophils to produce "Microparticles" and interleukin (IL)-1β which are responsible for vascular and neuronal damage[17].

There may also result a low grade systemic inflammatory state in the body with a possible relation with cardiovascular injury by releasing pro-inflammatory cytokines[18].

CO_2 as a gas is both an asphyxiant and a toxic chemical. Scientists showed that CO2 can damage biological life not only by hypoxia but inhalation of high concentrations of it can also result in CO2 poisoning. However, at low concentrations this toxic effect is thought to be negligible[19].

The Wisconsin department of health in USA warns of rise in CO_2 levels and describes a level of up to 2000 ppm and above capable of casing drowsiness, headache, loss of concentration and attention. With rising levels more serious health issues are described. It is worrying to note that at least in two area of Lahore the CO_2 level was found to be above 2000ppm. This measurement was however made in the particular area for 5 minutes only. If we consider a human bound to be stationed in this particular area for several hours, it is not difficult to imagine what a daily dose of a raised CO_2 could result in. individuals can react to this raised level for hours on end in different ways but this would depend on the genetic makeup of the individual. Both the length of the exposure and the amount of the dose of the CO_2 will affect the response to the onslaught.

The same US governmental department considers 1000ppm as "high" and can potentially lead to health issues[20].

US researchers have looked at CO2 causing health problems in humans in detail recently. Jacobsons et al, have looked at several studies and found effects such as inflammation and cognitive effects[21,22,23].

These studies looked at 1000-2700ppm (CO2 levels) and had the measurements taken from 1 to 6 hours duration. This can be correlated with the results of the present study as well where most of the places had readings close to or above the 1000ppm mark. These measurements were done for 5 minutes at the particular place and one can understand what effects can be seen with exposure times increased to 1 to 6 hours as in the earlier studies above.

A study included by Jacobsons et al, measured the levels over a period of 2 to 3 months duration where the CO_2 concentration was found to be above 2000ppm.

Schaefer et al found calcium being removed from the bones and stone formation in the kidneys if the person was exposed for such a period. This, however, was shown in guinea pigs, so that human studies should be the next step[24].

Thus in a poor country like Pakistan where there is stunted growth of the children and even adults are malnourished, if environmental stress is added on top of this then it is understandable what individuals like policemen on duty, shopkeepers on the roadside, hawkers and most of all school children will be exposed to on a daily basis because of these urban CO_2 "domes"[25]

The rising trend of the CO2 foretells a worrying future for these exposed individuals.

CONCLUSION

The CO_2 concentration is rising in the environment and it is almost all due to human activity. This is damaging the Earth's atmosphere. But more importantly, this increase in the CO2 concentration can damage human health especially the more vulnerable members of the society such as the elderly, the infirm and children.

It is our duty to put a halt to this damage to our Planet and our health.

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