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A CASE STUDY ON THE IMPACT OF PARTICULATE MATTER ON HEALTH

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Abstract

In our busy schedule and in this changing environment every individual is forgetting the valuable property that they are earning i.e health. Every human being is technologically and professionally they are sound but still ignorant in certain aspect of environment. This paper basically is being developed taking into account the present grooming problem which is being neglected. This paper projects the various aspects and dimensions of air pollution which has an effect on health. In this paper various strategies and methods are being given so as to help reducing the pollutant. This paper is basically developed through secondary data and it is purely conceptual in nature. The study is being undertaken and the paper is purely developed taking into account the countries of eastern Europe, the Caucasus and central Asia.

Keywords: Health Policy, Health Effect, Types of Particulate Matter , Policy Making , Climate Effect. Recent trends

Introduction

As generation to generation and decades to decades there is transformation in the life style of the human beings as well as there is a change in the environment. As days are moving we are gradually proceeding towards the development may be in the sense of economy, technology, talent,etc but still living and leading our life with ignorance. Ignorance in terms of the air we are sharing and the pollutants we are living within the environment. There are different types of particulate matter present in the environment which do show harmful effect. The major issue being identified by various reputed agencies like the United Nations Economic Commission for Europe (UNECE)and WHO are now taking steps and formulating strategies of ambient air quality standards so as to create a safe zone. This benchmark has been achieved by these agencies by taking certain valuable measures to reduce harmful air emissions including the various protocols under the Convention on Long-range Trans boundary Air Pollution (1). There is still certain evidence being found in the present scenario that the current levels of air pollution still pose a considerable risk to the environment as well as to the human health. From the recent study it has been found that the Executive Body of the Convention has adopted amendments to the Convention's 1999 Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone. Since long years of negotiations, the approved revised text of the Protocol now specifies national emission reduction commitments for main air pollutants to be achieved by the UNECE . The revised Protocol includes for the first time commitments to reduce the emission of fine particulate matter ($PM_{2.5}$). The most important component of $PM_{2.5}$ can be black carbon or soot. Black carbon acts as an influential air pollutant which has an impact on health and also contributes to climate change.

Types of particulate matter

The term particulate matter is the combination of both solid as well as liquid particles which are suspended in the air. The particulate matter comprises of the combination of inorganic and organic chemicals which includes

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carbon, sulfates, nitrates, metals, acids, and semi-volatile compounds. Particulate matter consists of various different sizes which generally ranges from within a range of approximately 0.005 to 100 micrometers (μm) in diameter which is equivalent to the size of few atoms to about the thickness of a human hair. Particles neither have fixed size nor they can be measured through any other means so they are generally expressed through diameters. Particulate matter for better understanding is defined in simplest manner and is divided basically into three major groups those are as follows:

- **Coarse :** It comprises of larger particles whose size ranges from 2.5 to 10 μm (PM_{10} - $PM_{2.5}$).
- **Fine:** It comprises of smaller ones with a size upto 2.5 μm ($PM_{2.5}$).
- **Ultrafine:** It comprises of particles smaller than 0.1 μm
- **Coarse Particles:** It is generally produced due to small fragmentation of the larger solid particles. It involves various gases from the environment , dust created by the vehicles, agricultural activities, gases produced due to burning of fossil fuels, pollen grains, etc.
- **Fine:** They are largely formed from the gases which afterwards results into particle. These particles can grow upto a size 1 μm either through condensation, when additional gas condensates on the particles, or through coagulation.
- **Ultrafine:** Ultrafine particles (up to 0.1 μm) are formed by nucleation

Recent Trends

The WHO Environment and Health Information System (ENHIS), which is based to a large extent on data submitted by European Union (EU) member states to the European Environment Agency Air Base (3) includes PM_{10} monitoring data from urban and suburban background locations. Fig. 1 represents the population exposure which is expressed as annual mean concentration of PM_{10} weighted among 34 WHO European Member States for THE year 2010. The result stated that only 9 member states the PM10 level was found to be below WHO AQG-level of 20 μg/m3. Approximately 83% of the population among the stated cities was found to exceed their AQG levels. Although this proportion remains high, it is an improvement as compared to the previous years with an average PM_{10} levels.

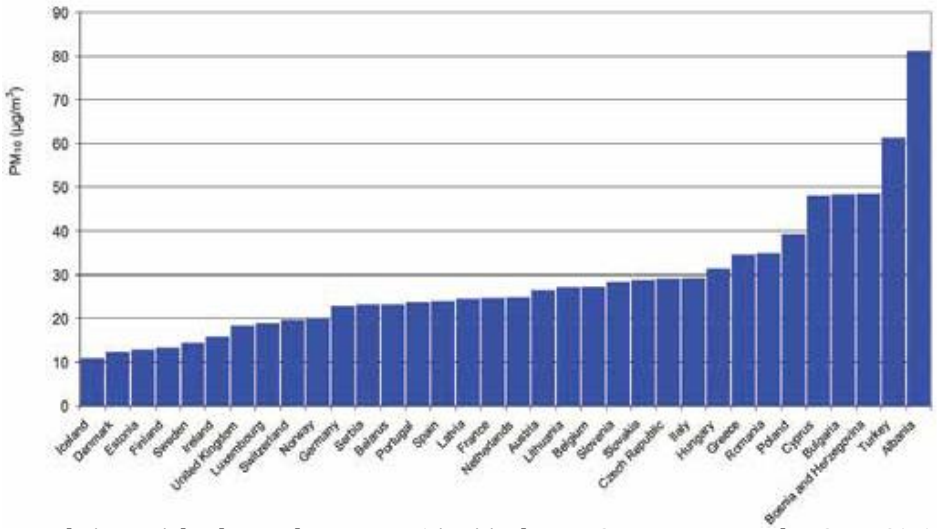

Fig. 1.Population-weighted annual mean PM10 in cities by WHO European Member State, 2010

Source: WHO Regional Office for Europe (4).

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Fig.-1Population-weighted annual mean PM10in cities by WHO European Member State, 2010 Source: WHO Regional Office for Europe (4) shown below. On the other hand, monitoring of PM10 and PM2.5 is very limited in countries like eastern Europe, the Caucasus and central Asia (EECCA). The WHO European Region includes 53 countries stretching from the Atlantic Ocean to the Pacific Ocean with a population of almost 900 million people. Initial data from the two Uzbek cities indicate that PM10and PM2.5levels are high in comparison with most of the other cities with PM monitoring in the Region. The levels in Nukus may be affected by dust storms (which are frequent in that area). Various combustion sources may be predominant in Tashkent. The proper assessment of levels of and trends in PM in EECCA countries requires PM10 and/or PM2.5 monitoring in more locations in those countries. The assessment of PM concentrations requires continuous monitoring conducted for 24 hours daily for 365 days a year with standardized methods or methods equivalent to the standard. Quantitative knowledge about sources and levels of and trends in emissions of primary particles and precursor gases plays an important role in finding the best control strategy for reducing risks. In view of the scarcity of ground-level data for PM, remote (satellite) sensing combined with modelling and existing surface measurements has recently been used for the assessment of population exposure at country level. Recent estimates have been published for PM2.5 concentrations using this technology as part of the Global Burden of Diseases, Injuries and Risk Factors Project (5). Further development of these methods and their precision depends to a large extent on the availability of surface measurements in all regions of the world..

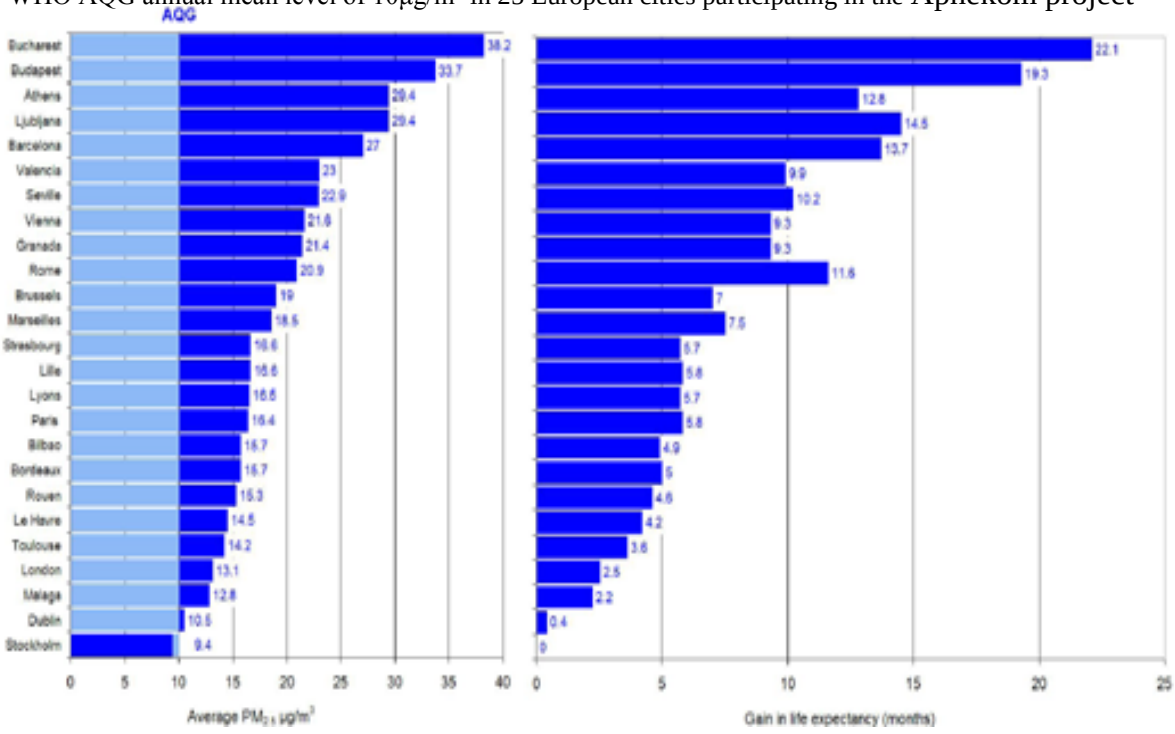
Effects of PM on Health

PM10 and PM2.5 include inhalable particles that are small enough to penetrate the thoracic region of the respiratory system. The health effects of inhalable PM are well documented. They are due to exposure over both the short term (hours, days) and long term (months, years) and include:• respiratory and cardiovascular morbidity, such as aggravation of asthma, respiratory symptoms and an increase in hospital admissions; • mortality from cardiovascular and respiratory diseases and from lung cancer.There is good evidence of the effects of short-term exposure to PM10on respiratory health, but for mortality, and especially as a consequence of long-term exposure, PM2.5is a stronger risk factor than the coarse part of PM10(particles in the 2.5–10 μm range). All-cause daily mortality is estimated to increase by 0.2–0.6% per 10 μg/m3of PM10(6,7). Long-term exposure to PM2.5is associated with an increase in the long-term risk of cardiopulmonary mortality by 6–13% per 10 μg/m3of PM2.5(8–10). Susceptible groups with pre-existing lung or heart disease, as well as elderly people and children, are particularly vulnerable. For example, exposure to PM affects lung development in children, including reversible deficits in lung function as well as chronically reduced lung growth rate and a deficit in long-term lung function (4). There is no evidence of a safe level of exposure or a threshold below which no adverse health effects occur. The exposure is ubiquitous and involuntary, increasing the significance of this determinant of health.At present, at the population level, there is not enough evidence to identify differences in the effects of particles with different chemical compositions or emanating from various sources (11). It should be noted, however, that the evidence for the hazardous nature of combustion-related PM (from both mobile and stationary sources) is more consistent than that for PM from other sources (12). The black carbon part of PM2.5, which results from incomplete combustion, has attracted the attention of the air quality community owing to the evidence for its contribution to detrimental effects on health as well as on climate. Many components of PM attached to black carbon are currently seen as responsible for health effects, for instance organics such as PAHs that are known carcinogens and directly toxic to the cells, as well as metals and

inorganic salts. Recently, the exhaust from diesel engines (consisting mostly of particles) was classified by the International Agency for Research on Cancer as carcinogenic (Group 1) to humans (13). This list also includes some PAHs and related exposures, as well as the household use of solid fuels (14,15) .

Types of diseases related to PM

PM has a great impact and role upon the individuals' health. It creates certain harmful diseases for the human beings. As per the study and survey approximately around 3% of cardiopulmonary and 5% of lung cancer deaths are being reported due to PM. As compare to other areas specifically in the European Region the proportion is being found within a range of 1–3% and 2–5% respectively in various sub regions (16). A recent study had published that the burden of disease related to ambient air pollution may be even higher. This study propounded that in the year 2010, ambient air pollution, as annual $PM_{2.5}$, accounted for 3.1 million deaths and around 3.1% of global disability -adjusted life years (17).).Exposure to PM2.5reduces the life expectancy of the population of the Region by about 8.6 months on average.As per the published results from the scientific project Improving Knowledge and Communication for Decision-making on Air Pollution and Health in Europe (Aphekom) indicates that average life expectancy in the most polluted cities could be increased by approximately 20 months if the long-term $PM_{2.5}$ concentration was reduced to the WHO (AQG) annual level (Fig. 2). Fig. 2 Predicted average gain in life expectancy (months) for people aged 30 years for a reduction in average annual levels of $PM_{2.5}$ down to the WHO AQG annual mean level of 10µg/m3in25 European cities participating in the Aphekom project Source: based on Medina (18).Fig. 2.Predicted average gain in life expectancy (months) for people aged 30 years for a reduction in average annual levels of $PM_{2.5}$ down to the WHO AQG annual mean level of 10µg/m^3 in 25 European cities participating in the Aphekom project



Source*: based on Medina *(18).fig-2

The well known and renouned Organisation clearly takes care of the impact /effect of PM on health.In the year 2005 ,WHO revised its AQG values for PM as follows:

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1- $PM_{2.5}$: 10 μg/m3 for the annual average and 25 $\mu g/m^3$for the 24-hour mean (not to be exceeded for more than 3 days/year);

2- PM_{10}: 20 μg/m3for the annual average and 50 $\mu g/m^3$ for the 24-hour mean.

In addition to these guideline values, the AQGs provide interim targets for each air pollutant, aimed at promoting a gradual shift to lower concentrations in highly polluted locations/ regions. To achieve the assigned target for significant reductions in risks for acute and chronic health effects from air pollution should be done. WHO is currently developing indoor air guidelines for household combustion of fuels for cooking, heating and lighting. These will provide recommendations for household fuels and technologies that will enable progress towards the AQGs.

Remedies

Lower is the air pollution levels higher is the health benefits for the population .Safety and risk both are directly proportional to each ther. After successful evalutation of various accountability studies few case with their practical results are being stated below

Case Study

Harvard Six Cities Study, United States.

A case study constituting o group of adults who resides in six cities in US was being taken as species during the year 1974 to 2009. The purpose of the study was to estimate the effects of air pollution on mortality. PM 2.5 concentrations, declined to below 15 μg/m3 by 2000 (except in one city). The findings of the study stated that a 2.5 μg/m3 decrease in the annual average level of PM 2.5 was associated with a 3.5 % reduction in all- cause mortality. (21 23). The results postulated that associations between chronic exposure to PM 2.5 and all- cause, cardiovascular and lung cancer mortality, with health effects seen at any PM concentrations. Results suggest that one year period exposure to PM 2.5 is enough For All Cause Mortality, Which Implies That Health Improvements Can Be Expected To Start Almost Immediately After A Reduction In Air Pollution. As per the study the reduction in fine particulate air pollution in the US in the year 1980 & 1990, accounted for as much as 15% of the 2.7 – year overall increase on life expectancy occurred in that period (24).

Decline in Industrial Emissions, United States.

The two examples such as a copper smelter strike in the year 1967-1968 on four states, and the closure and reopening of a steel mill in Utah Valley in the year 1986- 1987 projects a positive impact on health by declining air pollution concentrations in specified areas. The decrease in the rate of regional sulphur dioxide concentrations over eight months was noticed in the copper smelter strike to be led to a 60% drop and was simultaneously associated with na 2.5 % decrease in mortality. In the case of Utah Valley , the closure of the steel mill being the primary source of PM 10 lasted for around 13 months and resulted to a decline in PM 10 levels of approximately 50% . Hospital admissions for children were approximately three times lower and bronchitis and asthma admissions were halved when the mill was closed.

Respiratory Health Issues And Air Pollution Control Measures

In the year 1991 around eight swiss communities case study was postulated and again the survey was conducted in the year 2002 which relates to the Air pollution and the lung diseases in adults. Exposure to outdoor PM 10 estimated ar each individual's residence fell by an average of 6.2 μg/m3 so as to reach to range of 5 μg/m3 to 35 μg/m3 in the year 2002. The falling PM 10 levels were associated with fewer reports of respiratory symptoms such as cough, phlegm and wheezing and breathlessness. Falling levels of regional PM 10 were associated with

a declining prevalence of various symptoms including cough, bronchitis, cold, nocturnal dry cough and conjunctivitis. As per this study drastic improvements in ambient air quality is beneficial for both children and adults. These examples show that decrease levels of particulate air pollution declines respiratory and cardiovascular death rates.

Air Quality Management And Policy

Approximately around 80% of particulate air pollution in EECCA countries can be reduced with currently available technologies (31). In the path of reduction of air pollutants and PM certain specific action are concerted by public authorities, industry and individuals at national, regional and even international levels. The responsible authorities with a vested interest in air pollution management include the environment, transport, land planning, public health, housing and energy sectors. As the burden of air pollution on health is significant at even relatively low concentrations, the effective management of air quality is necessary to reduce health risks to a minimum.The development and exchange of information on policies, strategies and technical measures to reduce emissions are part of the fundamental principles of the Convention on Long-range Transboundary Air Pollution. The Working Group on Strategies and Reviewsof the Convention, and in particular its Expert Group on Techno-economic Issues(32),maintains the database of information on control technologies for air pollution abatement and their costs. An example of its work is provided by the Group's 2010 report summarizing progress in work to reduce dust emissions from small combustion installations(33).There are co-benefits to addressing particulate air pollution that go beyond just the positive impact on health. For example, reductions in black carbon emissions from the strategic mitigation of combustion sources will also simultaneously reduce global warming (34).Finally, integrated policies on urban planning and transport can encourage the use of cleaner modes of transport and lead to changes in individual behaviour by promoting walking, cycling and increased commuting by public transport. These policies contribute to cleaner air while promoting physical activity and largely benefiting public health.

Conclusion

The term pollution is very well known among every individual. Environmental pollution is the phenomenon which acts as a silent killer and its impacts on the society is very much harsh which includes all the age groups. As per copious studies, the results indicates that the death rate is found to be more higher due to particulate matter as compared to the other pollutants present in the environment. Several environmental norms have been developed by the government for reducing the harmful impact on the environment. On implementation of the norms as directed by the World Health Organization (WHO) had shown tremendous satisfactory results. Various norms developed with respect to particulate matter which includes the feasibility in the economic, political and technical as well. Ultimately the objective of air quality guidelines is the protection of human health. Particulates (PM_{10}) causes adverse health impacts as compared to the coarse particulates. The evidence places a relationship between short term and long term ambient particulate concentrations and human mortality and morbidity effects. According, to WHO in the year 1987 there is no such safe threshold level beyond which the health hazard rates can decrease. Policy makers have to consider the ratio between acceptable risk and absolute safety. Safety and risk goes hand in hand and are directly proportional to each other. Many steps and strategies have been implemented by various bodies so as to reduce the impact of particulate matter on health. Even the results shown on the society is also setting a benchmark for the next decades.

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