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The air pollution from vehicles and health risks in the city of Tirana

Asllan Hajderi *[1], **Ledia Bozo** [2]

[1]*Universiy College of Business, Department of Higher Technical Studies, Tirana, Albania, ahajderi@kub.edu.al*
[2]*University of Tirana, Faculty of Natural Sciences, Department of Informatics, Tirana, Albania*

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Abstract

In this paper, the problem of environmental pollution in urban intersections, from vehicle. The challenge today for human health remains the improvement of air quality. For this reason, the city of Tirana was studied, where the main elements of air pollution from vehicles, which are particles PM10/ PM2.5, nitrogen dioxides NO/NO_2, Benzene C_6H_6, Ozone O_3, carbon monoxide CO, were initially treated. , carbon dioxide CO_2 and sulfur dioxide SO_2, Then the effects that each pollutant causes on human health are addressed, In the following, the assessment of the health risks from the main pollutants is analyzed, where premature deaths, lost years of life and morbidity are used as indicators by the WHO, which are given for the three main pollutants, PM particles, nitrogen dioxide and ozone. For these, the WHO has determined the methodology of the impact of each pollutant, for 100,000 inhabitants. EU reports show that for 2020 in Albania premature deaths were 3600 from PM particles, 330 from nitrogen dioxides and 310 from ozone. While the lost years of life per 100,000 inhabitants were 1296 for PM, 116 for NO_2 and 115 for O_3. At the end, the ways to reduce air pollution are discussed.

Introduction

With the development of industry and the concentration of human habitation in large cities, air pollution has become a deadly threat to humans. About 7 million premature deaths are estimated from air pollution in the world every year [1].

Air pollution directly affects human health. With every breath we take, we inhale tiny particles that can damage our lungs, heart and brain, causing a host of other health problems. Most affected by air pollution are those areas, where the population density is very high, such as in big cities.

Meanwhile, in addition to premature death from air pollution, several diseases are caused to people, which make people unable to work. In 2019, in 31 European countries, exposure to NO_2 led to 175,070 years of disabled life (YLD) due to diabetes mellitus. This year, in 23 European countries, 12,253 people were hospitalized with lower respiratory tract infections and chronic pulmonary disease as a result of exposure to ozone [2].

This is why in 2021, the WHO updated its air quality guidelines by halving the previous level of 2005 norms [2]. A new OSCE report, "The Economic Consequences of Air Pollution," estimates that by 2060, air pollution will cause 6-9 million premature deaths [3].

Therefore, today's challenge for human health remains the improvement of air quality.

In our country, the city of Tirana faces the most serious air pollution in Albania, due to the heavy traffic of vehicles, the density of residential development and its geographical positioning.

The city can now be considered a problem area for a number of pollutants, but the PHI, which has the duty of health protection, does not provide regular information to the public [2].

Meanwhile, in April 2023, the media raised the problem of exceeding the pollution from nitrogen oxides and benzene in the city of Tirana above the allowed values 2-4 times and the high health risk associated with them.

Based on the above conditions and the importance of environmental pollution in human health, we undertook the study to analyze air pollution from vehicles and health risks for people in the city of Tirana.

Material and Method

The main elements of air pollution from vehicles

According to the WHO, vehicles are the biggest culprits of air pollution [1]. The main sources of air pollution come from vehicles and are [2].

Carbon monoxide (CO) is a tasteless, colorless and odorless gas. The main source is the vehicles. It arises from incomplete combustion of fuels in the engine and the highest concentrations are found near major roads and intersections.

Hydrocarbons (HC) are parts of unburned fuel (HC), which react in the presence of NOx and sunlight to form ozone (O_3) at ground level, which is a major component of smog.

Fine particles, PM2.5/ PM 10, they come mainly from cars with diesel engines. Particulate matter is the unburned carbon or soot that comes out of diesel engines.

Nitrogen oxides (NO_x) are formed from nitrogen and oxygen atoms under conditions of high pressure and temperature in the engine. It consists of nitrogen oxide and nitrogen dioxide. In the presence of sunlight, it helps in the formation of terrestrial ozone.

Benzene (C_6H_6) Benzene is an aromatic hydrocarbon. There are many sources, but the main remains the combustion of fuels from vehicles.

Carbon dioxide (CO_2) is produced by burning fossil fuels, such as coal, oil, gasoline, natural gas. The main source is vehicles, electricity production, etc. Carbon dioxide emissions contribute to climate change. Until 1995 CO_2 was considered not as a pollutant but as a perfectly burning fuel.

Ozone (O_3) is a very reactive gas that exists in the lower part of the atmosphere (ground level) but also in the troposphere. It is not directly caused by vehicles, but is formed by chemical reactions between other pollutants, initiated by strong sunlight.

Sulfur dioxide (SO_2) is a very toxic, colorless, non-flammable gas. It is formed when fuel contains sulfur.

Effects on human health

Among the effects caused to human health, according to pollutants, we have: [2, 4]:

Carbon monoxide easily combines with oxygen in red blood cells to form CO_2, preventing the supply of oxygen to the human body and brain. This paralyzes muscles and all organs and in high concentrations is extremely dangerous poison. Symptoms from CO are : mental confusion, vomiting, loss of muscle coordination, loss of consciousness. Even the doctor confuses it with a virus. Staying longer eventually results in a pleasant death.

Hydrocarbons are partially poisonous, some with the potential to cause cancer. Breathing aromatic hydrocarbons in high concentrations for long periods of time causes fatigue, headaches, dizziness and vomiting.

Fine particles cause respiratory and heart diseases, other harmful health effects and death. Long-term exposures contribute to lung cancer. According to the WHO, it is considered the most dangerous pollutant for human health.

Nitrogen oxides are active poisons, which cause irritation of the respiratory tract, when it is at a concentration greater than 150 ppm. *Nitrogen dioxide* can cause lung disease, inflammation in the respiratory tract and problems in the functioning of the lungs .

Carbon dioxide with concentration of 10% or more causes death, unconsciousness or convulsions and may harm a developing fetus. It can also cause hyperventilation, visual impairment, lung congestion, central nervous system damage, muscle contractions, high blood pressure, and shortness of breath.

Benzene increases the risk of cancer and other diseases, and is a cause of bone damage, in Albania up to 10.89 $\mu g/m^3$

Ozone in the air can harm our health, especially on hot sunny days, when it reaches unhealthy levels. Ozone irritates the eyes, nose, throat and damages the lungs. Ozone in the upper atmosphere is beneficial because it blocks harmful ultraviolet rays that contribute to skin cancer.

Sulfur dioxide causes breathing difficulties, inflammation of the respiratory tract, eye irritation, weakening of the heart. Sulfur dioxide is also linked to asthma, chronic bronchitis and death in elderly people and infants.

Health risk assessment from air pollution

Air pollution mainly affects the lungs and heart. The most common respiratory diseases are acute respiratory disease, chronic pulmonary disease, heart disease and lung cancer, which kills most people [5]. So, air pollution is the killer that freely enters the human lungs.

Chronic lung disease blocks the flow of air to the lungs and this gets worse over time. As long as the polluted air passes through the bronchial tube in the throat, it causes inflammation in the alveoli, and they stop bringing oxygen to the blood. Cancer prevention means eliminating risk factors, including air pollution [6].

Ischemic heart diseases affect the blood supply to the heart, which is the most common cause of death in many countries around the world.

To characterize the impact of air pollution on human mortality, 2 indicators are used:

*Premature deaths (*PD) are deaths that occur before a person reaches the expected age. Premature deaths are considered preventable, if their causes can be eliminated

Years of life lost (YLL) are the years of life lost due to premature deaths. It estimates the average number of years people would have lived if they had not died prematurely. This indicator for comparison between countries is used by estimating the years of life lost per 100,000 inhabitants.

In order to assess the health risk from air pollution, the WHO in 2013 defined the methodology for calculating the number of premature deaths attributable to exposure to the 3 main pollutants, fine particles, nitrogen dioxide and ozone at a certain degree of pollution [5]. For this, the methodology that shows the correlation between the degree of pollution and mortality has been built.

Also, air pollution affects the growth of many diseases in the human body, which become the reason for the creation of people's incapacity for work. This is a burden that brings personal suffering, but also significant costs for the health care sector. This is determined by the indicator of saliency**,** which represents the impacts of each pollutant in the increase of diseases that lead to the increase in the rate of disability.

Thus, morbidity expressed in years lived with disability (YLD), due to the impact of the 3 main pollutants, fine particles, nitrogen dioxide and ozone. The WHO for morbidity has defined the methodology for calculating the increase in the number of people with disabilities attributable to exposure to each pollutant at a given pollution level. This indicator is used as years of life with disability per 100,000 inhabitants [5].

Results

According to WHO, deaths related to urban air pollution are [2]:

-80% of premature deaths are from heart attacks and heart diseases,

-14% of deaths from chronic obstructive pulmonary diseases or acute pulmonary diseases,

- 6% of lung cancer deaths

In Albania, the main factors that cause respiratory diseases are carbon dioxide and benzene, which are twice the values approved by WHO [7]

The number of premature deaths in Europe from 2005 to 2020, due to the impact of O_3 Ozone above the value of 70 μg / m^3, is increasing [2].

The degree of impact of each pollutant on the human body depends not only on the amount of pollutant in the air, but also on the duration of stay in the polluted air. There is no evidence that low levels of pollution do not affect human health. So, all concentration levels are considered harmful to human health. To determine the permissible rate of a pollutant in the air, WHO has relied on studies of the impact of each pollutant, leading to a minimum of premature deaths and years of life lost. Thus, three factual concentrations were analyzed for PM 2.5 particles: 20, 10 and 0 μg/m^3, from which the rate of 5μg/m^3 was set. The same was done for other pollutants. This is the reason that the WHO changed the permissible rates in 2021, reducing the values compared to 2005 by almost half.

In Albania, according to data from INSTAT, in 2019, 21,937 people lost their lives. While in 2020 in Albania, premature deaths (PD) and years of life lost (YLL) calculated for exposure to concentrations above the norm for the 3 pollutants are given in Table 1 and 2 [5].

Table 1. Premature deaths (PD) of Albania in 2020

Average annual concentration	Premature deaths	Average annual concentration	Premature deaths	Average annual concentration	Premature deaths
15.6	3600	12.8	330	5.78	310

Table 2. Years of life lost (YLL) of Albania in 2020

Lost years of life	YLL/100,000 inhabitants	Lost years of life	YLL/100,000 inhabitants	Lost years of life	YLL/100,000 inhabitants
36,900	1,296	3,300	116	3,300	115

Conclusion

The main pollutants that affect human health in the city of Tirana are fine particles, nitrogen dioxide and ozone, which cause the main respiratory diseases up to lung cancer, cardiovascular diseases and high blood pressure. Also, dangerous pollutants are carbon monoxide, which is deadly, and carbon dioxide, which causes vision impairment, lung congestion, damage to the central nervous system, muscle contractions and high blood pressure.

In Albania, from exposure to pollution in 2020 have occurred 3,600 PD from PM particles, 330 PD from nitrogen dioxide and 310 PD from ozone. While YLL/ 100,000 inhabitants were 1296 from PM particles, 116 from nitrogen dioxide and 315 from ozone.

PM particles have the greatest impact on premature deaths, years of life lost and years of incapacity for work, followed by nitrogen dioxide and ozone. This requires the Municipality of Tirana to impose restrictions on the circulation of diesel cars in the city and GDRTS to strengthen the technical control over the level of pollution.

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