AIR POLLUTION IN CITY PARKS DURING THE COVID-19 PANDEMIC

Aleksandra M. Cavic[1], Dragan Dj. Solesa[1], Snezana M. Aksentijevic[2], Jelena S. Kiurski[1]

[1]University Business Academy in Novi Sad, Faculty of Economy and Engineering Management in Novi Sad, 21000 Novi Sad, Cvecarska 2, Serbia
[2]Business Technical College, Trg Svetog Save 34, 31000 Uzice, Serbia
e-mail: aleksandra.cavic22@gmail.com

Abstract

The degree of coverage of the urban greenspace area and the factors which affect the concentration of particles in the air in those limited greenspace areas are rarely studied, especially during the Covid-19 pandemic. This paper is based on researching the effects and different impacts of the microclimate parameters on the concentration of particulate matter ($PM_{2.5}$ and PM_{10}) in the studied city parks and their multidisciplinary impact on the most important aspect – The Public Health. In Novi Sad, Serbia, three parks of different sizes and locations have been chosen, depending on the traffic frequency. The measurement results of particle pollution (PM) pointed out the variations of levels of concentration of the PM pollutants, $PM_{2.5}$ particles were in range from 2 to 10 μg/m^3 and PM_{10} were in range from 3 to 12 μg/m^3. Some of the measured values are exceptionally low so it can be concluded that the air was clean. The time of the measurements of the PM pollutants in the parks was in a period from 11a.m to 2 p.m., with temperature oscillation between 15^o-24.3^{o}C and air humidity from 41-50%.

Key words: Air Pollution, Particle Pollution ($PM_{2.5}$ and PM_{10}), City of Novi Sad, Covid-19, City Parks.

Introduction

Particle pollution in air is of course inhalable and as such very harmful for the health of the population, recently experts, legislative and regulatory bodies as well as the civilian sector with the wide public, are pointing out and paying attention to this.

Atmospheric particles (PM – particulate matter) are microscopic suspended particles (in solid or liquid state) in the Earth's Atmosphere. The origin of respirable particles can be natural or anthropogenic, and the composition may include both organic and inorganic particles, such as dust, pollen, soot, smoke and liquid droplets. Particles are differentiated by their size, content and their source. The smaller particles are more dangerous for the respiratory tract because they end up deep in the respiratory system and they cause serious problems with respiratory organs, which can have lethal outcome [1].

Particles that originate from nature are particles which originated from earth, Vulcan eruptions, dust from forests, salts and vegetation, particles which are formed by chemical reactions of various gasses (H_2S, NH_3, NO_X and HC), whereby the already existing particle is being changed in the air or a solid matter product is formed.

Particles of anthropogenic origin are formed in the combustion process, which produces soot from diesel fuel, exhaust gases from motor vehicles, waste gases from industrial facilities where processes take place at high temperatures, waste incineration, as well as from resuspended dust during photochemical reactions, all leading to real urban smog.

Human activity, such as the combustion of fossil fuels in motor vehicles [2], burning of wheat stubbles, power plants, wet cooling towers and other various industrial processes generate significant amounts of particles. Developing countries still use coal as their primary way to heat homes which currently forms about 10% of the total mass of aerosol in the atmosphere [3]. The

increase of environmental consciousness as well as the essential need of every man to have a clean and healthy air has brought us into question during this research, how's the air quality and does the declared epidemic of the virus Covid-19 in Novi Sad affect the air quality and in what way. Considering that the parks are places where people go to relax and to better their psychological and physical state and that the most common visitors of these parks are children and older people, as the most vulnerable groups, this research is completely justified. Especially with the disclosure that the virus Covid-19 is transmitted by droplets [4] and that the parks are ideal places for citizens to visit because of the preventive anti-epidemic measures that can be complied with the physical distance between people and that the public health can be bettered with clean and healthy air. Namely, parks represent the most attractive natural area of the urban ecosystem which gives the urban environment more quality of life and a more esthetically pleasing living environment. It also regulates the urban microclimate and encouraging sustainable urban development which directly affects the public health because the greenery positive influences on the psychological and physical status of man, and it also improves the disturbed city microclimate.

The objective of this research is to determine and compare the differences in pollution of air with the $PM_{2.5}$ and PM_{10} particles in three city parks, which were measured during normal life/work activities in the year 2019 with the values measured during the extraordinary circumstances, because of the Covid-19 epidemic, in the year 2020. The assumption that there would be less air pollution during the Covid-19 epidemic was confirmed, because of the changed and considerably reduced regime of life and work.

Experimental

To measure relevant data regarding the quality of air, relative to the particle pollution $PM_{2.5}$ and PM_{10}, the portable device Aeroqual series 500-monitor was used, which can measure and report changes of the levels of pollution in real time. A non-standard and indicative method was used based on laser and optical sensors. The optical sensor transforms the diffused light into electronic signals which are processed to ensure the measurement of mass – in this case $PM_{2.5}$ and PM_{10} [5]. The device uses a long lasting lithium battery. The display of the device shows the minimum, maximum and average values of the measured gas in ppm or mg/m^3 [6].

Localities: For this research of measured particle pollution $PM_{2.5}$ and PM_{10} three city parks were chosen from which two of them are categorized city parks: Futog Park (FP), Dunav Park (DP) which are classified in category III, they are treated as natural monuments and they are under state protection as a protected park area in an urban construction zone of Novi Sad, and the third Liman Park (LP) which to this day is not covered in categorization [7]. All three parks vary in size, they are located in different parts of the city and they are surrounded by different traffic frequencies and they occupy only 500000 m^2 of a total of 9786416 m^2 of the area of the entire city, which is percentage wise drastically below the world and EU standards. These parks are included with a goal to evaluate the quality of air, to detect possible pollution, to be assessed and compared with the measurements done in 2019, in order to suggest the measurements for further reduction of the pollution of the environment as well as influence an aggressive greening of other public spaces with the building of new city parks.

Results and discussion

Observing the common anthropological meaning of adults and children going to the park, which contributes to the development and maintenance of the physical and psychological health, maintaining vitality, quality of life, relaxing and having fun all of this represents the special pastime activity of adults and children. Those are sets of activities which directly affect the modern man, upgrading physical and psychological public health.

As parks are zones for vacation and recreation mostly outdoors, on them besides the inadequate equipment of urban furniture and greenery a big influence has the ambient air, which in Novi Sad is evidently contaminated in a way that directly or indirectly affects the health of children and adults. A large concentration of the industrial plants located in one place, obsolete technology, dense traffic as well as flouting of environmental laws affect the quality of the green space zones for relaxing and recreation for citizens. Parks in Novi Sad during the Covid-19 epidemic have showed themselves as extremely important like the only way for an easy and available stay in a natural environment, because departures to remote locations in most cases weren't possible due to the limited time windows for getting around. Emissions of the main polluting substances of air in Europe, in the last couple of decades, have went down which shows a positive shift in air quality. However, certain sectors deviate from this positive trend because there was a registered increase in levels of pollution because of fine suspended particles ($PM_{2.5}$), which occur when coal and biomass is burned (in domestic houses and commercial as well as institutional plants), as well as the coarse suspended particles (PM_{10}) which come from industry and transport and are emitted directly into air. Suspended particles represent the deadliest form of air pollution because they have the potential to penetrate deep into the lungs and bloodstream, thereby they can cause benign and malignant transformations in the respiratory system, mutation of DNA, heart attacks and premature death, which with the additional infection caused by the Covid-19 virus, can have an even more complicated and faster course of illness with a larger percentage of lethal outcome. Latest research in Serbia on impact of air pollution on people's health are usually linked to certain cities, such as for example the city Nis [8] and studies on wider areas in Serbia in this field were not carried out. By Regulation of the monitoring conditions and requirements for air quality [9], the limit value of the average daily concentrations of PM_{10} amounts to 50 $\mu g/m^3$ and average yearly to 40 $\mu g/m^3$. Within one year it is allowed for the daily concentration of PM_{10} to be 35 times larger than the limit value.

The measured concentration of particle air pollution in all three city parks in Novi Sad, for PM_{10} total in the range from minimum measured to maximum measured values from 9-12 $\mu g/m^3$, whereas the minimum and maximum values of $PM_{2.5}$ in the range from 2-10 $\mu g/m^3$. Which is considerably below the allowed limit values, and the measured temperature during the measurements was in an interval from 15°-22.8°C, measurements were done from 11 a.m. to 2 p.m. o'clock and the humidity was in the range from 46-50% which is to be expected because of the timing of the measurements with the upwind of medium strength. While the measured concentrations of particle pollution in year 2019 in all three parks in Novi Sad were the same in minimum and maximum values and were about 30 $\mu g/m^3$, which is below the limit daily value for both particle sizes [10].

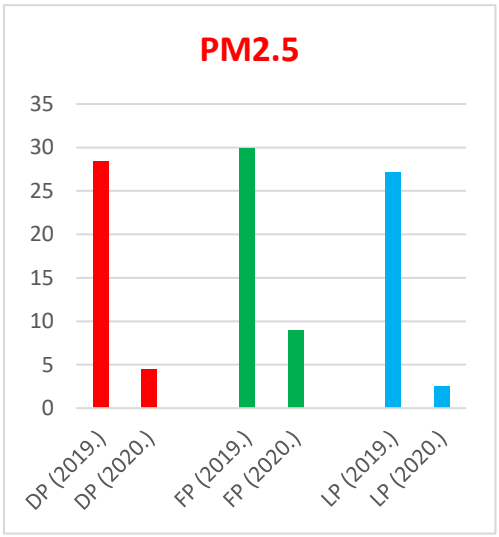

Figure 2 Graphic view of the $PM_{2.5}$ particles concentration in year 2019 and 2020

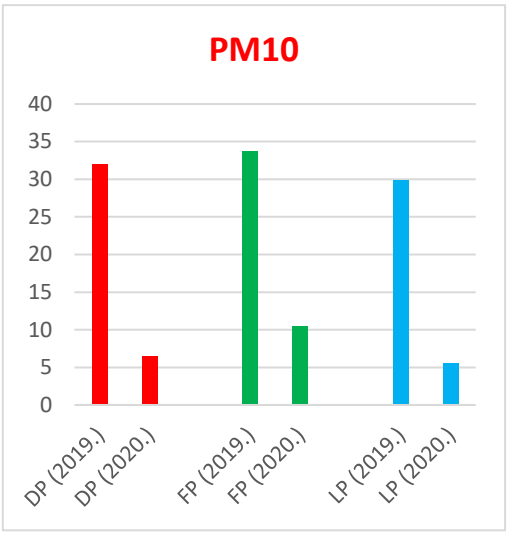

Figure 1 Graphic view of the PM_{10} particles concentration in year 2019 and 2020

Table 1 The reduction of particle pollution during two years of measurements in city parks of Novi Sad

Location	Reduction of $PM_{2.5}$ (%)	Reduction of PM_{10} (%)
Dunav Park	84.15	79.62
Futog Park	69.89	68.84
Liman Park	90.77	81.60

When we compare the average values that were measured in 2019 with the average values that were measured in year 2020, it is concluded that all of the measured values of particle pollution $PM_{2.5}$ and PM_{10} in year 2020 are drastically lower. From Table 1 we can see: Dunav Park $PM_{2.5}$ 84.15% reduction whereas for PM_{10} particles 79.62% reduction, Futog Park seen a smaller reduction with the $PM_{2.5}$ particles seeing a 69.89% reduction whereas for PM_{10} particles 68.84% reduction and Liman Park with the biggest reduction for $PM_{2.5}$ particles for 90.77% whereas PM_{10} particles have seen an 81.60% reduction, Figure 1 and Figure 2.

This comparative data has a large discrepancy if we compare 2019 and 2020 and they show on a noticeable reduction of particle air pollutants in year 2020, which is the consequence of the extraordinary pandemic-epidemic situation which struck the entire World as well as the local. Restrictions in movement and having people stay at home most of the time reduced the dynamic of traffic, people worked less, traveled less and only the most important life activities were done. All of that had an impact on the particle pollution. Of course, temperature, humidity and wind also favor in the reduction of the particle pollution but of course, not to such an extent.

Conclusion

Control of air quality in the city parks of Novi Sad during the Covid-19 pandemic, gives results which are unexpectedly low referent values which are the result of the extraordinary situation caused by the pandemic/epidemic of Covid-19 on the territory of Serbia and the territory of the local government of the city of Novi Sad. With insight in the official data on the status of the economy and employment which is actually in an increase during Covid-19 in the local government of Novi Sad, the low values of particle pollution that were measured in the three green spaces wasn't expected but the measured values direct that the contamination of air was lowered significantly from the products of combustion in motor vehicles in traffic and industry.

This relevant fact of good quality air that was measured in parks during the Covid-19 epidemic could be an incentive for expanding air quality monitoring (stationary or portable) also when life activities get back on their regular state, in order to ensure good and healthy air as an essential requirement for a healthy and safe life of citizens and a bettering of the Public Health as well as a healthy environment for the upcoming generations. It can be concluded that the air is clean and that it is recommended to spend daily more time in green space areas in city parks.

Acknowledgements: The authors acknowledge the financial support of the Provincial Secretariat for Higher Education and Scientific Research, Autonomous Province of Vojvodina, Republic of Serbia, within the Project No. 142-451-3156/2020-03.

References

[1] WHO, Fifty-Third World Health Assembly, 2000, A53/4, 1-10
[2] Omidvarborna H., Kumar A., Kim D-S., Renewable and Sustainable Energy Reviews, 2015, 48: 635–647
[3] NASA (2010) Aerosols: Tiny Particles, Big Impact https://earthobservatory.nasa.gov/Features/Aerosols
[4] WHO, Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide Summary of risk assessment, 2005, WHO/SDE/PHE/OEH/06.02
[5] Aeroqual (2010) Aeroqual Product catalogue
http://www.aeroqual.com/wp-content/uploads/2010/12/AQL-Product-Catalogue.pdf.
[6] Kiurski J., Solesa D., Ignjatijevic S, Vapa-Tankosic J., Characteristic aero pollutants of the city Novi Sad (in Serbian), Monography, 2019, University Business academy in Novi Sad, Faculty of Economics and Engineering Management in Novi Sad
[7] Monuments of nature (in Serbian), 2018, http://www.pzzp.rs/rs/sr/zastita-prirode/zasticena-podrucja/spomenici-prirode-sp.htm
[8[Nikic D., Bogdanovic D., Nikolic M., Stankovic A., Zivkovic N., Djordjevic A., Environ. Mon. Assess., 2009, 158: 499-506
[9] "Official Gazette RS", No. 11/10, 75/10, 63/13, (in Serbian)
[10] Kiurski S.J., Ralevic M.N., Ignjatijevic D.S., Vapa-Tankosic M.J., Solesa Dj.D., Air Qual Atmos Health, 2019. 12, 955–962, https://doi.org/10.1007/s11869-019-00712-w