Study on the influence of the variation of PM$_{2.5}$ index of gaseous pollutants on human health in Gansu Plateau in recent years

Jike Gao*

Institute of National Sports Culture, Gansu Normal College for Nationalities, Hezuo gansu 747000

*Corresponding author: jike_gao@gnun.edu.cn

Abstract. In recent years, the party and the country to environmental governance as a new era of socialism with Chinese characteristics of the basic guarantee of the development of various undertakings, clean air is a necessary condition for human health survival, quality air quality is a beautiful livable important indicator. The diurnal, monthly and annual changes of PM$_{2.5}$ in Gansu Plateau in recent years were tracked and analyzed by means of instrument measurement and mathematical statistics. Based on the analysis of the data model, the promotion strategies are put forward from the perspective of human health.

1. Research objects and methods

1.1. Subjects
Changes of air pollutant index and its impact on human health in Gansu Plateau in 2018, 2019 and 2020.

1.2. Research Methods

1.2.1. Literature method. By searching the library of Gansu Normal University for Nationalities and CNKI, we collected the data about the air pollutant index characteristics and the impact of the plateau climate characteristics on human health.

1.2.2. Instrumental measurement. Using PM$_{2.5}$ monitor for beta ray monitor, model XHPM2000E, the instrument using beta ray absorption principle.

1.2.3. Mathematical Statistics. The PM$_{2.5}$ data collected were statistically analyzed to prepare the original data for theoretical research $I = I_0 e^{-\mu_m t}$. In the formula, $I_0$ is the intensity when there is no absorbing substance on the filter paper; $I$ is the intensity of β-rays after passing through the absorption material with the thickness of $t_m$ on the filter paper. $\mu_m$ is called the mass absorption coefficient or mass attenuation coefficient in cm$^2$/g.
2. Impacts of PM2.5 on human health and physical exercise

Analyzing the characteristics of the regional environment in Gansu province, located in the Loess Plateau, in recent years, with the national environmental policy dynamics enlarging unceasingly, environmental improvement, but because before the blind pursuit of economic growth, the ecological environment, vegetation destruction after the repair period is longer, plus the Loess Plateau frequent wind and time characteristics, so more dust storms. On the other hand, industrial development is relatively slow, large factories are relatively few, and industry produces relatively few particulate pollutants. Coarse particles in the air are mainly from construction cement dust, soil wind dust and coal dust, including silicon, calcium, iron, magnesium, aluminum and other elements, as well as organic carbon formed by incomplete coal burning in motor heating, and a small amount of zinc, arsenic, lead, copper and other elements from industrial dust.\[^1\][^2]

The relative risk of PM\(_{10}\) is small, while the relative risk of coarse particles PM\(_{2.5-10}\) is almost zero. They are basically filtered by the nasal system and kept out of the nose. The main sources of fine particles are mainly coal burning, material combustion, dust and automobile exhaust products, which are rich in pumps, copper, lead, manganese, zinc, nickel and other metal elements. Fine particles are not easy to be blocked by the respiratory system due to their small diameter. PM\(_{2.5}\) in particular poses the greatest risk, which is significantly higher than PM\(_{10}\) and API index. It can travel to the upper respiratory tract and then directly to the bronchi, where it severely interferes with air exchange in the alveoli, causing physiological disruptions in the lungs and leading to conditions including asthma, bronchitis and cardiovascular disease. In addition, PM\(_{2.5}\) is associated with more additional harm, becoming the carrier of many viruses and bacteria, causing more pathological changes to respiratory diseases. During exercise, the alveolar gas exchange is accelerated, and the human lungs will be under heavy load or even overload with the increasing intensity of exercise. At this time, PM\(_{2.5}\) enters the lungs and damages the human respiratory system particularly seriously.\[^3\]

3. Changes of gaseous pollutant PM2.5 in Gansu Plateau in recent three years

3.1. Diurnal variation of PM2.5

As can be seen from Figure 1, the daily variation value of PM\(_{2.5}\) in Gansu Plateau in 2018, 2019 and 2020 showed a large peak at about 11 am, and the peak value lasted until about 13 PM before returning to a stable level, with the highest PM\(_{2.5}\) concentration of 137\(\mu g/m^3\). There is also a small low value, with a minimum of 47\(\mu g/m^3\) between 15pm and 18pm. Analysis of the reasons for the peak, there are mainly the following aspects: First, in the morning, after work, there are more vehicles, vehicle exhaust emissions serious. Second, at noon, the wind is usually frequent, and the dust concentration is large.

![Daily change of PM2.5 in the past three years(ug/m^3)](image-url)

\[^{12}\]
3.2. Monthly variation of PM2.5
As shown in Figure 2, PM$_{2.5}$ concentration in 2017, 2018 and 2019 has a similar monthly variation trend, with an asymmetric "U" shaped curve. The peak value occurs in January and February each year, and the second highest value occurs in November and December, with the highest concentration of 91ug/m$^3$. PM$_{2.5}$ data was stable in May, July, August, September and October every year, and the minimum concentration was 23ug/m$^3$. By comparing the daily variation of PM$_{2.5}$, it is found that the monthly variation and daily variation show the same graph, and the highest values all appear in winter. The main reasons are directly related to heating and automobile flow.

Since this year, with the improvement of living standards, the improvement of infrastructure and the improvement of the environment, people's health awareness has been greatly enhanced, and green travel has become a fashionable and healthy lifestyle. Especially in spring and autumn, outdoor running, cycling and other exercise methods become the best choice, the number of vehicles is less, exhaust emissions and pollution will be reduced to a minimum.

![Figure 2. Monthly Changes of PM$_{2.5}$ in the past three years(ug/m$^3$)](image)

3.3. Annual variation of PM2.5
The data structure in Fig. 3 shows that the PM$_{2.5}$ concentration changes in 2018, 2019 and 2020 show a trend of linear decline, from the highest annual average concentration of 32.8 ug/m$^3$ in 2018 to the highest annual average concentration of 31.1 ug/m$^3$ in 2019. Although the change is not obvious, it is also an inflection point of environmental improvement. In 2020, the lowest annual concentration in the last three years was 27.3ug/m$^3$. According to the national "Ambient Air Quality Standard (GB3095-2012)", the annual mean value of the three years was all around the range of the national second-level standard.

According to the curve trajectory of daily and monthly variation of PM$_{2.5}$, it is positively correlated with annual variation. In recent years, the state issued a number of policies and related measures to govern the environment, in the local strict implementation of the national environmental governance policies, the overall ecological environment has been a huge change, there is a beautiful livable new look. On the basis of implementing the national environmental protection and following the natural laws, Gansu Province has built sports towns and sports health areas with beautiful environment and suitable for people's physical exercise, providing a high-quality environment for local people's physical exercise. It is of great significance to promote people's physical health.
4. Environmental optimization strategy based on scientific physical exercise

4.1. Popularize the harm of PM2.5 and select the safe environment and time for physical exercise

Give full play to the role of the community, sports and fitness instructors, together with environmental protection department professionals, establish a professional team of physical exercise guidance, popularize and publicize the harm of PM2.5 to human body, and how to deal with the harm of PM2.5. Based on the special environmental characteristics of Gansu Plateau and taking the daily variation characteristics of PM2.5 as the variable, the PM2.5 peak hours in the morning should be reasonably avoided and physical exercise should be avoided in squares and highways with large traffic flow as far as possible.

From the data curve of PM2.5 monthly change, the pollution index in summer and autumn is in a stable period, suitable for physical exercise. In summer and autumn, the outdoor scenery is beautiful and the natural environment is suitable for physical exercise. High PM2.5 values in winter and spring, coupled with low outdoor temperature, are not suitable for outdoor physical exercise. Therefore, it is safer to choose indoor physical exercise.

4.2. Based on the modernization of environmental governance, we should strictly implement the construction of ecological civilization system and create a beautiful and livable living environment

Promoting ecological progress and eco-environmental protection is an important part of modernizing China's governance system and capacity in the new era. It is also an important process for building an ecologically livable and beautiful China. The 19th National Congress of the Communist Party of China put forward a great rural revitalization strategy that is of great significance to The Times. In the next few years, we will accelerate the implementation of the rural green development mode, vigorously promote and strengthen the improvement of the living environment, aiming to build a new look of harmony between man and nature, and create a healthy and beautiful living environment for the people. Environmental governance requires the concerted efforts of the government, communities, families and individuals. Therefore, it is necessary to develop a strict PM2.5 monitoring mechanism to reduce and eliminate the source of PM2.5 as well as the ways of its generation. PM2.5 harms the human body from the respiratory tract into organs, and is not easy to be filtered by the human respiratory system, serious damage to the human respiratory system, especially for sports people. The government has increased investment in scientific site selection in addition to living and working areas to build special sports and leisure areas based on a beautiful ecological environment and clean air quality.
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