Study on the outdoor scientific physical exercise of the masses in Gansu plateau from the Environmental Science

Jike Gao*
Institute of National Sports Culture, Gansu Normal University for Nationalities, Hezuo gansu 747000
*Corresponding author e-mail: gjkhwn1982@163.com

Abstract. Based on the perspective of environmental safety, this study uses literature, instrument measurement and data statistics to study the physical exercise of the masses in the Gansu Plateau. It points out the environmental characteristics of the Gansu Plateau and the impact of the plateau environment on human health. Environment construction strategy. According to the WHO, outdoor environmental air pollution in urban and rural areas caused 4.2 million premature deaths in 2016 due to exposure to particulate matter (PM$_{2.5}$) with a diameter of 2.5 μm or less, which can cause cardiovascular and respiratory diseases and cancer. The World Cancer Organization's International Cancer Research Institute conducted an assessment in 2013 and found that outdoor air pollution has a carcinogenic effect on humans. The particulate matter composition of air pollution is closely related to the increase in the incidence of cancer, especially lung cancer. [1] A study by Kunai et al, Points out that outdoor air pollution causes approximately 800,000 deaths worldwide each year, and the total healthy life expectancy of the world population is reduced by approximately 4.6 million years. Among them, twice as many people die each year as a result of traffic accidents. [2] Environmental pollution has severely affected our work and life, especially the haze weather in recent years has seriously harmed our physical and mental health.

1. Research objects and methods

1.1. Research Object
Gansu Plateau Mass Exercise

1.2. Research methods

1.2.1. Literature method. According to the needs of the research purpose, consult academic papers on mass sports, plateau physical exercise, physical exercise and environmental science, and read books on sociology and environmental science related to this research.
1.2.2. Instrument measurement method. The air indicators measured by the LGH-01 long-light-path DOAS instrument were obtained from the Gansu plateau urban Environmental Protection Bureau. The indicators include two parts, pollutants and meteorology.

2. Gansu Plateau Environmental Characteristics
The main climatic characteristics of the Gansu Plateau are the continental monsoon climate of the plateau, with high and cold humid, long cold season, short warm season, and large temperature difference between day and night. The Gansu Plateau is sparsely covered with vegetation, sandy sand on the surface, fast heat absorption and fast heat dissipation, resulting in high temperature at noon and low temperature in the morning and evening. The year-round sunshine is long, and the ultraviolet burn ability is strong. The air is thin, the content of water vapor is low, the climate is cold, dry, and low pressure and hypoxia.

3. Impact of Gansu Plateau Environment on Human Health

3.1. Impact of high altitude on human health
The data show that the human heart rate increases with altitude at rest. At an altitude of 4500m, the average heart rate is 63.7/min. At an altitude of 3000m, the average heart rate is 77.3 beats/min. Compared with the plain area, the heart rate has increased by 45% and 21.3%, respectively. Low-pressure hypoxia is the most obvious feature of the Gansu plateau environment. For every 100m above sea level, the air pressure decreases by 1KPa, and at altitudes between 5000 and 6000m above sea level, air pressure decreases by 0.7 KPa. As the altitude increases, the oxygen content in the air decreases, and the partial pressure of oxygen in the alveoli decreases. The oxygen diffused into the blood of the pulmonary capillaries will decrease, and the partial pressure and saturation of the oxygen in the arteries will also decrease. Insufficient oxygen supply in various organs and tissues.

### Table 1. Impact of increased altitude on human health

| Altitude (km) | Atmospheric pressure (KPa) | Partial oxygen pressure (KPa) | Alveolar partial oxygen pressure (KPa) | Arterial blood oxygen saturation (%) |
|--------------|----------------------------|-------------------------------|--------------------------------------|-------------------------------|
| 0            | 101.3                      | 21.1                          | 13.9                                 | 95                            |
| 1            | 89.6                       | 18.8                          | 12.0                                 | 95                            |
| 2            | 79.3                       | 16.6                          | 9.6                                  | 92                            |
| 3            | 70.5                       | 14.8                          | 8.2                                  | 90                            |
| 4            | 61.6                       | 12.9                          | 6.6                                  | 85                            |
| 5            | 53.8                       | 11.3                          | 6.0                                  | 75                            |
| 6            | 47.2                       | 9.8                           | 5.3                                  | 66                            |
| 7            | 41.2                       | 8.6                           | 4.7                                  | 60                            |
| 8            | 35.9                       | 7.4                           | 4.0                                  | 50                            |
| 9            | 30.6                       | 6.4                           | < 3.3                                | 20-40                         |

3.2. Impact of Climate Environment on Human Health
The temperature decreases with increasing altitude. Generally, when the altitude increases by 1,000m, the temperature decreases by about 0.6℃. Alpine environment will cause a series of uncomfortable psychological and physiological changes in the human body, excite people's sympathetic nerves, constrict terminal blood vessels, increase left ventricular load, and increase myocardial oxygen consumption. The plateau region has a dry climate, low humidity, high wind and sand, and the water vapor in the atmosphere is easy to evaporate, and the water vapor content decreases with increasing altitude. Therefore, it is easy to cause dehydration, dry skin and lips, and even induce blood concentration and blood lipids. [3]
The air on the plateau is small in density, thin and clean, and contains less dust and water vapor. The transparency of the atmosphere is more than double that of the plains. The ultraviolet radiation is strong, causing burns to human skin and damaging skin cells. [4]

![Figure 1](image_url)

**Figure 1.** The average monthly temperature, humidity, pressure, and wind speed in the Gansu Plateau in the past three years (units: °C, %, Pa, m/s)

### 3.3. Impact of air pollution on human health
Air pollution in cities, due to similar sources of pollutants, is often suspended particulate matter and gaseous pollutants (NO₂, O₃, CO, SO₂). SO₂ has a strong stimulating effect on the upper respiratory tract mucosa, invades the respiratory tract, weakens alveolarity, causes bronchitis, bronchial asthma, or worsens it. NOₓ, especially NO₂, can directly invade macrophages in the alveoli, release proteolytic enzymes, and damage the alveoli. Polosa believes that with the process of urbanization and the development of transportation, traffic pollution caused by automobile exhaust is a major risk factor for allergic diseases. Particulate pollution from cars can mediate allergic inflammation, and air pollution can also make the body's immune surveillance function is low, which causes the body's resistance to other diseases. Be-sen believes that the prevalence of lung cancer is positively correlated with the average concentrations of PM₁₀ and SO₂. The PM₁₀ concentration increases by 10μm/m³, and the incidence increases by 3% -6%. [5]
| Name of pollutant | Value time  | Level 1 | Level 2 |
|------------------|-------------|---------|---------|
| SO$_2$           | Annual average | 0.02   | 0.06   |
|                  | Daily average  | 0.05   | 0.15   |
| NO$_2$           | Annual average | 0.04   | 0.04   |
|                  | Daily average  | 0.08   | 0.08   |
| PM$_{10}$        | Annual average | 0.04   | 0.07   |
|                  | Daily average  | 0.05   | 0.15   |

Source: Ambient Air Quality Standard of the People's Republic of China (GB3095—2012)

4. The scientific construction of a safe environment for mass sports in the Gansu Plateau

4.1. Popularization of environmental safety knowledge

Environmental safety knowledge is the guarantee for the masses to carry out physical exercises. Therefore, education on environmental safety knowledge among the masses in the Gansu Plateau, improve the people's awareness of environmental issues, strengthen the theoretical knowledge reserve of physical exercises, and effectively prevent the masses from exercising Environmental hazards, improve the exercise effect of exercisers. Exercise should understand the safe environment of physical exercise under the framework of environmental science, and choose the safe place and time of physical exercise according to the air pollutant index in accordance with the API pollutant concentration limit announced by the Chinese Ministry of Environmental Protection.

$$I_i = \frac{C_i \cdot C_{i,j} - C_{i,j+1}}{C_{i,j+1} - C_{i,j}} (I_{i,j+1} - I_{i,j}) + I_{i,j} (j = 2,3,\ldots,6, i = 1,2,\ldots,n)$$

In the formula, $I_i$ is the pollution sub-index of the $i$-th pollutant; $C_i$ is the concentration detection value of the $i$-th pollutant; $I_{i,j}$ is the pollution sub-index of the turning point of the $i$-th pollutant $j + 1$; $C_{i,j}$ is the $j+1$ concentration limit for $i$ pollutants at the turning point. The sub-index of each pollutant can be obtained through the above formula, and the maximum value is the value of the city API [5].

4.2. Flexible selection of appropriate exercise methods and means

Most areas of the Gansu Plateau are above 3000 meters above sea level, the most obvious feature is hypobaric hypoxia. When exercising in a plateau environment, you should formulate scientific exercise prescriptions under the guidance of professional personnel. According to people at different altitudes and different ages, choose a suitable exercise form, a reasonable amount and intensity of exercise. Small Tai Ji, ethnic fitness, walking and other sports. Carrying out suitable physical exercises in high altitude areas and developing a scientific concept of fitness can effectively promote human blood circulation, enhance physical fitness, improve human body's ability to resist hypoxia and achieve longevity.[6]

4.3. Scientific choice of exercise period

Studies have shown that the "inversion layer phenomenon" is prone to occur at dawn, especially on the roadside. Harmful gases accumulate in the inversion layer, whose components are mainly composed of automobile exhaust and soot. The concentration is extremely high, and the humidity of the air is high, which is not conducive to the heat dissipation of the skin, and is likely to cause chest tightness and dizziness. Moreover, the temperature in the Gansu Plateau is relatively low in the early morning, especially frostbite is prone to occur in winter and spring. It can be seen that in terms of choosing the time of exercise, research by Greg Atkinson et al. Shows that the highest and lowest points of an individual's physical strength are controlled by the "biological clock," such as the sensitivity of heartbeat, blood pressure, vision, touch, smell, The regulation of the body's hormones, the activity of
enzymes, and the maximum oxygen uptake reach an ideal maximum value from 16 to 19 pm, and this stage is the period of the strongest human performance. [7]

4.4. Establish a complete environmental safety monitoring system

A comprehensive environmental monitoring system can escort physical exercise. In Gansu Plateau urban central areas, or in towns and cities where conditions permit, multi-functional electronic screen devices can be set up to broadcast the weather conditions, air index, temperature, humidity, etc, every day and every time. Physical exercise related indexes remind exercisers to adjust exercise time, etc. Under the guidance of social instructors, exercise groups can choose appropriate exercise methods based on environmental factors. The environmental safety monitoring mainly adopts the unified standard stipulated by the China Meteorological Administration, human comfort index (kssd), \( k_{ssd} = 1.8 \times t - 0.55 \times (1.8 \times t - 26) \times (1 - r/100) - 3.2 \times v^{1/2} + 32 \), where \( k_{ssd} \) is the human comfort index, and \( v \) are daily average values of temperature (°C), humidity (%), and wind speed (m/s), respectively. [8] According to calculations, the kssd of Gansu Plateau is 1 (very cold) most of the time. The average annual time of kssd is 5 (comfortable) is only 38.3 days, and the average annual time of kssd is 6 (warm) is 20-40d. The Tibetan Plateau in Gansu Province has low temperature, low humidity, and low human comfort index. It feels uncomfortable most of the time. It should be kept warm during physical exercise. It is better to choose the sun setting. The winter is late and the sunset is early.

| Index | Level      | Somatosensory                        |
|-------|------------|--------------------------------------|
| 1     | kssd≤25    | Cold, uncomfortable, risk of frostbite|
| 2     | 25 < kssd≤38 | Cold, most people feel uncomfortable  |
| 3     | 38 < kssd≤50 | Cold, some people feel uncomfortable  |
| 4     | 50 < kssd≤55 | Cold, most people feel comfortable    |
| 5     | 55 < kssd≤70 | Comfortable, most people feel comfortable|
| 6     | 70 < kssd≤75 | Warm, most people feel comfortable    |
| 7     | 75 < kssd≤80 | Heat, few people feel very uncomfortable|
| 8     | 80 < kssd≤85 | Hot, most people feel uncomfortable   |
| 9     | 85 < kssd   | Very hot, uncomfortable               |

Acknowledgments

Research on "Good Governance" of Fitness Order in Urban Community Plazas in Gansu Province; Project ID: GST201980.

References

[1] Lu Rushan, Hu Shiping.WHO pays attention to the impact of air pollution on human health [J]. Foreign Medical Information, 2002, 22 (2): 20-21.
[2] Kunai N, Kaiser R, Medina S et al. Public-health impact of outdoor and illness traffic-related airpollution: a European assessment [J]. Lancet, 2000, 356 (9232): 801.
[3] Li Jianguo, Zhang Shijie, et al. Effects of different physical activities on blood oxygen saturation and its sanitary limits in plateau areas [J]. Chinese Journal of Public Health, 1993, (8): 354.
[4] Wang Dewen. Impact of plateau environment on human body [J]. People's Military Medical, 1992, (3): 6.
[5] Greg Atkinson, Damien Davenne. Relationships between sleep, physical activity and human health [J]. Physiol Behav, 2007 (2): 229-235.
[6] Daigle CC, Chalupa DC, Gibb FR, et al. Ultrafine particle deposition in humans during rest and exercise. Inhal Tox-icol, 2003, 15: 539-552.
[7] Katsouyanni K, Touloumi G, Samoli E. et al. Confounding and effect modification in the short-
term effects of ambient particles on total mortality: results from 29 European cities within the APHEA2 project. [J]. Epidemiology 2001 Sep; 12 (5): 521-31.

[8] Steadman R G. Assessment of suhriness.Pt.1a, A temperature-humidity index based on human physiology and clothing science [J]. Journal of Applied Meteorology, 1997, 18 (7): 861-873.