Research on the Strategy of Physical Exercise Promoting Human Health in Tibetan Plateau Environment

Jike Gao

The Institute of national sports culture, Gansu Nationalities Normal University, Hezuo Gansu 747000, China

Abstract. Based on literature data, expert interviews, questionnaires, data monitoring and other methods, taking Tibetan Plateau's environmental characteristics as an entry point, conduct the empirical research of physical exercise on health in Gansu Tibetan Plateau. Conclusion: the promotion strategy of physical exercise on health under plateau environment should be scientifically designed from three aspects: the scientific time of physical exercise, the safety environment and the appropriate exercise prescription.

1. Research Objects and Methods

1.1. Research Object

Research on the Promotion of Physical Activity to Human Health in Plateau Environment.

1.2. Research Methods

1.2.1. Literature and Data Method. According to the needs of the research, we will consult academic papers on plateau environment, plateau physical exercise, physical exercise and environmental science, and screen, analyze, and sort relevant documents and data retrieved.

1.2.2. Expert Interview. According to the needs of this study, a total of 10 sports theory and medical experts were interviewed for the relationship between high altitude environment and health.

1.2.3. Instrument Measurement. Based on the LGH-01 long path DOAS instrument, we monitored the air indicators in the Tibetan Plateau of Gansu. The indicators included two parts: pollutants (SO_2, NO_2, PM_{10}) and Meteorology (wind speed, humidity, temperature and air pressure).

1.2.4. Questionnaire Survey. This study compiled a questionnaire on the status《the Tibetan Plateau's participation in sports activities》.The respondents were 968 Tibetan men and women in the plateau (excluding students and army officers). The total recovery rate was 96.6%, the effective rate was 92.9%. The reliability of the questionnaire was 0.87 and the validity was 0.88.

Content from this work may be used under the terms of the Creative Commons Attribution 3.0 licence. Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.
Published under licence by IOP Publishing Ltd

2. The Environmental Characteristics of Tibetan Plateau

In the field of sports medicine, the definition of plateau is mainly from the perspective of plateau training, except for the geographical factors.In 2001, Chinese scholar Hu Yihai divided the relative standard of altitude:2400m~3000m, 2000m~2300m and 1800m~2000m. [1] Many foreign research to Saunders as the representative of altitude to define standards for low plateau low altitude (500m~1500m), mod-erate altitude (1500m~3000m) Plateau, plateau high altitude3000 above M [2], this study adopts the altitude circle.3 The Analysis on the Current Situation of Mass Physical Exercise in Gansu Tibetan Plateau.

The Gansu Tibetan area is located in the south of Gansu Province in China, and is located on the northeast edge of the Qinghai-Tibet Plateau. The geographical coordinates lie between longitudes 100°46′to 104°44′east longitude and 33°06′to 36°10′north latitude. The territory of 1100 to 4900 meters above sea level, in most areas more than 3, 000 meters. The main climate of Gansu Tibetan Autonomous Prefecture is a plateau continental monsoon climate, with high cold and humid, long cold season, and short warm season. The temperature difference between day and night is large, and the average temperature is 1~13℃.The hottest month is July, the average temperature is 17.9℃, and the coldest is December. The average temperature is -6.8℃.The vegetation in the Tibetan plateau in Gansu Province is sparsely populated, with many sandstones on the surface, fast heat absorption, and rapid heat dissipation, resulting in high temperatures at noon and low temperatures in the morning and in the evening. The average annual precipitation is 400~800mm, and the average sunshine duration is 1800~2600 hours. The sunshine duration is long throughout the year, and the ultraviolet radiation burn ability is strong. The amount of ultraviolet radiation is the smallest in winter and the largest in summer, especially in the grades from June to September. It is 7 to 10 grades, and the intensity is the strongest, with the spring and autumn seasons in the middle. The daily change of ultraviolet light is regular, and it is very early at noon, and it is basically symmetrical in the afternoon. Thin air, low water vapor content, cold weather, dryness, hypoxia, etc.

3. The Influence of the Tibetan Plateau Environment on Human Health

The main factors affecting human health in Tibetan plateau areas are air pressure, oxygen partial pressure, ultraviolet light, temperature, humidity, and air quality. Studies have shown that when the human body is resting, the heart rate increases with elevation. At an altitude of 4500 m, the average heart rate is 63.7/min. At an altitude of 3000m, the average heart rate is 77.3beats/min, which is an increase of 45% and 21.3% compared with the plain area. However, long-term settlement of the plateau immigrants and family members appear slow heartbeat, in the 4500-4700m above sea level pastoral areas, the heart rate of most Tibetan herdsmen is lower than 60 beats / min, easy to fatigue during exercise, and long recovery time.[3]

3.1. The Influence of Air Pressure, Oxygen Partial Pressure and Solar Radiation on Human Health

Table 1. The relationship between altitude and atmospheric pressure, oxygen partial pressure, and oxygen saturation of human artery

Altitude	Atmospheric Pressure		Oxygen partial pressure		Alveolar oxygen pressure		Arterial oxygen
(km)	KPa	mmHg	KPa	mmHg	KPa	mmHg	saturation(%)
0	101.3	760	21.1	159	13.9	105	95
1	89.6	674	18.8	141	12.0	90	95
2	79.3	596	16.6	125	9.6	72	92
3	70.5	530	14.8	111	8.2	62	90
4	61.6	463	12.9	97	6.6	50	85
5	53.8	405	11.3	85	6.0	45	75
6	47.2	355	9.8	74	5.3	40	66
7	41.2	310	8.6	65	4.7	35	60
8	35.9	270	7.4	56	4.0	30	50
9	30.6	230	6.4	48	< 3.3	< 25	20-40

Source: Occupational Diseases of Altitude Diseases, Military Medical Science Press, April 2010.

As can be seen from table 1, each elevation of 100m, the air pressure decreased by 1 KPa, at the altitude of 5000~6000m, the elevation of 100m, and the reduction of air pressure by 0.7 KPa. As altitude increases, the oxygen content in the air decreases, resulting in the decrease of the oxygen partial pressure in the alveoli. The oxygen in the blood diffused into the pulmonary capillaries will decrease, and the arterial oxygen partial pressure and saturation will also decrease, which will cause insufficient oxygen supply to all organs and tissues. High altitude hypoxia environment is easy to make people feel low, attention is difficult to concentrate, appetite and sleep will also have a certain impact.

The air density of the plateau is small, thin and clean, the content of dust and water vapour is little, and the ultraviolet radiation is strong. Between the Gansu plateau, the average annual solar radiation 4433.39~5486.7MJ/m2, solar radiation penetration rate with the altitude increasing, mainly produce strong ultraviolet radiation burns to the exposed skin, damaged skin cells, acute injury showed edema, sunburn, pigmentation, skin thickening, striation formation.

3.2. The Influence of Temperature, Humidity and Other Factors on Human Health

The climate in the plateau is dry, the humidity is low, the wind and sand are large, the water vapor in the atmosphere is easy to evaporate, and the water vapor content decreases with increasing altitude. As a result, the organism is prone to dehydration, dry skin and lips, and even induce blood condensation and blood. The temperature decreases with increasing altitude. In general, for each elevation of 1000 m above sea level, the temperature drops by about 0.6℃.The alpine environment will cause a series of unpleasant psychological and physiological changes in the human body, causing the sympathetic nerves to be excited, and the vasoconstriction of the peripheral vessels, the left ventricular load will increase, and the myocardial oxygen consumption will increase. Cold can also stimulate coronary artery spasm, medical experiments have shown that if inhaled cold air at -23℃, ECG changes appear similar to angina.[4] It can be seen from Figure 1 that the human body exercises in a high-temperature, high-humidity environment. The body will experience a temperature rise in a short time, which can effectively reduce the damage.When the body exercises at low temperature and low humidity, body temperature rises slowly, which is not conducive to physical exercise.

4. Strategies for Promoting Human Health by Physical Exercise in Tibetan Plateau Environment

4.1. Scientific Choice of Physical Exercise Session""

Studies have shown that the"inversion of temperature phenomenon"tends to occur at dawn, and its composition is mainly composed of automobile exhaust and smoke. High concentration, high air humidity, is not conducive to skin heat, easily lead to chest tightness, dizziness symptoms. The plateau temperature in the Tibetan Plateau of Gansu is low in the early morning hours, especially in the winter and spring seasons. Greg Atkinson et al.'s study showed that the body's hormone regulation, enzyme activity, and maximum oxygen uptake reached an ideal maximum at 16 to 19 o'clock in the afternoon, and this stage is the strongest period of human exercise performance.[5] Therefore, it is advisable to spend the afternoon in physical exercise.

4.2. Select the Safe Environment for Physical Exercise

It is particularly important to select a safe environment for SO_2, NO_2, PM_{10} and automobile exhaust. The concentration of $S0_2$ in Gansu Tibetan area is high, the time of pollution is longer, the daily change is Shuangfeng value, about 8 in the morning and around 22 in the evening, the maximum value is 0.126 mg/m3.SO_2 can harm human health in different ways, reduce the activity of enzymes, damage the liver, and destroy the respiratory tract. The concentration of NO_2 was concentrated at the two peak period of work. The morning concentration was the highest, which was 0.189 mg/m3.In the afternoon, the value of the sun was slightly lower. Research on Atkinson et al showed that particulate pollution and respiratory diseases are closely related to the number of emergency. [6]

Gansu Tibetan Plateau plateau area is windy and sandy, and the wind is strong. It usually starts windy around 13:30, and stops at 17 o'clock. At this time, the PM10 reaches the maximum value of 0.252 mg/m3, exceeding the national two level standard. Therefore, try to avoid this period of time when exercising. The concentration of CO is proportional to the traffic volume in the air of the road or square. During the 12 hour continuous monitoring of a day, at the rush hour of 9:00~11:00 and 15:00~17:00, CO concentration has two peaks. [7] at this time, people who often exercise in roads or squares should understand air pollution scientifically, choose exercise sites away from pollution sources or avoid pollution peak.

4.3. According to Different Altitudes, Develop a Auitable Exercise Prescription

The elevation of the Tibetan areas in Gansu Province is 1, 100 to 4, 900 m above sea level, and most areas are more than 3, 000 m above sea level. Tibetan health believes that in the plateau hypoxia special climatic conditions for physical exercise should be combined with movement and take appropriate forms of exercise before they can improve the function of the body's various systems to achieve the effect of physical exercise. In physical exercise on the plateau, a scientific exercise prescription should be established, and according to different altitudes and age groups, select the appropriate form of exercise, reasonable exercise capacity and intensity. Proper physical exercise at high altitudes and the development of a scientific fitness concept can effectively promote human blood circulation, increase appetite, improve sleep quality, and strengthen the body's ability to resist hypoxia and achieve longevity.

Acknowledgments

This work was financially supported by 2017 Sports Education and Health Education in Gansu Province Educational Education Specialized Task for National Defense Education 2017B-33 and National Youth Program of Social Sciences, project number14CTY014 fund.

References

[1] Hu Yihai, more than Kewang. The basic principle of altitude training method and its application [J]. Journal of Wuhan Sports Institute, 2001, 35 (4): 59-62.

[2] P.U.Saunders et al. Improved running economy in elit e runners after 20days of simulated moderate- alt itude exposure. Ja ppl Physiol, 2004, 96: 931-937.
[3] Wang Hai. Medical treatment of occupational high altitude disease [M]. Military Medical Science Press, 2010, 4: 2; 3-5.
[4] Li Jianguo, Zhang Shijie et al. The influence of different physical activities on blood oxygen saturation and its hygienic limit in plateau area [J]. Chinese Journal of public health, 1993, (8): 354.
[5] Greg Atkinson, Damien Davenne.Relationships between sleep, physical activity and human health [J]. Physiol Behav, 2007 (2):229-235.
[6] Atkinson RW, Anderson HR, et al.Acute effects of particulate airpollution on respiratory admissions results from APHEA 2 Project [J]. American Journal of Respiratory and Critical Care Medicine, 2001, 164: 1860-1866.
[7] Zhao Xiaohong, Wen Chunsheng. Lanzhou city vehicle exhaust pollution investigation [J]. arid environmental monitoring.1997.6: 11.