

THE QINGHAI-TIBETAN PLATEAU: HOW HIGH DO TIBETANS LIVE?

International Society for Mountain Medicine Newsletter, **10** (3): 6-9 (July 2000)

As is well known, one remarkable aspect of chronic mountain sickness (CMS, or Monge's disease) is its apparent rarity in the Himalayas and Tibet. However, it has been reported most commonly in Quechuas and Aymaras living in the Andes. Much speculation about this has been expressed by some scientists. Among them, one of the most popular views on the question suggested that "the geographical differences between the Andes and the Himalayas could be important in the apparent difference in the incidence of CMS"(1). This means that permanent settlements can be established at lower altitudes in the Himalayas, even though the mountains are much higher (1). Heath et al also point out that "these differences are largely explained by the fact that the Tibetans and Sherpas live permanently at considerably lower altitude than do the Quechuas and Aymaras" (2). Hamilton stated that most of the Altiplano of South America lies above 3500m, the Tibetan plateau being at 3000m (3). Thus, absence of CMS in the Himalayas is because of the lack of communities there who live high enough (1).

Interestingly, we have found that the above conditions are only suited to Sherpas of Nepal. Because in the Nepalese Himalayas the geography allows residents to move to lower altitude more easily than from the altiplano of the Andes (4). Also, the permanent settlement of the Sherpas are nowhere as high as those of the Quechuas (5).

Conversely, like the Andeans, Tibetans live on a high altitude plain, Qinghai-Tibetan plateau, and cannot easily move up and down(6). Likewise, on the Tibetan side of the Himalayas people here live permanently at or above the heights of the Andes.

In order to clarify these inconsistencies in the geographical factors related to the incidence of CMS, what is to be done? First, a brief introduction of the Qinghai-Tibetan plateau is needed to establish whether such geographical differences exist.

Tibet is well-known, but the term "Qinghai-Tibetan plateau" is unfamiliar to some western scientists. Politically, Tibet is an autonomous region in China. Geographically, however, Tibet is the Xizang-Qinghai Plateau (Qinghai-Tibetan plateau) (6), which includes all of Tibet and Qinghai, the southern part of Gansu, the western part of Schuan, the southwestern part of Yunnan provinces, and the Ali area of the Xinjiang Uygur autonomous region in China. The distance from north to south is 1400 Km in width, and its length from east to west is 2700 Km. The plateau covers about 2.5 million square kilometers, it occupies 26 percent of the China's total land area, and is the largest and highest plateau in the world, much of it between 4600 and 4900m, the average altitude is 4000m. The so called "roof of the world " or " the third pole in the earth-high pole".

The Qinghai-Tibetan plateau is a dynamic geological area. Before the tertiary period, it was covered by the Tethys sea, the so-called Ancient Mediterranean. In the late

tertiary and early pleistocene, the drastic Himalayan orogenic movement, also called the New Alps Orogenesis, occurred in the plateau. During this time, the plateau ascended rapidly as the sea regressed westward. This orogeny has not ceased and continues to impact the topographical structure of the plateau and its peripheries. It has also influenced various Plateau cultures, economics and ecologies (7).

Also, the Qinghai-Tibetan plateau is a very special natural geographic unit, the plateau is encircled by the Himalayas in the south-west, and the Kunlun and Algin Mountains in the north-east (Fig. 1). The Himalayas contains all of the world's high mountains which exceeding 8000m. Mount Qomolangma (Everest), situated on the southern rim of the plateau on the Sino-Nepalese border is the highest peak in the world. These mountains not only heighten the altitude but also hinder the atmospheric circulation, causing the climate to be arid, frigid and hypoxic. The highest region is in the northern part of the plateau, Chantang, which means "northern wildness" in Tibetan. Chantang is situated mainly above 4500m covering 620,000 km², amounting to an one third of the Tibet's total area with an average of less than 1 person per km², which is the lowest population density on the plateau. Tibetans are the sole population and nomads. In Chantang temperature varies from a maximum of 15oC to a minimum of -35oC, and rainfall varies from 150-200mm each year. Chantang is generally considered a remote, distant and mysterious region. To date, the above mentioned highland areas are even more distant and isolated. Therefore the ecological environment remains complete and changed little. This may provide an ideal natural condition for high altitude biomedical research.

Second, how high are Tibetans actually living on the Qinghai-Tibetan plateau? Perhaps, the geographical distribution and altitude of residence of the Tibetan population could help us to settle the issue of the geographical differences.

The Qinghai-Tibetan plateau is a vast territory with a sparse population. According to the last Chinese Census in 1990 (9), the total Tibetan ethnic population is 4,594,188, among which, a total 1,185,510 (25.8%) inhabitants live over 2000m, 51.3% of the population lives over 3000m, 20% over 4000m, and 1.02% live at altitude exceeding 5000m (Table 1).

Table 1. The Tibetan ethnic population of the Qinghai-Tibetan plateau according to altitude of residence

Altitude (m)	Number of counties	%	Tibetan population	%
1501-2000	3	2.6	87,244	1.90
2000-2500	13	11.1	317,934	6.92
2501-3000	21	17.9	867,576	18.88
3001-3500	26	22.2	1,327,965	28.91
3501-4000	23	19.7	1,028,187	22.38
4001-4500	23	19.7	680,932	14.82
4501-5000	5	6.8	237,569	5.17
5001-5300	3	1.0	46,992	1.02
Total	117	100.0	4,594,188	100.0

In Qinghai-Tibetan plateau 117 counties were recorded which were distributed into three provinces and two autonomous regions, among them, a total of 34 (29%) counties were located above 3 000m, 26.5% above 4000m, and 1.0% over 5000m(Table 1).

In Peru, according to figures from Conzales (10), the total population living in mountainous regions (above 1500m) is estimated at 8 million, of which, a total 3,233,789 (40.2%) people live over 2 000m, 50.1% of the population lived at altitude above 3000m, with 2.7% over 4000m. This provides further evidence that the permanent settlements of the Tibetans are as high as the Quechuas.

Qinghai-Tibetan plateau is one of the natural resources of China, abundant in livestock, salt, petroleum and natural gas, non-ferrous metal minerals and non-metal minerals as well as the hydro-electric power. However, all of the resources are situated at high altitude or extreme altitude. For example, there are gold mines at Tok Dschalung at 4880m in the Western Himalayas. Opencast mining for coal was carried out at an altitude of 5250m of Machala in eastern Tibet. Also, the Tibetans work at altitudes up to 6000m in central Tibet in the Tanggula range, mining quartz for many months of the year (6). The above elevations are higher than those of Cerro de Pasco (4330m) and Morococha (4540m) mines in Peru, and at comparable altitude of Aucanquilcha mine in Chile.



Figure 1 Qinghai-Tibetan plateau

The Tibetan nomads in Qinghai-Tibet are life-long residents at altitudes up to 3000-4500m and move in the summer up to 5450m. The highest grazing land is on the northern slopes of the Himalayas at altitudes between 4500m and 5000m. The Qinghai-Tibetan Highway stretches from Xining (2261m) to Lhasa (3658m), covering a distance of 1937 km, at an average altitude of 3500m above sea level. Particularly, the section between Mt. Kunlun and Tanggula range is situated in

permanently frozen earth above 4460-5200m and is 500 km long. It is higher than highways in Andes. Each year, many thousands of workers involved in constructing roads have lived and worked at between 3200m to 5200m, and many hundreds of the Tibetan caretakers live there permanently.

Permanent buildings on the plateau are found up to 5000m. There are also many lameries located in the high mountains, situated at heights of between 3200m and 5000m. The most famous one is the Rongbu Temple, which is located at the foot of the Mt. Everest at an altitude of 5600m. The Tibetan monks live here for all their life. It is also much higher than the Holy land of the Andeans. Relatively small groups (1.9%) of Tibetan peasants live in the agricultural regions, such as Chayu and Motuo areas in Tibet and the Huangshui valley in Qinghai, situated at heights of between 1 800m and 2500m.

Reports of CMS from the Himalayas indicate the condition to be prevalent in Chinese Han immigrants (11), however, CMS is now being report in the indigenous Tibetan population too (12). As for the geographical factors, the permanent settlement of the Tibetans in Himalayas is as high as the Quechuas in the Andes. Also, like the Andeans, Tibetans live on high Qinghai-Tibetan plateau and cannot easily move up and down, some live all the year at just below 5 000m, slightly lower in the winter, and slightly higher in the summer. According to the above data that we believe that the difference in the incidence of CMS between the Tibetans and the Andeans is not because of geographic differences. Recently work in Qinghai-Tibet suggests that there are different physiological adaptive models of native highlanders whose characteristics are the result of the complex interaction between genetic and environmental influences (13). This may also be the reason for the different incidence of CMS between the Andes and the Himalayas. Although more evidence is needed it would seem that CMS is a serious publichealth problem in all the highlanders of the world and we should paying a great deal of attention to such a disease.

Wu Tianyi

High Altitude Medical Research Institute, Xining, Qinghai, 810012, China

1. Winslow RM, Monge Cc. Hypoxia, polycythemia, and chronic mountain sickness. The Johns Hopkins University Press. Baltimore and London. 1987, 17-18.
2. Heath D, Williams DR. High-Altitude Medicine and Pathology. Butterworths, London. 1989, 53, 161-162.
3. Hamilton AJ, Cymerman A, Black PM. High altitude cerebral edema. Neurosurgery 1986, 19:841-849.
4. Ward MP, Milledge JS, West JB. High Altitude Medicine and Physiology. Second Edition, Chapman & Hall Medical. London, 1995, 422.
5. Heath D, William DR. Man at High Altitude. Churchill Livingstone, London and New York, 1981, 174-
6. Ward MP, Tibet: human and medical geography. J Wilderness Med 1990, 1:36-46.
7. Sun HL, Zheng D. Formation, Evolution and Development of Qinghai-Xizang (Tibetan) Plateau. (In Chinese), Guangdong Science & Technology Press. Guangzhou, China. 1998, 1-8.
8. Luoshang LD. Qinghai-Tibetan Plateau: Environment and Development. (In Chinese), Tibetanology Press, Beijing, 1996, 6-27.
9. China's Fourth National Census of 1990. Chinese Statistic Press, Beijing, 1991.
10. Ganzales GF. Demographic, reproductive, morbidity and mortality patterns at high altitude in Peru. In: Ohno H, Kobayashi T, Masuyama S and Nakashima M (Eds)- Progress in Mountain Medicine and High Altitude Physiology. Matsumoto, 1998, 174-179.

11. Pei SX, Chen XJ, Si-Ren BZ, Liu YH, Cheng XS, Harris EM, Anand IS ,Harris PC. Chronic mountain Sickness in Tibet. Q J Med 1989, 71:555-74-
12. Wu TY, Zhang Q, Jin BS,XU F, Cheng Q, Wang X. Chronic mountain sickness (Monge's disease): an observation in Qinghai-Tibet plateau- 'Ln:Ueda G, Reeves JT,Sekiguchi M (Eds). High Altitude Medicine. Sinshu University Press, Matsumoto, 1992, 314-24-
13. Wu TY, TU D, Zha C.L, LI WS, Wei LI,GE RL, Wang SZ, Cheng QH. The physiological differences between the Tibetans and Andeans. In:ohono H,Kobayashi T, Masuyama.S. Nakashima M(Eds). Progress in Mountain Medicine and High Altitude Physiology. Press Committee of the 3rd World Congress on Mountain Medicine and High Altitude Physiology. Matsumoto, 1998, 120-125.

Content copyright© 2000 ISMM

Last modified 01-Aug-2001