Observations on the Blood Pressure of Tibetans

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SUMMARY

Observations on the blood pressure of a group of 660 displaced male Tibetans revealed striking dissimilarities in regard to the mean systolic and diastolic figures as compared to those reported for Europeans and Americans. The average Tibetan figures are lower than those of Western populations; however, a comparable variability after the fourth decade and a parallel spread of values with age and weight were found in the Tibetan data. The socioeconomic status and height bore no relation to the blood pressure levels. The results obtained from this survey on the Tibetans are compared with those of other Mongolian groups. It is suggested that the differences of blood pressure among related Mongolian groups and populations studied in the West are largely determined by environment.

Additional Indexing Words:
Weight  Age  Height  Socioeconomic factors
Altitude  Mongolian groups compared

IN RECENT YEARS there has been an increasing awareness that useful information can be obtained about the factors influencing blood pressure from a study of different racial groups. Although differences in sampling and variations of technique make strict comparisons difficult, reviewers of the epidemiology of blood pressure have discussed the differences that exist among Mongolian, African, and Caucasian stocks inhabiting different countries.\(^1\)\(^-\)\(^5\) Little comparative data, however, are available with regard to the people of Mongolian descent, and no study has yet explored the pattern of arterial tension among the inhabitants of Tibet. Some papers have suggested that the blood pressure readings of the Chinese are lower than those of Western people,\(^6\)\(^-\)\(^16\) and comparisons have been attempted between Chinese resident in China and those resident in the West.\(^16\) Lower blood pressures have also been recorded among Koreans,\(^3\) Eskimos,\(^17,\)\(^18\) and the Chinese resident in Formosa.\(^19\) One of these studies\(^13\) has extended to the aboriginal Chinese tribes in Szechwan, West China, this being a group culturally and geographically closest to the racially homogeneous Tibetan stocks inhabiting Central Asia. The Tibetan community, which for centuries has carefully preserved the ancient and exclusive features of a shamanistic religiocultural organization, has not been accessible to scientific study so far. Information derived from a study of arterial tension in a Tibetan population which was recently displaced from Tibet and subsequently settled in Dalhousie, Northern India, is now available and is reported in this paper. The cardiovascular epidemiology of this group has been reported elsewhere.\(^19\)

**Methods**

The survey was conducted in November 1962. Measurements were made during the day between 9:00 a.m. and 7:00 p.m., no attempt being made to assess the diurnal variations of blood pressure. The total Tibetan population resident at Dalhousie (altitude, 6,778 feet above sea level) was

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Blood Pressure of Tibetans

Figure 1

Relationship of blood pressure to age.

A population of 810 persons was available at Dalhousie. Most of these people had been residing there over a period varying from 1 to 2 years. The population consisted entirely of displaced persons from various parts of Tibet, now lodged in groups of 20 to 40 in refugee homes maintained by the Government at the hill resort. With the cooperation of Tibetan interpreters and the local Government authorities, a 100% response was obtained from the people. The clinical assessment could be completed for only 698 individuals (86.2%). In this paper, however, the results pertaining to 660 male members of the population are reported. The remaining subjects (28 females and 10 males) have been excluded from the study as the data for the males were not complete in all respects, and the number of females was too small for evaluation.

The resident male population was stable, racially homogeneous, and socially representative. It is, however, to be expected that several alterations must have occurred in the diffusion and the density of various groups as a result of migration. The lamas, who formed the biggest single group, are a socially privileged, but a celibate, monastic, and temperate Buddhist clergy drawn from all classes in the social order of Tibet. The responsibilities of this group range from the academic, ritual, and vocational to those of servants and warriors. The rest of the population comprised either of ranking Government officials, landlords, businessmen, and nobles, or the physically active lower class traders, herdsmen, peasants, and manual laborers. The peculiar social structures and the prevalence of a system of barter imposed difficulties in stratifying the population into well-demarcated socioeconomic groups. An unavoidable overlapping, therefore, is likely to be present in the socioeconomic groups delineated in this paper.

Table 1

Blood Pressure in Relation to Age

<table>
<thead>
<tr>
<th>Age group (yr)</th>
<th>No. of cases</th>
<th>Mean body weight (lb)</th>
<th>Blood pressure (mm Hg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Systolic</td>
</tr>
<tr>
<td>16-20</td>
<td>11</td>
<td>133</td>
<td>123.5</td>
</tr>
<tr>
<td>21-25</td>
<td>106</td>
<td>130</td>
<td>117.5</td>
</tr>
<tr>
<td>26-30</td>
<td>116</td>
<td>128</td>
<td>118.5</td>
</tr>
<tr>
<td>31-35</td>
<td>85</td>
<td>132</td>
<td>117.5</td>
</tr>
<tr>
<td>36-40</td>
<td>78</td>
<td>128</td>
<td>116.5</td>
</tr>
<tr>
<td>41-45</td>
<td>70</td>
<td>144</td>
<td>119.5</td>
</tr>
<tr>
<td>46-50</td>
<td>45</td>
<td>132</td>
<td>126.5</td>
</tr>
<tr>
<td>51-55</td>
<td>64</td>
<td>133</td>
<td>130.5</td>
</tr>
<tr>
<td>56-60</td>
<td>52</td>
<td>132</td>
<td>134.5</td>
</tr>
<tr>
<td>61 and above</td>
<td>33</td>
<td>126</td>
<td>138.6</td>
</tr>
</tbody>
</table>

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Results

The average systolic and diastolic blood pressures along with their standard deviations (SD) in different age groups are set out in table 1 and graphically represented in figure 1. Histograms showing frequency distributions of systolic and diastolic blood pressure by age are given in figure 2.

The systolic blood pressure remained more or less constant around 117 mm Hg for ages...
between 21 and 40 years and thereafter increased almost in a linear manner (fig. 1) to 139 mm Hg to age 61 or more. The diastolic pressure could be treated as constant in the age groups between 21 and 40 years; it increased up to the age 50 but showed no further increase even to the age of 61 and above. The systolic blood pressure showed greater variability than the diastolic blood pressure; the variation of blood pressure, both systolic and diastolic, was highest between ages 38 and 48 years. A positive significant correlation ($P < 0.05$) between age and blood pressure (systolic or diastolic) was revealed by the data; the coefficient of correlation between age and mean systolic pressure was $+0.50$ and that between age and mean diastolic pressure was $+0.89$. Second degree curves were fitted with the help of the principle of least squares and the fitted equations were:

Systolic pressure:
$$Y = 140.17 - 1.436x + 0.0229x^2$$ (1)

Diastolic pressure:
$$Y' = 79.56 - 0.153x + 0.0046x^2$$ (2)

where $Y$ and $Y'$ denote expected systolic and diastolic pressures at age $x$.

Equations 1 and 2 explained 92 and 93% of the variations, respectively, thereby indicating that these represent adequately the underlying relationship between age and arterial pressure. The close association between the observed and fitted values is also seen in figure 1.

When the systolic and diastolic blood pressures were plotted against the body weight (fig. 3), it was observed that with the increase in body weight (beyond 115 lb) there is a definite trend toward increase in systolic blood pressure. This trend, however, is not so strong in diastolic blood pressure (table 2). The systolic blood pressure showed greater variability than the diastolic blood pressure, except in persons with body weight between 141 and 150 lb. A positive significant correlation ($P < 0.05$) between body weight and blood pressure (systolic and diastolic) was observed. There was no significant relation between body weight and age ($P > 0.05$), showing that the influence of weight was not through the factor of age. The partial correlation between body weight and systolic blood pressure was not significant ($P > 0.05$), whereas, in the case of diastolic blood pressure, it remained significant ($P < 0.05$). The coefficient of correlation between body weight and mean systolic blood pressure works out as $+0.79$ and that between body weight and mean diastolic blood pressure as $+0.77$.

Linear and second degree curves, when fitted in the data with the help of the principle of least squares, explained variations of the following orders as follows: systolic pressure: linear, 62; quadratic, 79; and diastolic pressure: linear, 59.07; quadratic, 59.11.

The corresponding equations are:

Systolic pressure:
$$Y = 62.30 + 0.789x - 0.0026x^2$$

Diastolic pressure:
$$Y' = 76.56 + 0.032x$$

where $Y$ and $Y'$ denote the expected systolic

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**Table 2**

<table>
<thead>
<tr>
<th>Weight (lb)</th>
<th>No. of cases</th>
<th>Blood pressure (mm Hg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>Mean</strong></td>
</tr>
<tr>
<td>91-100</td>
<td>13</td>
<td>114.90</td>
</tr>
<tr>
<td>101-110</td>
<td>52</td>
<td>117.70</td>
</tr>
<tr>
<td>111-120</td>
<td>65</td>
<td>117.75</td>
</tr>
<tr>
<td>121-130</td>
<td>198</td>
<td>124.30</td>
</tr>
<tr>
<td>131-140</td>
<td>161</td>
<td>120.85</td>
</tr>
<tr>
<td>141-150</td>
<td>117</td>
<td>122.10</td>
</tr>
<tr>
<td>151-160</td>
<td>26</td>
<td>123.00</td>
</tr>
<tr>
<td>161-170</td>
<td>14</td>
<td>122.30</td>
</tr>
</tbody>
</table>

*Exclusive of 14 subjects whose weight was not recorded.
and diastolic pressures of persons with body weight x.

It is, thus, evident that a second degree curve adequately represents the underlying relationship between body weight and systolic pressure, while in case of diastolic pressure, a straight line is equally good. This is also seen in figure 3 where a close association between the observed and fitted values is evident.

To study the relationship between blood pressure and economic status, three socioeconomic groups (high, middle, and low) have been recognized in the study. The blood pressure in relation to socioeconomic groups is shown in table 3. The mean values of systolic and diastolic blood pressures of persons belonging to the high and the middle socioeconomic groups are almost similar, but in the low income group the mean systolic and diastolic blood pressures are each lower by about 3 mm. In the low income group, both the average age and body weight appear to be lower than those in the other two classes, but the differences between the mean values in the three classes have not been found statistically significant with respect to both age and body weight.

The data also revealed that there was no association between height and blood pressure (systolic or diastolic). The coefficient of correlation between height and systolic blood pressure and height and diastolic blood pressure was not found to be significant (P > 0.05).

Discussion

Several observers have suggested that it may be reasonable to infer that variations in the pattern of blood pressure in different populations may be a racial trait.\(^2\)\(^-\)\(^5\) These observations, however, largely arose from a number of comparative cross-sectional studies conducted among stocks of Caucasian or African origin,\(^4\)\(^,\)\(^20\)\(^-\)\(^22\) since there has been a paucity of information concerning the pattern of blood pressure among the peoples of Mongolian origin.

The facts available can be summarized briefly. A number of papers, mostly published between 1920 and 1937, have engendered the opinion that the blood pressures of the Mongolian groups inhabiting China are lower as compared to those of people of European descent.\(^6\)\(^-\)\(^16\) Two groups are easily recognizable in these studies; in the wealthier group of life insurance risks reported by Ling,\(^9\) the blood pressure is higher than that of the poorer Chinese, and a rise of blood pressure is noticed with the aging population; in the poorer groups,\(^10\),\(^13\) the blood pressures are consistently low and uninfluenced by age (fig. 4). A low blood pressure has also been reported among Koreans,\(^8\) Eskimos,\(^17\),\(^18\) and Chinese resident in Formosa.\(^15\) Krakower, on the other hand, has stated that the blood pressure of the Chinese, after long residence in

### Table 3: Blood Pressure in Relation to Socioeconomic Groups

<table>
<thead>
<tr>
<th>Socioeconomic Group</th>
<th>No. of Cases</th>
<th>Average Age (yr)</th>
<th>Average Weight (lb)</th>
<th>Blood Pressure (mm Hg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Systolic</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mean</td>
</tr>
<tr>
<td>High</td>
<td>48</td>
<td>40.71</td>
<td>130.60</td>
<td>123.70</td>
</tr>
<tr>
<td>Middle</td>
<td>504</td>
<td>38.35</td>
<td>130.60</td>
<td>122.26</td>
</tr>
<tr>
<td>Low</td>
<td>108</td>
<td>37.12</td>
<td>126.75</td>
<td>120.70</td>
</tr>
</tbody>
</table>

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Canada, approximates that of the Canadian residents. Similarly, in Japan, hypertension is a common disease and the pattern of arterial tension of the urban Japanese closely parallels that of the Americans.

It appears from the literature covering several geographical and cultural groups, that the spread of the mean systolic and diastolic pressures in a population tends to increase with age. This correlation was not found to be present among the aboriginal Chwan Miao, Ta Hwa, and Nosó tribes from Szechwan, China, who are culturally and geographically closest to the Tibetans. Similar observations have been made by Kilborn among the Miao tribes of Kweichow, and by others among population groups in Asia, Africa, and Australia. The Tibetan data are at variance with the reported figures for the poorer Chinese. The figures obtained from this survey are higher and show a positive significant correlation for age, but the results are closer to those obtained for the wealthier groups of Chinese studied by Ling. The spread of values is approximately parallel, though the mean figures are significantly lower than those reported for Europeans and Americans. A comparable variability after the fourth decade, however, is seen in both Tibetan and Western studies.

In regard to height, the results of this work are in conformity with some excellent studies which indicate a negative correlation. Weight, on the other hand, carries a positive correlation; the present survey endorses these observations with regard to the systolic figures of the Tibetans, but the trends though significant are less noticeable in the diastolic pressures. More recent studies have attempted to relate blood pressure levels to the type of build, and Lowenstein in his review has discussed the possibility that the lower blood pressures among the Chinese as compared to those of Americans may result from the anthropometric differences between the two. Although some studies have shown lower weights and a predominantly leptosomous typology among the Chinese, the biometric data for the Chinese are scanty and unrepresentative. In contrast to Stevenson's data on Chinese, our observations on this group have shown a predominantly sthenic build for Tibetans. In this connection Lowenstein also refers to one other constitutional factor with a possible bearing on the pattern of blood pressure among the Mongolian races. This is the greater "femaleness" of the Chinese male, in reference to the amount and distribution of body hair. Notwithstanding this, a sex differential of blood pressure in subjects below the age of 45 years seems to be maintained in some groups in China as far as can be gathered from the sparse data on females. Whether this fact can be garnered to explain the observed differences in Tibetan and Western populations is, at best, speculative.

From the foregoing it seems evident that the distribution of blood pressure in the Tibetans shows trends similar to those of American and European populations in regard to age and weight, but the mean figures for the Tibetans are lower and the parallelism is less marked for the diastolic than for the systolic pressures. The differences of blood pressure between the Tibetans and geographically and culturally close groups from

![Figure 4](http://circ.ahajournals.org/)

Comparison of blood pressures of Tibetans and some Chinese groups: Ling, wealthier group; Tung and Morse and Beh, poorer groups.
China, as well as those more distant, are made out in figure 4.

Of considerable interest to us were some environmental factors peculiar to the Tibetans. From the sociocultural point of view, the Tibetan has been invested for centuries in an inviolable exclusiveness. A huge number of the population enters the monasteries as the privileged Buddhist clergy, and the rest of the social classes are deeply influenced by the religious precepts of Buddhism. The fact that no significant influence was exercised by the socioeconomic status on the blood pressure may stem from similar mental attitudes of the rich and poor belonging to a community far less exposed to the shifting stresses and the complexities of living found in materially advanced countries. Schroeder, while commenting on the lesser incidence of hypertension among the Orientals, laid emphasis on the differences of mental and emotional responses of the Oriental and Western minds to stressful situations. In the absence of quantitative methods of calibrating psychic stress in epidemiological work, caution must be exercised in assessing the magnitude of the mental factor contributing to lower pressures among the Tibetans, especially when it is conceivable that a recently uprooted community must have been subjected to mental and physical strain during migration from Tibet. There is one environment variable, however, which needs comment. Geographically, Tibet is a high plateau comprised of rugged tablelands averaging 15,000 feet above sea level, and valleys ranging from 12,000 feet to 17,400 feet, with few localities below 10,000 feet in elevation.

Does prolonged habitation at such high altitudes under rigorous climatic conditions influence the blood pressure levels of a group? There is some evidence which records an unpredictable and variable influence of altitude on blood pressure. This survey does not suggest that prolonged habitation at high altitudes is an environmental variable of great significance.

Of some consequence is the reported relation of blood pressure in some populations to the intake of salt. In the course of this survey we were struck by the high average consumption of salt by the Tibetans. The staple diet of the ordinary Tibetan in Tibet is yak meat, mutton, barley, flour, and cheese; the main beverage is brick tea flavored with soda and salt. The consumption of this beverage among the Tibetans is enormous, for they drink 20 to 30 cups of tea a day, a custom preserved to a lesser extent even after migration from Tibet. The overall incidence (8%) of hypertension (140/90 and over) in this group obviously does not reflect the true incidence of hypertension among native Tibetans. In accordance with the observations of Dahl, the high intake of salt suggests the possibility that the prevalence of hypertension among the Tibetans in their natural environment may have been higher than the figures obtained in this study.

Before any conclusions are drawn from this survey, it should be pointed out that because of the unavoidable inadequacies of sampling inherent in a study of a refugee population and because of the differences of techniques employed by different observers, such cross-sectional studies do not lend themselves to strict comparison. We are aware that the present study is not likely to reflect in entirety the pressure patterns of its progenitor. Nevertheless, this survey provides an opportunity to place in perspective the pattern of arterial tension in a Mongolian group not subjected to study before. It is evident from the data presented that not only are there differences in the distribution and in the mean values of systolic and diastolic pressures among the people of Mongolian descent and the Caucasians, but differences are to be found in closely related Mongolian groups as well. It is conceivable that these differences are largely influenced by environment.

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References


Ventilation in Mines (Circa 1550)

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