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Geographic Variation of Stature in Chinese Youth of Age 18+

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ABSTRACT The data is derived from a national survey on students constitution and health carried out by the government in 2005 in China. A total of 20707 subjects, 18-year-olds from 30 provinces and municipalities in China participated in this study. The differences of mean values of stature among different areas were compared. The 30 provinces and municipalities were divided into three groups: higher, middle and lower stature region. A map of stature distribution among Chinese youth was made, higher stature region is distributed mainly over the area around Bohai sea, north-east China and eastern coastal areas, and lower stature region is distributed mainly over the south of China. There was statistically significant correlation between the average stature of youth and the local GDP per capita, per capita annual consumption of eggs and average annual temperature. There were significant differences among districts in China. This difference is related to the local geographical conditions, socio-economic environment and genetic factors.

1. INTRODUCTION

There are wide-ranging differences in human growth. These differences are not only present in ethnic groups but also in regions. China is vast in territory and has a very large population. The natural conditions and socio-economic status are usually widely different among districts. As a result, there are obvious variations in the level of development for youth among different districts. In recent years, we have progressively understood that the statures of youth are higher in north than those in south in China (Ye 1999). However, this is a rough wording, since in some areas, they are higher along the coasts than those in inland adjacent to them (Zhang 2005). Based on the nation-wide data in 2005, this article reported the concrete geographic distribution characteristics of stature in Chinese Han nationality and the influence of environmental factors on the stature of youth. A map of stature distribution among Chinese youth in China was made.

2. SUBJECT AND METHODS

The data is derived from the national survey on students' constitution and health carried out by the government in 2005 in China. (Since 1985, a system of National Surveys on Chinese Students' Constitution and Health by Government Education and Health Department has been set up. The first author is a member of the leading group in Shandong province). The sampling method was stratified multistage sampling based on selected primary and secondary schools. All of the subjects were primary and secondary students, covering the age-range from 7 to 18 years of age, and all of them were of Han ancestry which accounts for approximately 93.3% of the total population in China. The age groups were divided following the criteria of 'exact age', so that, for example, cohort 18+ designates students aged 18.0 to 18.9 years. All subjects had a thorough medical examination before the measurements were taken. They were all in apparently good healthÿ free from overt diseases or deformities. Metal column height–measuring stands (each 200cm long with 0.1cm precision) were used to measure height. The subjects were required to stand straight on the instruments barefoot and at ease. A total of 20707 subjects of age 18+ from 30 provinces and municipalities (except Xizang, Hongkong, Macao and Taiwan) in China participated in this study. *t*- test was made on the stature between the 30 provinces and municipalities in China and the average of total youth.

In order to explore the influence of environmental factors on the stature of youth, some

major economic and climatic indicators in 30 provinces and municipalities in 2005 were obtained from the statistical yearbook released in the official website of China Statistics Bureau (http://www.stats.gov.cn/tjsj/ndsj), and the correlation coefficient between these indicators and the average stature of local youth was calculated.

3. RESULTS

There were obvious geographic variations of stature among the Chinese youth of age 18+, the maximum values of difference were 7.90cm for urban male (Liaoning, 175.41cm; Guizhou, 167.51cm), 7.28cm for urban female (Shandong, 163.11cm; Guizhou, 155.83cm), 8.33cm for rural male (Beijing, 173.90cm; Guizhou,165.57cm) and 6.85cm for rural female (Tianjin, 161.16cm; Guizhou, 154.31cm). Within the whole country, the average stature of youth in Guizhou province is the lowest.

The results of *t*- test between the 30 provinces and municipalities in China and the average of total youth are given in Table 1. According to the results of *t*- test, the 30 provinces and municipalities were divided into three groups: higher, lower and middle stature region. The higher stature region is mean that the stature of youth from urban male, urban female, rural male and rural female for each province all significant above the total means ($P< 0.05$, or 0.01), the lower stature region is mean that the stature of youth from urban male, urban female, rural male and rural female for each province all significant below the total means($P< 0.05$, or 0.01), and the middle stature region is mean those provinces except higher and lower stature region.

Table 1: Mean heights (cm), standard deviations of 18-year-old youth in 30 provinces and compare with the total average heights

Categories	*Regions*	*Urban male*		*Urban female*		*Rural male*		*Rural female*	
		n	*Mean± SD*	*n*	*Mean± SD*	*n*	*Mean± SD*	*n*	*Mean± SD*
Higher Stature	1, Heilongjiang	152	173.75±6.89*	151	161.29±5.34*	141	172.71±5.74*	150	160.41±4.72*
	2, Jilin	181	173.91±5.43*	176	161.46±4.79*	179	171.99±5.43*	179	160.15±4.50*
	3, Liaoning	158	175.41±5.88*	160	161.51±5.54*	157	173.06±6.38*	152	160.46±5.49*
	4, Beijing	213	174.97±6.76*	221	162.23±5.41*	165	173.90±5.24*	166	160.22±5.00*
	5, Tianjin	166	174.59±6.15*	168	162.06±6.09*	153	173.51±6.01*	149	161.16±5.57*
	6, Hebei	174	174.14±5.98*	188	160.69±5.45*	191	171.10±6.37*	216	159.47±5.29*
	7, Shandong	166	175.31±6.09*	156	163.11±5.47*	177	173.22±6.05*	178	160.18±6.07*
	8, Jiangsu	220	173.86±5.44*	211	160.60±4.94*	250	171.58±5.56*	205	160.13±5.07*
	9, Shanghai	150	173.68±6.05*	150	161.72±4.95*	150	172.67±5.40*	150	159.64±5.18*
Middle Stature	10, Xinjiang	213	172.08±5.92	215	160.50±5.81	213	171.21±5.78*	203	159.39±5.07*
	11, Qinghai	153	172.41±5.46	153	160.12±5.08	152	166.56±8.07$^{\Delta}$	167	158.14±4.96
	12, Gansu	184	172.56±5.84	166	159.59±5.35	188	169.90±5.50	196	157.90±4.85
	13, Neimenggu	127	172.83±6.25	130	160.26±5.27	163	171.24±5.72*	170	158.70±5.33
	14, Ningxia	218	172.64±6.29	219	160.02±5.42	236	169.82±5.67	226	158.39±5.30
	15, Shaanxi	150	170.96±6.07	150	158.95±5.26	150	168.34±5.95$^{\Delta}$	150	157.02±4.78$^{\Delta}$
	16, Shanxi	150	172.57±5.52	150	160.94±4.83*	150	170.39±5.39	150	158.32±4.84
	17, Henan	180	172.32±5.57	179	159.75±5.21	180	170.85±4.99	179	158.91±4.94*
	18, Hubei	185	170.95±5.97	176	158.56±4.86$^{\Delta}$	186	169.56±6.12	190	157.25±5.34
	19, Zhejiang	152	171.50±5.43	150	158.94±5.13$^{\Delta}$	151	170.80±5.51	150	158.32±4.43
	20, Fujian	183	172.42±5.19	196	160.23±4.92	228	170.29±5.56	236	158.96±5.33*
Lower Stature	21, Sichuan	190	170.32±5.87$^{\Delta}$	322	158.52±5.56$^{\Delta}$	216	167.19±5.51$^{\Delta}$	301	156.30±4.89$^{\Delta}$
	22, Chongqing	175	167.74±6.22$^{\Delta}$	150	156.16±5.32$^{\Delta}$	179	166.51±5.50$^{\Delta}$	172	155.40±4.67$^{\Delta}$
	23, Yunnan	161	170.64±6.59$^{\Delta}$	164	158.59±5.95$^{\Delta}$	164	168.81±5.57$^{\Delta}$	165	157.01±5.31$^{\Delta}$
	24, Guizhou	150	167.51±5.84$^{\Delta}$	150	155.83±5.17$^{\Delta}$	150	165.57±5.85$^{\Delta}$	150	154.31±5.01$^{\Delta}$
	25, Hunan	158	169.94±5.29$^{\Delta}$	143	158.63±5.34$^{\Delta}$	155	168.70±5.84$^{\Delta}$	154	156.48±6.22$^{\Delta}$
	26, Guangxi	150	170.18±5.27$^{\Delta}$	150	157.18±5.30$^{\Delta}$	150	167.46±6.00$^{\Delta}$	150	155.85±5.09$^{\Delta}$
	27, Guangdong	150	170.77±5.75$^{\Delta}$	150	158.05±5.44$^{\Delta}$	150	167.34±5.00$^{\Delta}$	150	155.74±5.08$^{\Delta}$
	28, Hainan	167	169.04±5.17$^{\Delta}$	149	156.87±4.74$^{\Delta}$	209	167.48±5.99$^{\Delta}$	135	155.73±5.17$^{\Delta}$
	29, Jiangxi	153	170.45±6.22$^{\Delta}$	154	158.62±6.09$^{\Delta}$	155	167.90±5.22$^{\Delta}$	154	155.75±5.10$^{\Delta}$
	30, Anhui	150	169.72±5.90$^{\Delta}$	150	158.56±5.15$^{\Delta}$	150	168.43±5.69$^{\Delta}$	150	156.70±5.44$^{\Delta}$
Total		5079	171.89±6.39	5147	159.78±5.60	5238	170.14±6.07	5243	158.11±5.43

* Significant above the total average height $P< 0.01$ or 0.05; Δ Significant below the total average height $P<0.01$ or 0.05

This study has shown that the higher, middle and lower stature regions consist of nine, eleven and ten provinces respectively. The average statures of youth in the three groups were calculated respectively. The average statures were 174.40cm, 171.65cm and 169.62cm for urban male, 172.62cm, 170.41cm and 167.53cm for rural male, 161.61cm, 159.81cm and 157.70cm for urban female and 160.20cm, 158.33cm and 155.94cm for rural female respectively. The average values of difference in stature between higher and lower stature region were 4.78cm for urban male, 5.09cm for rural male, 3.91cm for urban female and 4.26cm for rural female respectively.

Figure 1 shows the district distribution of stature in Chinese youth. We can clearly find out that higher stature region is distributed mainly over the area around Bohai sea northeast China and eastern coastal areas, and lower stature region is distributed mainly over the south of China.

4. DISCUSSION

There are wide-ranging differences in human growth. These differences are not only present in ethnic groups but also in regions. The obvious geographic variation of stature can be found in different countries as well as districts in the same country (Meredith 1971; Boldsen et al. 1984; Ji et al. 1991; Schmidt et al. 1995; Cavelaars et al. 2000; Padez 2002). China is vast in territory and has a very large population. As the natural conditions and socio-economic status are different among districts, the geographic variation of stature for youth is obviously too. Based on the nationwide data in 1985, the distribution of stature among rural Chinese youth from 28 provinces was analyzed. There is a tendency in the whole country that the statures are higher in north than in the south (Tang et al. 1994). More precisely, they are higher along the coasts than those in inla-

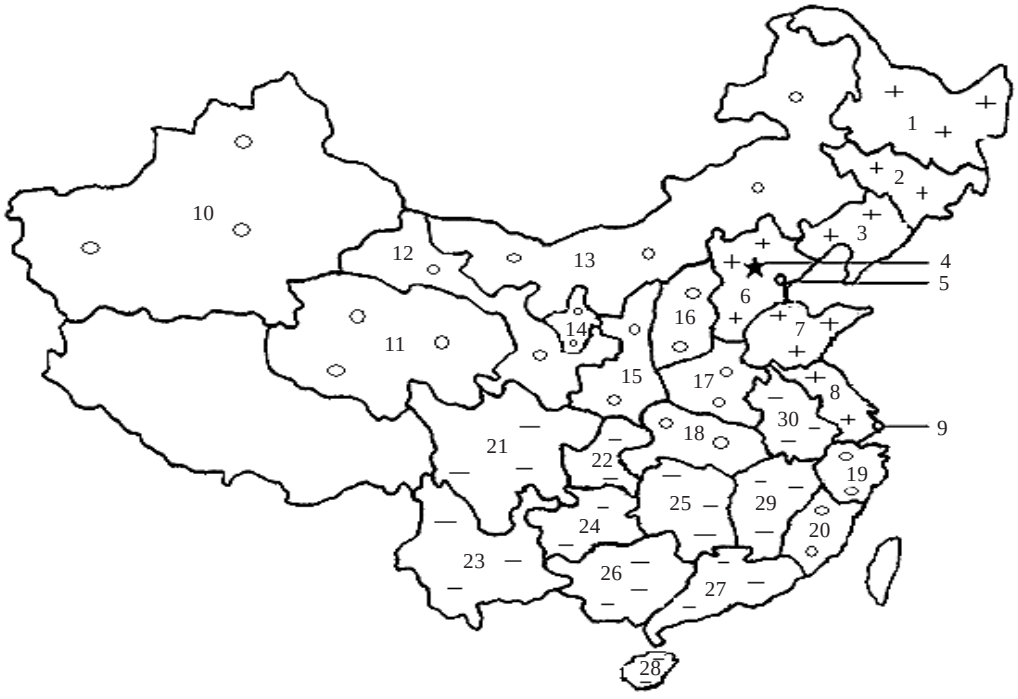

Fig. 1. The map of stature distribution in Chinese youth
+ **Higher Stature Region:** 1,Heilongjiang; 2,Jilin; 3,Liaoning; 4,Beijing; 5,Tianjin; 6,Hebei; 7,Shandong; 8,Jiangsu; 9,Shanghai.
○ **Middle Stature Region:** 10,Xinjiang; 11,Qinghai; 12,Gansu; 13,Neimenggu; 14,Ningxia; 15,Shaanxi; 16,Shanxi; 17,Henan; 18,Hubei; 19,Zhejiang; 20,Fujian.
- **Lower Stature Region:** 21,Sichuan; 22,Chongqing; 23,Yunnan; 24,Guizhou; 25,Hunan; 26,Guangxi; 27,Guangdong; 28,Hainan; 29,Jiangxi; 30,Anhui.

Table 2: The correlation coefficient between youth stature and related factors

Indicator	*Urban male*	*Urban female*	*Rural male*	*Rural female*
GDP per capita	0.548**	0.558**	0.639**	0.553**
Urban per capita income	0.302	0.300	-	-
Rural per capita income	-	-	0.578**	0.475**
The average annual temperature	-0.526**	-0.550**	-0.421*	-0.559**
Per capita annual consumption of eggs	0.630**	0.649**	0.728**	0.650**

* Correlation is significant at the 0.05 level (2-tailed),** Correlation is significant at the 0.01 level (2-tailed)

nd adjacent to them (Zhang 2005). Within the whole country, the average statures of youth in the area around Bohai sea is the highest and in Guizhou province the lowest (Zhang 2004). This study has shown that there were obvious geographic variations of stature in Chinese youth, the higher stature region is distributed mainly over the area around Bohai sea northeast China and eastern coastal areas, and lower stature region is distributed mainly over the south of China.

Geographic variation of stature is the result of a comprehensive effect involving many complicated factors, and cannot be explained by a single factor. These factors include genetic and environmental aspects: the possibility of growth is controlled by genetic factors and the reality by environmental factors. Improvements in environmental factors, including socio-economic development, nutrition and living conditions, etc., provide conditions that allow genetic potential to be fully realized. Table 2 has shown that GDP per capita, per capita income and per capita annual consumption of eggs were positively associated with the stature of local youth, in contrast, the average annual temperature was negatively associated with the stature of local youth.

This study has shown that within the whole country, the average stature of youth in Guizhou province is the lowest. It may be related to the local natural conditions and socio-economic status: Guizhou province is one of the least developed provinces which is located in Yunnan-Guizhou plateau in south-west China, where the average elevation is 1100m. It is mountainous, has more rain and is less sunlight area.

In summary, these results demonstrated that there are obvious differences in stature for youth among districts in China. The geographic distribution characteristics of stature in Chinese were related to the geographical conditions, socio-economic environment and genetic factor.

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