Analysis of height growth of Tibetan Adolescent Children living in high altitude area and Serum bone metabolism indexes

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Abstract. Objective to explore the characteristics of height growth, bone metabolism biochemical indexes and the regulation of hormone of Tibetan puberty Children in different elevation plateau environment and provide basic data for clinical use.Select 1580 people of 12~18 years Tibetan children in Tibet Lhasa and Naqu, and measure the height and the level of serum carboxyterminal propeptide of I type procollagen (PICP) and Bone glaprotein (BGP), growth hormone (GH) and insulin-like growth factor I (IGF-1).Lhasa children were significantly higher than Nagqu children in each age group in height and serum PICP, BGP, GH and IGF-1, and there is statistically significant differences. Height growth peak of Lhasa female is at the age of 12 ~ 13 years, and male is at the age 13 ~ 14 years. Serum PICP, BGP, GH, IGF-1 levels of two groups were significantly decreased with age, and is closely related to height. Height of adolescent Tibetan children in Naqu was significantly lower than that of children in Lhasa, and levels of serum bone formation markers PICP, BGP and GH, IGF-1 can reflect the height growth.

Introduction

Adolescence is the key period of human growth and development, especially the exuberant stage of bone development. Height is the mark of bone morphology growth, and regulated by growth hormone and thyroid hormone. Bone formation markers is products of osteoblasts in different differentiation stages, and indirectly reflects the growth of height.Bone formation markers is basis for clinical diagnosis of adolescent developmental disorders and treatment effect observation index of this kind of disease [1].Tibetan Plateau special folk and geographical environment may have some influence on the development of adolescent growth [2]. In this experiment, Tibetan children in two areas of Lhasa and Naqu were as the research object, and observed the height growth, the characteristics of biochemical markers of bone metabolism and the regulative hormone, and provide basic data for clinical use.

The experimental objects and methods

The experimental objects. Using the method of stratified cluster sampling, 1580 people (802 people in Lhasa, Nagqu 778 people) were randomly selected in 12~18 years old adolescent Tibetan children from large, middle and primary schools of Lhasa city (elevation 3650 meters) and Naqu area (elevation 4513 meters),and determined their height.Each of the 2 districts were divided into 7 age groups, each 24 people of male and female were randomly selected from each age group, and determined level of serum procollagen I C-terminal propeptide (PICP), Bone glaprotein (BGP), growth hormone (GH), insulin like growth factor I (IGF-1).All parents of the selected objects are Tibetan, and endocrine, liver, kidney and other diseases known to affect bone metabolism were excluded. Schools and parents signed informed consent.

Methods. Height determination Height was determined in accordance with the "Method for determination of human quality" [3], the application of the Beijing Sports Bureau provided by Ma

Dingce Grohe. Acquisition and processing of serum samples 5ml blood was drawed from the vein in 8~10am, and serum were separated packaging, then placed in the refrigerator storage of -70 ℃. Determination of serum PICP, BGP, GH and IGF-1 levels. Levels of PICP (Metra, USA) and IGF-1 (DRG, Intema-tional, USA) were measured using enzyme immunoassay and full automatic enzyme (BIOCELL 2010, Zheng Zhou) determination results. BGP (Beijing Institute of atomic energy) and GH (Tianjin Jiuding Company) were determined by radioimmunoassay, and the use of automatic gamma counter (BH6018, Beijing).

Statistical analysis. Using SPSS11.0 software, Groups were compared by t test, the same index were compared in same sex age groups using analysis of variance, correlation analysis were used between index. The difference of P<0.05 had statistical significance.

Results

Determination results of Tibetan adolescent height. Height of Lhasa area Tibetan adolescent in both men and women were significantly higher than that of Naqu area (P<0.01) (Table 1). Height growth peak of Lhasa male is at the age of 13 ~ 14 years, with the annual growth rate of 5.8%.and the female is in 12 ~ 13 years, with the annual growth rate of 3.3%.Spurt peak of Nagqu male and female were appeared at 12 ~ 13 years, with the annual growth rate of 4.9% and 5.1%, respectively. It is worth noting, the Lhasa women and Naqu men after the age of 16, the Naqu women after the age of 15 had no significant difference in height (P>0.05), which is the height of almost no growth.

Serum biochemical markers of Tibetan adolescents. The overall level of serum PICP, BGP, GH and IGF-1 in Lhasa area children were higher than that of Nagqu children, and the difference was statistically significant (P <0.05) (Table 2, 3). Serum PICP, BGP peak appeared at 12 ~ 13 years old, then decreased rapidly with the growth of age.Secretion peak of GH and IGF-1 was 14 years for Lhasa men, and women ware 13 years old, but peak appeared of Nagqu men and women respectively has a year ahead of schedule.

Relationship between height growth and serum index. serum PICP, BGP, GH and IGF-1 of Male and female children were negatively correlated with age.Effect of controlling the age factor, height and each marker were analyzed by partial correlation analysis ,and results showed that there was a positive correlation between height and 4 biochemical markers (r=0.45,0.64,0.71,0.62 P value of <0.01).

Table 1 Height levels of Tibetan adolescents in different altitude regions（$\bar{x} \pm s$）

Age (years)	Lhala Male		Naqu Male		Lhala Male		Naqu Female	
	Cases(n)	Height(cm)	Cases(n)	Height(cm)	Cases(n)	Height(cm)	Cases (n)	Height(cm)
12～	67	148.03±8.73**	54	142.01±11.17	48	146.02±9.27**	49	142.79±9.56
13～	59	150.86±7.08*△△	56	148.96±9.13△△	56	150.89±6.39△△	58	150.06±6.84△△
14～	50	159.67±7.92**△△	47	154.07±8.23△	61	154.68±7.88**△	51	151.59±8.54
15～	53	163.62±6.95**△	67	158.65±9.94△△	55	155.85±7.41 *△	47	153.64±7.31△
16～	64	166.14±7.11	57	165.24±8.05△△	49	156.58±6.35*	64	155.11±5.16
17～	73	168.86±5.02*△	66	165.53±6.68	56	157.87±5.37*	48	155.52±5.16
18～19	52	168.97±6.08*	70	166.57±7.47	59	157.23±5.66**	44	154.89±6.99
合计	418	160.87±8.59**	417	157.29±10.47	384	154.30±7.96 **	361	151.94±6.93

Height difference in different altitude regions and the same sex and age *P < 0.05, **P < 0.01, Height difference in the same area and same sex and adjacent age group, △P<0.05 △△P<0.01.

Table 2 Serum PICP and BGP levels of Tibetan adolescents in different altitude regions（$\bar{x}$ ±s）

Age	PICP（U/L）		PICP（U/L）		BGP（ng/ml）		BGP（ng/ml）	
（years）	Male Lhala	Male Naqu	Female Lhala	Female Naqu	Male Lhala	Male Naqu	Female Lhala	Female Naqu
12～	284.97±78.44*	315.20±112.42	343.34±59.20**	313.62±55.01	44.05±16.10	55.02±15.81	54.38±19.90**	29.64±11.97
13～	350.37±123.98	302.00±67.53	339.42±65.01*	270.21±49.15	66.55±24.94*	45.25±18.08	28.51±14.64 *	17.05±11.73
14～	390.99±53.61**	233.92±58.74	285.75±55.53 **	187.42±89.18	67.36±18.38**	29.99±13.07	16.69±5.42	13.23±5.86
15～	297.74±24.84**	185.73±69.23	185.82±62.00**	121.21±36.21	54.68±16.98**	25.33±13.70	12.90±3.67**	6.57±2.52
16～	217.64±98.79	189.18±68.55	125.42±46.47	107.59±31.49	37.32±12.09**	21.69±11.69	8.64±3.97*	4.78±1.78
17～	166.37±58.34	117.28±36.42	122.77±31.09	105.85±34.16	14.85±5.57	10.42±3.58	7.02±2.36 *	4.74±2.89
18～19	138.65±24.95	114.47±26.65	124.66±31.05	109.24±25.63	12.56±5.52	12.21±6.79	5.74±2.42	6.51±2.03
合计	263.79±112.02 *	204.48±6.63	218.17±107.31*	170.17±92.03	41.93±25.50 *	27.65±19.15	19.13±18.76 *	11.79±3.35

Serum PICP and BGP levels difference in different altitude regions and the same sex and age *P < 0.05, **P < 0.01.

Table3 Serum GH and IGF-1 levels of Tibetan adolescents in different altitude regions（$\bar{x}$ ±s）

Age	GH（U/L）		GH（U/L）		IGF-1（ng/ml）		IGF-1（ng/ml）	
(years)	Male Lhala	Male Naqu	Female Lhala	Female Naqu	Male Lhala	Male Naqu	Female Lhala	Female Naqu
12～	2.16±0.25*	3.42±1.06	4.85±1.43**	10.34±3.47	239.66±65.01	218.67±60.88	251.09±52.59	271.90±24.09
13～	3.45±0.97*	10.74±1.41	10.75±2.55*	7.45±2.74	281.84±28.99	284.07±53.72	297.45±41.89*	252.68±42.99
14～	12.25±2.14**	5.86±3.14	6.28±2.09**	3.25±0.78	327.50±58.26**	249.67±65.09	282.11±36.01**	229.33±45.22
15～	5.14±2.43**	4.28±1.08	5.44±1.75*	2.85±0.96	298.78±44.08**	208.57±44.72	272.17±46.34*	228.86±31.32
16～	4.34±1.14	2.76±0.66	3.14±0.98	2.42±0.95	261.24±28.38**	182.45±62.10	224.67±38.37	213.00±39.42
17～	3.07±1.35	2.37±0.54	1.76±0.85	1.88±0.44	241.23±41.23**	163.93±42.35	221.77±39.42	208.42±60.98
18～19	2.23±0.85	1.65±0.43	1.66±0.65	1.65±0.24	172.17±69.95	164.00±45.82	191.80±40.57	95.35±36.97
合计	4.95±0.93	4.44±0.18	4.84±0.65 *	4.26±0.94	260.35±67.32 *	210.81±67.15	249.41±53.78 *	228.22±46.93

Serum GH and IGF-1levels difference in different altitude regions and the same sex and age *P < 0.05, **P < 0.01,

Discussion

Human height growth is the result of long bone longitudinal growth. During adolescence, the secretion of GH increased, and consistent to time of the height growth spurt increase [4]. IGF-I and IGFBP-3 which is downstream products of GH are also consistent to height growth spurt increase with the increase secretion of GH [5].IGF-I is an essential factor in the growth of long bones, and it can stimulate the proliferation and differentiation of osteoblast cells, increased PICP and BGP production, while the latter two are representative as a sign of bone cell function, and indirectly reflect the growth of height [6, 7].

The results of the study show that height of Tibetan boys, girls in Lhasa area were significantly higher than those in Nagqu. Spurt peak of Female height in Lhasa region is 1~2 years earlier than men. Lhasa female and Nagqu male after the age of 16 years, Nagqu women after the age of 15 years, and they have basic height and no growth again.Tibetan adolescent height in each age group was lower5～10 cm than same age adolescent in the plain area, and this result suggested that the plateau region growth is lower than the low altitude and the higher the altitude, the greater the gap[8].The determination results of serum biochemical indexes also confirmed that the serum GH, IGF-I, PICP and BGP changes of young Tibetans in two regions were significantly related with the age and sex. The peak age of serum indexes of male and female in Nagqu area and the age of stable to low level are earlier than those in Lhasa, and serum indexes are favorable height growth peak age, suggesting that in Naqu area, the degree of active bone metabolism may be lower than Lhasa, bone metabolism during vigorous is relatively short, quickly reached the adult level. This paper also further proof that dynamic monitoring levels of bone formation markers PICP and BGP and the hormone GH, IGF-I, can reflect the growth status of adolescent body.

The study showed that genetic factors effect on height and size large, but diet and other economic conditions and altitude also plays a very important role[9，10].Tibet is at higher elevations, alpine hypoxia, especially carbohydrate is the main of diet in Naqu area, and high calcium food is intaked less. To improve and enhance the development condition of the local youth. Improving the nutritional status of youth in Tibet, especially the Nagqu area, is very important.

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