

An Anthropometric Study of the Head and Face in Uygurs of Xinjiang, China

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Abstract

Stature and four cephalometric measurements(head length, head breadth, bizygomatic diameter, bigonial diameter) were examined from samples of 461 Uygur in Xinjiang, China. Comparisons of head and facial morphology with geographically adjacent tribes were carried out to characterize Uygur population and to understand racial hybridity. Most of Uygur were hyperbrachycephalic as expressed by cephalic index and had larger lateral facial and smaller antero-posterior dimensions than Western Caucasians. The values of metric traits showed differences between East and West among Uygur populations. The results support the genetic diversity that seems to be caused by genetic hybridity and unequal growth between East and West in Uygur.

KEY WORDS:Uygur, Head, Face, Cephalometrics, Geographic difference,

Introduction

The Uygur population in the Xinjiang Uygur autonomous province, northwest region of China forms a distinct small ethnic group. The

region they inhabit, which is well known as historical 'Silk-Road', makes a large part of China, but most of the region is composed of desert. The Uygur have problems of poverty and social unrest. There was an abundance of

study for head and face measurements using fossil skulls in Xinjiang(Han, 1986a, b, 1991). However, no work has so far been carried out on living Uygur population.

Racial differences in craniofacial size and shape have been recognized, even though it is not known what genetic factors contribute to variations in such differences. In spite of uncertainty of genetic factors, the heritability of a trait is a function of population study. Especially, anthropometric data provide a valuable source of information on biological similarities in population groups. Recently, studies of serological analysis offered some help to estimate the genetic distances between population groups, but were most often limited in terms of sample size and the number of loci. Recent analysis of human leucocyte antigen (HLA) in Uygur population revealed a specific antigen, B59, which was known to be present in only a several populations including Korean (Han et al., 1986).

Instead of the racial classifications, studies of anthropological variation have shown how these data may be analyzed with respect to the anthropological genetics. Genetic variation is reflected in phenotypic variation. Nevertheless, recent studies revealed that genetic variances are not found in geographically remote area and in same populations migrated into the other area(Macbeth and Boyce, 1987;Relethford, 1988). But these results were not keeping with other study(Susanne et al., 1983).

The present study proposes to explore on the stature and four craniofacial measurements in Uygur population. The purpose of this study is to compare the measurements in Uygur population with those reported in other populations of geographically adjacent region

and those in Western and Korean populations. Owing to geographic difference, this study summarized the results as comparison of two populations between in east Xinjiang and west Xinjiang for some anthropometric variables.

Materials and Methods

The data were obtained as a part of a field project conducted with Uygur population in 1993. The sample consisted of 461 Uygur adults (299 males and 162 females), aged 15 to 90 years(mean age of 26.9), living in four villages in Xinjiang autonomous province, China. Uygur populations of the three villages(Aksu, Kuqa, Hotan)were analyzed as a group named 'West' and those of one village(Turpan) which is geographically distinct from the former were analyzed as 'East'. In West and East, 213 samples(117 males and 96 females) and 248 samples(182 males and 66 females) were measured respectively.

All measurements were taken by a same member to minimize personal error. Stature was measured with Martin-type stadiometer(GPM, Swiss) and cephalic and facial measurements were carried out with Martin-type spreading cephalometer(GPM, Swiss). Four cephalometric items—head length, head breadth, bizygomatic diameter, and bigonial diameter—were measured by the method of Olivier(1969). Cephalic index, the most basic proportion, was obtained by the formula, (head breadth/head length) x 100. We adopted Retzius' classification as classical distribution categories for cephalic index(Retzius, 1843). Transverse cephalofacial index(100 times bizygomatic diameter/head breadth) and zygomandibular index(100 times bigonial diameter/bizygomatic

diameter) were also obtained. Classifications of cephalofacial index and zygomandibular index were based on Olivier's method(1969).

All measurements were standardized within the age-sex cohort(Table 1) and data analysis was carried out by student t-test.

Table 1. Age and Sex Distribution of the Sample

Age	East		West		Total	
	Male	Female	Male	Female	Male	Female
15~19	48	18	29	29	77	47
20~29	71	33	53	49	124	82
30~39	39	9	13	12	52	21
40~49	13	5	8	3	21	8
above 50	11	1	14	3	25	4

Results

The means, standard deviations of the measurements and indices are shown in Table 2.

These results demonstrated sexual dimorphism in all cephalometric measurements. All the

anthropometric measurements showed larger values in males than in females, as expected. Cephalofacial index and zygomandibular index showed the sexual dimorphism, however, difference of cephalic index was not significant between males and females.

Table 2. Sex Differences of Cephalometric Measurements and Indices in Total Uygur

Parameter	Male		Female		Total	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Anthropometric measurements						
Stature*	1660.0	66.2	1555.9	56.1	1607.5	80.5
Head length*	181.8	7.1	173.3	6.5	178.9	8.0
Head breadth*	156.9	6.8	151.1	5.4	154.9	6.9
Bizygomatic diameter*	142.5	5.6	134.7	4.7	139.7	6.5
Bigonial diameter*	111.9	6.2	104.1	5.6	109.1	7.0
Indices						
Cephalic index	86.5	5.5	87.3	4.4	86.8	5.2
Cephalofacial index*	90.9	3.3	89.2	2.9	90.3	3.2
Zygomandibular index*	78.5	3.6	77.3	3.1	78.1	3.5

*expressed $P < .05$ by comparing between male and female

The distribution of the cephalic, transverse cephalofacial, zygomandibular indices into the traditional categories are presented in Table 3.

Most of subjects were hyperbrachycephalic, with cephalic index of 86.8; a few were brachycephalic. Especially, the proportions of hyperbrachycephalic were higher in East than in West. In West, mesocephalic, brachycephalic and hyperbrachycephalic heads showed relatively uniform distribution. However, in East,

only a few were mesocephalic and the majority were hyperbrachycephalic, with the others brachycephalic.

With respect to the shape of face, they were far from being so homogeneous. In zygomandibular index, Uygur had a somewhat wide jaw. A little over half had broad mandibles, another quarter had narrow jaws, and the fourth quarter were intermediate.

Table 3. Percent Distribution of Indices in Uygur Population

	Male		Female		Total	
	East	West	East	West	East	West
Cephalic index						
Dolichocephalic	0.0	6.8	0.0	0.0	0.0	3.8
Mesocephalic	4.9	28.2	0.0	10.6	3.7	20.4
Brachyocephalic	22.0	35.0	20.0	38.3	21.5	36.5
Hyperbrachycephalic	73.1	29.9	80.0	51.1	74.8	39.3
Number of sample	182	117	60	94	242	211
Transverse cephalofacial index						
Microside	46.2	23.1	66.7	60.4	51.6	39.9
Mesopside	31.3	42.7	24.2	33.3	29.4	38.5
Macropside	22.5	34.2	9.1	6.3	19.0	21.6
Number of sample	182	117	66	96	248	213
Zygomandibular index						
Narrow jaw	21.4	23.1	27.3	37.5	23.0	29.6
Medium jaw	18.1	17.9	30.3	26.0	21.4	21.6
Wide jaw	60.4	59.0	42.4	36.5	55.6	48.8
Number of sample	182	117	66	96	248	213

The mean values of 5 anthropometric measurements and 3 indices of males and females in East and West are presented in Table 4. In West, all variables showed

significant differences between males and females ($P < .05$). However, cephalic index, cephalofacial index, and zygomandibular index of males had no significance compared with

females in East. Other variables of males in East showed significance ($P < .05$). Interestingly, head length and head breadth showed geographic differences in our study. In both sexes, the head length was larger in West than in East, while head breadth in East was markedly larger than in West. Statistically, the comparison of mean values of head length and head breadth between East and West showed great significance ($P < 0.1$). Therefore cephalic index showed difference between East and West.

Table 4. Distribution of Mean for Cephalometric Measurements and Indices in East and West of the Xinjiang Uygur

Parameter	Male		Female		Total	
	East	West	East	West	East	West
Anthropometric measurements						
Stature	1662.9 ±55.5	1659.6 ±68.4	1561.3 ±52.9	1553.4 ±57.7	1596.6 ±72.3	1611.0 ±82.8
Head length	179.4* ±6.5	185.5 ±6.4	170.5** ±6.1	175.1 ±6.1	177.2*** ±7.5	180.9 ±8.1
Head breadth	158.9* ±6.1	153.7 ±6.6	152.1** ±5.6	150.4 ±5.2	157.1*** ±6.7	152.2 ±6.2
Bizygomatic diameter	143.2* ±5.6	141.3 ±5.5	135.8** ±4.7	134.0 ±4.6	141.2*** ±6.3	138.0 ±6.2
Bigonial diameter	112.5* ±6.1	110.8 ±6.0	105.3** ±5.7	103.3 ±5.3	110.6*** ±6.8	107.4 ±6.8
Indices						
Cephalic index	88.7* ±4.8	83.0 ±4.6	89.5** ±4.3	85.9 ±3.8	88.9*** ±4.7	84.3 ±4.5
Cephalofacial index	90.2* ±3.3	92.0 ±2.8	89.3 ±2.9	89.2 ±3.0	89.9*** ±3.2	90.7 ±3.2
Zygomandibular index	78.6 ±3.7	78.4 ±3.6	77.6 ±3.3	77.1 ±3.0	78.3 ±3.6	77.8 ±3.4

*expressed $P < .05$ by comparing between East and West in male Uygur

**expressed $P < .05$ by comparing between East and West in female Uygur

***expressed $P < .05$ by comparing between East and West in total Uygur

Discussion

Even if anthropological data on Uygur is meager, genetic studies of Uygur have employed blood antigen frequency and enzyme distribution pattern to analyze the racial interrelationship. Li *et al.*(1986) showed that blood enzyme glyoxalase I patterns are different among 6 ethnic groups in China, especially in comparing Uygur with Korean. Wakisaka *et al.* (1986) demonstrated among 30 races that Uygur populations have close relationship with Mexican and Caucasians except European Caucasians. Nevertheless, distribution of the specific antigen is unlike above report. Han *et al.*(1986) pointed out that the specific antigen, B59, shows distributional similarity in a few population, such as Uygur, Korean, and small tribes of northern Thailand(Lahu) etc. This discrepancy of previously published data reflected that there are considerable differences in the geographic and ethnic distribution of gene frequencies. Therefore, quantitative measurements in cephalofacial structure are valuable genetic markers in human population genetic survey.

It is worthwhile to compare the present data of Uygur with data collected from the adjacent populations even though studied by different investigators(Table 5).

Regarding to stature, Uygur at 166.0cm male and 155.6cm in female was considered small to medium when compared to worldwide populations. Hujino(1993) reported the mean height for the Uygur as 167.7cm which is somewhat

lower than adjacent minor populations, Xibo and Kazak(168.5cm and 168.9cm, respectively). But his finding is somewhat higher than ours. This can be explained by the fact that his sample included only males aged 18 to 22 years being drawn from a group. And his sample was a selected one limited to university students, relatively with good nutrition. However, our data included both sexes with variable ages. In the present study, the stature of male Uygur was expressed as 166.0cm and this mean value is in similar to above report. Hujino(1993) pointed out that in Uygur, there is no geographic difference of stature between Ili Uygur and Urumqi Uygur, geographically west and east respectively. When we compared the stature between East and West, our data also showed no difference in males, but the female Uygur in East was somewhat taller than those in West.

Zaidi(1989) published cephalofacial measurements in the Pakistani Caucasian, a geographically adjacent race with Uygur population. In studying of interracial effect on cephalometric measurements, Chung *et al.*(1986) measured the head and face in Hawaii Caucasian, who is known to be in close relationships of blood antigen with Uygur. Cephalofacial measurements in Korean by Rha(1968), Chang(1989), and Cho(1993) and those in Lahu by Shima (1942) were also reported.

Head length of Uygur in the present study was 178.9mm. This result was considered to be somewhat larger when compared to Pakistani Caucasian while much smaller than Hawaii

Caucasian. However, the head length of Uygur showed similar values to Korean and Lahu. Head breadth of Uygur was markedly larger than other Caucasian population but similar to Korean and Lahu. While it should be considered the age effects on cephalometric measurements, Farkas et al.(1992) pointed out that the head length and breadth reach full maturation at 10 to 14 years in both sexes. Therefore, cephalometric measurements of our sample can be considered as a meaningful value of adult Uygur.

The present study showed that Uygur, Korean, and Lahu have large lateral facial dimension, as measured by bizygomatic and bigonial diameter. Table 5. shows that Uygur, in spite of genetic relationship with Caucasian, is characterized by larger lateral dimensions than other Caucasian. On the other hand, the antero-posterior dimension expressed by head length showed the opposite tendency with the exception of Pakistani Caucasian. Surprisingly, the results of these observation reflected that Uygur population shows greater similarity with Korean and/or Lahu. Of course, this can be explained by the fact that Uygur were admixed with other populations historically and geographically. However, because historical data on Uygur are scanty, it seems to be impossible for the anthropometric comparisons on Uygur between past and today.

Geographic differences of cephalometric measurements are regarded as a clue for solving this problems. Geographically, Uygur of West in present study is close to Afghan and

Pakistani, known as Caucasian, and those of East have close relationship with Han tribe, major population of China. Because of these geographic relationship with other tribes, it is possible to think that Uygur has variable hybridity. In our data, head length was larger in West than in East, but head breadth showed opposite trend. Lateral facial dimension as expressed by bizygomatic diameter also showed this trend as expected. These results represented that Uygur in West is slightly narrower in head and face than those in East. Because bizygomatic diameters were affected by hybridity(Chung et al. 1986) and similar results were shown in our study, it can not be eliminated the possibility of racial crosses in Uygur.

Even if we do not have confidence that these differences are due to geographic distance completely, it can be thought geographic distance and hybridity have influence partially on the cephalometric measurements. Hybridity effects and migration effects on head and face morphology has been studied enormously. There were considerable discussion on the increased variability in hybrid population(Trevor, 1953; Relethford, 1988). However, Chung et al.(1986) reported that interracial hybridities do not affect cephalic index. And the reports that migrations have no effect on morphological characteristics are published(Macbeth and Boyce, 1987; Williams-Brangero and Blangero, 1990). These discrepancies of previous reports remained as problems to be solved.

Table 5. Means of Comparative Anthropometric Variables for some Racial Groups.

	Uygur		Caucasian		Korean	Lahu		
	present study	Hujino	Zaidi	Chung et al.				
Number	461	1	50	475	2,216	–	1,300	10
Male	299				1,532		650	10
Female	162				684		650	
Stature	1,608		1,674	–	–	–	–	
Male	1,660	1,677						1,643
Female	1,556							
Head length	178.9	–	174.2	187.6	178.4	183.1		
Male	181.8				181.9		183.2	179.0
Female	173.3				174.8		175.9	
Head breadth	154.9	–	141.9	146.7	149.7	155.6		
Male	156.9				153.1		160.8	154.5
Female	151.1				146.2		156.3	
Bizygomatic diameter	139.7	–	130.0	130.3	138.6	144.3		
Male	142.5				143.4		141.5	142.4
Female	134.7				133.7		135.1	
Bigonial diameter	109.1	–	–	101.1	–	112.1		
Male	111.8						128.2	107.7
Female	104.1						117.8	
Cephalic index	86.8	–	82.0	78.3	84.0	86.5	–	
Male	86.5				84.3			86.4
Female	87.3				83.7			
Cephalofacial index	90.3	–	92.8	–	92.6	–	–	
Male	90.9				93.7			92.4
Female	89.2				91.6			
Zygomandibular index	78.1	–	–	–	–	–	–	
Male	78.5							75.9
Female	77.3							

– not cited

The cephalic index showed that Uygur sample is predominantly hyperbrachycephalic. Significant differences of cephalic index between Uygurs in West and in East were also shown (Table 4). Hujino(1993) reported that Uygur is brachycephalic to hyperbrachycephalic and Kazak is more hyperbrachycephalic than Uygur. He discussed that the difference of cephalic index between Uygur and Kazak represents the differences of life style and hybridity. Zaidi (1989) stated that the Pakistani is brachycephalic or hyperbrachycephalic though many are dolichocephalic. His data are similar to our findings in Uygur population in West. In the previous reports(Shima, 1942; Chang, 1989), brachycephalic and hyperbrachycephalic were overwhelmingly abundant in Korean and Lahu, and this distribution is similar to Uygur population in East.

The comparison between cranial index of dry skull and cephalic index of living head should be considered worthwhile. Especially, because digged fossil skulls were believed to be Uygur historically, comparison of both index between fossil skull and living head can be considered as comparison between past and today. Han(1991) pointed out that the cranial indices of fossil skulls digged in Xinjiang Uygur autonomous province are 71.1 to 83.8. It was much smaller than cephalic index of present living head. Remarkable increase of the index in our sample may represent an example of the brachycephalization in the present people. In truth, there seems to be a general tendency toward increased brachycephaly nowadays. Such a tendency was reported in Negro(Michelson, 1943) and more recently in Japanese

(Nakashima, 1986).

Zaidi(1989) reported the cephalofacial index of 92.8 in Pakistani. Even though Pakistani has somewhat broader face than Uygur, both populations belong to mesopside, classical category meaning medium size face. In Korean and Lahu, cephalofacial indices, 92.6 and 92.4 respectively, were similar to Pakistani Caucasians (Shima, 1942; Rha, 1968), and these values were also classified to mesopside. By comparing today with past in Mexico Indians, Drusini and Tommaseo(1981) stated the slenderization due to increase of cephalic index and reduction of bizygomatic diameter. Chung et al.(1986) also reported the maternal effect on lateral dimension of face and hybridity effect on bizygomatic diameter. Even if geographic differences of cephalofacial index were shown between in East and in West, these differences were less significant. On the other hand, differences of zygomandibular index were not found between Uygur in West and those in East.

Especially, while it is known that bigonial diameter is of little racial difference but there is a definite sexual difference(Olivier, 1986), our result showed the racial and sexual differences. In addition, geographic difference was also shown. This result is supported by the report of Chung et al.(1986) stated that bigonial diameter is significantly related to the maternal effect of hybrid. However, although there were some reports that bizygomatic and bigonial diameters are altered by hybridity and time depth, it is generally known that cephalofacial index and zygomandibular index are less important categories than cephalic index to

estimate the anthropological genetic diversity.

To sum up, this study showed that Uygur is characterized by larger lateral dimensions than Caucasians, and there are some geographic differences of metric trait between East and West, as shown that Uygur in West bears some resemblance to Pakistani Caucasian but Uygur in East is more likely to resemble Korean and Lahu in appearance. Therefore, it can be thought that there is genetic hybridity of Uygur, historically and geographically. Because more work is needed to elucidate genetic diversity and characteristics of trait in Uygur population, the anthropometric studies on facial morphology and fingerprint are in progress.

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국문요약

신장 위그루인의 머리와 얼굴에 대한 체질인류학적 연구

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중국 신장성자치구에 거주하는 461명의 위그루인을 대상으로 신장, 머리길이, 머리너비, 얼굴너비, 턱너비를 측정하여 그들의 체질인류학적 특징을 알아보려고 하였다. 위그루인을 동부와 서부로 나누어 비교하고 이를 지역적으로 가까운 주위의 종족, 코카서스인, 한국인 등에서 이미 보고된 자료와 비교하여 위그루인의 형태적 특징을 구명하고자 하였다. 위그루인은 머리의 앞뒤길이가 비교적 짧고 머리와 얼굴의 너비가 긴 동양인의 특징을 많이 가지고 있었으며 같은 위그루인 중에서도 머리와 얼굴의 길이와 너비는 동부와 서부에서 큰 차이를 보였다. 측정한 길이와 너비를 이용해 산출한 지수로 부터 서부의 위그루인은 지역적으로 가까운 코카서스인과 유사하며 동부의 위그루인은 한국인 등의 동양인과 더 가까운 특징을 가지고 있음을 알았다. 이상의 차이는 주위종족과의 혼혈이나 성장의 차이와 같은 유전적 다양성에 의해 나타나는 것으로 보여진다.