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The evaluation of craniofacial dimensions in female Arak newborns (central Iran) in comparison with other Iranian racial subgroups

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SUMMARY

Although anthropometric dimensions evaluate the health of newborns, there is not enough information in this field in Iran. This study was undertaken on female newborns from Arak to determine the range of their head and face dimensions in comparison with other subgroups of the Iranian population. The means and SD of cephalic and prosopic indices were 81.5 ± 4 and 94.9 ± 8.1 respectively. The dominant type of cephalic index was mesocephalic and the rarest one was dolichocephalic. The dominant and rare types of faces were hypereuryprosopic and hyperleptoprosopic. The means of head length did not show statistically significance in the Arak, Turkmen and Fars populations, while head breadth was higher for the Arak individuals in comparison with Fars (P<0.01) and Turkmen (P<0.002). Although the mean of head circumference for the Arak was higher, there was no statistical significance in comparison with the Kurd, Turkmen and Fars racial subgroups. Morphological classification of the head showed that there were no statistical significant differences between Arak and Fars. The percent of the brachyocephalic type for Arak and Fars subgroup was statistically higher than that for Turkmen (P<0.02), while the dolichocephalic type was lower for Arak and Fars (P<0.02) Morphological classification of the face showed that there were no statistical significant differences between Arak and Fars. The most marked differences were observed in the face shapes of the Arak and Fars in comparison with Turkmen. The types of head and face of the female Arak newborns differ somewhat from those observed in populations from other parts of Iran. However, the cephalometric evaluation indicates that the craniofacial features of Arak newborns are more similar to the Fars racial subgroup living in Iran. In sum, it can be said that across the racial differences, socio-ecological factors such as colder climates and nutrition may influence craniofacial parameters.

Key words: Cephalic index – Cephalometry – Newborn – Prosopic index – Race

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Introduction

The distinctions among races by geographical location, historical origins, culture, or language have usually been subsumed into three major racial groups: Asiatic or (Mongoloid), Black (or Negroid), and White (or Caucasoid) (Coon et al., 1950; Montague, 1942).

Anthropological observations indicate not only that each racial group has its own standards (Guo, 1971; Baccon et al., 1983) but that, within the same race, each subgroup also has its own standards (Burstone, 1958).

One of the important parts of anthropometry, which considers the dimensions of head and face, is cephalometry (Williams et al., 1995). Cephalometric results are used in pediatrics, forensic medicine, plastic surgery and oral surgery (Sakakibara et al., 1999; Will et al., 1995).

Ecological, biological, geographical and racial factors influence the dimensions of the human body (Alvear and Brooke, 1978; Alcalde et al., 1998; Kumar et al., 2003; Farkas et al., 2005). These dimensions are also affected by the sex and age of the respondents (Chamella, 1997; Iscan, 2005).

The body dimensions of newborns can be a basis for all changes in anthropometric indices and later problems (Mi et al., 2000). Indeed, the use of newborns' anthropometric references for the evaluation of growth has shown that children whose growth was restricted are more predisposed to metabolic disturbances and alterations in somatic and neurocognitive development during infancy, increased morbidity and mortality in the first years of life and the appearance of chronic non-transmissible diseases during adulthood (Godfrey, 1998; McCormick, 1985).

Although the dimensions of newborns have been evaluated in some parts of Iran (Azizi et al., 1993, Golalipour et al., 2000, 2003, 2005; Mibodi et al., 1996; Shahgheibi et al., 2005), only two of such studies have compared the cephalometric characteristics of subgroups of the Iranian population (Golalipour et al., 2003, 2005).

The present study aimed at determining the cephalometric characteristics of normal newborns in Arak (Central Iran) and compares the data obtained with other racial subgroups living in Iran. The data of this research, together with other geographic anthropometric data from Iran, may help for the establishment of Iranian anthropometric norms.

Materials and Methods

This cross-sectional research was carried out in 2006 on 978 normal female newborns. **The native** populations were selected from amongst the last three generations who lived in Arak.

The anthropometric data on the newborns were measured in the delivery room immediately after birth. Their gestational ages were between 26-42 weeks. The head circumference of the newborns was determined using a tape measure around the largest occipitofrontal diameter without elasticity (+ 1 mm <n). To assess the cephalic and facial indices, Hrdlicka's method was used (Hrdlicka, 1939).

The head and face measurements determined with a Martin's spreading caliper included:

Head length = Distance between the glabellas and the furthest occipital point

Head breadth = Greatest breadth at right angles to the median plane

Facial length = Distance between the gnathion and nasion

Facial breath = Distance between the two zygomatic arches

The cephalic index (CI) was obtained from the maximum head breadth/maximum head length multiplied by 100, and for the facial index (FI) from the facial length/ bizygomatic breadth multiplied by 100. Based on these indices, the types of head and face shapes were classified as suggested by Standring et al. (2005):

Head shape	Range of Cephalic Index (CI)
Dolichocephalic	< 74.9
Mesocephalic	75 –79.9
Brachycephalic	80 – 84.9
Hyperbrachycephalic	85 – 89.9

Face Shape	Range of Prosopic Index (FI)
Hypereuryprosopic	< 79.9
Euriprosopic	80 – 84.9
Mesoprosopic	85 – 89.9
Leptoprosopic	90 – 94.9
Hyperleptoprosopic	> 95

The data for each individual was recorded in a special form and then processed using the SPSS software for Windows (version 15). Differences were tested by means of the ? [2] test; significance was set at $P < 0.05$. The data from our research were compared with the data of other racial subgroups living in Iran using ANOVA test analysis.

Results

1. The means and SD of head length, width, and circumference and the length and width of the face are depicted in Table 1.

2. Indices: The means plus SD of the cephalic index was 81.5 ± 4, and the Prosopic index was 94.9 ± 8.1 (Table 1).

3. Morphological classification of the head (Table 2): The head was classified according to the cephalic index.

The mesocephalic type was dominant with 35.7% and the hyperbrachycephalic type, with 12.4%, was the rarest.

4. Morphological classification of the face: The face was classified according to the prosopic index. The hypereuryprosopic type (66.2%) and hyperleptoprosopic type (5.5%) were the dominant and rarest types respectively (Table 3).

5. Comparison of the data on the heads and faces of female Arak newborns with other racial subgroups from Iran -the Fars subgroup living in Gorgan and Turkmen (Golalipour et al., 2005) and the Kurds (Shahgheibi et al., 2005)- are shown in figures1 and 2.

The head length of female Arak newborns did not show statistical differences with the data for Fars while head breadth showed a statistical increase for the Arak in comparison with the Fars (P<0.01) and Turkmen (P<0.002) (Fig. 1A,B). The mean of face length of the Arak showed a statistically significant decrease in comparison with the Turkmen (P<0.02), and although it was lower than the Fars, it was not statistically signifi-

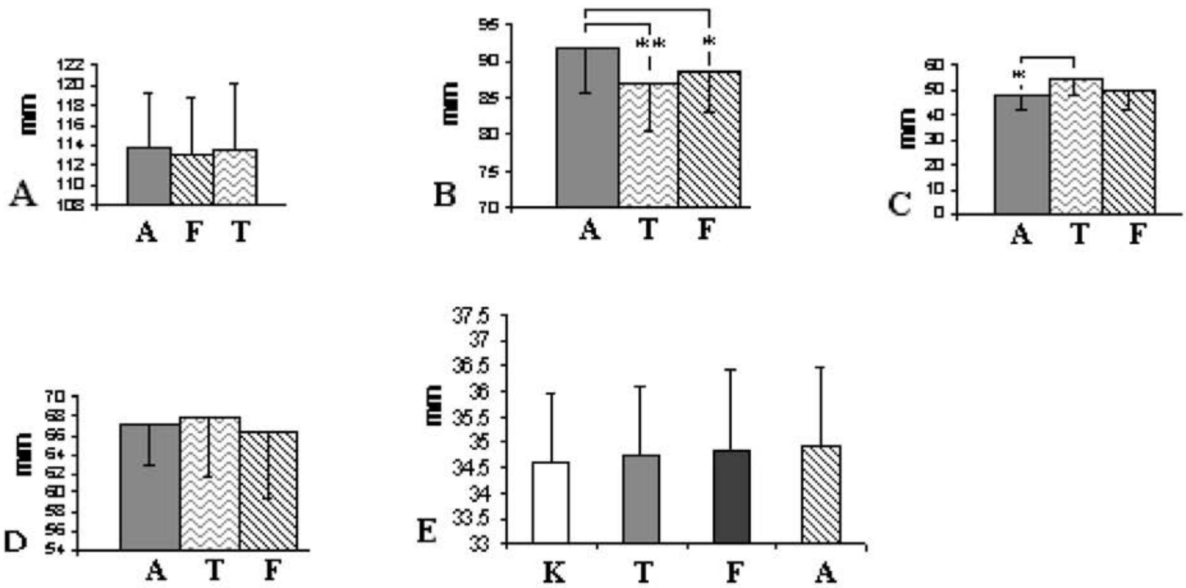

Fig. 1. Comparison of head and face measurements of female Arak newborns in comparison with the overall Iranian population (**A**) Head length, (**B**) Head breadth, (**C**) Face length (**D**), Face breadth, (**E**) Head circumference. (* P< 0.05; ** P< 0.01) (A= Arak, F= Fars, K= Kurds, T= Turkmen).

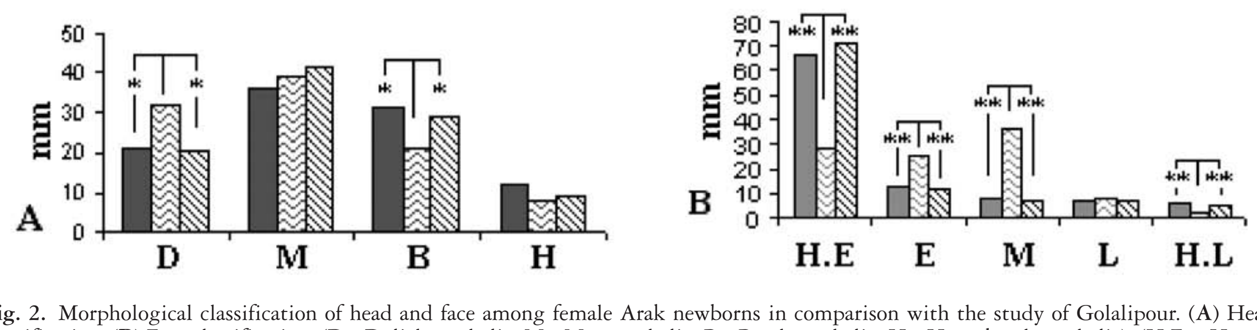

Fig. 2. Morphological classification of head and face among female Arak newborns in comparison with the study of Golalipour. (**A**) Head classification, (**B**) Face classification. (D= Dolichocephalic, M= Monocephalic, B= Brachycephalic, H= Hyperbrachycephalic). (H.E = Hypereuryprosopic, E= Euryprosopic, M= Mesoprosopic, L= Leptoprosopic, H.L= Hyperleptoprosopic) (* P< 0.05; ** P< 0.01).

Arak Turkman Fars

cant (Fig. 1C). Although, the face breadth of Arak was lower than that of the Fars subgroup from Gorgan and higher than that of the Turkmen, the difference was not statistically significant (Fig. 1D).

The head circumference of the female Arak newborns was higher than that of the other racial subgroups but it did not show statistical differences with those of the Fars, Kurds and Turkmen (Fig. 1E).

Morphological classification of the head revealed that there were no statistically significant differences between the Arak and Fars. Comparison of head shapes showed that the percentage of the brachycephalic type for the Arak and Fars subgroups was statistically higher than that for Turkmen ($P<0.02$), while the dolichocephalic type was lower for the Arak and Fars ($P<0.02$) (Fig. 2A).

Morphological classification of the face showed that the dominant type was hypereuryprosopic for both Fars subgroups from Gorgan and Arak, while it was of the mesoprosopic type for the Turkmen. There were no any significant differences in the morphological classification of faces between the Arak and Fars. A statistically significant difference was observed in the morphological classification of the face of the Turkmen with respect to the other two subgroups. Indeed, the hypereuryprosopic type showed a statistically significant decrease in comparison with the Arak ($P<0.001$) and Fars ($P<0.001$). This decrease was also seen for the euryprosopic ($P<0.001$) in comparison with the Arak ($P<0.0009$ as compared with Fars) and hyperleptoprosopic ($P<0.001$ as compared with the Arak) and $P<0.001$ as compared with the Fars subgroup. The range of mesoprosopic type in the Turkmen was higher than in the Arak and Fars ($P=0.001$) (Fig. 2B).

Table 1. Means ± SD of several cephalo-facial measurements among female Arak newborns.

	Length		Breadth		Indices		Circumference (of head)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Head	114	5.1	92.1	5.9	81.5	4	346	14
Face	48.4	5	67	4.1	94.9	8.1	-	

Table 2. Morphological Classification of heads among female Arak newborns.

Dolicocephal N (Percent)	Mesocephal N (Percent)	Brachycephal N (Percent)	Hyperbrachycephal N (Percent)
203 (20.7)	349(35.7)	305 (31.2)	121 (12.4)

Table 3. Morphological classification of faces among male Arak newborns.

Hypereuryprosopic N (Percent)	Euryprosopic N (Percent)	Mesoprosopic N (Percent)	Leptoprosopic N (Percent)	Hyperleptoprosopic N (Percent)
647 (66.2)	128 (13.1)	83 (8.5)	66(6.8)	54 (5.5)

Discussion

In our study, we measured head circumference (HC), head breadth (HB), head length (HL), face length and face breadth in order to determine the differences between normal Arak newborns with other racial subgroups, Kurds, Fars and Turkmen living in Iran.

Measurement of the maximal occipitofrontal circumference or HC provides a simple and reproducible measurement (Tanner, 1990). Figure 1E compares the mean HC of normal Arak newborns with other Iranian subgroups. The HC of all the subgroups did not show significant differences, such that this parameter masks the effect of race factor (Fig 1E). This means that, there is similarity in the HC between the Asiatic and Caucasoid subgroups. This observation, in agreement with other studies, shows that although the HC of newborns of different races differs from each other, those differences were not statistically significant (Alexander, 1996; Thomas et al., 2000).

Kurds, who live in the west of Iran, and Turkmen, who live in the north-east of the country have many ethnic similarities, but both of these two subgroups have many ethnic differences with the Fars subgroup. Fig. 1E showed there were no significant differences in the head circumference of newborns in the Arak, Kurd, Turkmen and Fars populations living in Gorgan.

This confirms the notion that the differences observed between the different populations of the region can be explained by ecological reasons and not ethnic differentiation alone (Alexeeva, 2005).

The present results indicate that the head length of newborns is 114 ± 5.1 while head breadth is 92.1 ± 5.9 (Table 1). The mean head length of newborns for the Fars subgroup in Gorgan is 113.08 ± 5.6 and head breadth is 88.53 ± 5.6 for Turkmen (Golalipour, 2005). Figure 1A shows that there are no significant differences in the head length of the Arak and Fars subgroup from Gorgan. However, mean of head length in Arak was higher than for the Fars subgroup from Gorgan. Head breadth was statistically greater than for the Arak in comparison with the Fars subgroup from Gorgan (Fig. 1B). Finally, theses differences in head size point to a higher distribution of brachycephalic and hyperbrachycephalic types, with no significant differences for the Arak as compared to the Fars subgroup from

Gorgan (Fig. 2A). It is been reported that the distribution of brachymorphic types are higher in mountain living people in comparison with those who live on steppes (Alexeeva, 1977). Brachycephalization is the result of secular changes in the growth rate in head breadth and head length, both being components of the cephalic index. Moreover, the fact that very rapid secular changes in height and head breadth occur simultaneously suggests that common environmental factors with direct effects on growth would influence both height and head breadth (Kouchi, 2000).

Thus, the increased amount of head breadth and head length of Arak newborns can be explained in terms of the height of the city of Arak (1700 m above sea level) as compared with Gorgan (150 m above sea level) where the nutrition pattern of these two Caucasoid subgroups are the same.

This is in agreement with the results of other anthropometrical studies carried out in central Asia that have reported that craniofacial differences between two subgroups of mongoloids are derived from ecological conditions and are not affected by nutrition.

These studies separate the morphological features of the people of central Asia into two forms, according to the altitude of the lands they live in; steppe zones and taiga regions. These studies also confirm that because nutrition in all parts of central Asia is the same (rich in protein and fatty food), nutrition can hardly explain the differences in body build among the native populations of Central Asia (reviewed in Alexeeva, 2005).

Although anthropometric indices are influenced by gonadal steroids, the secretion of adrenal androgen levels in both boys and girls is not affected by nutrition or altitude (Farkas et al., 1998; Gonzales et al., 1994). Moreover, there is no documentation about the effect of altitude on the secretion of female hormones. Thus, altitude causes craniofacial differences among racial subgroups without changing the secretion of gonadal steroids of female newborns.

Face length of the Arak newborns was 48.4 ± 5 and face breadth was 67 ± 4.1(Table 1). The mean face length of female newborns for the Fars subgroup in Gorgan was 49.07 ± 7.22 and face breadth was 66.4 ± 7 (Golalipour, 2005). A strong association between head breadth (HB) and face breadth or bizygomatic breadth (BZB) appears to be a universal phenomenon (Mizoguchi, 1992). However, the present results indicate that HB and BZB react differently to factors that cause brachycephalization; thus, HB increased, but BZB did not. It has been assumed that craniometric and somatometric data provide very similar information about secular changes, and this assumption can apparently be applied to measurements of the neurocranium.

The dominant type of newborn head shape was mesocephalic for the Arak, the Fars subgroup living in Gorgan, and the Turkmen, with no significant differences. However, the types of head shape among three groups were somewhat diverse.

Anthropological studies on the basis of racial changes have determined that the dominant head type in people from Africa, India, Australia, the central part of Europe and North America is dolichocephalic, whereas in the Pacific Ocean it is brachycephalic, and in the Atlantic Ocean border, the Middle East, Russia and central parts of Asia it is mesocephalic (Chamella, 1997).

In the case of prosopic indices, the dominant type of face shapes was hypereuryprosopic for the Arak and Fars (Table 2 and Fig. 2B) and the distribution of face shape was similar for the Arak and the Fars subgroup from Gorgan. This shows that neither the environmental nor nutritional factors influence the dominant type of the face and head shapes among subgroups of an individual race.

The dominant type of face shape of the Turkmen was mesoprosopic, differing from that for the Arak and the Fars subgroup from Gorgan. These data indicates that face shapes are more influenced by racial factors than head shapes.

The craniofacial evaluation of female Arak newborns reveals a considerable similarity with the Fars subgroup living in Gorgan, and the existence of some differences can be explained in terms of the environmental factors that separate these two racial subgroups from each other. Although some craniofacial measurements, such as HC, do not show statistical differences in different subgroups of Iran, it seems that the distribution of the prosopic index is the parameter most influenced by the race.

In conclusion, it can be said that across the racial differences ecological factors such as colder climates may influence craniofacial parameters.

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