

Comparison of the Cranial Capacity and Brain Weight of Arak (Central Iran) with other Subgroups of Iranian Population

Comparación de la Capacidad Craneana y el Peso del Cerebro de Arak (Irán Central) con otros Subgrupos de la Población Iraní

*Parvin Dokht Bayat & **Ali Ghanbari

BAYAT, P. D. & GHANBARI, A. Comparison of the cranial capacity and brain weight of Arak (Central Iran) with other subgroups of Iranian population. *Int. J. Morphol.*, 28(1):323-326, 2010.

SUMMARY: Newborn's body dimensions such as brain weight and cranial capacity can be basis for all changes in anthropometric indices and later problems. This study is undertaken on 978 term-born normal and native newborns in Thaleghany Hospital, Arak, Iran. The measurements of the heads were done according classic cephalometry. The cranial capacity and brain weight of males and female statistically evaluated by using χ^2 - and t test and significance was set up at $p < 0.05$. Means and SD of the cranial capacity were 606.2 ± 26 and 440.82 ± 28 for males and females. Means and SD of the brain weight were 627.41 ± 30 for males and 456.24 ± 32 for females. The data showed that cranial capacity and brain weight of males were greater for males than that for females. This data in accompany with other studies proves that, the manner of distribution of cranial capacity and brain weight neither is depend on the age nor the ethnicity of correspondents in Iranian population. The differences in the data of this study with other studies in Iran confirm the effect of ethnicity and environmental condition on cranial capacity and brain weight of Iranian population.

KEY WORDS: Cranial capacity; Brain weight; Ethnicity; Hrdlic̃ka's method; New born.

INTRODUCTION

Physical anthropology is a branch of science which separates human races; evaluates the effects of geographical, ecological and biological factors and also determines the influence of sex and age on physical characteristics of correspondents by comparing the physical dimensions of the body (Alvear & Brooke, 1978; Coon *et al.*, 1950; Farkas *et al.*, 2005; Kumar & Reddy 2003; Montague 1942).

Cranial capacity, which is in close correlation with brain volume, is especially influenced by the race and is thus one of the most common measurements made in physical anthropological studies (Hwang *et al.*, 1995). Cranial capacity and brain weight can be measured indirectly in living subjects (Dekaban, 1977; Verdun & Bourdiol, 1962).

Newborn's body dimensions can be basis for all changes in anthropometric indices and later problems (Mi *et al.*, 2000). Indeed, the use of newborn's 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).

One of the important parts of anthropometry that considers the dimensions of head and face is cephalometry (Standing *et al.*, 2005). Although the dimensions of newborns are evaluated in some part of Iran (Azizi, 1993; Golalipour *et al.*, 2000, 2003, 2005a; Mibodi & Farahani, 1996) but only one author compared craniofacial characteristics of subgroups of Iranian population (Golalipour *et al.*, 2003; Golalipour & Heydari 2004; Golalipour *et al.*, 2005b) and the only one report compared the cranial capacity and brain weight in newborns of different parts of Iran (Golalipour & Heydari 2004). However, there

* Assistant professor in the Department of Anatomy at the Arak Medical School, Arak University of medical sciences, Arak, Iran.

** Assistant professor in the Department of Anatomy at the kermanshah Medical School, Kermanshah University of medical sciences, Kermanshah, Iran.

was no data in the field of evaluating cranial capacity and brain weight of female newborns within subgroups of Iranian population.

In this study, normative values for brain weight and cranial capacity of an Iranian population (newborns in Arak, Central Iran) are presented. In addition, these craniofacial dimensions are evaluated with the data of other racial subgroup living in Iran.

MATERIAL AND METHOD

This cross sectional research was carried out in the year 2006 on 978 term-born normal and native newborns in Thaleghany Hospital. Native populations have been selected from amongst last three generations who lived in Arak.

The anthropometric data for the newborns were measured in the delivery room immediately after birth. Their gestational ages were between 26-42 weeks. For assessing the cephalic and facial indices we used classic cephalometric method (Hrdlic`ka, 1939).

The head measurements that were determined by Martin’s spreading caliper included:

- Head length = Distance between the and the furthest occipital point
- Head breadth = Greatest breadth, at right angles to median plane
- Auricular height = Distance between external acoustic meatus to the vertex.

Cranial capacity (CC) was determined by the following formula (Manjunath, 2002; Standring *et al.*).

Males: $0.000337 (L - 11) (B - 11) (H - 11) + 406.01$.

Females: $0.000400(L-11) (B-11) (HT-11) +206.60$

Brain weight and the cerebral index were determined as follows:

Brain weight = cranial capacity \div 1.035, where 1.035 is the mass density of the brain, and cerebral index = brain weight/body weight.

The data for each individual was recorded in a special form and then processed using SPSS software for windows (version 15). Differences were tested by means of the χ^2 -test; significance was set up at $p < 0.05$.

RESULTS

The means and standard deviations of body weight, head length, head width and auricular height in Arak newborns are depicted in the Table I.

The mean cranial capacities in Arak newborns were 606.2 ± 26 for males and 456.24 ± 32 mm for females which showed significant difference ($p < 0.02$).

The mean brain weights in Arak newborns were 627.41 ± 30 for males and 456.24 ± 32 mm for females which showed significant difference ($p < 0.018$).

DISCUSSION

In this research, the cranial capacity and brain weight of male's newborns were greater than the females. There was evidence which evaluated the cranial capacity and brain weight between male and female of Iranian newborns population (Mibodi & Farahani). However, in compared with this study and the other which is carried out on 17-20 Years old population of Iran, the cranial capacity and brain weight of males are greater than that for females in accompany with the result of the study (Golalipour *et al.*, 2005b; Mibodi & Farahani).

The native Arak population belongs to the majority racial subgroup of Iran called Fars. There are two report in the case of cranial capacity of male new born among Iranian majority racial subgroup: Mibodi & Farahani in in Tehran,

Table I. Mean \pm SD of body weight, head length, head width and auricular height in Arak newborns

Parameters	Males	Females	Mean	p value
Head length, mm	114.2 \pm 4.8	114 \pm 5.1	114.1 \pm 4.95	0.09
Head width, mm	92.2 \pm 5.7	92.1 \pm 5.9	92.15 \pm 5.8	0.12
Auricular height, mm	81.8 \pm 7.1	81.1 \pm 6.8	81.45 \pm 6.95	0.085
Cranial capacity	606.2 \pm 26	440.82 \pm 28	523.41 \pm 27	0.02
Brain weight	627.41 \pm 30	456.24 \pm 32	541.82 \pm 31	0.018

Iran (557 ± 61.3 ml) and Ghalipour & Heydari in native Fars subgroup in Gorgan (599 ± 30 ml).

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

Moreover, it's been recently shown that high altitude can change the anthropometric data of new born (Julian *et al.*, 2009) thus the higher cranial capacity and brain weight of Arak new born can be explain by the height of Arak city (1700m above sea level) in compared with Tehran (1191 m) and Gorgan (150 m).

The anthropometrical studies derived in central Asia showed the craniofacial differences of two subgroups of mongoloid is derived from ecological condition and is not affected by nutrition. Because of the similarity in the pattern of nutrition in three subgroups of Iranian population (Arak, Tehran and fars subgroup of Gorgan), in agreement with Alexeeva (2005) we declare that the cranial capacity

and brain weight of Iranian population is not affected/ or the least affected by the nutritional factor.

In conclusion, the manner of distribution of cranial capacity and brain weight between males and females in Iranian population is not affected by the differences in ethnicity or geographical features. Indeed, in all parts of Iran, the cranial capacity and brain weight of males are higher than that for females. We suggest that the differences in cranial capacity and brain weight of this study in comparison with other related studies in Iran is derived from both ethnicity and geographical factor and the nutrient is less effective.

ACKNOWLEDGEMENTS

We appreciate the research department of Arak University of Medical Sciences and newborns ward of Thaleghany Hospital in Arak and Raphyi, M. for statistical analysis.

BAYAT, P. D. & GHANBARI, A. Comparación de la capacidad craneana y el peso del cerebro de Arak (Irán central) con otros subgrupos de la población Iraní. *Int. J. Morphol.*, 28(1):323-326, 2010.

RESUMEN: Las dimensiones corporales del recién nacido tales como el peso del cerebro y la capacidad craneal puede ser la base para todos los cambios en los índices antropométricos y problemas futuros. Este estudio se llevó a cabo en 978 recién nacidos normales en el Hospital Thaleghany, recién nacidos nativos de Arak, Irán. Las medidas de las cabezas se realizaron de acuerdo a la cefalometría clásica. La capacidad craneal y el peso del cerebro de hombres y mujeres fueron evaluados estadísticamente mediante el uso de c^2 y prueba T, con un nivel de significancia de $p < 0.05$. La media y DS de la capacidad craneal fueron $606,2 \pm 26$ y $440,82 \pm 28$ para los hombres y mujeres, respectivamente. La media y DS del peso del cerebro fueron $627,41 \pm 30$ g para los hombres y $456,24 \pm 32$ g para las mujeres. Los datos mostraron que la capacidad craneana y el peso del cerebro fue mayor en los hombres que en las mujeres. Estos datos junto con otros estudios, demuestran que la forma de distribución de la capacidad craneana y el peso del cerebro no dependen de la edad ni el origen étnico de la correspondiente población Iraní. Las diferencias en los datos de este estudio con otros estudios en Irán confirman el efecto de la etnicidad y la condición del medio ambiente en la capacidad craneana y el peso del cerebro de la población Iraní.

PALABRAS CLAVE: Capacidad craneal; Peso del cerebro; Etnia; Método de Hrdlic̃ka; Recién nacido.

REFERENCES

- Alexeeva, T. I. Anthroecological investigations in Central Asia. *J. Physiol. Anthropol. Appl. Human Sci.*, 24(4):285-7, 2005.
- Alvear, J. & Brooke, O. G. Fetal growth in different racial groups. *Arch. Dis. Child.*, 53(1):27-32, 1978.
- Azizi, F. The survey of infant's weight and height in Tehran. *Journal of Daru and Darman*, 26:5-12, 1993.
- Bacon, W.; Girardin, P. & Turlot, J. C. A comparison of cephalometric norms for the African Bantu and a caucasoid population. *Eur. J. Orthod.*, 5(3):233-40, 1983.
- Burstone, C. J. The integumental profile. *Am. J. Orthod.*, 44:1-25, 1958.
- Coon, C. S.; Garn, S. M. & Berisll, J. B. *Races: A study of the problems of race formation in man*. Springfield,

- Charles C. Thomas, 1950. pp.65-71.
- Dekaban, A. S. Tables of cranial and orbital measurements, cranial volume, and derived indexes in males and females from 7 days to 20 years of age. *Ann. Neurol.*, 2(6):485-91, 1977.
- Farkas, L. G.; Katic, M. J.; Forrest, C. R.; Alt, K. W.; Bagic, I.; Baltadjiev, G. et al. International anthropometric study of facial morphology in various ethnic groups/races. *J. Craniofac. Surg.*, 16(4):615-46, 2005.
- Godfrey, K. M. Maternal regulation of fetal development and health in adult life. *Eur. J. Obstet. Gynecol. Reprod. Biol.*, 78(2):141-50, 1998.
- Golalipour, M. J.; Vakikili, M. A. & Ahmadvpour, M. The relation of weight and height with race, parity, age and kind of delivery of mother. *J. Quzvin. Univ. Med. Sci.*, 16:58-64, 2000.
- Golalipour, M. J.; Haidari, K.; Jahanshahi, M & Farahani, R. M. The shapes of head and face in normal male newborns in South-East of Caspian sea (Iran-Gorgan). *J. Anat. Soc. India*, 52:28-31, 2003.
- Golalipour, M. J. & Heydari, K. Effect of the ethnic factor on cranial capacity and brain weight of male newborns in northern Iran. *Neuroembryol Aging*, 3:146-8, 2004.
- Golalipour, M. J.; Jahanshahi, M. & Haidari, K. The variation of head and face shapes in female newborns in the South-East of the Caspian sea (Iran-Gorgan). *Eur. J. Anat.*, 9(2):95-8, 2005a.
- Golalipour, M. J.; Jahanshaei, M. & Haidari, K. Estimation of Cranial Capacity in 17-20 Years Old in South East of Caspian Sea Border (North of Iran). *Int. J. Morphol.*, 23(4):301-4, 2005b.
- Guo, M. K. Cephalometric standards of Steiner analysis established on Chinese children. *J. Formosa Med. Assoc.*, 70:97-102, 1971.
- Hrdlic̃ka, A. *Practical Anthropometry*. Philadelphia, Wistar Institue, 1939.
- Hwang, Y. I.; Lee, K. H.; Choi, B. Y.; Lee, K. S.; Lee, H. Y.; Sir, W.S. et al. Study on the Korean adult cranial capacity. *J. Korean Med. Sci.*, 10(4):239-42, 1995.
- Julian, C. G.; Wilson, M. J. & Moore, L. G. Evolutionary adaptation to high altitude: a view from in utero. *Am. J. Hum. Biol.*, 21(5):614-22, 2009.
- Kumar, V. & Reddy, B. M. Status of Austro-Asiatic groups in the peopling of India: An exploratory study based on the available prehistoric, linguistic and biological evidences. *J. Biosci.*, 28(4):507-22, 2003.
- Manjunath, K. Y. Estimation of Cranial Volume-an Overview of Methodologies. *J. Anat. Soc. India.*, 51:85-91, 2002.
- McCormick, M. C. The contribution of low birth weight to infant mortality and childhood morbidity. *N. Engl. J. Med.*, 312(2):82-90, 1985.
- Mi, J.; Law, C.; Zhang, K. L.; Osmond, C.; Stein, C. & Barker, D. Effects of infant birthweight and maternal body mass index in pregnancy on components of the insulin resistance syndrome in China. *Ann. Intern. Med.*, 132(4):253-60, 2000.
- Mibodi, I. M. A & Farahani, M. R. Study of normal range of anatomical dimensions of one- day old newborn by cephalometry. *J. Med. Counc. Islamic Repub. Iran*, 14:1-8, 1996.
- Montague, A. *Man's most dangerous myth. The fallacy of Races*. New York, Columbia University Press, 1942.
- Standring, S.; Ellis, H.; Healy, J. C.; Johnson, D.; Williams, A. & Collins, P. *Gray's anatomy*. 39th Ed. London, Elsevier – Churchill Livingstone, 2005. pp.487-9.
- Verdun, M & Bourdiol, R. The disproportions of cranial volume. Anthropometric criteria. Mental and psychosocial correlations. Etiological research based on the study of 281 male subjects from 9 years to the adult age. *Bull. Acad. Natl. Med.*, 146:392-407, 1962.

Correspondence to:
Ali Ghanbari, Ph. D
Fertility and infertility center
School of Medicine
Kermanshah University of Medical Sciences
Sorkheh_Ligeh,
Kermanshah, P.O.
Box 1568.
IRAN

Email: aghanabri@kums.ac.ir

Received: 01-11-2009

Accepted: 27-02-2010