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Research Article

An ultrasonographic evaluation of foetal head types during second and third trimester of pregnancy

Dr. Lokesh Goyal[1], Dr. Prem Chandra Srivastava[2], Dr. Sangita Agarwal[3], Dr. Shikha Saxena[4], Dr. Ranjana Gupta[5]

[1]Associate Professor, Department of Radiodiagnosis, Rohilkhand Medical College & Hospital, Bareilly-243006, U.P., India

[2]Professor, Department Of Forensic Medicine, Rohilkhand Medical College & Hospital, Bareilly-243006, U.P, India

[3]Professor and Head, Department of Pharmacology, Varun Arjun Medical College & Hospital, Shahjahanpur, U.P., India

[4]Assistant Professor, Department of Biochemistry, Rohilkhand Medical College & Hospital, Bareilly-243006, U.P., India

[5]Associate Professor, Department of Obstetrics & Gynaecology, Rohilkhand Medical College & Hospital, Bareilly-243006, U.P., India

***Corresponding author**
Dr. Prem Chandra Srivastava
Email: premshikha1115@rediffmail.com

Abstract: Among foetuses of different population, mesocephalic, brachycephalic and hyperbrachycephalic heads have been frequent. The present research was conducted to study various head types and its distribution among foetuses after first trimester up to full term of pregnancy by ultrasonography. Brachycephalic (5.2%) head was more frequent than hyperbrachycephalic (3.2%) during first four weeks of second trimester. During 16.1-20 weeks of gestational age, brachycephalic head type (6.4%) predominated over mesocephalic and hyperbrachycephalic. Mesocephalic head (4%) ranked next to brachycephalic (5.2%) during 20.1-24 weeks. But during 24.1-32 weeks, mesocephalic head predominated over brachycephalic head. During subsequent age interval, brachycephalic type (17.2%) outnumbered mesocephalic type (10.4%) and continued to dominate (11.2%) over mesocephalic head (2.8%) up to full term. Overall, brachycephalic foetal head type constituted the major chunk (54%; CI 82.11 ± 1.39) followed by mesocephalic (33.6%; CI 77.88 ± 1.36) and hyperbrachycehalic head (8.4%; CI 86.67 ± 1.16). Dolichocephalic head was noted to be the least (4%; CI 73.2 ± 3.16) among the foetuses during 12.1 – 40 weeks of gestation. The present study concluded that the commonest type foetal skull was brachycephalic followed by mesocephalic whereas dolichocephalic was the least common type in this part of country.
Keywords: Foetus, Cephalic index, Gestational Age, Brachycephalic, Mesocephalic

INTRODUCTION

Anthropology is the scientific study of humankind [1]. According to Cambridge Dictionary, Anthropology is defined as"the study of the human race, its culture and society, and its physical development". Cephalometry is an important tool for anthropologists and forensic experts used for identification of the racial differences, sexual differences, comparison of changes between parents, offspring and siblings towards their genetic transmission of inherited characteristics and also to a great extent for the facial reconstruction of disputed identity. Cephalic index is one of the parameters that help to differentiate between different human races.

Various studies on cephalometry have been conducted in our country and accordingly human population has been categorised as different head types based on cephalic index in a particular population. Majority of these studies has been conducted on adult population. Only few studies have been conducted among foetuses so far in India with various conclusions as far as distribution of foetal head types is concern. Out of various head types, mesocephalic, brachycephalic and hyperbrachycephalic head has been shown to be frequent among foetuses of different population as far as gestational age group has been concerned [2,3].

The aim and objective of the present research work was to study various head types and its distribution among foetuses after first trimester up to full term of pregnancy by ultrasonography. This study will serve as basis of comparison for future studies in the same as well as other geographical region population.

MATERIAL & METHODS

The present study was conducted in the Department of Radiodiagnosis, Rohilkhand Medical College & Hospital, and Bareilly and at Ganesh diagnostic, Bareilly, U.P. (India) on pregnant women who were advised for ultrasonography with certain indications conforming the provisions and guidelines of the Pre-Conception and Pre-Natal Diagnostic Techniques (Prohibition of Sex Selection) Act, 1994. The data was collected from two hundred fifty healthy pregnant women during routine ultrasonography in the 2^{nd} and 3^{rd} trimester with a single live foetus after taking informed and understood consent. Pregnant women with diabetes mellitus, hypertension, renal disease, thyroid disease, tuberculosis, asthma, and with complications of pregnancy known at the moment of the ultrasound scan e.g. bleeding, pre-eclampsia, etc. were excluded from the study. Subjects with congenital anomalies including craniocephalic abnormalities and other foetal malformation, polyhydramnios & oligohydramnios, intrauterine growth retardation, etc. if detected during the examination were also excluded from the study.

Bi-parietal diameter (BPD), occipito-frontal diameter (OFD and femur length measurements was taken into consideration to calculate average gestational age (in weeks) of each foetus. The foetuses after 12 weeks were categorised into groups with four weeks of age intervals up to full term. Both diameters i.e. OFD and BPD were measured from outer to outer margin using a gray scale real time ultrasonographic scanner, medison sonoace X-8, 3.5MHz sector transducer. Foetal bi-parietal diameter measurements were made in an axial plane at the level where the continuous midline echo is broken by the cavum septum pellucidum in the anterior third and that includes the thalamus [4]. This transverse section should demonstrate an oval symmetrical shape. Measurement of BPD was from the outer edge of the closest temporo-mandibular bone to the outer edge of the opposite temporo-mandibular bone. The occipito-frontal diameter (OFD) was measured in the same plane between the leading edge of the frontal bone and the outer border of the occiput. The cephalic index (CI) was calculated as the ratio of the same two diameters multiplied by 100 (BPD/OFD × 100). Based on this CI value, the foetal heads were categorised as dolicocephalic, mesocephalic, brachycephalic and hyperbrachycephalic head with cephalic index value ≤74.9, 75.0 - 79.9, 80.0 - 84.9 and 85.0 - 89.9 respectively [5]. The data was collected, compiled and analyzed, and Mean and standard deviation (SD) were calculated using computer software Microsoft Excel 2007 software.

RESULTS

Out of 250 foetal heads, we observed more numbers of head shape being brachycephalic (5.2%) followed by hyperbrachycephalic (3.2%) whereas none of the heads was in dolichocehalic category during first four weeks of second trimester. During 16.1-20 weeks of gestational age, brachycephalic head type (6.4%) predominated over mesocephalic and hyperbrachycephalic (1.6 each). Mesocephalic head (4%) ranked next to brachycephalic (5.2%) during 20.1-24 weeks. However, dolichocephalic head outnumbered (1.6%) during this age as compared to other gestational age intervals. But during 24.1-32 weeks, mesocephalic head predominated over brachycephalic head. Again during subsequent age interval, brachycephalic type (17.2%) reoccupied its position over mesocephalic head type (10.4%) and continued to dominate (11.2%) over mesocephalic head (2.8%) up to full term. However, we could not note any foetal head in dolichocephalic and hyperbrachycephalic category during the last gestational age interval. [Table-1]

Table 1: Distribution of foetal head type during second & third trimester

Gestational Age (Weeks)	Number (n) (%)	Head Shape (Type of Skull)							
		Dolicocephalic heads (≤74.9)		Mesocephalic heads (75 - 79.9)		Brachycephalic heads (80 - 84.9)		Hyperbrachycephalic heads (85 - 89.9)	
		Mean ± SD	(n) (%)	Mean ± SD	(n) (%)	Mean ± SD	(n) (%)	Mean ± SD	(n) (%)
12.1 - 16	25 (10%)	-	-	77.53 ± 2.06	04 (01.6%)	82.85 ± 1.42	13 (05.2%)	86.96 ± 1.57	08 (03.2%)
16.1 - 20	25 (10%)	74.00	01 (00.4%)	79.18 ± 0.75	04 (01.6%)	82.29 ± 1.55	16 (06.4%)	85.96 ± 0.77	04 (01.6%)
20.1 - 24	30 (12%)	71.98 ± 4.75	04 (01.6%)	71.16 ± 1.51	10 (04.0%)	81.74 ± 1.23	13 (05.2%)	85.8 ± 0.99	03 (01.2%)
24.1 - 28	30 (12%)	74.4	02 (00.8%)	78.58 ± 1.11	14 (05.6%)	82.18 ± 1.48	12 (04.8%)	87.2	02 (00.8%)
28.1 - 32	30 (12%)	73.3	01 (00.4%)	77.37 ± 1.03	19 (07.6%)	81.21 ± 1.57	10 (04.0%)	-	-
32.1 - 36	75 (30%)	74.6 ± 0.28	02 (00.8%)	78.03 ± 1.44	26 (10.4%)	82.06 ± 1.23	43 (17.2%)	86.93 ± 0.98	04 (01.6%)
36.1 - 40	35 (14%)	-	-	77.67 ± 1.32	07 (02.8%)	82.12 ± 1.32	28 (11.2%)		-

Overall, brachycephalic foetal head type constituted the major chunk (54%; CI 82.11 ± 1.39) followed by mesocephalic (33.6%; CI 77.88 ± 1.36) and hyperbrachycehalic head (8.4%; CI 86.67 ± 1.16). Dolichocephalic head was noted to be the least (4%; CI 73.2 ± 3.16) among the foetuses during 12.1 – 40 weeks of gestation. [Table-2]

Table 2: Classification of foetal head types during second & third trimester

Foetal Head Type	Mean ± SD	Number (n = 250); (%)
Dolichocephalic	73.2 ± 3.16	10 (04.0%)
Mesocephalic	77.88 ± 1.36	84 (33.6%)
Brachycephalic	82.11 ± 1.39	135 (54.0%)
Hyperbrachycephalic	86.67 ± 1.16	21 (08.4%)

DISCUSSION

The present study provides valuable data pertaining to foetal head type belonging to north Indian population. Our study clearly indicates mixed types of foetal head with preponderance of a particular head type with increase in gestational age of the foetus. Predominance of brachycephalic head (mean range 82.85 – 81.74) in 12.1 – 24 weeks, mesocephalic head (mean range 78.58 – 77.37) in 24.1 – 32 weeks and again brachycephalic head (mean range 82.06 – 82.12) in 32.1 – 40 weeks of gestational age was noted among foetuses in this part of country.

The study conducted by Rajlakshmi *et al.;* [3] revealed the foetal skull of the Manipuri population to be mesocephalic during 12 to 16 weeks, brachycephalic during 20 to 32 weeks and hyperbrachycephalic during 32 weeks to full term of pregnancy. In their study, they observed gradual change in cephalic index with increase in gestational age of the foetus and that was said to be attributed to the ethnic speciality of that particular race. A constant mesocephalic head type was observed by Tuli *et al.;* [2] and Hadlock *et al.;* [6] during second and third trimester without significant change with increase in gestational age among the foetuses. Mesocephalic head during 12-16 weeks of gestational age and hyperbrachycephalic head at full term was recorded by Gray *et al.;* [7]. Present study reports the anthropometrical variations in cephalic index in foetuses. This may be because the growth of the human skeleton is under the influence of several factors; among them are hormones, nutritional status, cultural differences and environmental factors [8]. According to Golalipour *et al.;* [9], the variations of head shape may be due to hereditary factor or environmental which may act as secondary effect. It has been shown clearly and repeatedly that genetic variation within a population is greater than that between populations [10]. Interaction of gene expression and cranial dimensions can make the gene expression differences in various racial and ethnic groups in geographical zones [11]. Interestingly, Kasai *et al.;* [12] reported that dietary habits have been also shown to influence the craniofacial form of a population. Nutritional status of pregnant women could also play a role in influencing the dominant head shape. In India, poor nutritional status in the pregnant women is prevalent due to multiple reasons.

As it is obvious from the present study that the dominant type skull with mean cephalic index is 82.11 ± 1.39 followed by 77.88 ± 1.36, hence the head shapes could be classified Brachycephalic as the commonest followed by mesocephalic heads. According to Bharati *et al.;* [13] in tropical zones head from is longer (dolichocephalic), but in temperate zones head from is more round (mesocephalic or brachycephalic). The present study shows that there is tendency towards brachycephalization near full term of pregnancy. The present study classifies the sample examined as brachycephalic and mesocephalic. Since India is partly in temperate and tropical zone and our part of country is in temperate zone. But, the human foetus develops in the internal environment of mother's womb where the temperature remains almost constant throughout pregnancy. Therefore, probably this factor may not have its influence over change in foetal cephalic index. In respect to the variation of head shape in various races and geographical zones, Yagain *et al.;* [14] believe that hereditary factor primarily affects the head shape; however environment has a secondary effect on it. It must be remembered that the reaction to a given environment represents the interaction of the genotype of the population being studied with the environment [15].

Head shapes can also change from one generation to the other. For instance, in the first generation of Japanese immigrants in Hawaii it was noticed that they had an increased head breadth, a decreased head length and a higher cephalic index than their parents [16]. However, we could not get any previous study in the literature in this region which could be used to compare change in cephalic index between the generations.

CONCLUSION

The present study concludes that the commonest type foetal skull is brachycephalic followed by mesocephalic whereas dolichocephalic is the least common type in this part of country. An elaborative study on foetal head types is recommended considering various factors influencing the cephalic index with special reference to nutritional status of the pregnant women.

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