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Craniofacial anthropometric study of normal newborns in a tertiary care hospital of Solan

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Abstract

Facial anthropometry is very important for the study of human growth and variation in different races and also for clinical diagnosis and treatment. A study was conducted in the Department of Paediatrics, Maharishi Markandeshwar Medical College and Hospital, Kumarhatti, Solan to make a database of various anthropometric measurements, especially craniofacial anthropometry of normal full term newborns born in the hospital.

Objective: To measure craniofacial anthropometric parameters of normal full term newborns, make a database and to statistically analyze the correlation (comparison) between male and female neonates with respect to the above-mentioned parameters.

Material & Methods: Study was conducted from the month of February 2020 to October 2020 on 453 newborns. All the facial parameters were measured with the help of vernier caliper and were taken twice and final value was taken as the average value of the two measurements.

Statistics: Mann-Whitney U and Wilcoxon Rank Sum tests were used to compare 2 groups.

Findings: The mean value and range for all the parameters was determined. A statistically significant difference in Face Width ($p<0.038$), weight ($p<0.019$), Foot Length ($p<0.030$), Crown Heel Length ($p<0.049$) and Nasal Width ($p<0.046$) between male and female newborns was seen.

Conclusion: The local values have been derived from well-defined populations to make and expand the normative database of various craniofacial anthropometric parameters. Pediatricians can be benefitted by this study for screening and diagnosis of various craniofacial abnormalities as a part of complex genetic disorders and for craniofacial surgeries.

Keywords: LMA CTrach™, Betamethasone gel, postoperative sore throat and hoarseness of voice.

Introduction

The term anthropometria dates back to the 17th century in the naturalist field, when it first appeared in the short manual Anthropometria by Johann Sigismund Elsholtz A [1]. Physical measurements are used in every branch of medicine to make diagnosis in individuals. Association of certain body types with personality traits and predilection for specific diseases date back to ancient times [2]. This has been achieved over the years through physical anthropometry [3-4].

The word-anthropometry" (anthro-human, metry-measurement) was coined by the French naturalist Georges Cuvier (1769-1832). By definition it is the study of human body measurements especially on a comparative basis. Anthropometry has the measures of size, weight, and proportions of the human body as its study object.

Anthropometry is the longest used measure of human variation and it measures surface morphology naturally understood at the basic level [5].

Anthropometric practices could be used as a tool for social welfare, whereas factors such as culture, society, behaviour and the political economy played important but distal roles in the outcomes of growth and body size [6].

Physical anthropologists have been measuring skull for years and obtained results enabled them to trace the relationship between the races as they believe that the form of skull remain the same in each race and only different races show different facial index and cephalic index [7].

Every ethnic group should have its own chart or measurements that reflect the people and ethnic group they serve [8-9]. India is a diverse country with diverse people. Morphological studies which were undertaken by different authors agreed and recognized the existence of more than one racial type and a great deal of morphological heterogeneity among the people of India. The diversity is evident in their physical structure and anthropometric parameters. The changes in anthropometric measurements of newborn's body may be due to various maternal and infantile varieties influencing fetal growth.

Newborn anthropometry

Life begins when ovum is fertilized by the sperm and a microscopic monocellular zygote formed. Genetic and environmental influences may affect an embryo and fetus at any time during development, the fetal genome itself has a significant role in development and fetal survival. Different patterns of intrauterine weight gain are probably primarily caused by environmental factors, which somehow affect the immediate intrauterine environment of the fetus [10].

Newborn anthropometry is the most important as there is no such measurement for universal use because it is dependent on racial, ethnic, environmental, age factors, biological, ecological and geographic factors [11-12].

Anthropometry can be used in neonates as a tool for several purposes: diagnosis of foetal malnutrition and prediction of early postnatal complications; postnatal assessment of growth, body composition and nutritional status; prediction of long term complications including metabolic syndrome; assessment of dysmorphology and estimation of body surface.

Himachal Pradesh, dwelling in the hills of Himalayas is unique from rest of the nation because of its large tribal and other indigenous groups with its variety of cultures, languages, religions and history. People in hills are generally short, narrow to below medium nose, big and round faces. However the scheduled tribe has broad to round faces (Study from India anthropometric survey). The entire territory of Himachal Pradesh is mountainous with altitude varying from 350 to 7000 meters above the mean sea level. The people of Himachal Pradesh have different anthropometric dimensions which are usually visible in its different areas or parts located mainly in three geographical regions. It is essential to study the physical feature and environment in which a particular community is living. Growth restriction occurs in high altitudes due to restriction of foetal growth in third trimester which occurs mainly as a result of reduced uteroplacental blood flow [13]. On an average there is reduction of 100g/1000 m altitude gain [14]. This relationship is curvilinear with reductions being most evident at altitudes above 2000 m. unfortunately, in our country where 80% of births occur at home and are conducted by traditional birth attendants or relations; there is a paucity of recording of newborn parameters. It presents a major logistic problem to record their findings.

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Need

The face is the most changeable part of the body. Differing by race, ethnicity and sex, it is clearly distinguished from that of other members of the same family [15]. Facial structure may be complex and its development reflects strong evolutionary forces controlling patterning of the craniofacial apparatus [16]. It is recognized that the mechanisms that regulate the growth and development of the face include complex interaction between genes, hormones, nutrients and epigenic factors that produce the final craniofacial morphology and any disturbances in these mechanisms may result in deviating growth patterns [17]. Measurement of craniofacial structures, especially in the first days of life, is an important complementary data on neonatal health status, its results have already been used in pediatrics, otorhinolaryngology, orofacial surgery and syndromes [18-22].

Embryology of the face is responsible for its involvement in many syndromes of dysmorphogenesis [23-24]. Anthropometry has been utilized in the characterization of many craniofacial anomalies including cleft lip and palate [25-26] and coronal synostosis [27] and in the assessment of surgical outcomes.

Normative data of facial measurements are indispensable for precise determination of the degree of deviations from the normal [28].

Measuring head circumference (HC) is a quick, non-invasive method of determining if infant head size is too large (megacephaly) or too small (microcephaly). When compared with normative growth curves, serial HC measurements are extremely important in monitoring infant health. The procedure has been described as the most simple, inexpensive and quick available [tool] to assess the development of the central nervous system and identify neonates at risk of neurodevelopment disorders. The most common disability associated with microcephaly is intellectual delay; other common concomitant conditions include epilepsy, cerebral palsy, language delay, strabismus, ophthalmologic disorders, and cardiac, renal, urinary tract, and skeletal anomalies.

A very important cephalometric dimension is height and breadth of head which is used in cephalic index determination. Cephalic index is very useful anthropologically to find out racial and sexual differences and can give a clue to genetic transmission of inherited characters [29].

Intercanthal distance estimation has been used in calculating combined width of maxillary anterior teeth. Accurate measurement of these distances is necessary for diagnosis of true ocular hypo and hypertelorism and a guide in various syndromes and in both reconstructive surgery and orthodontic treatment [30-31].

Ear length is important in the evaluation of congenital anomaly syndrome such as Down's syndrome.

Philtrum length and oral intercommissural distance are important in syndrome diagnosis in the newborn infant. Long philtrum is found in William’s syndrome, craniocarpotarsal dysplasia, Langer-Giedion syndrome, and other birth defects. A short philtrum is observed in Di George syndrome and Cohen syndrome. Wide mouth, expressed as long oral intercommissural distance, is found in Goldenhar syndrome and the 18p syndrome, while a small mouth (short oral intercommissural distance) accompanies craniocarpotarsal dysplasia, hypoglossia-hypodactyly syndrome, and trisomy 18 syndrome.

On examination of the newborn infant, the clinical impression may be misleading and therefore should be validated by quantitative criteria. The philtrum of the upper lip has a unique configuration and is a landmark of individual distinction [32]. Since it is frequently involved in disfiguring oro-facial malformations, it is important that a thorough understanding of its anatomical relationships be established so that functional and aesthetic surgical corrections can be accomplished [33].

Relevance of our study

India being land of diversity with people of each province having different food habits, lifestyle, socio-cultural trend and ethnicity. Physical structure and anthropometric parameters makes this diversity evident. It is essential to study the physical features and environment in which a particular community is living.

The face is involved in many inherited defects during its development [34] and facial morphology differs

from one ethnic and racial group to another [35-38]. What may be considered abnormal in a particular ethnic or racial group may actually be normal in another. Therefore, normative data of inner and outer canthal distances, the palpebral fissure length, philtrum and oral commissural measurements of different ethnic and racial groups are indispensable to the precise determination of the degree of deviations from the normal [39-42]. It is inappropriate to describe dysmorphic physical findings among the people without using proper measurements as well as suitable reference standards [43-44].

Present study was performed with objective to obtain normative values for all the anthropometric measurements studied. In some geographical and various racial groups there is scope for research although, anthropometric studies of neonates, adolescents and elderly have already being done with its relationship between health and disease. Cephalometric studies have not been carried out in this region whereas studies on some anthropometric features like weight, height and head circumference has been carried out by many researchers. Growth restriction occurs in high altitudes (as mentioned before). This study was carried out at a height of 5200 feet above sea level in our hospital and it can through some insight whether this is also seen in our study. Whether Anthropometric measurements other than birth weight will be useful to identify at risk babies and to quantitate foetal growth in rural community level can be understood by using the data of our study as it will provide baseline data for indigenous population. Paediatric surgeons can be benefitted by this study for screening and diagnosis of various craniofacial abnormalities as a part of complex genetic disorders and for craniofacial surgeries. Normative data, which is necessary to understand the context for any absolute clinical measurement, is lacking for newborns. Very few studies have been done on this topic of craniofacial anthropometry of newborns in India [45-46] and only one study from Himachal Pradesh [47]. Taking inspiration from them and continuing their efforts we want to make and expand the normative database of various craniofacial anthropometric parameters. We, therefore, evaluated a series of newborns with normal faces in order to establish normative data in this population.

Aim and Objectives

Study was conducted in the Department of Paediatrics, Maharishi Markandeshwar Medical College and Hospital, Kumarhatti, Solan. The aim and objectives of the present study are:

Aim of study

To make a normative database of various anthropometric measurements ,especially craniofacial anthropometry of normal full term newborns of Himachal Pradesh born at Maharishi Markandeshwar Medical college and Hospital, Solan.

Objectives of the study

1. To measure anthropometric parameters especially craniofacial anthropometry of normal full term newborns of Himachal Pradesh born at Maharishi Markandeshwar medical college and hospital, Solan.
2. To make a database of all the anthropometric measurements studied.
3. To statistically analyse the correlation between male and female neonates with respect to the above mentioned anthropometric parameter.

Material and Methods

Study was conducted in the Department of Paediatrics, Maharishi Markandeshwar Medical College and Hospital, Kumarhatti, Solan from the month of February 2020 to October 2020.

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Inclusion criteria

1. Gestational age ≥ 37 completed weeks.

Exclusion criteria

1. Neonates with cephalhematoma.
2. Major congenital malformations.
3. Newborns with craniofacial deformities.
4. Forceps or Instrumental delivery.
5. Multiple births.
6. Gestation age < 37 completed weeks.
7. Maternal history of Diabetes Mellitus, Hypertension, cardiac and renal diseases.

The anthropometric instruments used were

1. Non stretchable measuring tape (marked in centimetres, precise to 1 mm).
2. Infantometer (marked in centimetres, precise to 10 mm).
3. Vernier calliper.
4. Stiff transparent metric ruler (marked in centimetres, precise to 1 mm).
5. Digital weighing machine (with accuracy of 5 grams).

Equipment calibration

1. Calibration of the baby scale and the infantometer was done twice a week.
2. Calibration is not necessary for the head circumference tape.

Anthropometric measurements used in this study were

1. Head circumference (cm) (HC)
2. Head length (mm): (HL)
3. Head width (mm): (HW)
4. Face length (mm): (FL)
5. Face width (mm): (FW)
6. Inner Inter-canthal Distance (mm): (ICD)
7. Nasal height (mm): (NH)
8. Nasal width (mm): (NW)
9. Philtrum width (mm): (PW)
10. Philtrum length (mm): (PL)
11. Weight (grams): Wt
12. Foot Length (cm): (Ft L)
13. Crown heel length (cm): (CHL)

Facial swellings and distortions take around 24 hours to recede after birth and measurements were taken after 24 hours. Anthropometrical measurements were taken between 24-48 hrs of life so as to take them in morning time.

Measurements were taken twice and final value was taken as the average value of the two measurements. A third measurement was taken if difference between two measurements was more than 50 g for birth weight, more than 5mm for head circumference [48], more than 2mm for foot length, more than 7mm for length or more than 2mm difference for rest all measurements. Two measurements with the least difference were documented.

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Weight, Length and head circumference was done as per World Health Organisation (W.H.O) guidelines [49-50] and 2017-2018 Anthropometry manuals by National Health and Nutrition Examination Survey (NHANES) [51], conducted by the National Center for Health Statistics. W.H.O growth charts [52] was used to classify term neonates respectively as Appropriate for gestation age (AGA)/Large for gestation age (LGA)/Small for gestation age (SGA) [53].

Measurement procedure

Measurement of Head Circumference

Measurement of Head Length

Measurement of Head Width

Measurement of Face Width

Measurement of Intercanthal Distance and Nasal Width

Measurement of Nasal Width

Measurement of Philtrum Width

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Measurement of Weight

Measurement of Philtrum Width

Measurement of Crown Heel Length

Measurement of Foot Length

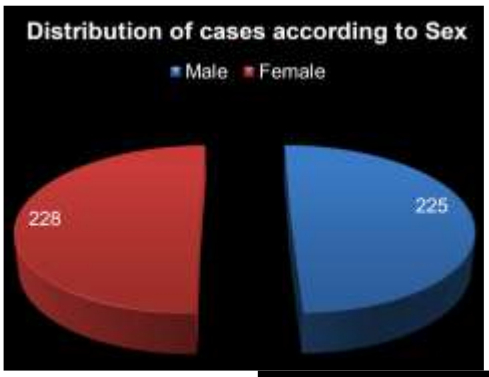
Statistical analysis

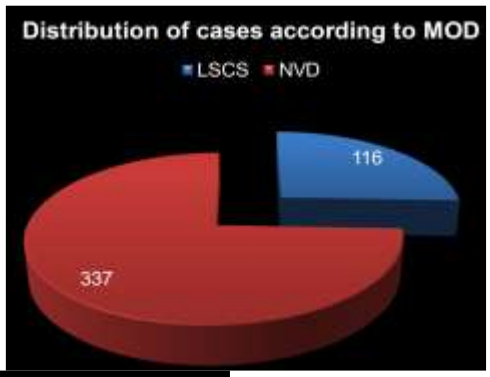
Descriptive data was described by Mean, median, Standard deviation and maximum value and Inter Quartile range.
Mann-Whitney and Wilcoxon Rank Sum tests were used to compare anthropometric data between males and females.
Data analysis was performed using SPSS-20 VERSION.
In this study, P value less than 0.05 was considered statistically significant.

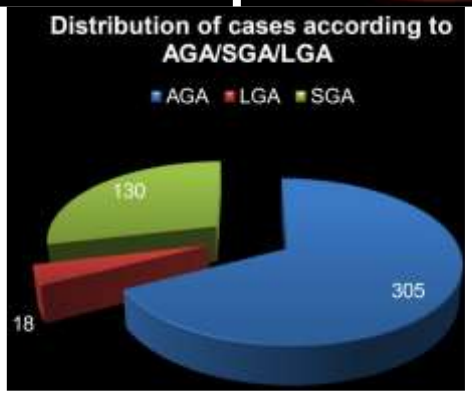
Ethical consideration

The proposed duty was approved by Institutional ethical committee.

Results







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ANTHROPOMETRIC DATA OF MALES

		Wt(gm)	HC (m)	CHL (cm)	HL (mm)	HW (mm)	FL (mm)	FW (mm)
N	Valid	225	225	225	225	225	225	225
Mean		2955.9511	33.9893	50.0747	113.5831	86.2702	60.8720	63.1502
Percentiles	3	2150.0000	31.5560	47.2000	106.2780	71.4780	53.1780	54.7560
	10	2400.0000	32.2200	48.0000	106.9000	76.4600	56.0000	56.7200
	50	2915.0000	34.1000	50.1000	112.7000	87.2000	60.1000	63.0000
	90	3600.0000	35.2000	52.0000	119.9400	92.8800	67.0000	69.5400
	97	3737.0000	35.4000	53.0000	123.1000	93.9000	69.0000	71.0100

		ICD (mm)	NH (mm)	NW (mm)	PW(mm)	PL (mm)	FtL (cm)	CI (%)
N	Valid	225	225	225	225	225	225	225
Mean		29.3480	21.2560	18.7987	8.7609	10.3489	7.1662	75.9665
Percentiles	3	23.6340	16.2000	16.5620	6.4000	7.4000	6.1000	66.8318
	10	24.5000	18.1600	16.900	6.9000	8.3600	6.5000	70.7999
	50	27.5000	21.3000	18.6000	8.8000	10.7000	7.2000	76.2821
	90	36.8400	24.0600	20.6600	10.7000	11.7000	7.8000	81.3859
	97	40.1000	25.3000	20.9300	11.0700	11.8700	7.9000	83.5847

a. SEX = Male

ANTHROPOMETRIC DATA OF FEMALES

		Wt(gm)	HC (mm)	CHL (cm)	HL (mm)	HW (mm)	FL (mm)	FW (mm)
N	Valid	228	228	228	228	228	228	228
Mean		2858.9254	33.7781	49.8355	113.9026	86.6026	60.4360	62.0807
Percentiles	3	2150.0000	31.6000	47.1870	106.3000	74.8220	53.0000	54.7000
	10	2328.0000	31.8000	47.6000	107.1900	77.8000	55.2000	56.3900
	50	2800.0000	33.9000	49.7000	113.2000	87.2000	59.8500	61.2000
	90	3495.5000	35.1000	52.0000	120.4600	92.3000	67.0200	69.3000
	97	3611.0000	35.3000	52.0550	123.1550	93.1550	68.6850	70.1000

		ICD (mm)	NH (mm)	NW(mm)	PW (mm)	PL (mm)	FtL(cm)	CI (%)
N	Valid	228	228	228	228	228	228	228
Mean		29.3281	21.2346	18.5320	8.6557	10.2925	7.0895	76.0681
Percentiles	3	23.3740	16.7870	16.3870	6.4870	7.8870	6.1000	66.9721
	10	24.9000	18.1600	16.7900	6.9900	8.1900	6.4000	71.2239
	50	27.5500	21.3000	18.4500	8.5000	10.7000	7.1000	76.2896
	90	36.8100	24.3400	20.4100	10.5000	11.6000	7.6000	80.8849
	97	40.1550	25.5100	20.9000	11.1550	11.8000	7.8000	84.2425

a. SEX = Female

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COMPARISON BETWEEN MALE AND FEMALE DATA

		Wt (gm)	CHL (cm)	HC (cm)	FW (mm)	NW (mm)	FtL (cm)
N	Valid	453	453	453	453	453	453
Mann-Whitney U		22388.500	22904.000	23234.500	22763.500	22874.500	22632.000
Wilcoxon W		48494.500	49010.000	49340.500	48869.500	48980.500	48738.000
Z		-2.341	-1.973	-1.735	-2.072	-1.993	-2.174
P Value		.019	.049	.083	.038	.046	.030

Discussion

Head Circumference

The head circumference value is between 32-36 cm in almost all the populations as calculated in several studies [54-64]. According to W.H.O growth charts head circumference range lies between 31.5cm-36.cm in the age group of 37 weeks -41 weeks of gestational age. Our study conforms to the values of 33.88 ± 1.16 cm in the total number of neonates. While measuring head circumference in males we got a mean of 33.98 cm ± 1.15cm and 33.77cm ± 1.17cm in females.

In our study we included total of 453 neonates and found out a head circumference of 33.98 cm for males and 33.77cm for females and we did not find any statistically significant correlation between male and female neonates p value = 0.083

Various authors could not find any significant sexual difference while comparing head circumference in male and female neonates Alshemeri [58], Jaya *et al*. [54], Agnihotri and Singh [56], Taksande *et al*. [62], Kaur *et al*. [60]; however a statistically significant sexual difference was reported in few other studies as done by Kataria and Gaur [61], Safak and Turguta [55].

Present study is in accordance with Alshemeri [58], Jaya *et al*. [54], Agnihotri and Singh [56], Taksande *et al*. [62], Kaur *et al*. [60] as the head circumference difference was not statistically significant.

Alshemeri *et al*. [58] studied 1001 neonates and the mean head circumference came out to be 34.67 cm ± 1.189cm and for males it came out to be 34.71 cm ± 1.13 cm and for females it was 34.62 cm ± 1.074 cm and p value was > 0.5. Jaya *et al*. [54] did a study on 3835 neonates and found head circumference was found out to be 32.37 cm ± 1.63 cm in males and 32.35 cm ± 1.82 cm in females with p value >0.05.

Kataria and gaur [61] studied 190 neonates and head circumference came out to be 36.57 cm ± 4.604 cm and 36.54 cm ±4.676 cm for males and females respectively with a statistically significant p value of <0.00.

Safak and Turgut [55] did a study involving 402 neonates and found out a statistically significant difference between male and female neonates with head circumference for males as 35 cm ± 1.3 cm and for females as 34.7 cm ±1.4 cm with a p value <0.001.

Facial width (FW)

In our study we found out facial width to be 63.15 mm ± 4.94 mm in males and 62.08 mm ±5.02 mm with a statistically significant difference between male and female sex (p value = 0.038).

The facial width was calculated by Garba *et al*. [57] in 60 neonates and found it to be 73.3 mm ±1.1 mm and 71.1 mm ± 0.8 mm in males and females respectively.

Golalipur [65] conducted a study involving 217 male neonates and found facial width to be 67.12 mm ±6.51 mm, whereas in a study conducted by Safak and Turgut on 402 neonates values found were 80 mm ± 4.1 mm in males and 79 mm ± 4.1 mm in female neonates with a statistically significant difference between male and female neonates (p value = <0.05).

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The sexual difference was insignificant as reported by other authors [55, 57, 64, 65] and our study found facial width to be statistically significant.

Weight

Weight for males had a mean of 2955.95 g ± 449.4 g and for females was 2858.92 g ± 415.03 g and was statistically significant (p value = 0.19) and in concordance with other study conducted by Sushama K Kataria [61] in which results showed that mean birth weight (male & female) was 2.92(+/-0.3924) kg, male: female was 2.92(+/-0.3924) kg: 2.92(+/-0.3896) kg respectively but was not statistically significant (p value = 0.88). According to Inter growth charts weight for males lie between 2500 g – 3800 g and between 2400 g – 3700 g for females in the age group 0f 37-41 weeks of gestation.

Foot length

In the present study the mean foot length was 7.12 cm; in males it was 7.16 cm ± 0.46 cm and 7.08 cm ± 0.46 in females. Statistically the difference between male and female neonates was highly significant (p value = 0.30).
In a study conducted by Gowri *et al*. in karnataka they found out the foot length to be 6.94 cm in babies weighing less than 2.5 kg and 7.68 cm in babies weighing between 2.5-3.5 kg and found a significant co relation between birth weight and foot length p value = < 0.05.

Crown heel length

Crown heel length for males was 50.07 cm ± 1.57 cm and for females it was 49.8 cm ± 2.07 cm with a statistically significant co relation between male and female neonates p value = 0.049. The value was in the range of 46-51 cm with Indian studies reporting CHL on a lower side (between 46-48 cm). If CHL is an indicator of future height of a newborn, the Indian neonates have lesser values than Turkish, Nigerian and Iranian population. Further no significant sexual difference was found in most of the studies as done by Jaya *et al*. [54], Taksande *et al*. [62], Kaur *et al*. [60], Shastry and Bhat [63].
Our study is in concordance with the studies conducted by Alshmeri [58], Kataria and Gaur [61] and Safak and Turgut [55] where they all found a correlation between crown heel length between male and female neonates p value = < 0.05.

Nasal width (NW)

Nasal width (NW) was measured and compared with previous studies Nasal width was found 12 mm ± 2.3 mm with a p value = < 0.05 by Rajlakshmi [66]; Soni *et al*. [64] found Nasal Width as 21.48 ± 1.61 mm in males and 20.59 ± 1.40 mm in females with a statistically significant p value = 0.0042.
The nasal width recorded in present study as 18.79 mm ± 1.33 mm for males and 18.53 mm ± 1.36 mm for females with a statistically significant p value = 0.046 between male and female neonates.

Conclusion

Mean value of the various variables in 453 neonates were

- Weight -2907.11 gms (2150-3675.80).
- Head Circumference -33.88 cm (31.60-35.30).
- Crown Heel Length -49.95 cm (47.20-52.10).
- Facial Width -62.61 mm (54.76-70.23).
- Nasal Width -18.66 mm (16.56-20.93).
- Foot Length -7.12 cm (6.10-7.80).
- From our study as we have found 5 parameters statistically significant when compared.

Between males and females and we need more of these kind of studies so as to make a

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Normative database that can help us in different aspects of clinical practice.

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