International Journal of Research in Medical Sciences
Acar M et al. Int J Res Med Sci. 2017 Apr;5(4):1445-1450
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012
DOI: http://dx.doi.org/10.18203/2320-6012.ijrms20171243

Original Research Article

An assessment of nasal and orbital parameters in human fetuses

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Received: 06 February 2017
Accepted: 07 March 2017

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ABSTRACT

Background: Nasal bone aplasia and hypoplasia have been reported on fetuses with aneuploidy. Trisomy 21 is one of the most common chromosomal abnormality detected in new-borns. The purpose of our study is to obtain data of some face parameters in Turkish fetal population and to contribute creation of reference ranges that may be used for prenatal diagnosis.
Methods: This study was performed in 66 spontaneously aborted fetuses (47 second trimester and 19 third trimester) (28 male and 38 female) with no detectable external pathology or anomalies. Measurements were designed as nasal bone length (NBL), nose length (NL), nose width (NW), nostril width (NsW), intraocular distance (IOD), innercanthal distance (ICD), outercanthal distance (OCD), orbital diameter (OD), biparietal diameter (BPD).
Results: In comparison between genders, ICD and BPD averages were found significantly higher in male fetuses than female fetuses ($P<0.05$). There was not any statistically significant difference between averages of the values on the right and left. The difference between second and the third trimester was significant in terms of all parameters ($P<0.05$). A strong correlation was detected between gestational age and our parameters.
Conclusions: Present study has contributed to create reference ranges of Turkish community. When importance of early diagnosis is considered, we believe that this data will be useful for clinicians.

Keywords: Anatomy, Fetuses, Trisomy 21

INTRODUCTION

Biometric data are accepted as basic values in definition of malformation syndromes. Measurement of some fascial parameters and comparison of these with normal values are quite instructive in diagnosis of a possible chromosomal abnormality. Measurement of these parameters of fetuses during different periods will provide information about growth quantity on these formations as well as a comparison with normal values will be possible.[1] Nasal bone aplasia and hypoplasia have been reported on fetuses with aneuploidy such as trisomy 13, trisomy 18 and trisomy 21.[2] Trisomy 21 is one of the most common chromosomal abnormality detected in new-borns.[3,4] Langdon Down has described trisomy 21 first in 1866 and observed that such individuals have some characteristic features such as flat face and small nose.[5-8] Recognizing these general characteristics involved in trisomy 13 has helped to clinicians to diagnose the disease during prenatal period through radiological techniques.[2,9-11] In parallel with development of radiological techniques, fetal ultrasonography has become the most important diagnostic tool for early diagnosis of the disease.[9,10] Ethnic differences should not be ignored in assessment of the data obtained. In other words, it should be reminded

that different ethnic groups may have different reference ranges.[4,6] Therefore, many researchers have revealed reference ranges of face parameters on different ethnic groups.[3,5,11,12]

The purpose of our study is to obtain data of some face parameters in Turkish fetal population and to contribute creation of reference ranges that may be used for prenatal diagnosis.

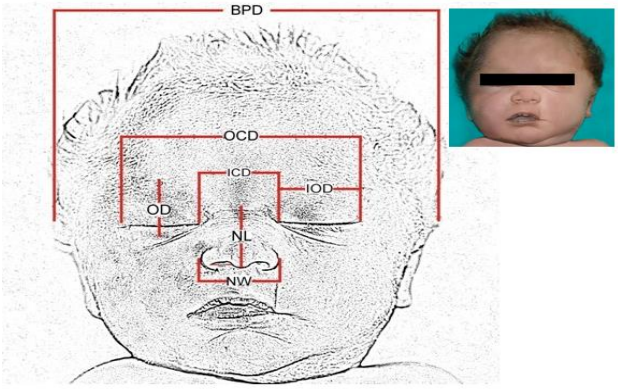
METHODS

This study was carried out with the fetus collection obtained from the obstetrical and gynaecology clinic of Meram Medical Faculty of Necmettin Erbakan University and Dr. Faruk Sukan Maternity Hospital. The dysmorphological features of the fetuses in the collection were examined.

The procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation of the department which are based on the Helsinki Declaration. This study was performed in 66 spontaneously aborted fetuses (47 second trimester and 19 third trimester) (28 male and 38 female) with no detectable external pathology or anomalies (omphalocele, gastroschisis, diaphragm hernia, Meckel diverticulum, colon malposition, renal agenesis, ectopic kidneys, agenesis of external genitalia, spinal cord abnormality, vertebral colon anomalies, etc.) after dissection.

All measurements were performed using electronic digital calipers (150x0.01mm) by the naked eye.

Measurements were designed as follows and shown in figure 1:



Nasal bone length (NBL), Nose length (NL), Nose width (NW), Nostril width (NsW), Intraocular distance (IOD), Orbital diameter (OD), Innercanthal distance (ICD), Outercanthal distance (OCD), Biparietal diameter (BPD).

Figure 1: The nasal and orbital parameters.

- Nasal bone length (NBL): The length of nasal bone along the midline.
- Nose length (NL): The distance between nasal apex and nasal radix along the midline.
- Nose width (NW): The maximum distance between nasal ala of both sides.
- Nostril width (NsW): The maximum distance between nasal ala and nasal septum.
- Intraocular distance (IOD): The distance between lateral canthus and medial canthus.
- Innercanthal distance (ICD): The distance between right medial canthus and left medial canthus.
- Outercanthal distance (OCD): The distance between right lateral canthus and left lateral canthus.
- Orbital diameter (OD): The distance between orbital superior margin and orbital inferior margin.
- Biparietal diameter (BPD): The distance between right tuber parietale and left tuber parietale.

SPSS for windows 10.0 was used for the statistical analysis.

The data were compared according to gender, trimester and lateralization by student's t-test and the relationships between the measurements were evaluated with Pearson's correlation test.

Data were summarized as mean±standard deviation. The significance level in statistical analysing was accepted as $P<0.05$.

RESULTS

Values obtained in present study were provided in Table 1 in detail. These average values of fetuses were compared in terms of gender (Table 1), lateralization (Table 2) and gestational age (Table 3).

In comparison between genders, ICD and BPD averages were found significantly higher in male fetuses than female fetuses ($P<0.05$).

Table 1: Comparison of the obtained data according to gender (mean±SD) (mm).

Parameters	Male (n=28)	Female (n=38)	P-value
NBL	8.30±2.20	7.97±1.53	>0.05
NL	12.99±4.43	12.39±2.91	>0.05
NW	13.71±4.40	12.63±2.96	>0.05
NsW_{right}	3.54±1.35	3.18±1.02	>0.05
NsW_{left}	3.54±1.35	3.14±1.00	>0.05
IOD_{right}	11.76±4.80	10.79±3.23	>0.05
IOD_{left}	11.78±4.79	10.67±3.17	>0.05
ICD	15.98±4.40	14.13±2.69	**<0.05**
OCD	38.28±15.0	34.40±8.78	>0.05
OD_{right}	11.43±4.50	10.13±3.62	>0.05
OD_{left}	11.57±4.61	10.34±3.37	>0.05
BPD	75.43±23.5	61.46±13.35	**<0.05**

P<0.05

Table 2: Comparison of the obtained data according to lateralization (mean±SD) (mm).

Parameters	Right (n=66)	Left (n=66)	P-value
NsW	3.34±1.18	3.31±1.17	>0.05
IOD	11.20±3.97	11.15±3.97	>0.05
OD	10.72±3.86	10.84±3.93	>0.05

There was not any statistically significant difference between averages of the values on the right and left. The difference between second and the third trimester was significant in terms of all parameters (P<0.05). Differences between both trimesters and average rates of growth were provided in Table 4. A strong correlation was detected between gestational age and our parameters.

Table 3: Comparison of the obtained data according to gestational age (mean±SD) (mm).

Parameters	2nd trimester (n=47)	3rd trimester (n=19)	P-value
NBL	11.05±2.50	16.60±2.85	<0.01
NL	11.29±2.49	17.55±2.37	<0.01
NW	7.47±1.15	9.53±2.24	<0.01
NsW_{right}	2.80±0.83	4.66±0.79	<0.01
NsW_{left}	2.78±0.83	4.63±0.80	<0.01
IOD_{right}	9.36±2.39	15.75±3.44	<0.01
IOD_{left}	9.34±2.40	15.63±3.43	<0.01
ICD	13.34±2.54	18.80±2.85	<0.01
OCD	30.33±6.65	50.18±10.03	<0.01
OD_{right}	8.91±2.76	14.69±3.00	<0.01
OD_{left}	9.00±2.73	15.04±2.90	<0.01
BPD	52.40±10.64	81.56±12.42	<0.01

Table 4: Average growth of obtained data at the 3rd trimester (mm).*

	No. (%)		No. (%)		No. (%)
NL	5.55 50.2)	NBL	2.06 (27.5)	OCD	19.85 (65.4)
NW	6.26 (55.4)	IOD_{right}	6.39 (68.2)	OD_{right}	5.78 (64.8)
NsW_{right}	1.86 (66.4)	IOD_{left}	6.29 (67.3)	OD_{left}	6.04 (67.1)
NsW_{left}	1.85 (66.5)	ICD	5.46 (40.9)	BPD	29.16 (55.6)

*Growth of each parameter calculated by subtracting 2nd trimester value from 3rd trimester value.

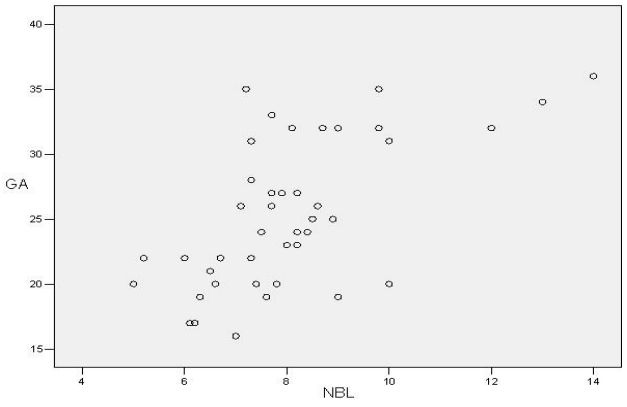


Figure 1: Correlation between gestational age (GA) and nasal bone length (NBL).

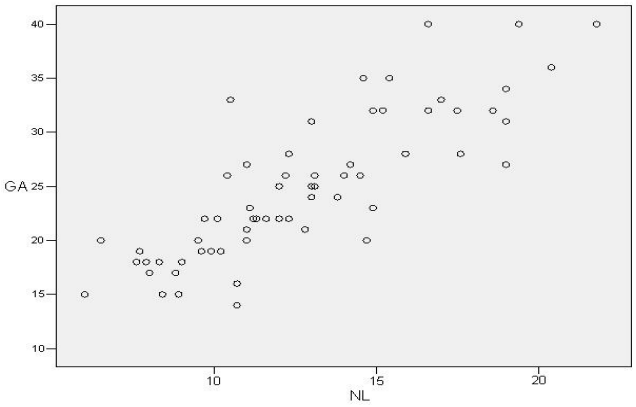


Figure 2: Correlation between gestational age (GA) and nose length (NL).

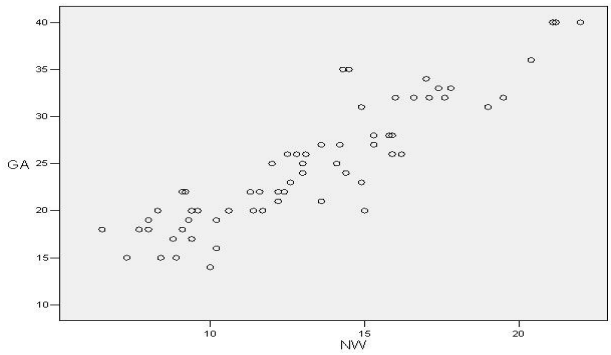


Figure 3: Correlation between gestational age (GA) and nose width (NW).

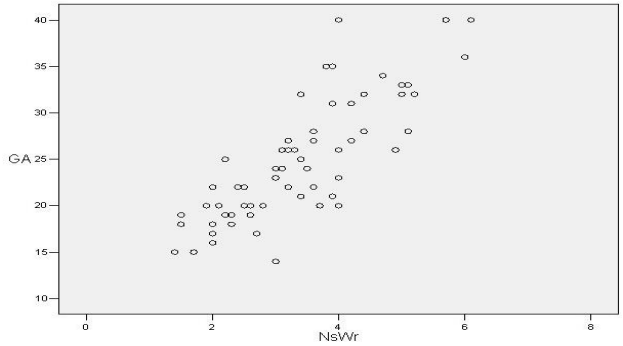


Figure 4: Correlation between gestational age (GA) and right nostril width (NSWR).

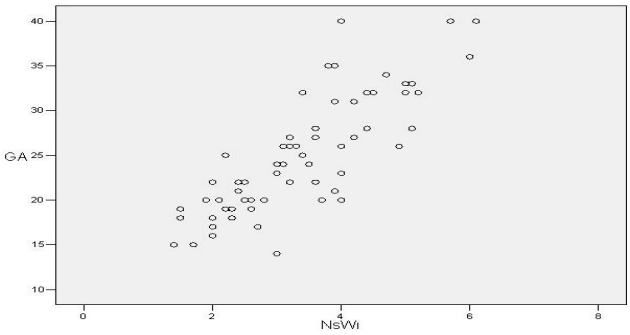


Figure 5: Correlation between gestational age (GA) and left nostril width (NSWL).

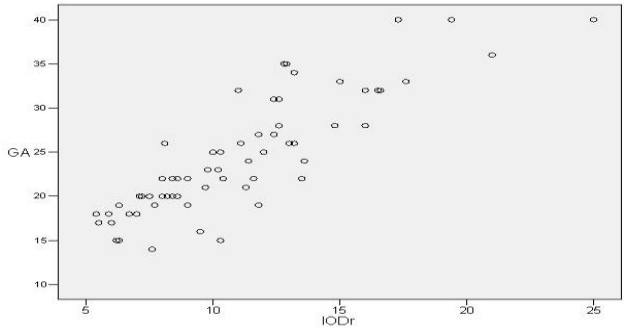


Figure 6: Correlation between gestational age (GA) and right intraocular distance (IODR).

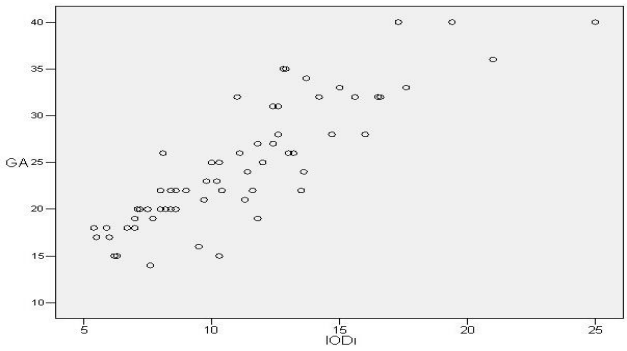


Figure 7: Correlation between gestational age (GA) and left intraocular distance (IODL).

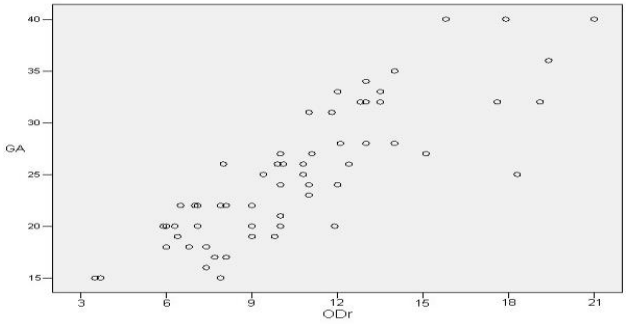


Figure 8: Correlation between gestational age (GA) and right orbital diameter (ODR).

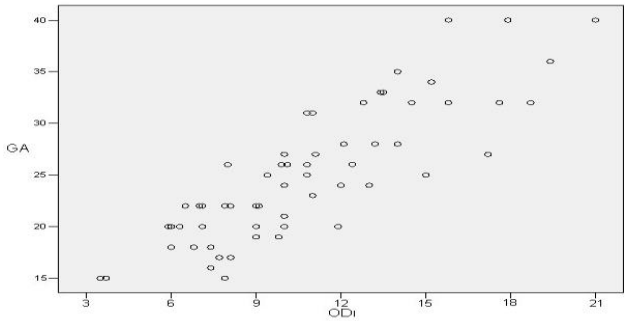


Figure 9: Correlation between gestational age (GA) and left orbital diameter (ODL).

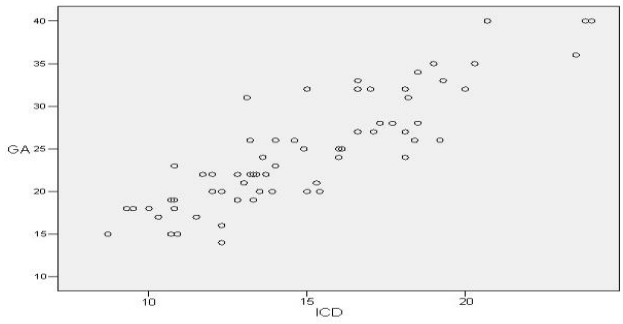


Figure 10: Correlation between gestational age (GA) and innercanthal diameter (ICD).

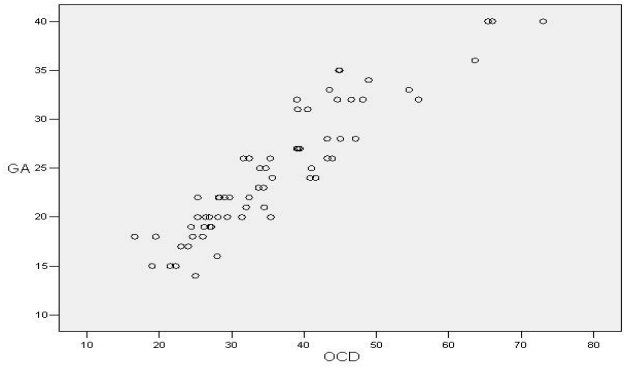


Figure 11: Correlation between gestational age (GA) and outercanthal diameter (OCD).

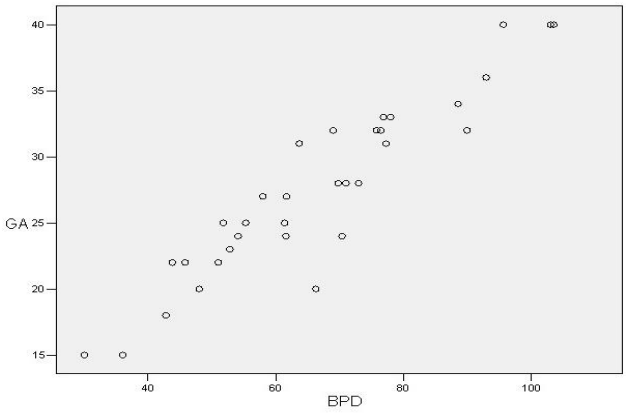


Figure 12: Correlation between gestational age (GA) and biparietal diameter (BPD).

DISCUSSION

In the present study, some facial values belonging to the nose and the eyes of the fetuses which did not have any chromosomal abnormality in Turkish population were revealed. Previous researchers have reported that there is a strong relation between lack or hypoplasia of the nasal bone and trisomy 21. Furthermore, it has been reported that length of the nasal bone is a specific determinative for diagnosis of trisomy 21.[3,4,6,14]

Casabueanas et al have detected nasal bone length in their study conducted on 11 to 144 week old healthy fetuses as 1.7±0.4mm.[5] Persico et al have detected the nasal bone length of 16 week old fetuses as 4.1mm.[15] Yanik et al have reported nasal bone lengths of Turkish gender as 3.8mm in 16 week old fetuses and 6.35mm in 23 week old fetuses.[16] Many researchers have reported in the literature that nasal bone length increased in parallel with the gestational age.[15-17]

In present study, nasal bone length was detected as 8.30±2.20mm in male fetuses and as 7.97±1.53mm in female fetuses. The difference between the literature and our study was originated from gestational age difference. In line with the literature, nasal bone length increased by gestational age significantly. The increase on experience of clinicians and modern technology provides significant developments to detect abnormalities involved in fetal nose shape and sizes. A wide nasal arch and root, prominent nose, hypoplastic nostrils or wings may be associated with many genetic syndromes and disorders.[18] Pinette et al have reported in their study that the increase of nostril width and wide nose are related with trisomy 21.[19] In their study, nasal width have been reported as 10.4mm in 20-week-old fetuses and 17.9mm in 30-week-old fetuses. In present study, nasal width was detected as 7.47±1.15mm in fetuses during 2nd trimester and as 9.53±2.24mm in fetuses during 3rd trimester. Present findings did not conform with findings of Pinette et al.[19] Furthermore, we also measured nasal lengths in present study by considering that differences on nose shape and sizes were important. We detected such values as 11.29±2.49mm during 2nd trimester and as 17.55±2.37mm in 3rd trimester. In the literature screening, we did not find any study where a measurement on nose length was included.

Nasal continuous positive airway pressure, nasal intermittent positive-pressure ventilation and high-flow nasal cannula therapy may be applied in a premature new-born who was born with chronic pulmonary disease.[20] Sivieri et al have emphasized the importance of nostril width in such procedures and they have reported the nostril width in a range between 3mm and 7mm.[20] In present study, such values were detected as 3.34±1.18mm on the right side and as 3.31±1.17mm on the left side.

It has been included in the literature that ocular parameters related with Down syndrome have significant differences when compared with healthy population.[21] These differences help prenatal diagnosis. Denis et al have measured IOD, ICD, OCD and OD parameters on 18.5-20-week-old and 28.5-34-week-old healthy fetuses.[1] These values were recorded in 18.5-20-week-old fetuses as 9.40±1.70mm, 12.7±1.57mm, 31.50±4.59mm and 9.31±1.27mm, respectively. They have been reported in 28.8-34-week-old fetuses as 16.47±2.82mm, 19.61±3.76mm, 52.44±9.30mm and 150.6±1.68mm, respectively. In present study, such values in the fetuses during 2nd trimester were reported as 9.34±2.40mm, 13.34±2.54mm, 30.33±6.65mm and 8.95±2.74mm, respectively. Same values were detected in the fetuses during 3rd trimester as 15.69±3.43mm, 18.80±2.85mm, 50.18±10.03mm and 14.86±2.95mm, respectively. Present results comply with results of Denis et al.

Mador et al have reported in their study conducted on fetuses that BPD is used to calculate the gestational age, to follow fetal growth and to reveal abnormalities.[22] In that study, average BPD has been detected as 49.4 mm in 20-week-old fetuses, as 78.4 mm in 30-week-old fetuses. It has been emphasized that there was a strong correlation between these values and gestational age. Shin et al have revealed in their study that there was a linear proportion between NBL and BPD.[23] In present study, BPD values

were detected as 52.40±10.64 mm in 2nd trimester and 81.56±12.42mm in the 3rd trimester. The values were found comply with findings of Mador et al and it was statistically significant in terms of growth quantity during 3rd trimester.[23]

CONCLUSION

Present study has contributed to create reference ranges of Turkish community. When importance of early diagnosis is considered, we believe that this data will be useful for clinicians.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Acar M, Salbacak A, Çiçekcibaşı AE, Büyükmumcu M, Şahin TK. An assessment of nasal and orbital parameters in human fetuses. Int J Res Med Sci 2017;5:1445-50.