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ORIGINAL ARTICLE

Single Centered Morphometric Analysis of Placenta in Different Ethnic Groups of Karachi

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ABSTRACT

Objective: To observe and interpret the variations in the morphology of placenta in pregnancies among ethnic groups.

Methodology: This was an observational study conducted in the department of obstetrics & gynecology, UMDC & Creek General hospital from October 2020 till October 2022. A total of 272 delivered patients belonging to different ethnicities like Sindhi, Punjabi, Baluchi, Muhajir and others were included after Informed consent. After delivery, the placenta was examined in labor room for placental weight, diameter, shape, site of cord insertion, placental & cord thickness, cotyledons &vessels in the cord. SPSS version 22 was used.

Results: A total of 272 patients which included 136 Muhajirs, 58 Punjabis, 34 Sindhis & 18 Pathan women; 26 included Hindko, Gilgiti, Burmese, Swati & Bengalis. Mean age range was 25.63 to 26.17 years. The mean placental thickness ranged 1.23 cm to 1.58 cm & Mean cord thickness ranged 0.70 cm - 0.83 cm. Total mean placental Weight was 0.74kg with SD of 0.32. Mean placental diameter was
19.57 with SD of 4.62 ; Mean placental circumference was 56.70 with SD of 10.63; mean cord length was 29.75 cms with SD of 11 cms. The shape of the placenta was round – 97. Among Muhajirs, the majority had a round shape in 82, oval in 45, irregular in 7 and triangular in 2 patients. There was central cord insertion in 85 and marginal in 50 patients.

Conclusion: Placenta examination provides vital information about the intrauterine environment and fetal development.

Keywords: ethnicity, fetal, maternal, morphology, placenta.

INTRODUCTION

Placental examination plays a vital role in optimal fetal development. Any maternal pathology manifests itself clinically and is associated with pathological changes in the placenta. The placental examination is so informative especially in cases of intrautrine deaths where changes in the placenta can be seen. The placental indices play a vital role in growth of the fetal weight and congenital anomalies. Hence a placenta study can be very informative as far as the fetoplacental weight relationship is concerned in pregnancy related disorders like pregnancy Induced hypertension and abruption.[1] The examination of the placenta is very informative in prolonged pregnancy which is a pregnancy that progresses beyond 42 weeks (294 days). This is important as it has a strong association with fetal distress responsible for increasing perinatal mortality and increased risk of operative delivery. The prolonged pregnancy is attended with aging effects in the placenta thus impairing placental function [2]

The placenta of a full term pregnancy is discoid in shape with a circular or oval outline. However apart from discoid, we can expect the placenta to be of different shapes as bidiscoidal, bilobed, circumvallate and fenestrated. There are abnormal shapes of placenta like notched or lobed placenta prevalent in 10% of women. Other abnormal shapes include membranous and other rare variants. There is not much research work done on the shape of the placenta. The variation in the shapes of the placenta is prevalent among different ethnicities [3]

In infants born small for gestational age(SGA) , placental pathology can be one of the factors. In pregnant females suffering from comorbidities like pregnancy induced hypertension, the placenta gets diseased with infarcts formation. This reduces the oxygen supply to the fetus resulting in fetal growth restriction. There can be a geographical variation of SGA based on the mothers ethnicity and nationality. Also included are the body weight, short stature and the parity status of the mothers. SGA is defined as infants born below the 10th percentile in birth weight for their gestational age. If geographical location is taken into consideration, South Asian women are more likely to give birth to SGA than a native pregnant female in high income countries.

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SGA and FGR are important landmarks of fetal growth and are associated with perinatal morbidity and mortlity due to perinatal and neonatal complications complication like perinatal asphyxia, polycythemia, hypothermia, hypoglycemia, respiratory distress and still birth.[4]

There is an association between neonatal weight and placental weight which needs to be observed during the morphometric studies of the placenta.[5]

The placenta is a connection between the mother and the fetus during intrauterine life and responsible for embryonic development. Evidence has revealed that histotrophic nutrition from the endometrial glands supports embryogenesis and organogenesis. The abnormal trophoblast proliferation is responsible for complicated pregnancies including impaired decidualisation.[6]

The human placenta is a strong connection between the mother and the fetus that develops during pregnancy and performs important functions for optimal fetal growth and development. It supplies oxygen and nutrients to the fetus and excretes waste products from the blood stream. It produces essential hormones like human chorionic gonadotrophin, progesterone and estrogen which can play essential role in the maintenance of the pregnancy. When these fuctions are disturbed due to ant etiology, then occurs placental insufficiency that can lead to intrauterine fetal death (IUFD), stillbirth, intrauterine growth restriction, low birth weight and premature birth. The intrauterine hypoxia is responsible for histologic changes in the placenta and can manifest as developmental delays or long term health issues for the baby. Hence a study of morphologic, morphometric and histologic changes in such pregnancies is useful and compare it with the placenta of live births.[7]

Placenta is one of the mediators which can identify patients at high risk of developing pre-eclampsia among different ethnic groups. The abnormalities in placental formation and development, immunologic factors and changes in the vascular topography with onset of inflammation are contributing factors in the pathophysiology of preeclampsia. This way, the study of the placenta is useful. [8]

In future, there is a dire necessity to establish gestational biomarkers for monitering normal and morbid pregnancies and to assess outcome. Proteomic biomarkers in placental tissue can be

useful for early diagnosis of gestational diseases. Placental proteins in the human placenta secreted in the maternal circulation during pregnancy blood is a no-invasive way of assessing fetal outcome. These include human chorionic gonadotrophin, human placental lactogen, placental growth hormone and placental growth factor(PlGF).[9]

METHODOLOGY

This observational study was performed in the Obstetrics & Gynecology department of United Medical and Dental College, Creek General Hospital (CGH) Karachi Pakistan from October 2020 till December 2022. The aim of the study was to observe the variations in the gross morphological features of placenta in patients belonging to different ethnicities delivering at Creek general hospital located at Ibrahim Hyderi in Korangi which is one of the largest districts of Karachi. This includes Bengalis, Burmese, Muhajirs, Sindhis, Punjabis, Hindko, Gilgiti, Swatis, Pathans and Baluch. In this population, the incidence of comorbidities is fairly common. Significance of the study is that when we know the normal morphology of the placenta within the different ethnic groups, then we can know the morphological differences in case of different obstetric morbidities like gestational diabetes, preclampsia and hypothyroidism. If we know the normal morphology, we can assess abnormalities. So the purpose of this research was to observe how ethnicity affects the gross morphological features of nonmorbid and morbid pregnancies.

The target demographic consisted of booked pregnant females delivering at CGH. Based on an adequate assessment, 272 participants were selected through convenient sampling technique to observes significant changes between the placentae from versatile ethnicities.

Placentae of all singleton, normal and morbid pregnancies delivered vaginally or abdominally at CGH were included in the study. Placentae of twin and triplet pregnancies were excluded from the study.

A Proforma was designed to collect biodata of the patients along with their ethnicities, and all the parameters to chart the morphometric features of the placenta. Ethical approval was taken from Ethical review board of UMDC and IRB was obtained. The participants were enrolled after given informed consent.

Immediately after delivery, the placenta was examined either in the second-stage labor room following a normal vaginal delivery or in the operating theater after a lower segment cesarean section (LSCS). The placenta was delivered with approximately 4 cm of the umbilical cord attached to the neonate.

To ensure accurate assessment, it was first washed under running tap water to clean any blood clots.

The examination included recording the shape of the placenta, the intactness of the membranes (both chorion and amnion), the consistency, and the site of cord attachment. The thickness of the placenta was assessed by holding its edge with tissue forceps and measuring the length using a ruler scale in centimeters. Similarly, the thickness of the umbilical cord was measured by holding its cut edge between tissue forceps and measuring the length on a ruler scale.

The weight of the placenta was recorded to the nearest gram using a weighing machine. Its diameter was measured by taking as average of the diameter taken across three different planes using a measuring tape. The circumference of the placenta, the presence or absence of infarcts, and the number of vessels in the umbilical cord (two arteries and one vein) were noted. The weight of the baby was also recorded. All collected data were documented in the proforma. Statistical analysis was performed using SPSS 23.

Rationale: The placenta plays a central role in fetal programming. It reflects the susceptibilty of the fetus to develop metabolic disorders, cardiovascular diseases and neurodevelopmental outcomes later in life. So a detailed placental analysis is helpful in understanding the placental adaptations and the longterm health risks in different ethnicities. This will be helpful in modifying antenatal care and the monitering starategies of maternal and fetal surveillance in pregnancy.

RESULTS

In this study, 272 participants from diverse ethnic backgrounds were enrolled. This included 136 Muhajirs, 58 Punjabis, 29 Sindhis, 23 Pathans, and 26 individuals from minor ethnic groups such as Hindko, Gilgiti, Burmese, Swati, and Bengali.

The mean age range of pregnant women was from 18-41 years. Among the participants, 172 had normal pregnancies, while 100 experienced pregnancy-related comorbidities, including anemia, pregnancy-induced hypertension, pre-eclampsia, and gestational diabetes.

The overall mean gestational amenorrhea ranged from 27 to 41 weeks. The mean weight of the placenta varied between 0.4 and 1.8 kg across all participants. Among different ethnic groups, the placental weight ranged from 0.45 to 1.3 kg in Sindhis,

0.4 to 1.8 kg in Punjabis, 0.4 to 1.6 kg in Pathans, and 0.4 to 1.8 kg in Muhajirs. In other ethnic groups, including Hindko, Gilgiti, Burmese, Swati, and Bengali, the placental weight ranged from 0.4 to 1.7 kg. (Table 1)

The shape of the placenta varied among the 272 pregnancies studied. It was round in 156 cases, with Muhajirs accounting for 87 (64%) of these. An oval-shaped placenta was observed in 102 (38%) pregnancies, including 40 Muhajirs, 31 Punjabis, 11 Sindhis, 7 Pathans, and 13 women from other ethnic groups. An irregular placenta was found in 10 (4%) cases, with the highest occurrence among Muhajirs (7 cases, 5%). A triangular placenta was noted in 4 (1%) cases, including 2 (1%) among Muhajirs.(Table 1),(fig 1).

The site of umbilical cord insertion varied among the 272 pregnancies (figure.1). It was central in 166 (61%) cases, with Muhajirs accounting for 86 (63%) of these. A marginal cord insertion was observed in 104 (39%) cases, including 49 (36%) among Muhajirs. Velamentous insertion was rare, occurring in only 2 (1%) cases. (Table 1) The overall placental mean diameter ranged from 12 to 35 cm across all ethnicities, while the circumference varied between 32 and 88 cm. The thickness of the placenta ranged from 0.3 to 3 cm, and the umbilical cord thickness varied between 0.1 and 1.8 cm. The length of the umbilical cord ranged from 10 to 72 cm, with the longest range observed among Muhajirs, spanning from 10 to 62 cm. The birth weight of the newborns varied between 0.9 and 4 kg across all ethnic groups. (Table 1)

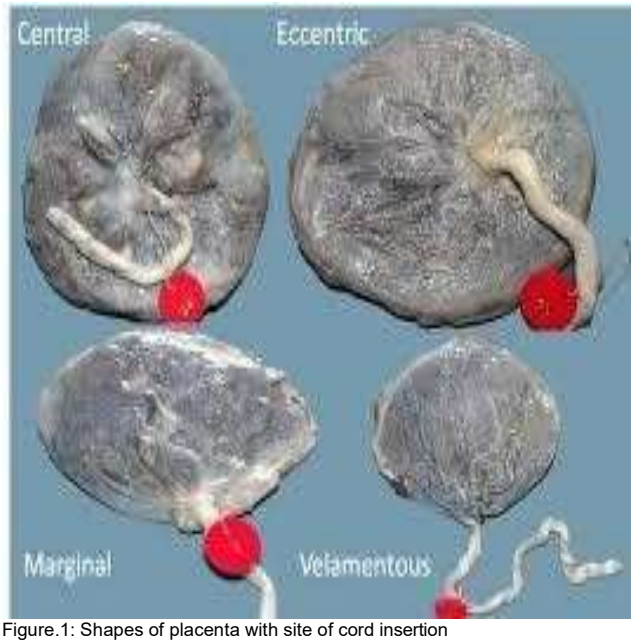


Figure.1: Shapes of placenta with site of cord insertion

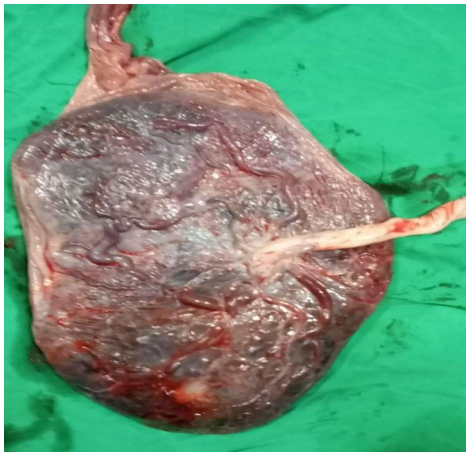


Figure.2: Placenta of a growth restricted pregnancy

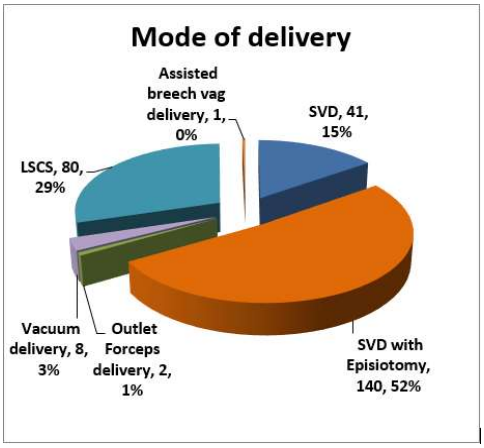


Figure.3: Pie chart shows Mode of delivery

Table 1: Placental charactristics in different ethnicities of Karachi

		Total	Sindhi N=29	Punjabi N=	Pathan	Balochi	Muhajir	Others
Gest age	Mean		38.14	38.59	38.00	36.00	37.89	37.62
(wks)	SD		1.22	1.44	2.42	1.52	1.91	1.88
Placental wt	Mean	0.74	0.80	0.79	0.64	0.63	0.72	0.63
(kg)	SD	0.32	0.33	0.39	0.19	0.22	0.31	0.30
Placental dm (cm)	Mean	19.57	19.17	20.72	19.07	18.06	19.29	19.52
Placental circumference e(cm)	Mean	56.70	55.62	57.73	58.73	65.88	56.55	53.62
Cord length (cm)	Mean	29.75	29.17	32.64	29.87	29.00	27.96	32.79
Weight of the baby	Mean	2.83	2.82	3.02	2.70	2.58	2.77	2.80
Placental	Oval	102(37.5%	11(37.9.	26(44.8	4(26.7%	1(20.0	45(33.%)	15(51.7%
shape		)	%	%)	)	%)		)
	Round						82(60.3	
	irregular	156(57.4%	17(58.6	29(56.2	11(73.3	4(80%)	%)	13(44.8%
		)	%)	%)	%	0(0%)	7(5.1%)	)
		10(3.7%)	1(3.4%)	2(3.4%)	0(0%)			0(0%)
Site of cord	Central	163(60.6%	12(41.4	35(61.4	11(73.3	2(50%)	85(63%)	18(62.1%
insertion	margina	104(38.7)	%)	%)	%	2(50%)	50(37.9	)
	l	2(0.7%)	17(58.6	20(35.1	4(26.7%	0	%)	11(37.9%
	velamen		%)	%)	)		0	)
	tous		0	2(3.5%)	0			0

Table 2: Placental characteristics in morbidities

	Total	No comorbid s	Anemia	PI H	PE	GDM	Leaking	Infection	others
GA	272	172	43	8	2	11	20	3	13
Mean ±	38.02	38.12±	37.77±	37.	39.	38.64	37.85±	39.00±	37.46±
SD	±			0±0	0±	±			
	1.80								
Placenta									
Wt	0.74±	0.78±	0.66±	0.6	1.0	0.77±	0.62±	0.73±	0.64±
Mean±	0.32	0.34	0.26	6±	0±	0.24	0.25	0.21	0.38
SD				0.2	0.7				
				3	1				
Dm									
placenta	19.57	19.65±	18.79±	19.	16.	21.00	21.15±	23.00±	17.00±
Mean±	±	4.38	4.14	88±	50±	±	6.08	8.54	2.94
SD	4.63			5.08	0.71	5.06			
Circumf									
placenta	56.70	56.39±	56.63±	59.	49.	59.91	60.40±	64.33±	50.46±
Mean±	±	9.44	10.73	3±8	50±	±	18.68	20.84	8.00
SD	10.63			7.8	3.5	7.76			
				0	4				
Length									
cord	29.75	28.84±	32.51±	27.	31.	32.82	32.45±	27.33±	28.08±
Mean±	±	10.56	10.83	50±	00±	±	9.25	9.71	13.30
SD	11.01			9.4	18.	17.48			
				4	38				
Wt baby									
Mean±	2.83±	2.82±	2.79±	2.7	3.0	3.00±	3.00±	3.27±	2.61±
SD	0.51	0.49	0.40	1±	0±	0.64	0.46	0.46	0.84
				0.5	0.0				
				33	0				

DISCUSSION

The human placenta is a transient fetal structure studied extensively by anatomists, embryologists, and obstetricians due to its diverse and vital functions. It serves as the primary connection between the developing fetus and the maternal uterus, facilitating the transfer of nutrients, removal of waste, and exchange of gases through the mother's bloodstream[10].

Lakshmi *et al*. identified a discoid placental shape in their study, while in our research conducted at UMDC found a greater prevalence of round placentae, particularly among individuals of Muhajir ethnicity. No cases of placenta lobata or succenturiata were observed in our study. However, Benirschke & Kaufmann reported a 5% incidence of placenta succenturiata. They also noted that fenestrated placenta is rare, extrachorial placenta occurs in 5.3% of cases (from 13,500 samples), and ring-shaped placenta has an incidence of 1 in 6,000 cases[11].

The placenta is generally round and discoid in shape, though variations such as oval, irregular, star-shaped, bi-lobate, multi-lobate, circumvallate, and circummarginate forms have been documented. The most frequently observed shape is circular (93%), followed by oval (7%)[12]. In our study of 272 pregnancies, central umbilical cord insertion was the most common, occurring in 61% of cases, with a higher prevalence among Muhajirs (63%). Marginal insertion was observed in 39%, including 36% among Muhajirs, while velamentous insertion was rare (1%). Compared to other studies, Sarwar et al. reported 66% eccentric, 24% central, 8% marginal, and 2% velamentous insertions, differing significantly from our findings where central insertion was predominant. Similarly, Shrivastava et al. in India found 58% central, 20% eccentric, 20% marginal, and 2% velamentous insertions, aligning more closely with our study but showing a higher marginal insertion rate. Another study reported 57.6% eccentric, 32.1% central, and 8.9% marginal insertions. One more study reported central 25.7%, eccentric 65.1%, marginal 8.8%, and velamentous 0.4% contrasting with our results where eccentric insertion was not observed. Overall, while our study found central insertion most frequently, others reported eccentric as the most common attachment type[12].

David Barker and colleagues established a link between placental weight and the risk of chronic heart disease. Epidemiological studies highlight strong associations between placental size, shape, and offspring health. Recent research suggests that maternal factors like BMI and height influence placental characteristics more accurately than birth weight alone in predicting disease risk. However, this aspect was not extensively explored in our study[13].

In our study, the placental diameter ranged from 12 to 35 cm, with a circumference of 32 to 88 cm and a weight between 0.4 and 1.8 kg across ethnicities. Placental weight varied among groups, with Sindhis (0.45–1.3 kg), Punjabis (0.4–1.8 kg), Pathans (0.4–1.6 kg), Muhajirs (0.4–1.8 kg), and other ethnicities (0.4–1.7 kg). In contrast, another study reported a mean placental weight of 494.45 ± 110.39 g (range 260–870 g), significantly lower than our findings. Placental weight is influenced by ethnicity, genetics, environmental factors, and maternal conditions. Placentomegaly is linked to maternal diabetes, anaemia, infections, and fetal disorders, while low placental weight may contribute to male infant colorectal cancer and reduced maternal blood flow due to a smaller chorionic plate. Low placental weight may be a risk factor for the onset of CRC in male infants[14].

Placental examination helps determine the feto-placental weight ratio. This ratio can be used to assess fetal growth and identify differences in birth weight between male and female babies. Variations in this ratio may also provide insights into placental efficiency and potential pregnancy complications, in our study we didn't assess the fetoplacental ratio[15].

Pre-eclampsia is a placenta-mediated pathology, and studies are exploring its association with race and ethnicity[16]. Research indicates that Black and South Asian women have a higher risk of pre-eclampsia and perinatal mortality compared to White women. Socioeconomic deprivation further exacerbates both general and pregnancy-related adverse outcomes. Placental examination may provide valuable insights into these disparities[17].

Placental examination may provide valuable clues to vascular impairments post-delivery[18]. Ethnic Asian, Black, and Hispanic mothers had a higher Cesarean section rate, and conditions like preeclampsia and gestational diabetes mellitus (GDM2) were significantly linked to low placental efficiency. In contrast, ethnic White mothers, SARS-CoV-2 status, maternal decidual vasculopathy (classic and mixed types), and maternal inflammatory responses were associated with high placental efficiency[19].

The placenta plays a crucial role in fetal development and is influenced by maternal homeostasis. It produces $1,25(OH)_2D$, and reduced maternal vitamin D levels have been linked to alterations in placental morphometry. Animal studies on mice confirm that vitamin D deficiency leads to lower placental weight, reduced villous labyrinth vascularization, and decreased VEGF-alpha expression, which may impact fetal growth and development [20].

Extensive research has explored the link between maternal ethnicity and pregnancy complications, as well as neonatal morbidity and mortality. Over the past two decades, the incidence of gestational diabetes, preeclampsia, pregnancy-induced hypertension, and preterm labor has risen among non-Hispanic Black and Hispanic women. Studies indicate that Asian mothers have the highest rates of gestational diabetes and intrauterine growth restriction (IUGR), while Hispanic mothers show increased occurrences of fetal vascular malperfusion and maternal inflammatory responses. These findings highlight the impact of ethnicity on maternal and fetal health outcomes[21].

Placental examination plays a crucial role in identifying placental pathologies that contribute to perinatal mortality. Studies suggest that placental abnormalities account for approximately 65% of stillbirth cases. In New Zealand, perinatal mortality reviews, including placental analysis, are recommended for every fetal demise to improve understanding and prevention. Our findings further support the significance of ethnic variations in placental pathology, reinforcing the need for comprehensive placental assessment to better understand disparities in perinatal outcomes[22].

The placenta plays a crucial role in the physiological adaptations of pregnancy, influencing maternal body composition, plasma volume, blood pressure, and glucose and lipid metabolism. Maternal health conditions, such as hypertension, type 2 diabetes, and obesity, can impact birth weight and fetal development. Ethnic variations in placental morphology have been observed, with South and East Asian mothers having lower placental weights than European women, primarily due to smaller surface areas. Even after adjusting for maternal characteristics and cardiometabolic factors, South Asian ethnicity remained significantly associated with reduced placental surface area. Additionally, increased maternal fat mass index in early pregnancy was linked to higher placental weight and thickness, highlighting the influence of maternal metabolic health on placental development and fetal outcomes[23].

Placental examination in overweight and obese women revealed increased placental weight and pathological changes, including chronic villitis, decidual vasculopathy, intervillous thrombosis, and normoblastemia. Higher maternal BMI was associated with reduced placental efficiency, as indicated by a lower fetal-placental weight ratio. Obesity in pregnancy was linked to a higher incidence of preterm birth and elevated birthweight percentiles. Placental lesions, particularly maternal vascular malperfusion (MVM) and fetal vascular malperfusion (FVM), significantly influenced birthweight percentiles. However, only MVM showed a distinct effect based on maternal obesity, emphasizing the impact of maternal vascular health on fetal growth and pregnancy outcomes[24].

Placental examination provides valuable diagnostic insights, particularly in pregnancies affected by hypertensive disorders. In these cases, abnormalities were primarily confined to the stem villi, whereas severely growth-restricted pregnancies with absent or reversed umbilical artery end-diastolic velocities showed defects in the terminal villi. Notably, no significant statistical interaction was found between the combination of fetal growth restriction and hypertension, suggesting that each condition may independently contribute to placental pathology[25].

CONCLUSION

Examination of the placenta in different ethnicities immediately after delivery provides vital information about the intrauterine environment and fetal development. It can be useful in prediction of morbidities by gross placental examination which can be useful in the etiology of IUGR, intrauterine deaths and stillbirths.

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Author Contribution:

Kumari. K: Basic research concept and design, data collection and manuscript writing. Anwer.S: Data collection, interpretation and manuscript writing.

Zain S: Drafting the manuscript, critical revision for intellectual content and corrections.

Sheikh. S: Data collection and analysis. Dhomeja.N: Manuscript final version.

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