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Effect of Maternal Haemoglobin on Anthropometric Measurements of Newborn Babies

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ABSTRACT

Objective: To determine the effect of maternal haemoglobin on the anthropometric measurements of newborn babies.
Study Design: Cross-sectional study.
Place and Duration of Study: Neonatal and Obstetric Department of Combined Military Hospital, Quetta Pakistan, from Jan to Jun 2020.
Methodology All newborn babies born during the study period were enrolled in the study. Anthropometric measurement of the newborn such as length, weight, fronto-occipital circumference (FOC), and mid chest circumference (MCC) were recorded. Moreover, the latest maternal haemoglobin level in the third trimester of pregnancy was observed.
Results: Of 357 patients, mean newborn weight, length, FOC, and MCC were 3032.8±409.3 grams, 48.16±4.57 cm, 35.26±3.77 cm, and 32.15±1.94 cm, respectively. Anaemia was observed in 164(45.9%) mothers [118/164(72%) had mild, whereas 46/164(28%) had moderate anaemia]. Amongst 118 mild anaemic mothers, mean newborn weight, length, FOC, and MCC were 2994.9±351.9 grams, 48.43±4.45 cm, 35.08±3.64 cm, and 32.01±1.47 cm, respectively. While amongst 46 moderate anaemic mothers, mean newborn weight, length, FOC, and MCC were 2726.17±347.51 grams, 47.54±3.02 cm, 34.09±1.38 cm, and 31.14±2.36 cm, respectively. Mean weight (p<0.001), fronto-occipital circumference (p=0.035), and MCC (p<0.001) was significantly lower among anemic mothers than non-anemic mothers. A positive significant correlation of maternal haemoglobin level was observed with newborn weight (r=0.176, p=0.001) and MCC (r= 0.194, p<0.001).
Conclusion: A considerably negative impact of maternal anaemia was observed on the weight, FOC, and MCC of the newborn.

Keywords Anthropometrics, Fronto-occipital circumference, Hemoglobin, chest circumference, Mothers, Newborn, Weight.

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INTRODUCTION

Anaemia is a prevalent condition among women of childbearing age.[1,2] Pregnant women are especially prone to develop anaemia because of physiological and pathological factors which may affect the fetal outcome adversely.[3,4] In pregnancy, anaemia is linked to intrauterine development retardation, premature birth, low birth weight, longer labour time, increased infection risk, increased maternal & neonatal mortality, and decreased physical capacity.[1,5] According to the World Health Organization (WHO), anaemia affects 36.5% of pregnant women worldwide.[6]

According to reports, maternal haemoglobin plays a critical function in fetal growth.[7] Various studies have established a link between maternal anaemia and worse neonatal anthropometric measurement levels, but the optimal haemoglobin level still needs to be determined.[8-10]

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Although the literature on this subject is extensive, more data is needed on newborns' maternal haemoglobin levels and anthropometric measures in Pakistan. The current study aims to determine the effect of maternal haemoglobin on the anthropometric measurements of newborns in Pakistan, especially those from underprivileged areas like Balochistan.

METHODOLOGY

The cross-sectional study was conducted at the Neonatal and Obstetric Units of Combined Military Hospital, Quetta Pakistan, from January 2020 to June 2020 after approval from the Ethical Review Board (CMH QTA-IRB/036). Epi Info sample size calculator was used to determine the sample size taking reported low birth weight in mothers with anaemia in a published study of 36.8%.[11]

Inclusion Criteria: All pregnant women over 37 weeks gestation who gave birth in the Obstetric Department of Combined Military Hospital, Quetta Pakistan during the study period and their newborns were included.

Exclusion Criteria: Premature babies having gestational age <37 weeks, neonates with intrauterine growth restriction, infants of diabetic mothers, and neonates with congenital abnormalities were excluded.

Signed informed consent was obtained from parents/guardians before conducting the study. Anthropometric measurements of the newborn, such as length, weight, fronto-occipital circumference (FOC), and mid-chest circumference were recorded. The same doctor took all measurements per the neonatal unit's protocol within 12 hours of delivery. Using an electronic weighing scale, the birth weight was assessed without clothes. Crown heel length was measured using an infantometer by following a supine position, with knees completely extended, soles of feet firmly contacting the footboard, and head touching the fixed board. The circumference of the head was measured above the supraorbital ridges and the ears at the level of the occipital protuberance. Three readings of the following parameters were taken, and their mean was recorded to eliminate instrumental error.

Sociodemographic characteristics of the mother, such as age, gestational age, parity, educational level, occupation status, total monthly household income, and the number of people in the house, were noted. This information, along with the latest maternal haemoglobin level in the third trimester of pregnancy, was included in the study. The presence of maternal haemoglobin level <11mg/dl was labelled as anaemia, which is further divided into three groups, i.e., mild as "10.9-9.0 g/dl", moderate as "8.9-7.0g/dl", and severe anaemic as less than "7 g/dl".[12]

Statistical Package for Social Sciences (SPSS) version 22.0 was used for the data analysis. Quantitative variables were expressed as Mean±SD and qualitative variables were expressed as frequency and percentages. Inferential statistics were explored using an independent t-test. Furthermore, binary logistic regression was also applied. The logistic regression incorporated all factors determined to be significant in the contingency table. Moreover, Pearson correlation analysis was also applied to see the relationship between anthropometric measurements of newborns and maternal anaemia. The *p*-value lower than or up to 0.05 was considered as significant.

RESULTS

Of 357 mothers, the mean maternal age was 25.22 ±1.99 years. 218 (61.1%) mothers were ≤25 years and 139 (38.9%) were >25 years of age. The mean gestational age was 38.11 ±0.99 weeks. Among the 357 newborn babies, there were 183 (51.3%) males and 174 (48.7%) females. Multiparity was observed in 248 (69.5%) mothers, primiparity in 94 (26.3%) and grand

Table-I: Variables associated with Maternal Anaemia (n=357)

Variables	Maternal Anaemia		OR (95% CI)	*p*-value	aOR (9%% CI)	*p*-value
	Yes n(%)	No n (%)				
Weight, grams						
≤3000	90(52.3)	82(47.7)	1.65(1.08-2.51)	0.02	1.47(0.88-2.47)	0.139
>3000	74(40.0)	111(60.0)	Ref		Ref	
Fronto-Occipital Circumference, CM						
≤35	131(49.4)	134(50.6)	1.75(1.07-2.85)	0.025	1.33(0.75-2.34)	0.328
>35	33(35.9)	59(64.1)	Ref		Ref	
Mid Chest Circumference, CM						
≤32	108(52.2)	99(47.8)	1.83(1.19-2.81)	0.006	1.64(0.98-2.74)	0.055
>32	56(37.3)	94(62.7)	Ref		Ref	
Maternal Age, Years						
≤25	121(55.5)	97(44.5)	2.78(1.78-4.36)	<0.001	2.85(1.77-4.58)	<0.001
>25	43(30.9)	96(69.1)	Ref		Ref	
Newborn Gender						
Females	95(54.6)	79(45.4)	1.99(1.30-3.03)	0.001	2.44(1.54-3.88)	<0.001
Males	69(37.7)	114(62.3)	Ref		Ref	
Parity						
Grand Multiparous	33(35.1)	61(64.9)	1.76(1.08-2.88)	0.024	2.02(1.18-3.45)	0.011
Multiparous	121(48.8)	127(51.2)	3.69(1.17-11.72)	0.026	5.74(1.57-21.04)	0.008
Primiparous	10(66.7)	5 (33.3)	Ref		Ref	

aOR: Adjusted Odds Ratio, CI: Confidence Interval, OR: Odds Ratio

Table-II: Mean difference of Anthropometric Measurements of Newborn Babies with respect to Maternal Anaemia (n=357)

Anthropometric Measurements of Newborn Babies		Maternal Anemia		
	Total	Yes (n=164)	No (n=193)	*p*-value
	Mean±SD	Mean±SD	Mean±SD	
Weight, grams	3032.8±409.3	2919.59±370.02	3129.13±417.43	<0.001
Length, cm	48.16±4.57	48.18±4.12	48.14±4.93	0.925
Fronto-occipital circumference, cm	35.26±3.77	34.81±3.20	35.65 ±4.16	0.035
Mid chest circumference, cm	32.15±1.94	31.75±1.80	32.48±2.01	<0.001

Table-III: Mean Difference of Anthropometric Measurements of Newborn Babies with respect to Maternal Anemia (n=357)

Anthropometric Measurements of Newborn Babies	Female Newborn Babies (n=183)		*p*-value	Male Newborn Babies (n=174)		*p*-value
	Maternal Anaemia			Maternal Anaemia		
	Yes (n=69)	No (n=114)		Yes (n=95)	No (n=79)	
	Mean ±SD	Mean±SD		Mean±SD	Mean±SD	
Weight, grams	2810.1±300.49	3114.13±410.12	<0.001	2999.01±396.1	3150.9±429.5	0.016
Length, cm	47.30±4.86	47.23±5.91	0.932	48.82±3.36	49.44±2.47	0.174
Fronto-occipital Circumference, cm	35.27±4.71	36.39±5.15	0.139	34.48±1.21	34.58±1.46	0.610
Mid chest circumference, cm	31.70±1.82	32.66±1.89	0.001	31.80±1.80	32.22±2.13	0.160

Table-IV: Relationship of Anthropometric Measurements of Newborn Babies and Maternal Anaemia

Anthropometric measurements of newborn	Maternal Anemia					
	Total (n=357)		Female Newborn Babies (n=183)		Male Newborn Babies (n=174)	
	r	*p*-value	r	*p*-value	r	*p*-value
Weight, grams	0.176	0.001*	0.224	0.002*	0.183	0.016
Length, cm	0.008	0.880	0.048	0.522	0.093	0.222
Fronto-occipital circumference, cm	0.066	0.210	0.018	0.808	0.045	0.551
Mid chest circumference, cm	0.194	<0.001*	0.241*	<0.001	0.119	0.117

Pearson Correlation test applied

multiparity was observed in 15(4.2%) mothers.

The mean maternal haemoglobin level was 11.45±1.42 g/dl. Anaemia was observed in 164(45.9%) mothers. Of these 164 anaemic patients, 118(72%) had mild, whereas 46(28%) had moderate anaemia. Severe anaemia was observed in none (0%) of the participants. The findings of the multivariable analysis showed that the odds of maternal anaemia were 2.85 times significantly higher among mothers with ≤25 years of age than mothers with >25 years of age (aOR: 2.85, 95% CI: 1.77-4.58). The odds of maternal anaemia were 2.44 times higher among female newborns than male newborns (aOR: 2.44, 95% CI: 1.54-3.88). Furthermore, the odds of maternal anaemia were 2.02 times significantly higher among grand multiparous mothers (aOR: 2.02, 95% CI: 1.18-3.45) and 5.74 times significantly higher among multiparous mothers (aOR: 5.74, 95% CI: 1.57-21.04) (Table-I).

The anthropometric measurement of the newborn showed that the mean weight of the newborn was 3032.8±409.3 grams, the mean length was 48.16±4.57 cm, the mean FOC was 35.26±3.77 cm, while the midchest circumference was 32.15±1.94 cm. Of 118 patients with mild anaemia, the mean weight of the newborn was 2994.9±351.9 grams, the mean length was48.43±4.45 cm, the mean FOC was 35.08±3.64 cm, while the mid-chest circumference was 32.01±1.47 cm. Of 46 patients with moderate anaemia, the mean weight of the newborn was 2726.17 ±347.51 grams; the mean length was 47.54±3.02 cm, the mean FOC was 34.09±1.38cm, while the mid-chest circumference was 31.14±2.36cm.

The mean weight (*p*-value <0.001), frontooccipital circumference (*p*-value 0.035), and mid-chest circumference (*p*-value <0.001) were significantly lower among newborns with maternal anaemia as compared to newborns without maternal anaemia (Table-II) When stratified based on newborn gender, a significantly lower weight was observed in females (*p*-value <0.001) and males (*p*-value 0.016). However, the mid-chest circumference was only to be significant among female newborns (*p*-value 0.001) (Table-III).

A positive significant correlation of maternal haemoglobin level was observed with the weight of the newborns (r=0.176, *p*-value 0.001) and mid-chest circumference (r= 0.194, *p*-value <0.001) Table-IV).

DISCUSSION

Maternal malnutrition and anaemia during pregnancy have adverse effects on the growth of the fetus. According to the current study findings, the mean weight, fronto-occipital circumference, and mid-chest circumference were significantly lower among newborns with maternal anaemia than newborns without maternal anaemia. These findings are consistent with earlier national and international studies that found that mothers with haemoglobin depletion gave birth to infants with considerably lower birth weights.[8,9,12-14]

Women create an average of 30-40 ml of plasma per kilogram, beginning in the middle of the second trimester of pregnancy, resulting in hypervolemia. Hemodilution occurs when the number of haematological cells does not rise in lockstep with this process, and maternal anaemia might result. As a result, low haemoglobin levels may promote placental angiogenesis and fetal hypoxia.[15] Hemoglobin depletion, according to this belief, may cause a decrease in nutrients and oxygen to the fetus owing to impairments in placental transport. A reduction in blood perfusion in the uterus, an increase in vascular resistance, and growth restriction of the trophoblastic surface, which is responsible for ejecting maternal arterial blood into the placenta, are all components of uterine growth limitation. Because of these occurrences, gas exchange within the maternal-fetal complex may be restricted, resulting in low birth weight.[16]

The burden of maternal anaemia in a previously published study by Figueiredo *et al*. was approximately 25%.[17] However, in our study, maternal anaemia was found to be considerably higher, i.e., 45.9%. This can be attributed to younger age mothers and grand multiparity in our population. There is no public health plan in Pakistan to reduce maternal and child malnutrition.[18-20]

Despite all the limitations, this study is a significant effort in reporting the findings from Quetta Baluchistan that are scarcely available in published literature. Furthermore, the findings of this study will aid in understanding the influence of maternal anaemia on infant anthropometric indices in Pakistan. To rule out the findings of this study, large-scale multicenter studies are suggested.

LIMITATION OF STUDY

The cross-sectional nature of the study designs limited us to finding out the temporal association of the maternal haemoglobin level with anthropometric measures of the newborn. Due to certain limitations, the majority of the important confounding variables, such as the dietary pattern of the mother during pregnancy, iron supplement intake, malnutrition status, and physical activity assessment during pregnancy, were not performed. Previously, some studies have reported findings based on maternal haemoglobin levels based on each trimester. Thus, the impact of maternal haemoglobin level on each trimester was correlated with the anthropometric measurements of the newborn. Our study findings were also limited in this area.

CONCLUSION

A considerably negative impact of maternal anaemia was observed on the weight, fronto-occipital circumference, and mid-chest circumference of the newborn. In particular, the risk of maternal anaemia was significantly higher among younger age mothers, female newborns, grand multiparous mothers, and multiparous mothers.

Conflict of Interest: None.

Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

HJ & AK: Data acquisition, data analysis, drafting the manuscript, critical review, approval of the final version to be published.

RT & KAB: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

MMK: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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