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Original Article

Epidemiology Section

Correlation between Maternal Mid Upper Arm Circumference and Neonatal Birth Weight: A Case-control Study

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ABSTRACT

Introduction: Birth weight is the best marker of optimal foetal growth and development. Apart from being an important determinant of newborn survival, Low Birth Weight (LBW) also indicates nutritional deprivation and poor health of the mother during and before pregnancy. On the other hand, Maternal nutrition and anthropometry also affect infant's birth weight.

Aim: To find out the correlation of maternal Mid Upper Arm Circumference (MUAC) and neonatal birth weight.

Materials and Methods: This case-control study was conducted at Datta Meghe Medical College and Shalinitai Meghe Hospital and Research Centre (tertiary care hospital), Nagpur, Maharashtra, India, from September 2021 to February 2022. Convenient sampling method was used to select cases and control. All the mothers who had delivered full term live singleton new born with birth weight <2.5 kg were selected as a case and mothers who had delivered singleton new born babies ≥2.5 kg were selected as a control. There was a total of 100 mother-infant dyads with 50 pairs having infant with LBW (cases) and the rest 50 with infants having normal birth weight (controls). Data was collected on the socio-demographic status of the mothers using a predesigned questionnaire along with their weight (from record), maternal MUAC measurement, and birth weight of their babies. Analysis was done using Statistical Package for Social Sciences (SPSS) version 16.0.

Results: Mean age of cases was 24.48±2.757 years and that of controls was 24.52±2.255 years. Mean birth weight was 2206±200.9 gm for cases and 2934±305.79 gm for the control group. Maternal MUAC was ≤23 cm in 52% of cases and only 16% in controls (OR- 5.69, CI: 2.23-13.74, p-value=0.001). A linear correlation was found between maternal MUAC and birth weight (r-value=0.3376, p-value=0.001).

Conclusion: As there was a positive correlation between maternal MUAC ≤23 cm and LBW babies, maternal MUAC can be used as a predictor of LBW, and hence, measurement of maternal MUAC should be included during antenatal check-ups.

Keywords: Anthropometry, Infant, Mother, Neonate

INTRODUCTION

Low Birth Weight (LBW) is an important indicator of maternal and child health in both developed and developing countries [1]. Worldwide, around 20 million infants are born with LBW and Asia contributes 72% of LBW cases, and half of those cases are from India [2]. Again, it is the single most important factor determining the survival chances of the child. LBW accounts for 50% of perinatal deaths and 33% of all infant mortality. Infant mortality is 20 times higher in LBW babies than in normal neonate. Another implication of LBW is the economic burden on families due to the high cost of special care and intensive care unit [1].

There are numerous factors contributing to LBW, both maternal and foetal. The maternal environment both biological and social is the most important determinant of birth weight. LBW reflects inadequate nutrition and ill health of the mother. Maternal nutritional status is an important contributor to foetal growth and infant birth weight [3].

Maternal anthropometry like weight, height, and maternal MUAC were identified as influential factors for an infant's birth weight and length [4]. During pregnancy, the weight of the mother may not be the best indicator of her nutritional status since it is a measure of both the mother and the foetus. Therefore, maternal MUAC which is a simple and inexpensive anthropometric measurement is used in many epidemiological studies like Thomas R et al., [3] Rani N et al., [4] and Danugama V et al., [5]. The maternal MUAC can be a useful screening tool to identify adverse pregnancy outcomes, as it indicates not only maternal fat or lean tissue store but also it is independent of gestational age [6].

But as such no standard cut-off of maternal MUAC has been fixed. The studies conducted in Asian and African countries recommend a cut-off of ≤23 cm for screening pregnant women at risk of having LBW babies [4-7].

In India, even minimum ANC visits of the pregnant woman cannot be ensured. So, screening with MAUC measurements which require only a single visit will help in the early identification of high-risk pregnancies [4].

With this background, the present study was done to identify the importance of maternal Mid Upper Arm Circumference (MUAC) as a screening tool in deciding poor pregnancy outcomes for LBW neonates.

MATERIALS AND METHODS

This case-control study was conducted at Datta Meghe Medical College and Shalinitai Meghe Hospital and Research Centre (tertiary care hospital), Nagpur, Maharashtra, India, from September 2021 to February 2022. Approval from the Institutional Ethical Committee was taken before commencing the study [DMMC (DU)/IEC/2021/07, Date- 30/10/2021] and written informed consent was taken from participant mothers.

Convenient sampling method was used to select cases and control. Cases and controls were pair (1:1) matched for maternal age, parity, and completed weeks of gestational age at the time of birth. Total 100 mother-infant dyads with

- Cases: 50 pairs having an infant with LBW
- Control: 50 pairs with infants having normal birth weight.

Inclusion criteria:

Cases: A 37 weeks completed mother free from any medical and surgical illness who had delivered a live singleton newborn with birth

weight less than 2.5 kg without congenital malformation and willing to participate in the study.

Control: A 37 weeks completed mother free from any medical and surgical illness who had delivered a live singleton newborn with birth weight more than and equal to 2.5 kg without congenital malformation and willing to participate in the study.

Exclusion criteria: All pregnant woman with any medical conditions or any surgical complications were excluded from the study.

Study Procedure

A questionnaire was designed to collect the information regarding the socio-demographic profile of the mother and her family; parity, haemoglobin, weight gain during pregnancy and weight of the mother before delivery. The information was verified from ANC cards and case sheets to minimise the recall bias. The socio-economic status was calculated using Modified Kuppuswamy scale [1].

Mid Upper Arm Circumference (MUAC) is defined as the circumference of upper arm measured at the midpoint between the acromion process and the olecranon process with the upper limb hanging loosely by the side [8]. Newborn weight recorded within 2 hours of birth [9].

STATISTICAL ANALYSIS

Data was analysed using Statistical Package for Social Sciences (SPSS) version 16.0. Continuous variables were summarised in terms of means and standard deviations while categorical variables were in the form of frequencies and percentages. Statistical analysis was done by percentages, Chi-square test and Pearson correlation coefficient.

RESULTS

The majority of mothers in both case and control groups belong to 21-25 years (56% and 74%, respectively). The mean age of mothers in the case group was 24.48±2.757 years and that of controls was 24.52±2.255 years. Only 10% of the mothers in both groups were illiterate. Among cases, maximum i.e. 38 (76%) mothers belonged to nuclear families. Among the control also 37 (74%) mothers were from the nuclear family [Table/Fig-1].

The mean age at marriage for cases was 20.68± 2.26 years and for control 20.62±1.81 years. Mean haemoglobin for cases was 9.68±1.009 gm% and for control 9.9±0.773 gm%. The mean weight of the newborn was 2206±200.9 gm for cases and 2934±305.79 gm for the control group. Among cases mean weight of the mother at the time of delivery was 51.46±5.027 kg and for control, it was 52.92±5.130 kg. Mean Maternal MUAC for cases was 22.646± 2.13 cm and for control 24.152±1.080 cm. MUAC ≤23 cm was found in 26 (52%) cases and in only 08 (16%) controls (OR- 5.69, CI: 2.23-13.47). Thus, MUAC ≤23 cm was 5.69 times more common among cases as compared to control and it was significant [Table/Fig-2]. Spearman rank correlation analysis was performed to assess the correlation of neonatal birth weight with maternal MUAC. It was found that a linear uphill correlation exists between maternal MUAC and neonatal birth weight (r-value=0.3376) [Table/Fig-3]. The sensitivity and specificity at cut-off of 23.55 cm was 72% and 72%, respectively [Table/Fig-4].

Variables	Cases (n,%)	Control (n,%)	p-value
Age (years)			
<20	5 (10%)	2 (4%)	χ^2 =1.38, p-value=0.2397, df: 1
20-25	28 (56%)	37 (74%)	
>25	17 (34%)	11 (22%)	
Education			
Illiterate	5 (10%)	5 (10%)	χ^2=0.93, p-value=0.3342, df: 1
Primary	8 (16%)	4 (8%)	
Secondary	12 (24%)	17 (34%)	
Intermediate	20 (40%)	22 (44%)	
Graduate and Postgraduate	5 (10%)	2 (4%)	
Socio-economic status (Modified Kuppuswami scale) [1]			
Upper	6 (12%)	7 (14%)	χ^2 =1.19, p-value=0.2752, df: 1
Upper middle	11 (22%)	22 (44%)	
Lower middle	23 (46%)	15 (30%)	
Upper lower	4 (8%)	6 (12%)	
Lower	6 (12%)	0	
Type of family			
Nuclear	38 (76%)	37 (74%)	χ^2 =0.05, p-value=0.8174, df: 1
Joint	2 (4%)	4 (8%)	
Three generation	10 (20%)	9 (18%)	
Age at marriage			
<19 years	8 (16%)	2 (4%)	χ^2 =4.00, p-value=**0.0455**, df: 1
19-25 years	39 (78%)	45 (90%)	
>25 years	3 (6%)	3 (6%)	
Parity			
1	18 (36%)	23 (46%)	χ^2=0.08, p-value=0.7794, df: 1
2	24 (48%)	20 (40%)	
3	7 (14%)	6 (12%)	
4	1 (2%)	1 (2%)	
Weight gain during pregnancy (kg)			
≤7	23 (46%)	16 (32%)	χ^2=2.06, p-value=0.1512, df: 1
>7	27 (54%)	34 (68%)	

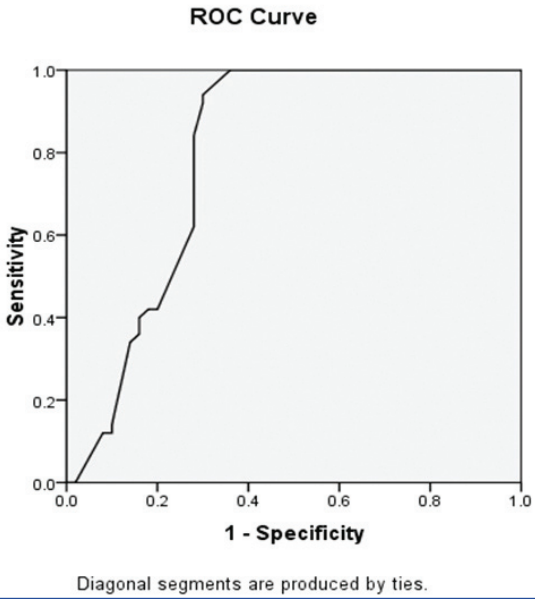
[Table/Fig-1]: Distribution of socio-demographic characteristics of cases and control (N=50).

Mid upper arm circumference	Cases (n,%)	Control (n,%)	OR (CI)	p-value
≤23 cm	26 (52%)	8 (16%)	5.69 (CI: 2.23-13.74)	**0.001**
>23 cm	24 (48%)	42 (84%)		

[Table/Fig-2]: Distribution of maternal MAUC among cases and control (N=50).

Parameter	Maternal MAUC	
Neonatal weight	Corelation coefficient	p-value
	0.3376	**0.001**

[Table/Fig-3]: Correlation of maternal MAUC and neonatal weight.



[Table/Fig-4]: ROC curve showing the sensitivity and specificity of MUAC.

DISCUSSION

The prepregnancy Body Mass Index (BMI) and gestational weight gain are the most commonly used parameters to identify poor pregnancy

outcomes. However, in India, pregnant women seek medical advice in their late pregnancies. So, prepregnancy anthropometry and antenatal weight gain records are not available. Epidemiological studies have demonstrated that maternal MUAC is closely related to maternal weight and fairly constant in mothers throughout the pregnancy. Thus, it can be used as a screening tool for the nutritional assessment of a mother [4,5]. Many studies found a positive correlation between maternal MUAC and LBW babies [4,10]. World Health Organisation (WHO) has recommended that maternal MUAC may be used to identify undernutrition in pregnancy [11].

In the present study, MUAC ≤23 cm was 5.69 times more common among cases as compared to control. The results are comparable with the study done by Sahu P and Soren S, with the cut-off of 22.59 cm (rho=0.32, p-value <0.05) [10]. Vasundhara D et al., compared the cut-off of 23 cm and 24 cm as a risk factor for LBW and found that MUAC <23 cm is a better indicator than 24 cm [5]. Similarly, the maternal MUAC value of ≤23 cm is recommended by Ververs M et al., in the Asian contexts [7]. The WHO Collaborative Study in1997 also showed maternal MUAC cut-off values of ≤23 cm as having a significant risk for LBW (OR-1.9, 95% CI: 1.7-2.1) [11]. Mohanty C et al., and Sen J et al., suggested a maternal MUAC cut-off of <22 cm while Shrivastava J et al., suggested a cut-off of <23 cm as a determinant for LBW [12-14].

Kpewou DE et al., also found a significant correlation between MUAC <23 cm of mother and linear growth of infants (r-value=-0.067,p-value=0.032) [15]. The study done by Oktavianda YD et al., found that the risk of birth of LBW infants is increased in pregnant women with MUAC <23.5 cm (OR: 20.4) [16]. Cardinal M et al., also found the significant value of 2.19 at 95% CI for MUAC cut-off of ≤23 cm [17]. However, Petraro P et al., took the cut-off of 26 cm and found that women with mean MUAC >26 cm had 38% lower risk of LBW (RR=0.62, 95% CI=0.45-0.86) compared to women with lower MUAC [18].

The advantage of using maternal MUAC as a screening tool for the prediction of LBW is that it is a simple, one-time exercise and can be done by any healthcare worker. So, it should be incorporated into ongoing local and international surveys or surveillance systems. If maternal MUAC is used as a surrogate marker for neonatal anthropometric parameters it will help us for early prenatal diagnosis of LBW infant and this can help us to design a targeted approach and to plan the timely intervention for the improvement of the health of a pregnant female.

Limitation(s)

The small sample size was the limitation of the study.

CONCLUSION(S)

Maternal MUAC ≤23 cm is five times more common among mothers with LBW babies. Thus, the MUAC cut-off of ≤23 cm during pregnancy can be considered for predicting LBW infant.

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