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Original Research Article

The Relationship of Maternal Mean Corpuscular Volume with Birth Weight of Baby at Term

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Abstract:
Objective: To determine the correlation of maternal mean corpuscular volume with the birth weight of the baby at term. **Study Design:** A descriptive cross-sectional study. **Place and Duration of Study:** Khyber Teaching Hospital between 17th August 2025 and 17th November 2025. **Methodology:** 270 women aged 20 to 40 years, having singleton pregnancy and gestational age 37+0 to 40+6 weeks, were enrolled using convenience sampling. Maternal blood samples were examined for mean corpuscular volume, while birth weight was recorded with a calibrated infant scale. Results were displayed as mean ± standard deviation and n (%). Pearson's correlation coefficient was applied to determine the association between maternal mean corpuscular volume and birth weight. Subgroup evaluation was carried out according to age, body mass index and gestational age. Statistical significance was set at p-value ≤0.05. **Results:** Participants showed mean age of 28.24 ± 4.00 years, gestational age of 39.01 ± 0.74 weeks and body mass index of 23.17 ± 2.40 kg/m^2. Middle socioeconomic category comprised 139 (51.5%), literate women numbered 136 (50.4%), unemployed women were 190 (70.4%) and rural residents were 172 (63.7%). Maternal mean corpuscular volume demonstrated significant positive correlation with birth weight ($r = 0.215$, $p < 0.001$). Significant correlations were observed among age ≤30 years ($r = 0.245$, $p = 0.001$), gestational age ≤39 weeks ($r = 0.279$, $p = 0.001$) and body mass index ≤25 kg/m^2 ($r = 0.294$, $p < 0.001$). **Conclusion:** Higher maternal mean corpuscular volume was significantly associated with greater birth weight at term.

Keywords: Birth weight, Gestational age, Maternal blood, Maternal mean corpuscular volume, Neonate, Pregnancy, Term birth.

INTRODUCTION

There are many physiological changes that occur in the complete blood count because of increased blood volume and increased requirement of oxygen and nutrition.1 There are certain physiological changes that take place in the complete blood count during pregnancy; there is more increase in the plasma volume than the volume of red blood cells in the body, leading to physiological haemodilution.2 Because of this physiological haemodilution, there can be decrease in haemoglobin and haematocrit values and at times, there are some changes in red blood cell indices as well.3 One of the red blood cell indices is mean corpuscular volume. Mean corpuscular volume is often utilized in assessing and classifying anaemia during pregnancy.4 It is important to determine whether red blood cells are small, normal or large compared to the normal range. Reduced mean corpuscular volume is often linked with iron deficiency, which is quite common during pregnancy due to the increased demand for iron for the production of red blood cells in mothers and the development of the foetus.5 Variations in mean corpuscular volume could also be associated with the nutrition status of the mother and other causes of anaemia.6 The blood status of the mother is important in providing oxygen to the placenta and foetus; hence, abnormal indices of red blood cells may impact pregnancy.7 Birth weight is an important factor determining the health status of the newborn child, which is affected by various factors that operate through the mother, placenta and foetus.8 Maternal anaemia and malnutrition may influence the delivery of oxygen and nutrients to the developing foetus, resulting in foetal growth restriction.9 Since mean corpuscular volume may be indicative of iron deficiency and other changes in red blood cells, there may be an association between maternal mean corpuscular volume and birth weight.10 However, the association between maternal mean corpuscular volume and birth weight at term has not been established across all populations. There is a necessity to find out the correlation between the mean corpuscular volume of the mother and the weight of the babies born at term. The mother's blood indices are always available in the antenatal period and the birth weight is one of the important indicators of neonatal health. Finding out any kind of correlation between mean corpuscular volume and birth weight may contribute to our knowledge about the effect of the mother's blood on the growth of the foetus.

METHODOLOGY

This cross-sectional study was conducted from 17th August 2025 to 17th November 2025 at Khyber Teaching Hospital. The study included 270 pregnant patients. The sample size was calculated using WHO sample size calculation method with 95% confidence level, 5% margin of error and 50% response distribution.11 Patients were selected through convenience sampling method.Patients were included who were aged 20 to 40 years and had singleton pregnancy with fetal gestational age from 37+0 to 40+6 weeks. Patients were excluded who had medical disorders of pregnancy including Gestational Diabetes mellitus and Gestational Hypertension, haemoglobinopathies, Thalassemia, Sickle cell anemia or multiple pregnancies. After obtaining ethical approval from the KTH ethical committee (Ethical Certificate No. 745/DMF/KMC), written informed consent was taken from the patients after explaining the purpose and procedure of the study. Demographic information including age and other required study variables was recorded. Maternal blood sample was obtained during the third trimester and collected in an EDTA tube. Complete blood count (CBC), hematocrit and RBC were analysed through an automated hematology analyser. Maternal Mean Corpuscular Volume (MCV) was calculated by dividing HCT by RBC and multiplying by 10 and the value was recorded in femtoliters (fL). For assessment of neonatal birth weight, the newborn was gently placed on a calibrated infant scale and the weight was recorded in grams. MCV referred to the mean volume of RBC (erythrocytes) present in the maternal blood sample and was obtained from the complete blood count. MCV lower than 80 fL was categorised as Microcytic Anemia, MCV between 80-100 fL was categorised as Normocytic Anemia and MCV greater than 100 fL was categorised as Macrocytic Anemia. Neonatal birth weight less than 2500 g was considered as Low birth weight. The relationship between maternal MCV level and birth weight of baby at term was assessed according to these recorded measurements. Statistical analysis was conducted through IBM SPSS Statistics version 26.0. Numerical variables, namely age, gestational age and BMI were summarized through mean and standard deviation. Categorical variables, including socioeconomic status, education status, educational status and residence, were expressed in frequencies and percentages. Pearson's correlation coefficient will be used to evaluate the relationship between maternal MCV and term neonatal birth weight. Statistical significance will be determined at p-value ≤ 0.05. Correlation analysis after stratification will also be carried out according to age, BMI and gestational age, using p-value ≤ 0.05 as statistically significant.

RESULTS

The study enrolled a total of 270 participants. The mean age of the participants was 28.24 ± 4.00 years, mean gestational age were 39.01 ± 0.74 weeks and mean BMI were 23.17 ± 2.40 kg/m². In terms of socioeconomic status, majority of the participants belonged to middle class 139 (51.5%), followed by lower class 96 (35.6%) and upper class 35 (13.0%). Regarding education status, 136 (50.4%) of the participants were literate whilst 134 (49.6%) were illiterate. With respect to employment status, 190 (70.4%) of the participants were un-employed and 80 (29.6%) were employed. As for the place of residence, 172 (63.7%) of the participants were from rural areas whereas 98 (36.3%) were from urban areas (Table 1).

Table 1. Patient Demographics. n=270

Demographics	Mean ± SD / n (%)
Age (years)	28.24 ± 4.00
Gestational Age weeks	39.01 ± 0.74
BMI	23.17 ± 2.40
Socioeconomic Status	
Upper Class n (%)	35 (13.0%)
Middle Class n (%)	139 (51.5%)
Lower Class n (%)	96 (35.6%)
Education Status	
Literate n (%)	136 (50.4%)
Illiterate n (%)	134 (49.6%)
Employment Status	
Employed n (%)	80 (29.6%)
Un-employed n (%)	190 (70.4%)
Residence	
Urban n (%)	98 (36.3%)
Rural n (%)	172 (63.7%)

The Pearson's correlation analysis was performed to examined the relationship between maternal MCV and birth weight of the baby. The results revealed a statistically significant positive correlation between maternal MCV and birth weight ($r = 0.215$, $p < 0.001$), which suggest that as the maternal MCV increases, the birth weight of the baby also tend to increase (Table 2).

Table 2. Pearson's Correlation Between Maternal MCV and Birth Weight. n=270

Variables	Pearson's r	p-value
MCV vs Birth Weight	0.215**	<0.001**

**Correlation is significant at the 0.01 level (2-tailed).

The subgroup analysis was further carried out to explored the correlation between maternal MCV and birth weight across different subgroups. With regards to age, a significant positive correlation was observed in participants aged ≤30 years ($r = 0.245$, $p = 0.001$), however, no significant correlation was found in participants aged >30 years ($r = 0.145$, $p = 0.177$). In terms of gestational age, significant positive correlations were noted in both ≤39 weeks ($r = 0.279$, $p = 0.001$) and >39 weeks ($r = 0.194$, $p = 0.029$) subgroups. With respect to BMI a significant positive correlation was observed in participants with BMI ≤25 kg/m^2 ($r = 0.294$, $p < 0.001$), whilst no significant correlation was found in participants with BMI >25 kg/m^2 ($r = -0.101$, $p = 0.447$) (Table 3).

Table 3. Subgroup Analysis of Pearson's Correlation Between Maternal MCV and Birth Weight. n=270

Subgroup	N	Pearson's r	p-value
Age (years)			
≤30	181	0.245**	0.001**
>30	89	0.145	0.177
Gestational Age (weeks)			
≤39	143	0.279**	0.001**
>39	127	0.194*	0.029*
BMI (kg/m²)			
≤25	211	0.294**	<0.001**
>25	59	−0.101	0.447

*Correlation is significant at the 0.05 level (2-tailed).
**Correlation is significant at the 0.01 level (2-tailed).

DISCUSSION

The findings of present study revealed a significant positive correlation between maternal MCV and birth weight ($r = 0.215$, $p < 0.001$), which suggest that higher maternal MCV values are associated with greater birth weight of the baby. This association may be explained by the fact that MCV is a marker of red blood cell size and its higher values reflect better iron and nutritional status of the mother, which in turn support adequate foetal growth and development through improved oxygen carrying capacity and nutrient delivery to the placenta.

With regards to age subgroup, a significant positive correlation was observed only in younger mothers aged ≤30 years ($r = 0.245$, $p = 0.001$) but not in older mothers aged >30 years ($r = 0.145$, $p = 0.177$). This may be due to the fact that younger mothers tend to have better physiological reserve and more responsive haematopoietic system, which make the MCV a more reliable indicator of nutritional and haematological status in this age group.

With respect to BMI subgroup, a significant positive correlation was found in participants with BMI ≤25 kg/m^2 ($r = 0.294$, $p < 0.001$), however no significant correlation were observed in those with BMI >25 kg/m^2 ($r = -0.101$, $p = 0.447$). This finding suggest that in overweight mothers, the relationship between MCV and birth weight may be confounded by other metabolic and inflammatory factors associated with excess adiposity, which may independently influence foetal birth weight and thus weaken the observed correlation.

The present study enrolled a total of 270 participants, of whom majority were from rural areas 172 (63.7%), un-employed 190 (70.4%) and belonged to middle socioeconomic class 139 (51.5%). A significant positive correlation was found between maternal MCV and birth weight ($r = 0.215$, $p < 0.001$), indicating that higher maternal MCV values were associated with greater neonatal birth weight. This finding is in agreement with the work of Sabir M et al. 12 who also reported that maternal haematological parameters, including MCV, had a significant influence on birth weight outcomes, with anemic mothers having lower birth weight babies (2950±420 g) as compared to non-anemic mothers (3300±350 g). Similarly, Almalki AAE et al. 13 reported that maternal haemoglobin were independently associated with birth weight ($B = -0.028$, $p = 0.020$) in term low birth weight neonates, which further support the role of maternal haematological status in foetal growth. The biological explanation for this association may be that MCV reflects the size of red blood cells and its higher values indicate adequate iron stores and better nutritional status, which in turn ensure sufficient oxygen and nutrient delivery to the foetus via the placenta, thereby promoting optimal foetal growth.

In contrast, Thakur AK et al. 14 reported no significant association between maternal anaemia and birth weight ($p = 1.00$), with mean birth weight of 3.10±0.40 kg in mild anaemia and 2.95±0.30 kg in moderate anaemia groups, which differ from the findings of present study. This discrepancy may be attributable to the fact that the majority of participants in that study had only mild-to-moderate anaemia, which may not have been severe enough to significantly impair foetal growth. Likewise, Kahyaoğlu İ et al. 15 reported no significant difference in birth weight between anaemic and non-anaemic mothers (3093±335 vs 3135±429 g, p = 0.757), despite significantly lower MCV values in anaemic women (67.8±4.6 vs 84.2±2.7 fL, p = 0.001). This suggest that birth weight alone may not fully capture the adverse foetal effects of low MCV and other parameters such as foetal oxygenation may be more sensitively affected.

Lakhiar K et al. 16 reported that anaemic pregnant women in the third trimester had significantly lower MCV values (64.56±7.55 fL) as compared to non-anaemic women (83.11±11.26 fL, p = 0.0001), which is consistent with the present study's observation that lower MCV is associated with poorer foetal outcomes. Muteshi CM et al. 17 also demonstrated that MCV were significantly lower in women with haemoglobin below 10.5 g/dL (77.4 fL vs 83.2 fL, p = 0.0015), although they noted that MCV had limited sensitivity (46.7%) for detecting iron deficiency when haemoglobin were normal, which highlight the importance of using MCV alongside other markers.

With regards to the subgroup analysis by age, a significant positive correlation between maternal MCV and birth weight were observed only in younger mothers aged ≤30 years (r = 0.245, p = 0.001), but not in older mothers aged >30 years (r = 0.145, p = 0.177). This finding is partially supported by Hmood MA et al. 18 who reported that maternal age group of 21–30 years comprised 50% of their study population and that maternal haematological parameters showed a highly significant positive association with child nutritional and haematological outcomes (p <0.01), suggesting that younger maternal age may be associated with more responsive haematopoietic physiology.

Regarding the BMI subgroup, a significant positive correlation was observed in participants with BMI ≤25 kg/m² (r = 0.294, p <0.001), whereas no significant correlation was found in those with BMI >25 kg/m² (r = −0.101, p = 0.447). This is in partial agreement with Almalki AAE et al. 13 who reported that BMI showed only a borderline association with birth weight (B = 0.027, p = 0.071) in their regression model, suggesting that the relationship between maternal nutritional indices and birth weight may be modified by adiposity. Qaiser DH et al. 19 reported a weak maternal-cord correlation for MCV (r = 0.30), which further suggest that the direct translation of maternal MCV to neonatal outcomes may be influenced by confounding factors such as BMI and metabolic status.

Timilsina S et al. 20 reported that maternal and foetal MCV were not significantly correlated (r = 0.058), whilst Jowhara PV et al. 21 observed that MCV were highest in preterm babies (111.73±8.9 fL) and that term IUGR babies had higher haemoglobin and RBC counts, indicating that foetal haematological adaptation were largely independent of maternal MCV values. These findings collectively suggest that although maternal MCV may influence birth weight through nutritional and oxygen delivery mechanisms, the direct correlation between maternal and foetal haematological indices is generally weak and multiple maternal and foetal factors likely interact to determine the final birth weight outcome.

Limitations

This study has many limitations that must be considered. First, it was a single centre study carried out in one particular center, which might have restricted its generalizability. Second, the sample size of 270 patients was relatively small, which could have limited its power to detect weak correlations, especially during the subgroup analysis. Third, other important confounders like maternal iron supplementation, dietary consumption, parity and gravidity were not considered, which would have had an impact on the observed correlation between maternal MCV and birth weight. Fourth, the cross-sectional nature of this study makes it impossible to establish any causal association between maternal MCV and birth weight.

CONCLUSION

This study has concluded that there is a strong and positive correlation between maternal MCV and birth weight of the baby born at term, implying that higher haematological status of mother has a direct impact on the birth weight of the baby. These results suggest the need for monitoring and improvement of maternal haematological status to reduce the risk of low birth weight among babies.

Ethical Approval

Ethical clearance for carrying out the research was obtained from the hospital's Institutional Ethical Committee prior to commencement of the study.

Patients' Consent

All participants provided written informed consent before being enrolled in the research.

Competing Interests

The author declares that no conflict of interest was related to this study.

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