

# A PRELIMINARY REPORT OF A SURVEY OF HAEMATOLOGICAL VALUES IN NEWBORNS OF AURANGABAD

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## Introduction

In our country there is no precise uniformity regarding the normal range of various hematological parameters in newborns. This is partly due to variability in the techniques used in establishing the various norms. Dhar (1934) from Calcutta reported 18.99 per cent haemoglobin in newborns. Three other workers (Mukerjee, 1940; Mukerjee, 1944; Banerjee, 1953) recorded 20 gm., 18.73 gm. and 15.52 gm per 100 ml of blood on an average, respectively. Within the last decade, techniques for obtaining the hematological values have improved and with it has come closer agreement as to what constitutes the normal value. With the realisation that many factors influence what is considered as normal, an attempt is made to present a consensus based on the observations of many investigators. The findings on haemoglobin estimation, erythrocyte count, haematocrit value are the subject matter of this communication.

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## Material and Methods

Cord blood was collected in oxalated bulbs at birth from 210 newborns of Medical College Hospital, Aurangabad. Haematological investigations performed included:

- i. Haemoglobin estimation by oxy-haemoglobin method;
- ii. Haematocrit value, Red cell count and red cell indices (standard) by technique described by Dacie and Lewis (1969).

## Results and Discussion

The values of haemoglobin, erythrocytes, packed cell volume, mean corpuscular haemoglobin concentration, total leucocytic count, are given in Table I with the range of variation. Differential count (percentage and absolute count) are given in Table II.

The average haemoglobin level in our series (16.4 gm per cent) approximates that reported by Walker and Turnbull (1953) and Mollison (1951). The values reported by Upadhyay *et al*, (1944) and Chaudhuri and Chaudhuri (1956) are little higher than the present series. Table III outlines other reported values in the literature, showing a wide range

TABLE I  
The Range of Variation of Different Haematological Values

Range	HB (gm%)	R.B.C. cu.mm	P.C.V. (%)	M.C.V. (Cu.μ)	M.C.H. (μμg)	M.C.H.C. (%)	T.L.C./ C.mm
Maximum	20.6	6.2	64	110.2	40.4	40.2	14000
Minimum	13.6	3.6	34	82.4	26.6	26.0	6000
Mean	16.4	5.3	49.6	88.2	32.4	34.1	9632
Standard deviation	1.34	0.4266	4.65	5.92	2.34	2.82	2084
Coefficient of variation	8.1707	8.049	9.487	6.712	7.222	8.269	23.29
Standard error	0.099	0.029	0.321	0.408	0.162	0.195	143.82

TABLE II  
Different Leucocytic Count

Values	Percentage count				Absolute count			
	poly	lympho.	Eosino.	mono.	poly	lympho.	Eosino.	mono.
Maximum	80	62	4	6	11200	8660	560	840
Minimum	30	15	0	0	1800	900	0	0
Mean	62.6	34.5	0.56	3.17	8426	4015	52.4	310.4

from 11.2 to 26.0 gm per cent. The standard deviation of 1.34 gm per cent and the coefficient of variation of 8.1707 per cent in the present series is also significant. Anderson and Ortman (1937) recorded a coefficient of variation of  $\pm 12\%$ , while Mollison *et al*, (1950) recorded a standard deviation of 2.0 gm % and a coefficient of variation of  $\pm 11\%$ . The disparity may be attributable to the adoption of different techniques by different workers for haemoglobin estimation. The bulk of recent studies has placed the normal value in the range of 16.6 to 17.1 gm/100 ml. When these results are corrected according to the number of observations in the series, the value for the mean cord haemoglobin concentration is 16.8 gm/100 ml. Sisson (1958) has suggested that 13.5 gm/100 ml be considered the lowest normal value, which agrees well with

Mollison's (1961) figure of 13.6 gm/100 ml. These values may prove to be low when infants with recognised transplacental haemorrhages are separated from the group. Haemoglobin values in this range of normal can best be interpreted when a reticulocyte count and a nucleated red cell count are also taken into account. If either or both of these last two values are elevated, it suggests that the body of the infant is attempting to compensate for a lower than normal haemoglobin and that the observed value represents anemia for the child under study.

Cord blood hematocrit values have been less extensively studied than hemoglobin concentration values. Reports of normal values have ranged from 51.3 per cent (Waugh *et al*, 1939) to 56.0 per cent (Gairdner *et al*, 1952). In the present study hematocrit value ranged

TABLE III  
Normal Cord Blood Haemoglobin as Reported by Several Workers

Author	Mean haemoglobin gm/100 ml	Range (gm/100 ml)	Number of observation
1. Upadhyay (1944)	17.8	—	—
2. Mollison et al, (1951)	16.6	—	134
3. Dochain et al, (1952)	17.9	14.4-21.6	40
4. Walker & Turnbull (1953)	16.5	—	145
5. Marks et al, (1955)	16.9	12.3-22.0	221
6. Paul (1956)	18.62	—	63
7. Chaudhari & Chaudhari (1956)	17.18	—	50
8. Guest & Brown (1957)	17.1	13.0-25.0	59
9. Rooth & Sjostedt (1957)	16.7	11.2-26.6	414
10. Mckay (1964)	17.4	—	60
11. Khanna & Manchanda (1964)	17.4	13.8-21.6	100
12. Khanduja et al, (1967)	16.5	15.3-18.6	—
13. Dacie & Lewis (1969)	15.6	13.6-19.6	—
14. Bhatnagar et al, (1973)	20.8	—	65
15. Present study (1974)	16.4	13.6-20.6	210

from 34% to 64%, with the mean value 49.6 per cent, the standard deviation was 4.65, a coefficient of variation 9.487. Chaudhuri and Chaudhuri (1956) reported hematocrit value as  $54.55 \pm 3.3$  per cent with a coefficient of variation 6.05 per cent. Most of the values lie within the range of 48.1 to 61.0 per cent. Chuinard *et al*, (1941) recorded average haematocrit value to be 45.85 per cent which was lower than our mean value. They, however, used only potassium oxalate powder as anti-coagulant which might have caused the shrinkage of the red cells. Regarding the standard deviation of coefficient of variation, all other workers were silent.

The red cell count, just as the hemoglobin and hematocrit values, show great variability at the time of birth (Table 1). Wegelius (1948) and Guest and Brown (1957) reported the mean red cell count to be approximately 4,600,000/cu.mm., while Lippman (1924) reported a value of 5,200,000/cu.mm. The average red cell count was 5.3 million/cu.mm., with a

range of 3.6 to 6.2 million/cu.mm. in the present study. Reported values for total erythrocyte count in the literature is shown in Table IV. The red cells of the newborn infant are in general much larger than the cells of the normal adult, although much variation in size can be observed in any infant. Saragea (1922) found the average diameter of the erythrocytes to be  $8.5 \mu$  at birth. Berg (1945) suggested that under the normal conditions of careful counting the standard deviation should be 0.39 million red cells and coefficient of variation should be 7.8 per cent in a 5 million red cell count. Hence, the erythrocyte count of 5.3 million of the present series with coefficient of variation 8.049 per cent may be considered as standard erythrocyte count of newborns.

Mean corpuscular volume of the newborn babies was 88.2 cubic microns. The coefficient of variation was 6.712 per cent. The values lie between 82.4 and 110.2 cubic microns. The value of M.C.V. was observed by Gairdner *et al*, (1952)

TABLE IV  
Showing Haematological Values in Newborn by Different Workers

Author	Haematological values					
	Total Hb% R.B.C./ cu.mm	P.C.V./ 100 ml	M.C.V. (Cu.μ)	M.C.H. (μμ gm)	M.C.H.C. (%)	
1. Upadhyay (1944)	17.8	6.2	52.3	92	40.4	
2. Gairdner et al (1952)	20.0	5.8	63.0	108	32.6	
3. Walker & Turnbull (1953)	17.36	4.5	53.4	116.8	35.0	
4. Paul (1956)	18.62	5.3	62.0	106.3	31.0	
5. Chaudhari & Chaudhari (1956)	17.13	5.1	54.5	107.2	31.4	
6. Brenemann & McQuarrie (1956)	17.5	5.5	54.0	108	32.0	
7. Guest & Brown (1957)	16.8	5.2	53.0	107	31.7	
8. Khanna & Manchanda (1964)	17.4	5.1	52.3	101.1	33.3	
9. Bhatnagar et al, (1973)	20.8	4.4	42.5	99.7	40.0	
10. Present study (1974)	16.4	5.3	49.6	88.2	34.1	

and Smith (1951) to be 108 and 110 cubic microns respectively. Chuinard *et al*, (1941) recorded the average M.C.V. to be 99.1 cubic microns. The mean corpuscular volume of erythrocytes at birth has been estimated to range from 104 to 118 cubic microns (Marks *et al*, 1955; Walker and Turnbull, 1953). Chaudhuri and Chaudhuri recorded M.C.V. of newborns as  $107.2 \pm 4.05$  cubic microns. The coefficient of variation was 4 per cent. The values lie between 99.1 and 115 cubic microns.

The average haemoglobin contents of each erythrocyte was 32.4 micro micrograms. The coefficient of variation was 7.22 per cent. The values ranged between 26.6 to 40.4 micro micrograms. The observation indicates that red cells of a newborn baby are always normochromic. The mean haemoglobin concentration of the red cells was 34.1 per cent. The range of variation was 26—40.2 per cent which was within the accepted normal range. These findings were in agreement with the findings of other workers (Gairdner

*et al*, 1952); Chaudhuri and Chaudhuri, 1956).

Total differential counts are shown in Table II. The reported figures vary from 11,000 to 18,000 per c.m. The premature infant has a slightly lower total white cell count (Burrell, 1952). Neutrophils in general as an average was reported about 61 per cent of the total cell by many workers (Wegelius, 1948; Lippman, 1924; Burrell, 1952). Washburn (1935) found that leucocyte fluctuation were extremely irregular and showed considerable variability for the same baby at the same hour and also for any two babies of the same age and weight. Bayer (1932) observed that the total leucocyte count at birth is directly proportional to the degree of asphyxia suffered by the child. In addition to the marked variations, total leucocyte counts in the newborns are, in general, higher than in the adults.

#### Summary

There is no precise uniformity regard-

ing the normal range of various haematological parameters of newborn in our country. As such there are very few studies reported from India regarding the normal range of haematological values in newborns. The present study is a preliminary report on normal haematological values in newborn. The haemoglobin, hematocrit, red cell count and red cell indices were investigated in 210 newborns. The mean haemoglobin was 16.4 per cent, MCV—49.6 per cent, RBC count—5.3 million  $\mu$ cu. mm., MCV—88.2 cu. $\mu$ ., MCH—32.4 micro-micrograms, MCHC—31.1 per cent and TLC—9632/cu. mm. of blood. The literature on the subject has been briefly reviewed.

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