

RED CELL VARIABLES IN YOUNG FEMALE POPULATION OF DEHRADUN REGION

Vineet Vishnoi¹, Upsana Raturi², D. K. Awasthi³ and Gyanendra Awasthi*²

¹Department of Chemistry, DAV (PG) College, Dehradun.

²Department of Biochemistry, DIBNS, Dehradun.

³Department of Chemistry, JNMPG College, Lucknow.

*Corresponding Author: Gyanendra Awasthi

Department of Biochemistry, DIBNS, Dehradun.

Article Received on 20/09/2022

Article Revised on 10/10/2022

Article Accepted on 31/10/2022

ABSTRACT

Background: This study aimed to assess the basic red blood cell variables and hematological indices in Young Female population of Dehradun region. **Methods:** In this cross-sectional study, blood samples of 30 female volunteers studying in Dolphin Institute, Dehradun were collected from May to August, 2022. Capillary blood samples were drawn and following hematologic parameters were measured: the red blood cell count (RBC), hemoglobin concentration (Hb), hematocrit level (Hct) and hematological indexes: mean corpuscular volume (MCV), mean hemoglobin concentration (MCH) and mean corpuscular hemoglobin concentration (MCHC). **Results and Conclusion:** All the Hematological parameters of young female students is found to be within the reference range of Indian healthy population and none of the parameter was too high or too low. Thus, as per our study the young female students were having normal hematological profile. The main Drawback of the study was that sample size was low and larger sample size is required in order to find out the reference range in the above region.

KEYWORDS: Red blood cells, Hemoglobin, Haematological indices, Anemia.

INTRODUCTION

Having excellent knowledge of the referent values of red blood cells (RBCs) variables with children and adolescents is profoundly important for proper interpretation of the results of complete blood count. Reference values for RBCs variables are lower with children in comparison with the adults.^[1] Several studies which investigated hematologic parameters have been done in different populations, racial, ethnic and gender subgroups, even in different seasons.^[2-5] In most of these studies, age, ethnic and sex differences were significant and therefore it was stressed the need for establishing normal reference values for different populations.

RBC variables are fairly stable through adult life, but significant differences exist in the pediatric population. The new born infant, older child, and adult show profound differences.^[6] Because hemoglobin level and red cell indices vary with age, it is crucial to take as reference standards that change in each period of life, from fetal life to adolescence. Adult value will be reached gradually during the second part of childhood, around 15 yr of age.^[7] To ensure that interpretation of hematology results in children are appropriate, the laboratory has to have established age-specific reference ranges.^[8]

The sex differences in hemoglobin level in adults are well documented, and the underlying mechanisms are probably a direct effect of sex hormones, both estrogen and androgens on erythropoiesis.^[9] "In pre-pubertal humans no major differences can be found between the sexes in red blood cell count or hemoglobin and serum ferritin concentrations".^[10] "The difference in hematological variables between sexes emerges after onset of menstruations and persistent until 10 yr after the menopause".^[9,10] Menstruation and nutritional intake are principal reasons for lower values of hemoglobin and iron of women regarding men.^[11]

The total amount of hemoglobin increases more in boys than in the girls in the period of puberty.^[12] Among children 6–14 yr old the values increased from about 12 to about 14 gr per 100 ml of blood. In girls between 14 and 20 yr of age, the hemoglobin values decreased slightly, reaching 13gr/100ml. In boys of corresponding ages, there was an increase to about 15gr/100ml. In both sexes, these values were attained at about 20 yr of age and remained characteristic of the third decade of life.^[13]

The aim of this paper was to determine the values of RBC variables in female young population studying in Dehradun region.

PATIENTS AND METHODS

Study population

In this cross-sectional study, blood samples of 30 female volunteers studying in Dolphin Institute, Dehradun were collected from May to August, 2022. This project was approved by the Ethics Committee of Dolphin Institute and signed informed consent was gathered from all patients before study initiation.

Enrollment to the survey was according to willingness of the participants and their good health condition (based on past medical history, physical examination taken by a single physician and laboratory findings including human immunodeficiency virus antibody (anti-HIV), Hepatitis B surface antigen (HBsAg), hepatitis C antibody (anti-HCV) and syphilis serology). Participants with evidence of fever, history of drug abuse, alcohol

consumption, drug and food hypersensitivity, smoking and chronic diseases such as diabetes mellitus, were excluded from the study.

Then, blood sample was collected. Complete blood cell (CBC) count and differential was performed using an automated hematology analyzer (Sysmex K-1000 Corporation, France). All instruments were operated and quality controlled according to the manufacturers' instructions and standard quality control protocols. The hematological values including hemoglobin, platelet count, WBC count and differential were analyzed.

RESULT AND DISCUSSION

In a study conducted at Dolphin Institute on 30 young female students of DIBNS Dehradun. The Anthropometric data is given in the table below.

Table 1.

PARAMETER	AVERAGE	MAXIMUM	MINIMUM
WEIGHT(kg)	49.6	65	39
HEIGHT(ft)	5	5'7	4'11
BMI	20.49	26.2	16

All were non-smokers and non-drinkers and had no tobacco chewing habit the total number of patients were thirty (30). The average weight is 49.63kg. Maximum weight is 65kg and minimum is 39kg. The total number of patients were thirty (30). The average Height is 5Feet. Maximum weight is 5'7Feet and minimum is 4'11feet.

The average BMI is 20.49(Healthy weight). Maximum BMI is 26.2 and minimum is 16.

The mean and reference intervals of various Hematological parameters of Dehradun females of age group (20-30) are given in table below.

Table 2.

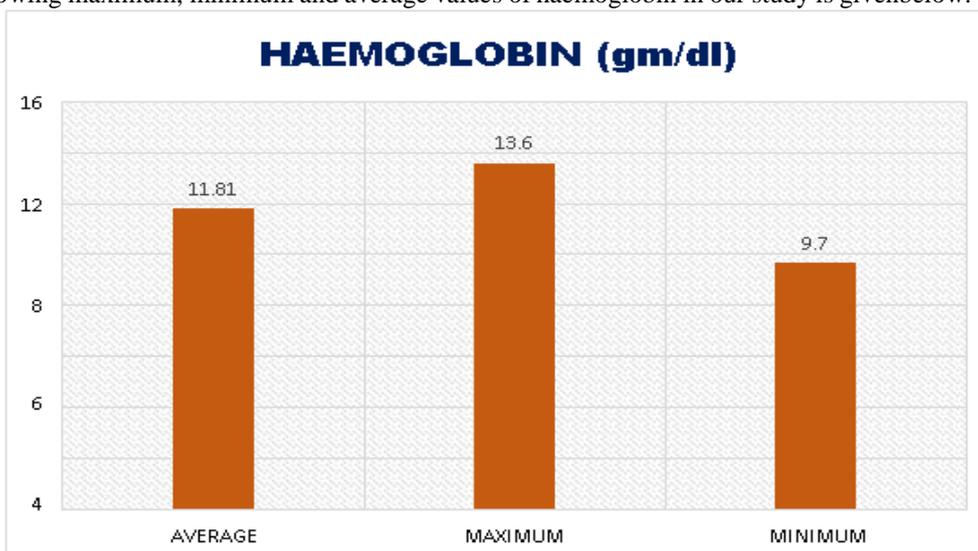
parameter	average	minimum	maximum	normal range
HAEMOGLOBIN (gm/dl)	11.81	9.7	13.6	12-15 gm/dl
TOTAL R.B.C. COUNT (million/cumm)	4.29	3.15	4.38	3.5-5.5million/cumm
MCV (fl)	86.5	68.07	104.76	76-96 fl
MHC (pg)	27.76	19.31	35.24	27-32 pg
MCHC(g/dl)	32	28.37	33.68	30.5-34.5g/dl

HAEMOGLOBIN

Total number of blood samples were thirty (30), out of them there are 14 samples which are below the normal range and remaining samples are normal, there is no sample which is above the normal range. The low level of haemoglobin maybe sign of several conditions, including Anemia and Thalassemia, Iron deficiency due to low iron intake, Chronic kidney diseases, Cirrhosis, Hypothyroidism, Ulcers, etc.

Graph 1.

The graph showing maximum, minimum and average values of haemoglobin in our study is given below.

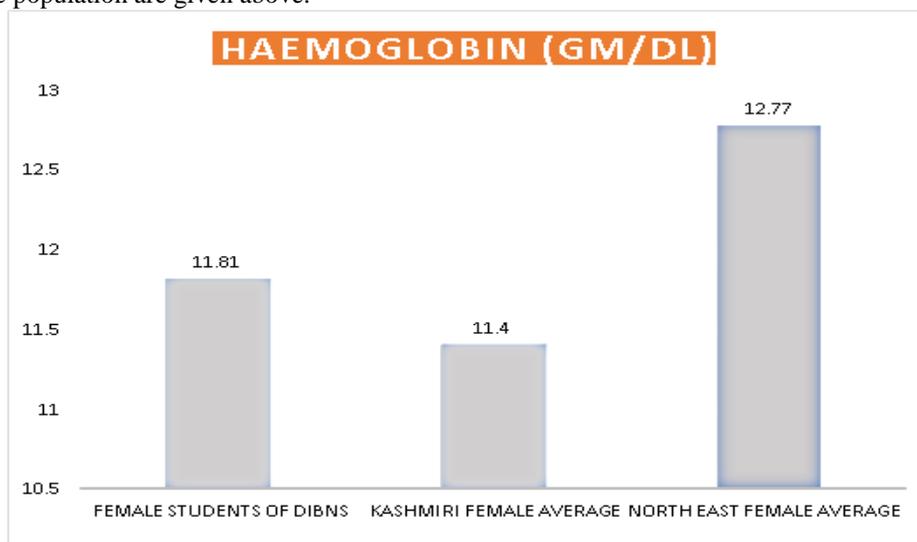


In our study the average value of haemoglobin for the thirty (30) blood sample is 11.81gm/dl, maximum value is 13.6gm/dl and minimum value is 9.7gm/dl. The survey done on Kashmiri females of Dolphin Institute of Biomedical and Natural Sciences Dehradun the average haemoglobin of Kashmiri female was 11.4 gm/dl, maximum value was 13.1gm/dl and minimum were 8.3gm/dl.^[14] The study done on north east male was found in the range of 14.99 gm/dl and in case of female the value is in the range of 12.77gm/dl. The maximum value of Hemoglobin found in male and female is 16.9gm/dl and 16.5gm/dl and the minimum value is 12.9gm/dl and gm/ respectively.^[15] The value of Hemoglobin in the study done in India on the people belonging to the age group of below 40 years was found to be in the range of (12.6-17.1gm/dl) in males and (9.6-14.3gm/dl) in females. In the same study, the values of

Hemoglobin found in different regions were found to be in range of 11.9-16.6gm/dl (male), 9.9- 14.2gm/dl (female) in Ahmadabad, 12.4-17gm/dl (male) and 10.4-14.6gm/dl (female) in Delhi, 13-17.2gm/dl(male) and 10.3-14.8gm/dl (Female) in Hyderabad, 11.5-16.8gm/dl (male) and 9.4- 14gm/dl(female) in Chennai.^[16] Where as in another study done at China the values of Hemoglobin were found to be in range of 13.1-17.2 gm/dl (male) and 11.3- 15.1gm/dl (female).^[16] In another study done at Iran on the people belonging to age group between 18-25, the value of hemoglobin is in the range of 15.5gm/dl (15.4-15.6).^[16] The average of haemoglobin in Dehradun females is found lower than in North East Females. Kashmiri females average haemoglobin is lowest. The value in our study is found in between the range as given in the Indian study.

Graph 2.

The graphs obtained by comparing the Mean value of Haemoglobin in young females of DIBNS with North East and Kashmiri female population are given above.



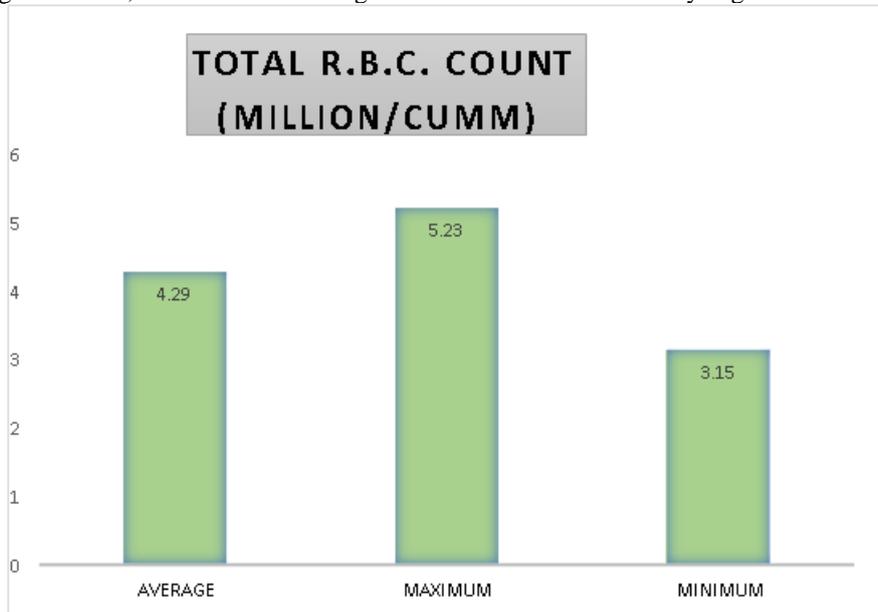
Total R.B.C. count

Total numbers of blood samples were thirty (30), out of them there is 1 sample 3.15million/cumm which is below the normal range and remaining samples are normal, there is no sample which is above the normal range.

The low level of R.B.C. count indicates Anemia, low iron levels in blood, chronic kidney diseases, cirrhosis, certain medications such as antiretroviral drugs for HIV infection and chemotherapy drugs. A high level of R.B.C. count can be sign of dehydration and heart diseases.

Graph 3

The graph showing maximum, minimum and average values of R.B.C. in our study is given below.



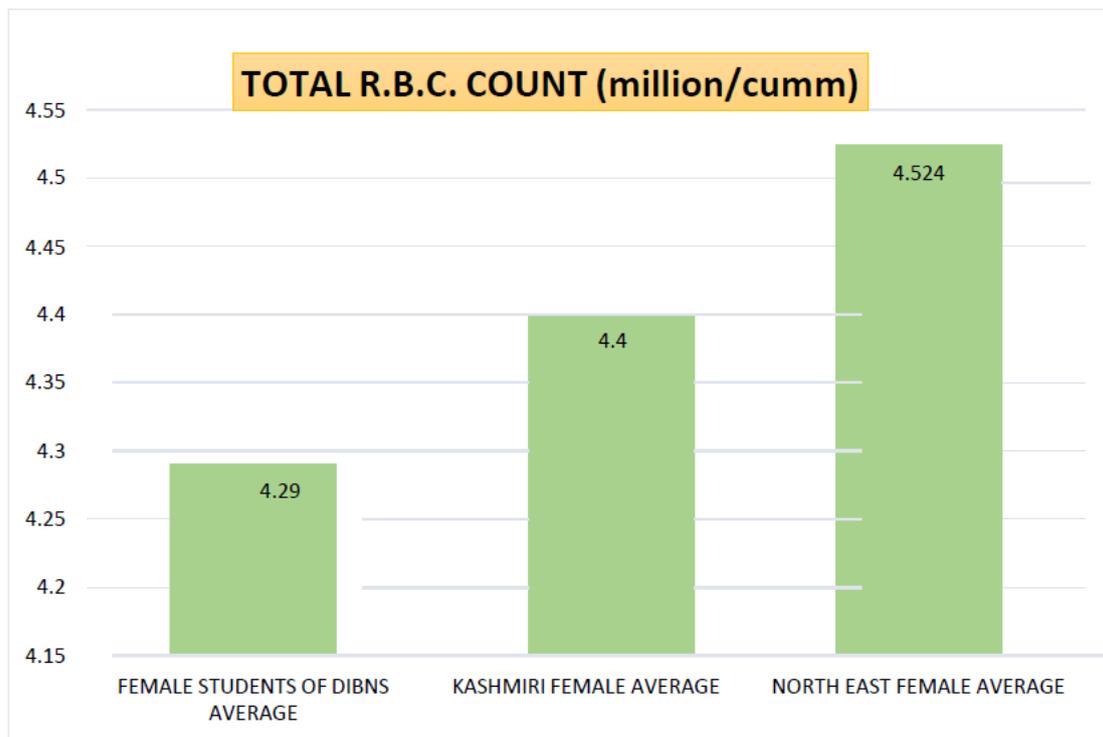
In our study the average value of Total R.B.C. Count for the thirty (30) blood sample is 4.29million/cumm, maximum value is 5.23million/cumm and minimum value is 3.15million/cumm.

al;2009).The value of RBC's were lower in Dehradun females as with reference to North East and Kashmiri females. The value of RBC in our study is found in between the range as given in the Indian study.

The survey done on Kashmiri females of Dolphin Institute of Biomedical and Natural Sciences Dehradun value of RBC in case of Kashmiri female the value is in the range of 4.4 million/cumm. The maximum value of RBC found in Kashmiri female is 5.09 million/cumm and the minimum value is 3.55million/cumm.^[14] The study done on north east female the mean value of RBC in case of female the value is in the range of 4.52 million/cumm. The maximum value of RBC found in our study in female is 5.93 million/cumm and the minimum value is 3.81million/cumm.^[15] The value of RBC in the study done in India on the people belonging to the age group of below 40 years was found to be in the range of (4.5- 6.0million/cumm) in males and (3.5-5.3) in females. In the same study, the values of RBC found in different regions were found to be in range of 4.0-5.9 (male) and 3.7-5.2(female) in Ahmadabad,4.0-6.0 in both male and female in Hyderabad and 3.9-6.0(male) and 3.5-5.1(female) in Chennai.^[16] Where as in another study done at South Africa the value of RBCwere found to be in range of 4.49-5.90 in male and 3.85-5.25 in female in Maseru Lesotho, 4.43-6.03 in males and 4.07-5.13 in female in Witwatersrand and 3.2-5.8 in male and 3.0-5.3 in female in Cape peninsula(Denise Lewrie, *et*

Graph 4.

The graphs obtained by comparing the Mean value of R.B.C. Count in young females of DIBNS with North East and Kashmiri female population are given below.

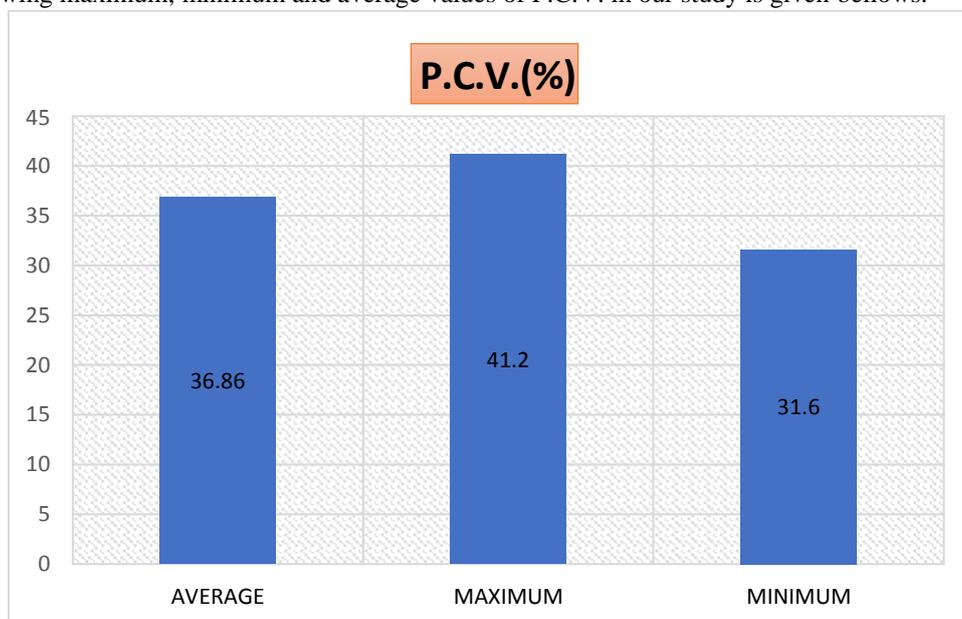


Packed Cell Volume

Total number of blood samples were thirty (30), out of them there are 10 samples which is below the normal range and remaining 20 samples are in normal.

Graph 4.

The graph showing maximum, minimum and average values of P.C.V. in our study is given bellows.



In our study the average value of P.C.V. for the thirty (30) blood sample is 36.86%, maximum value is 41% and minimum value is 31.6%. The survey done on

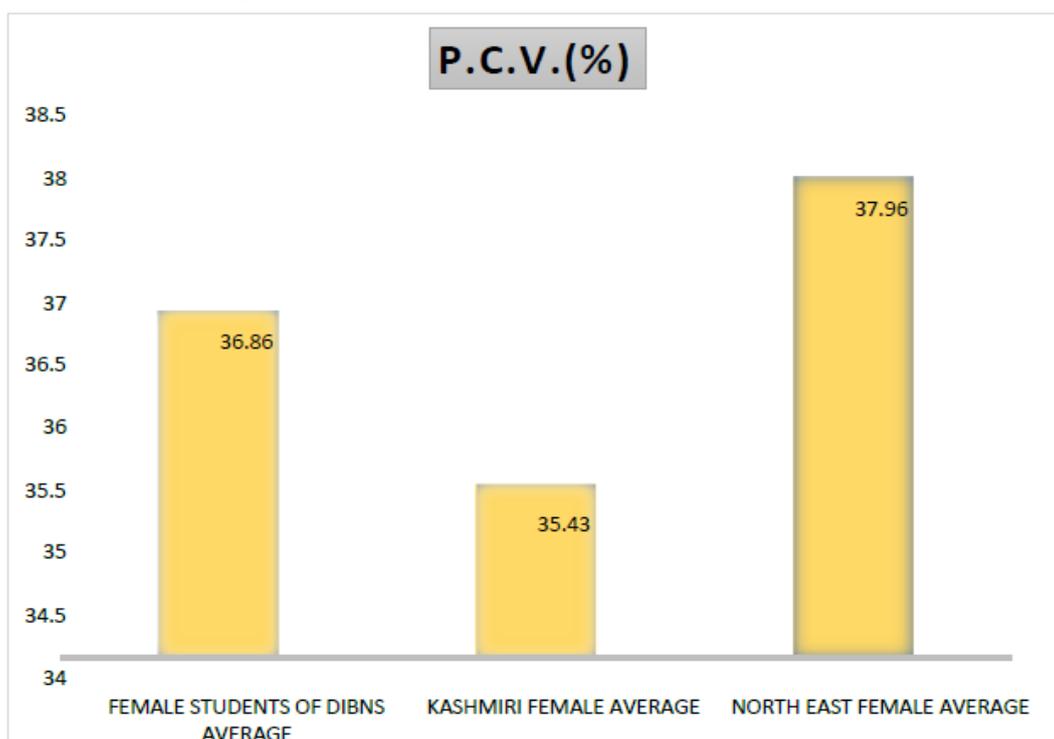
Kashmiri females of Dolphin Institute of Biomedical and Natural Sciences Dehradun the average value in case of Kashmiri female is in the range of 35.43%. The

maximum value of PCV found in female is 38.7% and the minimum value is 27.2%.^[14] Another study done on North East students the mean value of PCV in case of male is found in the range of 43.32% and in case of female the value is in the range of 37.96%. The maximum value of PCV found in our study in male and female is 45.8% and 47.60% and the minimum value is 36.4% and 34.00% respectively.^[15] The value of PCV in the study done in India on the people belonging to the age group of below 40 years was found to be in the range of (37-51) in males and (30-43) in females. In the same study, the values of PCV found in different regions were found to be in range of 37-49 (male) 32-44 (female) in Ahmadabad, 37-49 (male) and 31-42 (female) in Delhi,

39-52 (male) and 31-45 (female) in Hyderabad 35-49 (male) and 30-43 (female) in Chennai (**Shrilekha Sairam, et al;2013**). Where as in another study done at South Africa the value of PCV were found to be in range of 0.41-0.52 in male and 0.35-0.47 in female in Maseru Lesotho, 0.39-0.51 in males and 0.36-0.45 in female in Witwatersrand and 0.31-0.525 in male and 0.273-0.472 in female in Cape peninsula (**Denise Lewrie, et al;2009**). The value of PCV in Dehradun Females was higher than Kashmiri females but lower with reference to North East female. The value of PCV in our study is found in between the range as given in the Indian study.

Graph 5.

The graphs obtained by comparing the Mean value of P.C.V. in young females of DIBNS with North East and Kashmiri female population are given below.

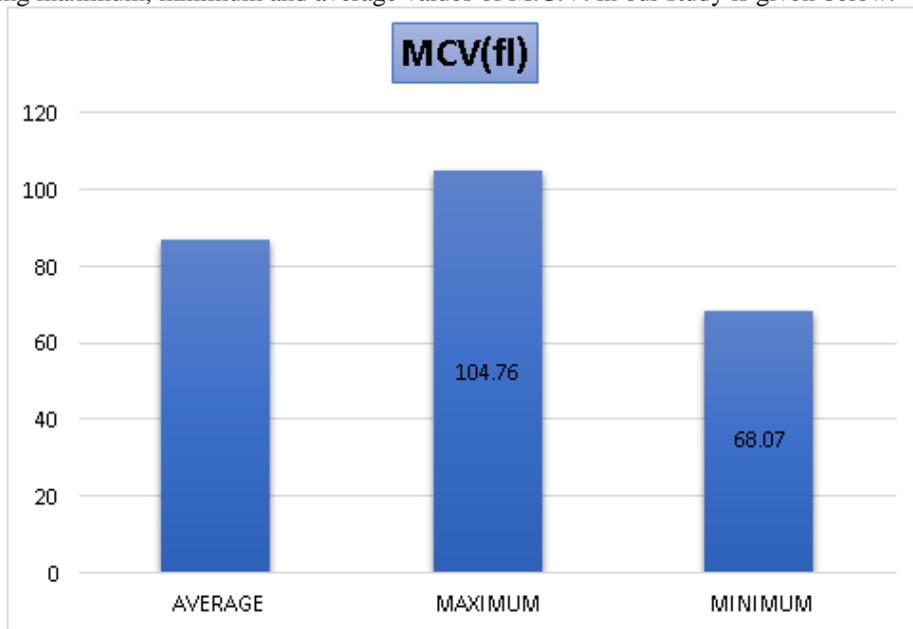


MCV (Mean Corpuscular Volume)

Total number of blood samples were thirty (30), out of them there is 1 sample 68.07fl which is below the normal range and 1 sample 104.76fl which is above the normal range, remaining 28 samples are in normal range (76-96fl).

Graph 6.

The graph showing maximum, minimum and average values of M.C.V. in our study is given below.

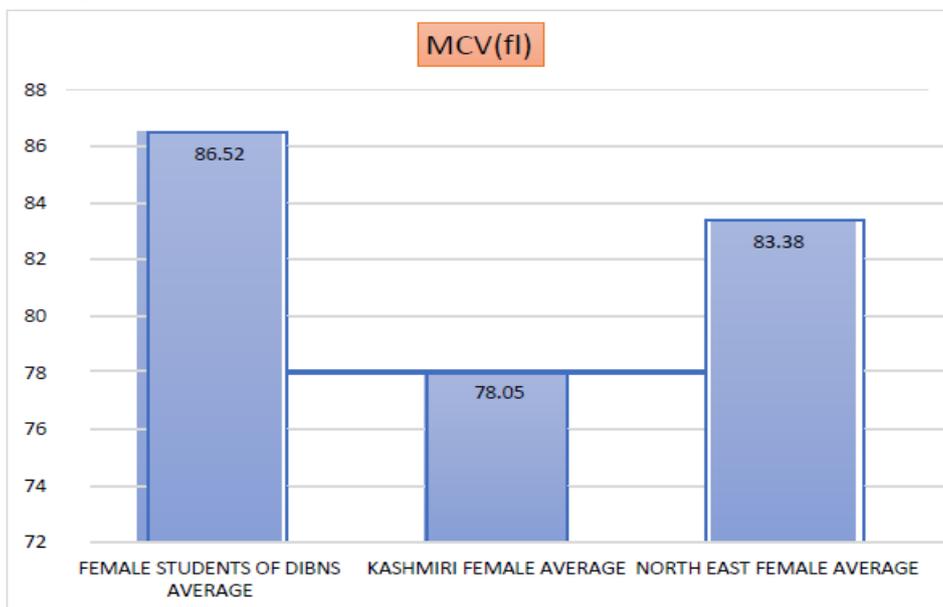


In our study the average value of MCV for the thirty (30) blood sample is 86.52fl, maximum value is 104.76fl and minimum value is 68.07fl. The survey done on Kashmiri females of Dolphin Institute of Biomedical and Natural Sciences Dehradun in case of female the value is in the range of 78.05fl. The maximum value of MCV found in female is 90.8fl and the minimum value is 70.82fl.^[14] Another study done on North East students the mean value of MCV in case of male was found in the range of 83.053fl and in case of female the value is in the range of 83.38fl. The maximum value of MCV found in our study in male and female is 92.09fl and 92.76fl and

the minimum value is 71.43fl and 79.41fl respectively.^[15] The value of MCV in the study done in different regions of India on people belonging to age group less than 40 years were found to be in range of 78-79 in male and 70-96 in female.^[16] Where as in another study done at South Africa the value of MCV were found to be in range of 81-99 in male in Maseru Lesotho, 77-94 in male in Witwatersrand and 82-110.4 in male and 76.2-106.7 in female in Cape peninsula.^[19] The value of MCV were higher in Dehradun females with reference to Kashmiri and North East. The value of MCV in our study is found in between the range as given in the Indian study.

Graph 7.

The graphs obtained by comparing the Mean value of MCV in young females of DIBNS with North East and Kashmiri female population are given below.

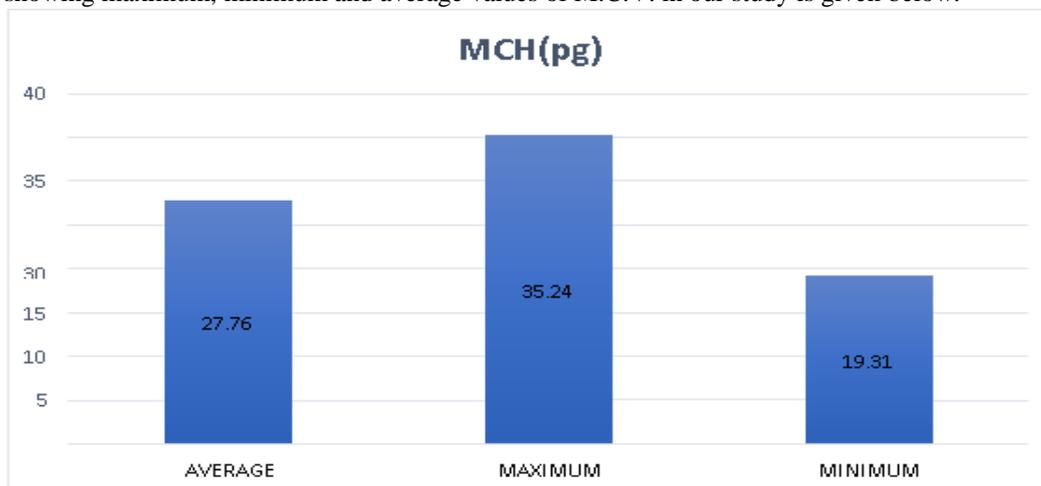


MCH (Mean Corpuscular Haemoglobin)

Total number of blood samples were thirty (30), out of them there are 11 samples which is below the normal range and remaining 19 samples are in normal.

Graph 8.

The graph showing maximum, minimum and average values of M.C.V. in our study is given below.

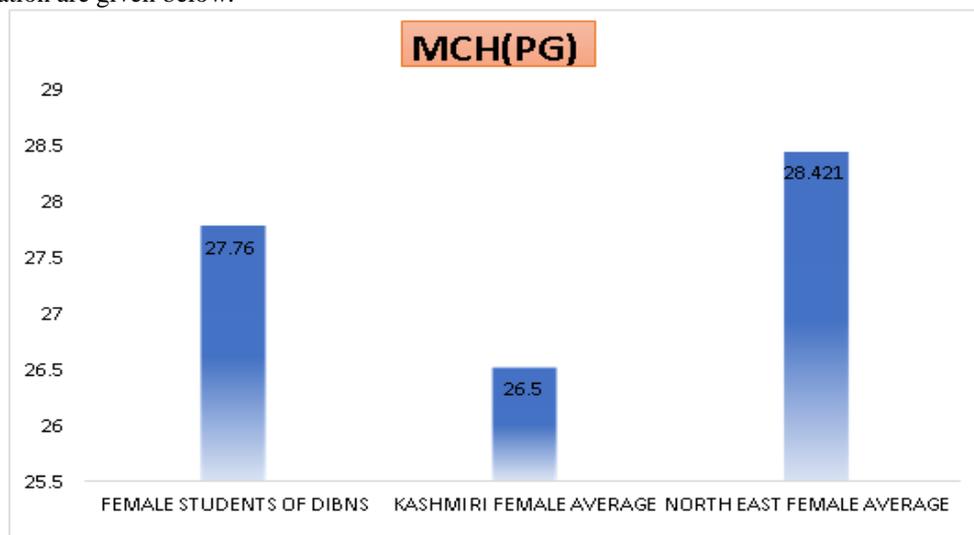


In our study the average value of MCH for the thirty (30) blood sample is 27.76pg, maximum value is 35.24pg and minimum value is 19.31pg. The survey done on Kashmiri females of Dolphin Institute of Biomedical and Natural Sciences Dehradun the average value in case of Kashmiri female is in the range of 26.5pg. The maximum value of MCH found in female is 30.53 pg and the minimum value is 21.99 pg.^[14] Another study done on North East students the mean value of MCH in case of male was found in the range of 28.87 pg and in case of female the value is in the range of 28.42pg. The maximum value of MCH found in our study in male and female is 32.75 and 38.06pg and the minimum value is 19.6 and 26.56 pg respectively.^[15] The value of MCH in

the study done in different regions of India were found to be in range of 26-33 (male) 23-32 (female) in Ahmadabad, 25-33 in both male and female in Delhi, 26-33 (male) and 23-32 (female) in Hyderabad 25-33 (male) and 24-32 (female) in Chennai.^[16] Where as in another study done at South Africa the value of MCH were found to be in range of 27.2-33.6 in male in Maseru Lesotho, 27.5-33.3 in male in Witwatersrand and 25.3-34.9 in male and 24.8-33.8 in female in Cape peninsula (Denise Lewrie, *et al*; 2009). The value of MCH in Dehradun Females was higher than Kashmiri females but lower with reference to North East female. The value of MCH in our study is found in between the range as given in the Indian study.

Graph 9.

The graphs obtained by comparing the Mean value of MCH in young females of DIBNS with North East and Kashmiri female population are given below.

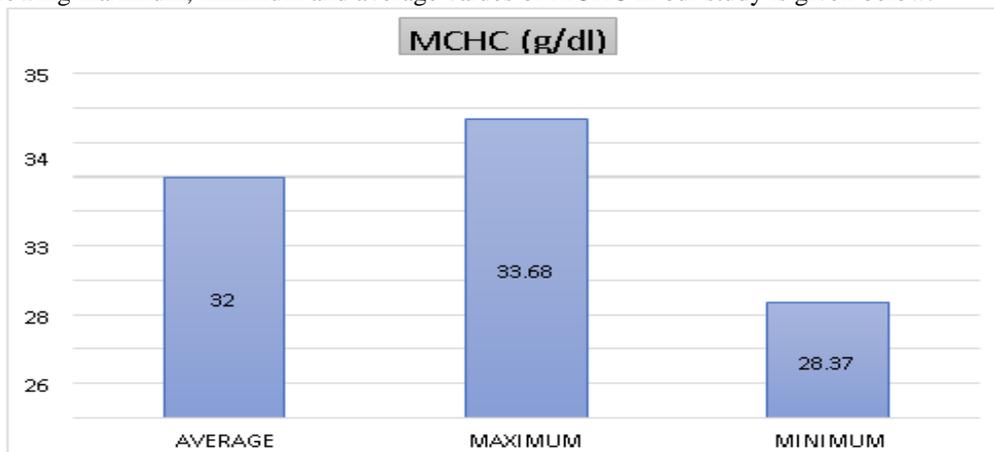


MCHC (Mean Corpuscular Haemoglobin Concentration)

Total number of blood samples were thirty (30), out of them there are 3 samples which is below the normal range and remaining 27 samples are in normal range.

Graph 10.

The graph showing maximum, minimum and average values of MCHC in our study is given below.



In our study the average value of MCHC for the thirty (30) blood sample is 32g/dl, maximum value is 33.68g/dl and minimum value is 28.37g/dl. The survey done on Kashmiri females of Dolphin Institute of Biomedical and Natural Sciences Dehradun in case of Kashmiri female the value is in the range of 33.09g/dl. The maximum value of MCHC found in Kashmiri female is 35.64g/dl and the minimum value is 30.51g/dl.^[14] Another study done on North East students the mean value of MCHC in case of male was found in the range of 34.71 and in case of female the value is in the range of 34.05. The maximum value of MCHC in this study in male and female is 36.78 and 42.65 and the minimum value is 33.4 and 32.26.^[15] The value of MCHC in the study done in

India on the people belonging to the age group of below 40 years was found to be in the range of (31-36) in males and (30-35) in females. In the same study, the values of MCHC found in different regions were found to be in range of 31-35 (male) 30-35 (female) in Ahmadabad, 33-36 (male) and 32-35 (female) in Delhi, 31-36 in both male and female in Hyderabad and 32-35 (male) and 29-35 (female).^[16] Where as in another study done at South Africa the value of MCHC were found to be in range of 32.1-35.5 in male in Maseru Lesotho, 33.4-37.0 in male in Witwatersrand and 29.9-36.0 in male and 30.3-35.4 in female in Cape peninsula^[19] The value of MCHC was found lower in Dehradun females with reference to Kashmiri and North East female.

Graph 11.

The graphs obtained by comparing the Mean value of MCHC in young females of DIBNS with North East and Kashmiri female population are given below.

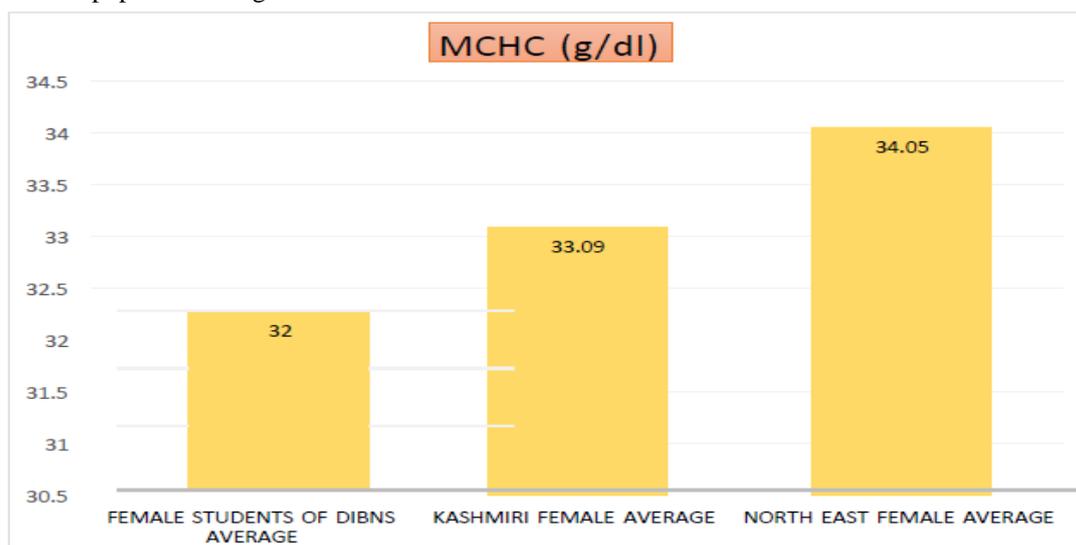


Table 3.

The table showing average value comparison of hematological profile of Young females students of with reference to Kashmiri and North East females.

Parameter	Dehradun females average	Kashmiri females average	North East Female average
Haemoglobin	11.81	11.4	12.77
R.B.C. Count	4.29	4.4	4.524
P.C.V	36.86	35.43	37.96
M.C.V	86.52	78.05	83.38
M.C.H	27.76	26.5	28.421
MCHC	32	33.09	34.05

CONCLUSION

Complete Blood Count (CBC) gives important information about the kinds and numbers of cells in the blood especially red blood cells (RBC'S). The CBC helps to check any symptoms such as weakness, fatigue or bruising, you may have. The CBC also helps to diagnose conditions such as anemia infection and many other disorders.

Whole blood samples of thirty young females were collected along with their anthropometric data. The Complete Blood Count (CBC) was done with fully automated cell counter. All the Haematological parameters of young female students is found to be within the reference range of Indian healthy population and none of the parameter was too high or too low. Thus, as per our study the young female students were having normal hematological profile. The main Drawback of the study was that sample size was low and larger sample size is required in order to find out the reference range in the above region.

REFERENCES

- World Health Organization, 2008. Worldwide prevalence of anaemia 1993–2005. Geneva: WHO; ISBN. Archived from the original on 12 March 2009.
- Kaestner L, Bogdanova A. (2014). Regulation of red cell life span, erythropoiesis, senescence and clearance. *Front Physiol*, 5: 269.
- Evans DM, Frazer IH, Martin NG. (1999). Genetic and environmental causes of variation in basal levels of blood cells. *Twin Res*, 2(4): 250–257.
- El-Hazmi MAF, Warsy AS. (2001). Normal reference values for haematological parameters, red cell indices, HbA2 and Hbf from early childhood through adolescence in Saudis. *Ann Saudi Med*, 21(3–4): 165–169.
- Taylor MR, Holland CV, Spencer R, et al. (1997). Haematological reference ranges for school children. *Clin Lab Haematol*, 19(1): 1–15.
- Roda k BF, Fritsma GA. (2002). *Hematology: Clinical Principles and Applications*. Elsevier Health Sciences, Amazon.com.
- Tchernia G. (1989). [Erythropoiesis and erythrocytes in children, physiology and standards]. *Rev Prat*, 39(24): 2111–6.
- Greenway A, Monagle P. (2004). Abnormal haematology results in children. *Aust Prescr*, 27: 64–61.
- Murphy WG. (2014). The sex differences in haemoglobin levels in adults - Mechanisms, causes, and consequences. *Blood Rev*, 28(2): 41–47.
- Wish JB. (2006). Assessing iron status: Beyond serum ferritin and transferrin saturation. *Clin J Am Soc Nephrol*, 1(1): S4–S8.
- Rushton DH, Dover R, Sainsbury AW, Norris MJ. (2001). Why should woman have a lower reference limits for hemoglobin and ferritin concentrations than men? *BMJ*, 322(7298): 1355–1357.
- Lakshmi A, Govindaraj J. (2015). Correlation of Haemoglobin with Body Mass Index in Male and Female Medical Students in North East Karnataka. *Biosci Tech*, 6(3): 709–712.
- Hawkins WW, Speck E, Leonard VG. (1954). Variation of hemoglobin level with age and sex. *Blood*, 9: 999–1007.
- Zubair, The Hematological parameters in Kashmiri students, 2015; 69-53.
- Pooja, The Hematological parameters in North East students, 2015; 44-55.
- Shrilekha Sairam, Suhasini Domalapalli, Sundaram Muthu Jayanthi Swaminathan, Vivek A Ramesh, Lalitha Sekhar Palak Pandeya Udhaya Balasubramaniam (2014) Hematological and biochemical parameters in apparently healthy Indian population: defining reference intervals *Indian J Clin Biochem*, 29(3): 290-7.
- Xinzhong Wu, Min Zhao, Baishen Pan, Jie Zhang, Mingting Peng, Lanlan Wang, Xiaoke Hao, Xianzhang Huang, Runqing Mu, Wei Guo, Rui Qiao, Wenxiang Chen, Hong Jiang, Yueyun Ma, and Hong Shang Complete Blood Count Reference Intervals for Healthy Han Chinese Adults *PLOS One*, 2015; 10(3): e0119669.
- Amitis Ramezani, Mandana Shams, Nader Zarinfar, Mohammad Banifazl, Arezoo Aghakhani, Ali Eslamifar, Fatemeh- Alsadat Mahdavian, Ghorban Deiri, Masoomah Sofian (2014) Hematological Reference Values for Healthy Males in the Central Part of Iran *Iranian Journal of Pathology*, 9(1): 50-55.
- Denise Lawrie, Lindi Marie Coetzee, Piet Becker, Johnny Mahlangu, Wendy Stevens, Deborah Kim Glencross (2009) Local reference ranges for full

blood count and CD4 lymphocyte count testing *S Afr
Med J*, 99: 243-248.