

A Prospective Study For Comparison Of Hematological Parameters In Healthy Young Adult And Elderly Age Group Subjects

Dr. Preeti Jain*, Dr. Roopam Jain**, Dr. Chinmay Shah***, Dr. R. S.Trivedi****, Dr. A. K. Jain*****,
Dr. Manisha Jindal[#], Dr. R. Dixit^{##}.

*Associate Professor, Dept. of Physiology, **Assistant Professor & In-Charge Transfusion Services, C.R.Gardi Hospital & R. D. Gardi Medical College, Ujjain, M.P. ***Associate Professor, Dept. of Physiology, Bhavnagar, Gujarat. ****Associate Professor, Dept. of Physiology, M. P. Shah Medical College, Jamnagar, Gujarat. *****Speciality Doctor, Dept. of Anesthesiology & Critical Care, NHS, UK.
[#]Professor, Dept. Of Physiology, SMS & R, Greater Noida, U.P. ^{##}Dean, Government Medical College, Surat, Gujarat

Abstract: Aims & Objectives: This study of hematological parameters is the object of continuing intensive research of hematopoietic system to the functional integrity in aging. (1) Assessment of Hb, total RBC count in healthy young adult as well as in elderly subject.(2) Assessment of Hct & blood indices (MCV, MCH, MCHC) in healthy young adult as well as in elderly subject.(3) Comparing the values of Hb & total RBC count in healthy young adult with the elderly subject.(4) Comparing the values of Hct & blood indices (MCV, MCH, MCHC) in healthy young adult with the elderly subject.(5) To co-relate the results of present study with findings of other studies. Material & Methods: The hematological indices analysed were Hb, HCT, and Total RBC Count, Blood indices like MCV, MCH & MCHC. Hematological values were measured by the different method in laboratory with the use of standard test reagent. Results: In present study, the result shows that a significant decrease in Hb concentration and RBC count are associated with decrease in Hct, MCH, MCHC and little increase in MCV. Conclusion: In present study, the overall assessment shows that a significant decrease in Hb concentration, reticulocyte count and RBC count are associated with decrease in Hct, MCH, MCHC and little increase in MCV. These results show a significant decrease in haematological parameters in old age and fairly accurate reflection of decreased erythropoietic activity of bone marrow. [Jain P et al NJIRM 2013; 4(3) : 78-84]

Key Words: Hematological parameters, Old age

Author for correspondence: Dr. Preeti Jain, Associate Professor, Department of Physiology, R. D. Gardi Medical College, Ujjain, M.P. – 456006. E- mail: prjain77@gmail.com, rupamj@yahoo.com

Introduction: Aging is described as the process that reduces the number of healthy cells in the body; therefore, the body loses its ability to respond to a challenge to maintain homeostasis.^{1,2}

Review of literature: "Genetic damage (particularly gene loss) is almost certainly a (or probably the) central cause of aging." Aging process can be viewed as an integral aspect of the continuous development of an organism. The study of the physical and biological aspects and physiological changes incident to old age is called gerontology.^{1,2,3}

Hematological changes in Aging: Various researchers have reported an association of hemorheological, hematological and metabolic changes with human aging.⁴ Studies of hematological aging in humans generally begin with investigations of population samples, representative for the background population regarding age, sex, and health status, socio-economic, environmental and hereditary factors. The increasing interest in the aging human is partly due to the fact that the fraction of elderly in most

countries is steadily increasing, i.e. the "geriatric boom".^{4,5,6}

The bone marrow also gets older: In the elderly, the amount of hematopoietically active bone marrow declines and the reserve capacity is diminished. Elderly men have fewer hematopoietic stem cells than elderly women and younger persons, as demonstrated by in vitro colony assay.^{7,8,9}

Haemoglobin: Hb values are affected by age, sex, pregnancy, disease & altitude. It has been suggested that Hb undergoes specific changes with age the alterations occur in content, structure and function of Hb within the aging erythrocyte.^{6,7,8,9}

Anaemia is common in the elderly and its prevalence increases with age. The increased incidence of anaemia with aging has led to speculation that lower Hb levels may be a normal consequence of aging. The most common causes of anaemia in the elderly are chronic disease and iron deficiency.^{7,8,9}

Hematocrit (Hct): The hematocrit or packed cell volume (PCV) determines the percentage of red blood cells (RBCs) in whole blood.

Total RBC count: The total RBCs count is the number of red cells in one cubic millimeter of blood. The changes characteristic of the aging erythrocyte involve a diminished cell size and increased cell density. Total red cell mass shows a significant diminution in elderly.^{9,10,11,12,13,14,15,16}

Red cell indices: Red blood cell indices (MCV, MCH & MCHC) are part of the CBC test: The MCV, MCH, and MCHC reflect the size and Hb content of individual RBCs. MCV values reflect the size, and MCH and MCHC reflect the Hb concentration of individual cells. These RBC indices are useful in the diagnosis of types of anaemia. Anaemias are classified on the basis of cell size (MCV) and amount of Hb (MCH). Assessments of hematological parameters in healthy young adult and elderly age group subjects, done in earlier studies for reference are as follows:

Here an attempt has been made to review the comparative hematological changes in young adult and elderly age subject.

Aims & Objectives: (1) Assessment of hemoglobin, total RBC count in healthy young adult as well as in elderly subject.(2) Assessment of hematocrit and blood indices (MCV, MCH, MCHC) in healthy young adult as well as in elderly subject.(3) Comparing the values of hemoglobin and total RBC count in healthy young adult with the elderly subject.(4) Comparing the values of Hct & blood indices (MCV, MCH, MCHC) in healthy young adult with the elderly subject.(5) To co-relate the results of present study with findings of other studies.

Material & Methods: The present study was carried out at Department of Physiology, Shri M. P. Shah Medical College & G. G. Hospital, Jamnagar. Total 60 healthy subjects were selected. Out of which 30 healthy subjects were young subjects and 30 healthy subjects were elderly subjects.

The hematological indices analysed were Hb, Hct, and Total RBC Count, Blood indices like MCV, MCH, and MCHC. Hematological values were measured by the different method in laboratory with the use of standard test reagent. Complete detailed history of each subject including age, sex, and height were noted. After detail history, general and systemic examinations were done thoroughly.

Determination of Hemoglobin: Sahli's method of Hb estimation has been used since long. I have estimated Hb by this method.^{11,12,13,14,15,16}

Determination of Hematocrit: The Hct also referred to as PCV is the proportion of a volume of whole blood made up of red cells and the remainder being the plasma volume. Each specimen was also tested for the Hct by the macrohematocrit method.^{11,12,13,14,15,16}

Total RBC Count: The estimation of TRBC count was done by manual method.^{11,12,13,14,15,16}

MCV: The average volume of the red cells measured in femtolitres. This concept utilizes the effect that the average sized RBC has on the Hct. The MCV is, therefore, calculated from the Hct and RBC count as follows: Reference values are 80-100 m³.^{11,12,13,14,15,16}

$\frac{\text{Hct (in \%)} \times 10}{\text{RBC Count (millions/m.m.}^3\text{)}}$	=	$\text{MCV [cubic micrometers]}$
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B. MCH: The average amount of Hb per RBCs in picograms. This concept is an estimate of the amount of Hb in the average red cell. This is done by comparing the blood Hb level to the RBC count as follows: (Reference values are 27-31 pg.)^{11,12,13,14,15,16}

$\frac{\text{Hb (gm \%)} \times 10}{\text{RBC Count (millions/m.m.}^3\text{)}}$	=	MCH [picograms]
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C. MCHC: The average concentration of Hb in the cells. This concept estimates the concentration of

Hb in the average RBC. It is different from MCH in that the average RBC concentration of Hb depends on the RBC size & the actual amount of Hb contained in RBC. MCHC is calculated as follows: (Reference values are 32-36 %.)^{11,12,13,14,15,16}

Hb (gm %) x 100	=	MCHC [%]
Hct (%)		

Data Analysis: 1) Mean 2) Standard deviation 3) Standard error of difference between two means 4) Calculation of 't' : Then probability is calculated from 't' tables.

Results & Observations: In our study 60 cases were studied. The control group comprised of the subjects of the age group ranging from 21 to 50 years. The experimental group included the subjects with age 61 years and above that we have considered the age of 60 years as a landmark to assess the effect of aging, on hematological parameter.

Table-I: Age group versus number of subjects and male: female ratio

Age groups in years	No. of subjects	Mean age in years ± S.D.	M/F ratio
Control group			
21-30	10	24.8 ± 3.01	6:4
31-40	10	37.6 ± 2.54	7:3
41-50	10	45.10 ± 2.46	5:5
21-50	30	35.83 ± 8.90	18:12
Experimental group			
61-70	11	64.36 ± 2.57	6:5
71-80	13	73.92 ± 2.81	10:3
81-90	6	82.5 ± 1.64	4:2
61-90	30	72.13 ± 7.25	20:10

The above table shows number of subject in various age groups with mean age and male / female distribution in both the groups. The mean age in control group was 35.83 ± 8.90 years and in experimental group it was 72.13 ± 7.25 years.

Table II shows Hb concentration in blood in each age group in both control and experimental group.

The Hb concentration decreases with age (except 71-80 years), remarkably decreases in 9th decade. The Hb concentration is higher in control group 13.73 ± 1.45 gm% than experimental group 12.27 ± 1.68 gm%. (P value 0.0069)

Table-II: Age group versus Hb concentration

Age groups (in years)	Hb concentration (gm %) mean ± S.D.
Control group	
21-30	14.36 ± 0.93
31-40	13.48 ± 1.61
41-50	13.36 ± 1.64
21-50	13.73 ± 1.45
Experimental group	
61-70	12.32 ± 1.54
71-80	13.10 ± 1.38
81-90	10.36 ± 0.97
61-90	12.27 ± 1.68

Table-III: Age group versus Hematocrit

Age groups (in years)	Hematocrit (%) mean ± S.D.
Control group	
21-30	43.67 ± 2.89
31-40	41.92 ± 4.42
41-50	40.54 ± 4.79
21-50	42.04 ± 4.18
Experimental group	
61-70	39.46 ± 4.48
71-80	40.49 ± 4.74
81-90	32.70 ± 2.28
61-90	38.55 ± 5.12

This table shows Hct in each age group in control and experimental group. There is reduction in Hct with advancing age (except 71-80 years). It is significantly decreased in 9th decade. The Hct is significantly lower in experimental group 38.55 ± 5.12 % as compared to control group 42.04 ± 4.18 %. (P Value 0.005)

Table IV shows total RBC count in each age group, in control and experimental group. There is significant reduction in total RBC count with age (except 71-80 years). It is significantly decreased in 9th decade. The total RBC count is significantly lower in experimental group 4.44±0.82 million

/m.m.³ of blood as compared to control group 4.80±0.40 million/m.m.³ of blood. (P Value 0.036)

Table-IV: Age group versus Total RBC count

Age groups (in years)	Total RBC count (million /m.m. ³) mean ± S.D.
Control group	
21-30	4.90 ± 0.33
31-40	4.89 ± 0.31
41-50	4.60 ± 0.51
21-50	4.80 ± 0.40
Experimental group	
61-70	4.57 ± 0.82
71-80	4.59 ± 0.90
81-90	3.89 ± 0.34
61-90	4.44 ± 0.82

Table-V: Age group versus Blood indices (MCV)

Age groups (in years)	MCV (in cubic micrometer) mean ± S.D.
Control group	
21-30	89.03 ± 3.29
31-40	85.54 ± 6.59
41-50	88.03 ± 2.15
21-50	87.53 ± 4.53
Experimental group	
61-70	87.69 ± 9.76
71-80	89.39 ± 7.97
81-90	85.15 ± 11.96
61-90	87.92 ± 9.29

Table-VI: Age group versus Blood indices (MCH)

Age groups (in years)	MCH (in picograms) mean ± S.D.
Control group	
21-30	29.26 ± 1.38
31-40	27.47 ± 2.91
41-50	28.73 ± 1.24
21-50	28.48 ± 2.07
Experimental group	
61-70	27.24 ± 2.74
71-80	28.00 ± 3.19
81-90	26.98 ± 4.16
61-90	27.40 ± 3.27

Table V shows MCV in each age group, in control and experimental group. The MCV increases significantly in experimental group 87.92 ± 9.29 cubic micrometer as compared to control group 87.53 ± 4.53 cubic micrometers. (P Value 0.83)

Table VI shows blood indices (MCH) in each age group, in control and experimental group. The MCH is significantly decreased in experimental group 27.40±3.27 picograms as compared to control group 28.48±2.07 picograms. (P Value 0.45)

Table-VII: Age group versus Blood indices (MCHC)

Age groups (in years)	MCHC (in %) mean ± S.D.
Control group	
21-30	32.85 ± 1.05
31-40	32.04 ± 1.53
41-50	32.86 ± 0.90
21-50	32.58 ± 1.21
Experimental group	
61-70	31.11 ± 1.52
71-80	32.09 ± 1.05
81-90	31.65 ± 1.36
61-90	31.61 ± 1.38

This table shows blood indices (MCHC) in each age group, in control and experimental group. The MCHC is lower in experimental group 31.61 ± 1.38 % as compared to control group 32.58 ± 1.21 %. (P Value 0.01)

Discussion: The present study included 30 cases of young adult subjects as a control group and 30 cases of elderly subjects as a experimental group. The mean age (in years) of young adult subjects was 35.83 ± 8.90 and for elderly subjects was 72.13 ± 7.25. General and systemic examinations of the all subjects were normal. Various investigators have studied age related changes in hematological parameters by different methods. Regardless of the methods used, the conclusion is that with advancing age hematological parameters decreases. The available literature on Indian subjects is scanty. So we have compared our observations with those available from western countries.

Vellar O. D. et al. (1967), observed decrease in hemoglobin, hematocrit and MCHC values in old men and women.^{10, 11,12,13,14,15,16,17} Giorno R. et al. (1980) observed significant decrease in the following hematologic parameters erythrocyte count, Hb, Hct, MCH & MCHC.^{10,11,12,13,14,15,16,18}

Significant age differences, which were most striking for leukocyte count, erythrocyte count, MCV and MCH were detected. Van Oosterhout EC. et al. (1989) reported the significant decrease in Hb values (7.4-10.5 mmol/l) & erythrocyte counts ($3.8-5.5 \times 10^{12}/l$).¹⁹ Ohhara Y. et al. (1994)⁶⁰ assessed hematological parameters in the elderly and reported that RBC count, Hb level, Hct value showed a significant decrease in the older group.²⁰ No significant age-related changes were observed in WBC. A significant decline with age was observed in both male and female MCV values. On the contrary, from a cross-sectional standpoint, the MCV values in the older female group were higher than those in the younger group. MCV gives an important clue to the anaemia mechanism.^{10,11,12,13,14,15,16,20} Low values indicate bone marrow depression, high values indicate hemolysis and/or bleeding. Suwannuruks R. et al. (1997) reported advancing age is associated with the decline of Hb, RBC count, Hct and other parameters.²¹ This study determined the hematologic parameters of Thai subjects aged over 50 years by using a fully automated cell counter. The MCV of both sexes showed an upward trend at age over 70. The RBC count and Hb levels in males were higher than females. These however, were not significant alterations.^{10,11,12,13,14,15,16,21}

Takubo T. et al. (2000) observed RBC count, Hb concentration and Hct for the healthy aged showed the tendency of moderate decreasing with aging.²² The MCV for the healthy aged showed the tendency of increasing with aging, while MCV and MCHC for the healthy aged showed tendency of decreasing with aging. No changes for the healthy aged were observed in the leukocyte differential, WBC count and platelet count with aging.^{16,17,18,19,20,21,22}

Martin H. et al. (2001) observed decrease in Hb concentration in aged people. Also reported that advancing age is associated with four indices shows significant differences MCV increasing, MCH decreasing, MCHC decreases, Red Cell Distribution Width increasing). In the older group, the iron level and the transferrin saturation were also significantly lower. In women, erythrocytes and the Hct are significantly higher in the older group whereas the indices MCH and MCHC are lower and the RDW increases. He also reported decrease in reticulocyte count in aged people.²³ Blain H. et al. (2001)⁵⁵ reported RBC count, Hb concentration and hct for the healthy aged showed the tendency of decreasing with aging. MCH and MCHC also decrease in aged.²⁴

Hb concentration: The mean Hb concentration in young adult subjects was 13.73 ± 1.45 gm % while in elderly subjects it was 12.27 ± 1.68 gm %. The Hb concentration decrease with age remarkably after 5th decade. This significantly decreases in 9th decade. These finding are comparable with the observations of other workers. Van oosterhout EC. at al. observed significant decrease in Hb concentration (7.4-10.5 mmol./lit.) in elderly subjects that is comparable with present study.¹⁹ Ohhara Y. et al. (1994) found decrease in Hb concentration in elderly subjects. This is similar with present study.²⁰ Suwannuruks R. et al. (1997) observed advancing age is associated with the decline of Hb concentration. This is similar with present study.²¹ Takubo T. et al. (2000) found the Hb concentration for the healthy aged showed the tendency of moderate decreasing with aging.²² Martin H. et al. (2001) observed that significant decrease in Hb concentration in aged. This is similar with present study.²³ Blain H. et al. (2001) observed significant age related decline in Hb concentration. This is similar with present study.²⁴ Chomon B. et al. (2001) observed Hb concentration showed significant decrease with aging. This is similar with present study.²⁵

Hematocrit: The mean Hct value in young adult subjects was 42.04 ± 4.18 % while in elderly subjects it was 38.55 ± 5.12 %. The reduction in Hct from its value in young adult groups to those in

elderly groups is significant in our study. This reduction observed in our study is comparable to the same in other studies. Ohhara Y. et al. observed significant decrease in Hct values in elderly subjects. This is similar with present study. Suwannuruks R. et al. (1997) found advancing age associated with the decline of Hct. This is similar with present study. Takubo T. et al. (2000) found the Hct value for the healthy aged showed the tendency of moderate decreasing with aging. This is similar with present study.²² Blain H. et al. (2001) observed age related decline Hct value. This is similar with present study.²⁴ Chomon B. et al. (2001) observed inverse correlation with age for Hct value.²⁵ This is similar with present study.

Total RBC count: The mean TRBC count in young adults and elderly was 4.80 ± 0.40 million / mm^3 of blood and 4.44 ± 0.82 million / mm^3 of blood respectively. In our study, there is reduction in TRBC count with age. It is remarkable in 9th decade. The reduction from its values in young adult group to elderly group is significant and comparable to the same in different studies. Van Oosterhout EC. et al. (1989) observed that decrease in TRBC count in elderly subjects. This is similar with present study.¹⁹ Ohhara Y. et al. (1994)⁶⁰, showed that significant decrease in TRBC count in elderly subject. This is similar with present study.²⁰ Suwannuruks R. et al. (1997) observed that advancing age is associated with decline of RBC count. This is also similar with present study.²¹ Takubo T. et al. (2000), observed that RBC count for the aged showed the tendency of moderate decreasing with aging. This is also similar with present study.²² Blain H. et al. (2001), showed age related decline in TRBC count in the elderly. This is similar with present study.²⁴ Chomon B. et al. (2001) observed inverse correlation with age for TRBC count. This is similar with present study.²⁵

Blood Indices: Referring back to table number V, in our study there is increase in MCV and decrease in MCH and MCHC with age. This increase and decrease from its values in young adult group to the values in elderly group is significant and comparable to the same in different studies. Vellar OD. et al. observed decrease in MCH & MCHC in

old age persons. This is similar with present study.¹⁷ Suwannuruks R. et al. (1997) observed the MCV of both sexes showed in upward trend in elderly subjects. This is similar with present study.²¹ Takubo T. et al. observed the MCV for the aged showed the tendency of Increasing with aging, this is similar with present study, while MCH and MCHC for the aged showed no tendency with aging.²² Martin H. et al. (2001) & Blain H. observed that advancing age is associated with significant increased in MCV but MCH and MCHC decreases significantly. This is similar with present study.^{23,24}

Conclusion: The study was aimed to evaluate some aspects of hematological parameters in both groups to assess effect of aging. Hematological parameters like Hb concentration, Hct, TRBC count, Blood indices (MCV, MCH, MCHC).

In present study, the overall assessment shows that a significant decrease in Hb concentration and RBC count are associated with decrease in Hct, MCH, MCHC and little increase in MCV. The result shows a significant decrease in Reticulocyte count is a fairly accurate reflection of erythropoietic activity of bonemarrow. This study of blood and blood cells (hematological parameters) is the object of continuing intensive research of hematopoietic system to the functional integrity in aging.

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