"Comparison of Hematological Parameters in Relation to Gender among Healthy Individuals."

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Author's contribution: IN and SN created the concept and design, while MW and MAA collected and analysed the data. MM and ZQ interpreted and wrote the manuscript. The manuscript was revised critically, and the final version was approved by all authors. All of the authors accept responsibility for the published article.

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ABSTRACT:

Background: Complete blood count analysis is useful for medical investigation. Multiple diseases can be diagnosed using hematological profiles. White blood cell counts, platelet counts, and red blood cell counts are linked to cardiovascular disease. It is concerning that women have a lower incidence of cardiovascular disease than men; this could be due to hormonal changes. The purpose of this study is to measure and compare various hematological levels in male and female participants.

Methodology: The serum hematological parameters of healthy males and females were investigated and compared in a cross-sectional study. Data from medical files were obtained from healthy participants aged 4–72 who had a routine medical examination in 2017–2018. Participants with a medical history, as well as those who had been using medicines or vitamin supplements, were not permitted to participate. Sysmex XP100 Tokyo, Japan was used to measure the levels of hematological parameters.

Results: In total, 240 people met the inclusion criteria. The gender difference revealed that Hb, RBC, MCV, MCH, MCHC, WBC, and platelet levels were significantly higher ($p<0.001$) in men as compared to women.

Conclusion: Our findings would serve to apprise presently available data pertaining to blood parameters, gender variation was observed.

***Index Terms*:** Hemaglobin, RBC, WBC, MCV, MCH, MCHC, platelet, gender and healthy

INTRODUCTION

The most basic laboratory blood tests is a complete blood count. Hematological parameters analysis is the most common diagnostic procedure used to establish a diagnosis of a variety of diseases. It can be used for preoperative assessment and periodic health inspections. Even in seemingly healthy people, the values of hematological parameters are valuable for a variety of reasons.

Multiple key hematological indices, including White Blood Cell (WBC) count and Platelet (PLT) count, have been linked to atherosclerotic diseases and cardiovascular diseases (Hou et al., 2013, van der Bom et al., 2009). Alteration in the hemogram, could thus play a significant role in meaningful clinical risks. According to randomized trials, age and gender are the most important determinants of hematological indices' heterogeneity (Bain, 1996, Biino et al., 2011). Sex, age, genetic makeup, pregnancy, ethnicity, and previous exposure to environmental pathogenic organisms are all factors that influence hematologic levels (Al-Jafar, 2016, Zeh et al., 2012). Although age and gender are the two most commonly used partitioning determinants, hematologic variations are also observed during pregnancy (Kaur et al., 2014).

Reference levels are critical for observing pathophysiological variations after infection or disease, as well as after administering drugs in therapeutic or clinical interventions and vaccine studies(Mine et al., 2012). Because diseases like malaria and HIV/AIDS affect hematological levels in different aspects, blood samples for full blood counts (FBCs) are now routinely analyzed to look for variations that could be caused by these diseases(Al Qouzi et al., 2002).

We sought to see how Hemoglobin (Hb), hematocrit (Hct), Mean Corpuscular Volume (MCV), Mean Cell Hemoglobin (MCH), Mean Cell Hemoglobin Concentration (MCHC), Red Cell Count (RBC), White Blood Cell (WBC) and platelet counts change with age and gender in our region from birth to adulthood.

The goal of the cross-sectional study in the context mentioned above was to evaluate and compare the impact of gender on hematological parameters such as Hb, RBC, MCV, MCH, MCHC, WBC, and Platelet count.

MATERIAL AND METHODS:

Since May 2017 to April 2018, a cross-sectional study was performed. The study was conducted at Baqai Medical University in Karachi. The samples were obtained from 240 apparently normal participants from different portions of Karachi. Children (n = 50), ages 4 to 12, adults (n = 118), ages 13 to 55, and the elderly (n = 72), ages 56 to 72, were among the respondents. Each age category was then divided into two gender categories: male and female. Prior signing the written approval, all respondents were thoroughly informed about the purpose. The study was approved by the Ethics Committee of Baqai Medical University in Karachi (Reference No. BMU-EC/2017-04).

In order to determine the participant's health status, a detailed history was taken. The following factors were considered: age, gender, height, weight, medical history, smoking, use of multivitamin supplements, and gestational stage. The study excluded people who used supplements, alcohol, proton pump inhibitors, malabsorption syndrome, kidney diseases, smoking, metabolic disorders, liver disease, cancers, hemorrhage, recent transfusion, gastrointestinal surgery, any debilitating illness, pregnancy, lactation, and strict vegetarians. "To assess dietary intake, including food and beverages, a food frequency questionnaire (one pen-and-paper form) was used."

Fasting venous blood samples of 10mL were collected using aseptic techniques. A comparable amount of blood was transmitted to purple top vacutainers with Ethylenediaminetetraacetic acid. The tubes were stored cold and away from light. Serum was extracted within an hour of collection by centrifugation (2000 rpm, 10 min) and transmitted to aliquots that were stored at – 20°C until analysis. Before being evaluated, whole blood samples were kept at 4°C for 2 hours. The complete blood count (CBC) of all samples was evaluated using the automated cell analyzer Sysmex XP100 Tokyo, Japan.

The statistical analysis was accomplished by using Statistical Package for Social Sciences (SPSS) version 20.0. Data was compiled as mean ± standard deviation. Independent t test and 1 way analysis of variance (ANOVA) with post hoc test was applied to examine the differences among the groups. Association of parameters was determined by Pearson correlation coefficient. P value of <0.05 was considered significant for all of the analyses.

RESULTS:

A total of 240 individuals were included. The study participants' characteristics were shown in table 1. Mean age (years) of males (n=128) and females (n=112) was 40.5± 20.9 and 34.68± 20.96, respectively.

Table 1: Baseline characteristics of study population

Variables	Measure of the difference	Males (n = 128)	Female (n = 112)	p- value
Age (y)	Mean ± SD	40.5 ± 20.88	34.68 ± 20.96	0.03
Hb (g/dl)	Mean ± SD	14.2 ± 1.03	13.3 ± 1.01	<.001

Hct (%)	Mean ± SD	43.9 ± 3.08	42.1 ± 3.19	<.001
RBC($x10^{12}$/L)	Mean ± SD	5.3±1.21	4.2±1.12	<.001
MCV (fL)	Mean ± SD	81.0 ± 5.48	78.6 ± 11.5	0.049
MCH (pg)	Mean ± SD	30±1.91	28±2.1	<.001
MCHC(g/dL)	Mean ± SD	35±1.71	32±1.34	<.001
PLT($x10^9$/L)	Mean ± SD	393±50.61	298±53.98	<.001
WBC($x10^9$/L)	Mean ± SD	6.9±2.21	4.5±1.61	<.001

SD, standard deviation; Hb, haemoglobin; Hct, haematocrit; RBC, red cell count; MCV, mean cell volume; MCH, mean cell haemoglobin; MCHC, mean cell haemoglobin concentration; PLT, platelet count; WBC, white blood count; Differences between groups (male and female) were assessed by using an independent t test ($p<0.05$, significant).

Hemoglobin (Hb):

- There was a significant differences in hemoglobin levels between males and females irrespective of the age ($p<0.001$).
- Males (n=58) had significantly higher hemoglobin concentrations than females (n=60) in the age group 13-55 years ($p<0.001$).
- Males (56-72 years old, n=42) had significantly higher mean hemoglobin levels than females (n=30) in the same age group ($p<0.001$).
- A one-way analysis of variance (Post Hoc test; scheffe) of hemoglobin levels showed significant difference among male of all three age groups ($p<0.05$).

Hematocrit (Hct):

- There was a significant differences in hematocrit levels between males and females irrespective of the age ($p<0.001$).
- Males (n=58) had significantly higher hematocrit concentrations than females (n=60) in the age group 13-55 years ($p< 0.001$).
- Males (56-72 years old, n=42) had significantly higher mean hematocrit levels than females (n=30) in the same age group (p - 0.004).
- A one-way analysis of variance (Post Hoc test; scheffe) of hemoglobin levels showed significant difference among male of all three age groups (p-<0.001)

Mean Corpuscle Volume (MCV):

- Significant differences in MCV levels were found between males and females (p-0.049)
- Males (n=58) in the age group 13-55 years had significantly higher MCV than females (n=60) in the same age group.
- A one-way analysis of variance (Post Hoc test; scheffe) of MCV levels showed significant difference among male of all three age groups (p-<0.001).

Mean Corpuscular Hemoglobin Concentration (MCHC):

- A group comparison of MCHC among females of all 3 age groups was done by 1- way analysis of variance (Post Hoc test; scheffe) (p<0.05) showed that there was a significant difference in levels of MCHC between the age groups, [F (2, 109) =7.0, P=.001].
- Specially the 4-12 years age group (33.0±1.4), 13-55 years (32.0±1.0) and 56-72 years age group (30.1±3.5) were significantly different from each other (p=.001).
- Likewise, comparison of MCHC among males of all age group showed significant difference, [F=2, 125) =31.0, p-<0.001] whereas, 4-12 years age group (32.7±1.3), 13-55 years (34.0±0.9) and 56-72 years age group (30.2±4.2) were significantly different from each other (p-<0.001).

Red blood Cell:

- Significant differences in Red Blood Cell was found between males and females (p<0.001)
- Males (n=58) in the age group 13-55 years had significantly higher Red blood cell count than females (n=60) in the same age group.
- A one-way analysis of variance (Post Hoc test; scheffe) showed significant difference among male and female of all three age groups (p-<0.001).

Platelet Count:

- Significant differences in platelet count was found between males and females (p<0.001)
- Males (n=58) in the age group 13-55 years had significantly higher Platelet count than females (n=60) in the same age group.

- A one-way analysis of variance (Post Hoc test; scheffe) showed significant difference among male of all three age groups (p-<0.001).

White Blood Cell Count:

- Significant differences in WBC count was found between males and females (p<0.001)
- Males (n=58) in the age group 13-55 years had significantly higher WBC count than females (n=60) in the same age group.
- A one-way analysis of variance (Post Hoc test; scheffe) showed significant difference among males and females of all three age groups (p-<0.001).

Table 3: Hematological levels by gender and age group.

Variable	Mean ± S.D	p-value
Hemoglobin		
• 4-12 years		
Male	13.5 ± 0.58	
Female	13.3 ± 0.52	0.365
• 13-55 years		
Male	14.8 ± 1.28	
Female	13.0 ± 0.98	<0.001
• 56-72 years		
Male	13.9 ± 1.53	
Female	13.2 ± 0.75	<0.001
Hct (%)		
• 4-12 years		
Male	40.9 ± 3.2	
Female	40.8 ± 3.0	0.961
• 13-55 years		
Male	45.1 ± 3.1	
Female	40.8 ± 2.5	<0.001
• 56-72 years		
Male	43.1 ± 3.2	
Female	40.6 ± 3.0	0.004

RBC ($x10^{12}$/L)		
• 4-12 years		
Male	4.7±0.3	0.6
Female	4.6±0.4	
• 13-55 years		
Male	5.31±0.4	<0.001
Female	3.45±0.5	
• 56-72 years		
Male	4.9±0.4	
Female	4.8±0.3	0.7
MCV (fL)		
• 4-12 years		
Male	77.9 ± 5.4	
Female	77.4 ± 6.9	0.783
• 13-55 years		
Male	85.6 ± 5.3	
Female	79.5 ± 5.8	0.006
• 56-72 years		
Male	77.2 ± 4.9	
Female	79.6 ± 5.1	0.847
MCH (pg)		
• 4-12 years		
Male	29.09±1.0	0.5
Female	28.85±1.0	
• 13-55 years		
Male	30.9±1.5	<0.001
Female	25.3±1.6	
• 56-72 years		
Male	29.1±1.2	0.8
Female	28.4±1.1	
MCHC(g/dl)		
• 4-12 years		
Male	33.1±1.3	0.7
Female	32.1±1.2	
• 13-55 years		
Male	34.0±0.9	<0.001
Female	32.0±1.0	
• 56-72 years		
Male	31.6±3.6	0.8
Female	30.3±4.2	

PLT($x10^9/L$)		
• 4-12 years		
Male	290.2±50.2	0.6
Female	279.7±48.80	
• 13-55 years		
Male	393.2±69.1	<0.001
Female	158.8±10.7	
• 56-72 years		
Male	168.3±15.9	0.9
• Female	167.2±16.8	
WBC ($x10^9/L$)		
• 4-12 years		
Male	5.6±0.7	0.4
Female	5.3±0.8	
• 13-55 years		
Male	6.6±0.5	
Female	4.6±0.5	<0.001
• 56-72 years		
Male	6.1±1.4	
• Female	5.7±1.3	0.4

DISCUSSION:

In terms of hematological value, the current study reported Hb, Hct, RBC, MCV, MCH, MCHC, WBC and Platelet levels for healthy people in Karachi's Gadap region. In our study, males had comparatively higher Hb levels than females across all age groups. One survey found that male participants had higher Hb values than female participants from the age of 12 to 90 years in an Indian population (Yandamuri and Yandamuri, 2013). The gender discrepancy in the hemoglobin levels is believed to be caused by a direct stimulating effect of androgen in the bone marrow in relationship with erythropoietin in males, a stimulatory effect of androgen on erythropoietin producing in the kidney, and an inhibitory action of estrogen on the bone marrow in females (Murphy, 2014).

The hematocrit levels was significantly higher than females in the current study, which again was correlated with elevated androgens levels in men, that enables erythropoiesis, but genetic variations in the erythropoietin gene and its receptor have also been identified (Zeng et al., 2001). Furthermore, women of reproductive age experience menstrual blood losses, which have been shown to lower hematocrit (Grau et al., 2018). The difference between the sexes can also be explained by body weight and dietary habits.

The count of RBC and the levels Hb, and Hct parameters decreased slightly with age from young to old age in male subjects. This decrease could be due to the gradual loss of androgens, which stimulate increased production of erythrocytes (Cui et al., 2003, Paul et al., 2012). In contrast, RBC, Hb, and Hct values increased slightly with age in females (Siebers and Carter, 1991). The same results were observed in North American populations (van Assendeift). In addition, the RBC, Hb, and Hct values were higher in males than in females at all ages due to chronic menstrual blood loss in females and a higher androgen level in males.

The overall and extreme age group in this study showed no statistically significant difference in MCV levels between male and females. These findings are consistent with those of other studies conducted in Africa (Isa et al., 2012, Yalew et al., 2016).

This study discovered that males had higher levels of RBC, MCV, and MCHC than females, which is consistent with previous reports from other African countries (Dosoo et al., 2012, Pertierra et al., 2017, Everett, 2013). Similarly, the study by et al found that males had higher levels of hemoglobin, MCV, HCT, and MCH than females, but there was no significant difference was evaluated (Sahoo et al., 2015).

An importance and variation among both genders in the CBC levels will help recognize hundreds of conditions, disorders, and infections by using a small amount of blood. It enables to keep track of health, screen for disease, and treatment.

CONCLUSION:

In the healthy population, hemoglobin, and hematocrit levels differed significantly by gender. All the evaluated hematological analytes were found to be higher in males. These values will be useful in interpreting change and gender-based influence of hematological parameters in our patients' management as well as for research purposes.

LIMITATIONS:

There were some limitations to the study. The study participants were chosen based on their willingness to participation in the research, which is a significant limitation. Because the participants are mostly from one region of Karachi, the results obtained from this study may not be generalizable to the entire adult population. Furthermore, it was not possible to screen for all medical conditions that could have an impact on the results.

Conflicts of interest:

There was no conflict of interest among the authors.

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