Archives of Pharmacy Practice
Research Article

ISSN 2045-080X Vol.3 , Issue 2, 2012

Changes Of The Haematological Indices Among The Clerks In Canton Of Sarajevo

Damir Secic[1*], Elma Ibrahimpasic[2], Amna Pleho-Kapic[1], Esad Pepic[1], Jasmin Musanovic[3]

[1]Department of Pathophysiology, Faculty of Medicine, University of Sarajevo
[2] Canton Sarajevo Institute of Occupational Medicine, Sarajevo
[3]Department of Biology and Human Genetics, Faculty of Medicine, University of Sarajevo

Citation: Damir Secic, Elma Ibrahimpasic, Amna Pleho-Kapic, Esad Pepic, Jasmin Musanovic. Changes Of The Haematological Indices Among The Clerks In Canton Of Sarajevo. Archives of Pharmacy Practice. 2012; 3(2) pp 144-150.

Abstract

Objective: The objective of this paper is to prove that there are some changes from reference values in haematological indices among clerks in Canton of Sarajevo.

Methods: Respondents are clerks with health records in the Sarajevo Canton Occupational Medicine Institute. All clerks involved in this study were working on a computer. The respondents had normal physical activity, and without infectious disease. Venous blood specimens were taken from fasting respondents, with arm bandage up to 20 seconds. We used CELL-DIN system for the haematologic indices measurement.

Results: The results refer to clerks from 2 institutions including 48 males and 110 females. Males had lowered red blood cell count 7-11% and females 5-7%, haemoglobin 3-5% for males and 3-7% for females. Haematocrit changes are the most expressive from all direct haematologic indicators with decrease of 9-11% for males and 8-10% for females. According to the indirect haematologic indices, there are no MCV changes, while mean cell haemoglobin MCH and mean cell haemoglobin concentration MCHC were increased.

Conclusion: Among the clerks, without health problems, reduction is found in the direct haematologic indices - haematocrit, erythrocytes and haemoglobin with increased haematologic indirect indices - MCH and MCHC.

Key words

Direct Haematologic Indices, Indirect Haematologic Indices, Variabilitv

Manuscript History

Article Received on: 27th Sept, 2011
Revised on: 12th Jan, 2012
Approved for Publication: 30th Jan, 2012

Corresponding Author

Damir Secic
Čekaluša 90, 71 000 Sarajevo, Bosnia and Herzegovina
Tel **387 33 226 472

Email: secic@lol.ba

Introduction

Haematological indices are an important indicator in respondents with anemia and other haematological disorders. The number of red blood cells is not a sufficient indicator for the interpretation of haematological disorders. It is therefore necessary to analyze the number of red blood cells and other parameters of the red blood count (haemoglobin, haematocrit, MCV, MCH, and MCHC). So-called haematological indices that give information about the quality of red blood cells were done, within the complete blood analysis. It has been noticed, in daily work with adults at general medical examinations, that - compared to referent values - a number of respondents have variations of red cell indicators. The most important task of any laboratory analysis is to provide a result that is sufficiently accurate and precise for clinical use [1].

Changes of haematological indices may confuse health professionals if these changes are not taken into account in the analysis [2].In the mentioned studies, possible annual variation of haematological indices are also observed [3,4,5].

Seasonal variations can cause significant deviations both in normal subjects and athletes [3,6,7]. Training can cause changes that can be added to normal biological variations in healthy subjects, however, the possible effects of associated, potential confounding factors have not been sufficiently investigated [8,9].

Haematological indices are: Direct haematological indices - erythrocyte count (Er), haemoglobin (Hb), haematocrit (Hct) and haematological indirect indices - mean cell volume (MCV), mean cell haemoglobin (MCH), mean cell haemoglobin concentration (MCHC). The goal of this stuyd was to prove that there are some changes from reference values, in haematological indices, among clerks in Canton of Sarajevo

Materials And Methods

Respondents are a working-age population – clerks from the Canton Sarajevo, whose medical records are in the Institute of Occupational Medicine Sarajevo. They did not have health problems but they were on a regular systematic review. A systematic review was conducted at the competent institution-The Institute of Occupational Medicine of Sarajevo Canton. All clerks involved in this study were working on a computer. The institutions are not named but are marked as Institution A and B because of labor law restrictions.

We studied 94 consecutive patients – Institution A (21 males and 73 females) and 64 consecutive ones from Institution B (27 males and 37 females) aged between 20 to 65 years. Average age is 41.7 years and standard deviation is ± 11,7 years.

Exclusion criteria were menometrorrhagia, diagnosed anemia and pregnancy. All subjects had normal physical activity and are not included in the training program. Tests were carried out from February until June. Respondents did not have the infectious diseases during the testing. Blood was extracted at fasting at morning from 08-09 AM. The blood sample was extracted from the cubital vein, with a supporter placed up to 20 seconds. To determine the haematological indicators, we used CELL-DIN ® 1700 System. Two independent methods were used for the determination of formed blood elements: a method for determining the electrical impedance of erythrocytes, leukocytes and platelets and cianomethaemoglobin modified method for the determination of haemoglobin. Haematocrit values are calculated based on the number of red blood cells and their mean volume.

Statistical analysis

With the Student t-test we tested the differences between the arithmetic mean of the reference values and values of our respondents to these parameters. These t values show the difference relating to haematological deviations. The level of significance in our study is *** $p \leq 0.001$).

Results

Male respondents had the average number of erythrocytes decreased from 7-11%, while for females this decrease was 5-7% compared to referent values. (♂ $t = 9.98$ *** $p \leq 0.001$; ♀ $t = 9.19$ *** $p \leq 0.001$). Average haemoglobin among male respondents was reduced by 3-5% and 3-7% for females. If we compare the erythrocytes and haemoglobin, we see that the decrease of erythrocytes is more pronounced than the haemoglobin. (♂ $t = 5.67$ *** $p \leq 0.001$; ♀ $t = 4.05$ *** $p \leq 0.001$).

Out of direct haematological indices it can be seen that the major reduction is in haematocrit because haematocrit is directly dependent from the number of red blood cells and their sizes. Since the size of erythrocytes decreased, it is quite understandable why the decrease in haematocrit is most pronounced. Reduction ranges from 9-11% for the males, and 8-10% for female respondents. Listed t values show the difference in deviations of erythrocytes for our respondents in referent values. (♂ $t = 14.6$ *** $p \leq 0.001$; ♀ $t = 13.1$ *** $p \leq 0.001$).

In comparison with previous indices that show a reduced value, MCH was increased in 7-10% for the male respondents, while for females it was 5-6%. The increased value of MCH is a result of more expressed decrease in the number of red blood cells but reduced haemoglobin. Derived from red cell indicators most pronounced were discrepancies of MCH (mean amount of haemoglobin in red blood cells) and MCHC. (♂ $t = 10.3$ *** $p \leq 0.001$; ♀ $t = 10.6$ *** $p \leq 0.001$).

Average value of MCHC for our subjects showed statistically significant differences which are channeled towards the upper limit of the referent values. (♂ $t = 18.2$ *** $p \leq 0.001$; ♀ $t = 4.76$ *** $p \leq 0.001$)

If we observe the percentage of reduction in major haematological indices (erythrocytes, haemoglobin, haematocrit) it is then obvious that the decrease in haematocrit levels is the most pronounced (males 9-11%, 8-10% females), followed by reduction of red blood cells (7-11% males, females 5-7 %), while the haemoglobin is the least reduced (males 3-5%, 3-7% females). Accordingly to above, haematological indices which showed the following changes, are derived (MCV, MCH, MCHC).

MCV is decreased by 1% in male subjects from institution A, and increased by 2% increase in institution B, while for females, the reduced value of MCV exist in both groups for about 1% so that these differences are not statistically significant. Among derived haematological indices, the increase of MCH is more pronounced than the increase of MCHC (MCH among the male respondents increased from 6.9 to 10% and for females, MCH has increased from 5.5 to 5.9%).

Discussion

Lipi and colleagues have studied how prolonged venous stasis can lead to errors in the values of haematological parameters. The measured values of these indices without deflation, deflation with the pressure of 60 mmHg (for 1 and 3 minutes). The overall correlation between the value was generally acceptable, however, main values were significantly different for all tested parameters except for MCV, MCH, PLT, MPV, eosinophils and basophils (after a one-minute stasis) and all parameters except MCV, MCH, MPV and basophils (3 minutes after venous stasis).

As expected, Er, Hb, Hct showed a significant trend in terms of increase, while the leukocyte count decreased [10].These results also lend the support that vein stasis (while taking the blood) can lead to significant errors in the measurement of some haematological parameters. However, for our respondents, the value of direct haematological indices was lower and the deflation was applied very shortly because blood taking was done by experienced laboratory technicians.

Capillary samples can be used for the analysis of haematological indicators; however, some doctors will only accept the values of vein samples. Taking of capillary samples leads to tissue damage so that it can be one of the reasons for elevated levels of basic haematological indices.

Capillary Hb, Hct, Er, MCV, MCH and Le were significantly higher than in venous samples, while the capillary MCHC values were lower. There was no difference in the values of platelets. In respondent group in the study of Schalk et al. only the differences in the values of Hb and Hct may be of clinical significance [11]. Since our samples are obtained by venipuncture, these changes do not apply to our respondents, and exclude the possibility of impact of damage to tissue changes in haematological indices.

In 40 adult volunteers of both genders in the study of Daae et al. samples were taken simultaneously from antecubital vein and from the finger. Increasing values of Er, Hb and Hct were significantly higher than venous values, while derived haematological indicators did not differ significantly [12]. Capillary and venous indirect haematological indices did not differ significantly, because the increased values of basic haematological indicators were evenly increased. However in our respondent group we found reduced value of direct haematological indices, unlike the above capillary samples where the values increased.

For example, the specific soccer training program leads to an increase in RBC, Hb and Hct. It is assumed that these results occur due to reduced plasma volume and can be explained by the training [13]. Exercise increases Hb, Hct and platelet count in healthy subjects and all levels in well trained persons. These changes of these parameters suggest that the exercise may have a physiological effect of mobilizing stem cells to an increased production [2]. In our group there were no respondents who were engaged in regular sports activities, and also the basic values of haematological indices of our respondents are reduced as opposed to subjects in the studies of Silva from 2009 and Wardin from 2008 where the values of basic haematological indicators are increased.

Seasonal changes in haematological indices (haematocrit and haemoglobin) were described in small studies. Kristalboneh and colleagues have investigated whether there are annual changes of haematological indices and how they are affected by the mean monthly temperature. Haemoglobin and haematocrit in August were significantly lower than during the rest of the year. Lower values of haematocrit in August are caused by the reduction of MCV more than reduced number of red blood cells. Changes observed in August were probably a result of high temperatures, more than circular sinusoidal rhythm [3]. Our respondents had the most pronounced decrease in Hct while the erythrocytes and MCV was not significantly reduced. Also, our testing was done during the period February-June.

As expected haematological indices MCV and MCH showed negligible circadian changes. Changes of Er, Hct and haemoglobin match circadian changes in body fluids [14]. Variations in our study showed no significant change compared to referent values, while in the study of Jones and colleagues these changes are of circadian character.

The study of Bryner and colleagues investigated the effects of in vitro oxygenation and deoxygenating on the values of haematocrit and MCV. In order to ensure more accurate results, it is recommended that the samples are fully oxygenated before determining these values, as done in our sample [15]. 55.7% of patients have a reduction of 1-24 g/L in haemoglobin values three days after onset of acute infection. Comparing the first, third and fifteen day values of Er, HTC, MCV, MCHC and RDW were not found statistically significant differences between the experimental and control group [16]. The results do not correspond, because our respondents did not have an infection, and also decrease in haemoglobin was most pronounced in case of infection, whereas in our case the most pronounced decrease is in red blood cells and haematocrit values.

Hu M et al. have tested the value of haematological indices in the group which was subjected to extensive training and the control group (without training). Haematological indicators were measured during first week (February and March), 10th week (May) and 20th week (August). Compared to the control group (where the reduced value of these haematological indicators is found) training group has significantly increased Hct, RBC and Hb, comparing the beginning of the study with the 20th week. While MCHC showed significant inverse phenomenon (control +0.40% compared to the training group -0.74%, p=0.044). Changes in MCV were not significant. These changes of haematological indices are explained by seasonal variations and the influence of training [6,8]. Results similar to ours were obtained by Hu and colleagues with those that there are at the greatest divergence in Hct, then Hb and RBC (in a smaller percentage). Our relatively higher values of variation besides potential seasonal variations probably have some other influencing factors.

As noted in other studies, variations of haematological indicators require further research to clarify the mechanisms of these changes [17,18,19]. Before the training there is no significant difference between the values of trained and untrained subjects[20]. We cannot divide respondents in our study into the trained and untrained so that factor with the potential effect on changes in haematological indicators should not affect our values. Compared are the values of haematological indices of the Olympic athletes and untrained subjects (control group). Blood samples were taken from a cubital vein for the determination of Er, Hb, Hct. There were no significant differences in indirect haematological indices (MCV, MCH, MCHC) between Olympic athletes and the control group[21]. As research has not revealed significant differences in indirect haematological indicators, approximately variable direct haematological indices are probably a consequence of changes in plasma volume.

Conclusion

In case of clerks from the Canton of Sarajevo without health problems we found reduction in the direct haematologic indices - haematocrit, red blood cells and haemoglobin are increased as well as haematologic indirect indices - MCH and MCHC. Changes in the subjects indicate the need to further examine the potential risk factors that lead to these changes.

Conflict of Interest

The authors declare no conflict of interest.

Funding Disclosure

There was no funding available for this project

References

1. Plebani M. Charting the course of medical laboratories in a changing environment. Clin Chim Acta 2002;319(2):87-100.
2. Wardyn GG, Rennard SI, Brusnahan SK, McGuire TR, Carlson ML, Smith LM, McGranaghan S, Sharp JG. Effects of exercise on hematological parameters, circulating side population cells, and cytokines. Exp Hematol 2008; 36(2):216-23.
3. Kristalboneh E, Froom P, Harari G, Shapiro Y, Green MS. Seasonal-Change In Red-Blood-Cell Parameters. Br J Haematol 1993; 85(3):603-7.
4. Thirup P. Haematocrit: within-subject and seasonal variation. Sports Med 2003; 33(3): 231-43.
5. Umemiya N. Seasonal variations of physiological characteristics and thermal sensation under identical thermal conditions. J Physiol Anthropol 2006;25(1):29-39.
6. Maes M, De Meyer F. Relationships of climatic data to immune and hematologic variables in normal human. Neuro Endocronol Lett 2000;21(2):127-36.
7. Schumacher YO, Jankovits R, Bultermann D, Schmid A, Berg A. Hematological indices in elite cyclists. Scand J Med Sci Sports 2002;12(5):301-8.
8. Hu M, Finni T, Sedliak M, Zhou W, Alen M, Cheng S. Seasonal variation of red blood cell variables in physically inactive men: Effects of strength training. Int J Sport Med 2008; 29(7):564-8.
9. Banfi G, Del Fabbro M, Mauri C, Corsi MM, Melegati G. Haematological parameters in elite rugby players during a competitive season. Clin Lab Haematol 2006; 28(3):183-8.
10. Lippi G, Salvagno GL, Montagnana M, Franchini M, Guidi GC. Venous Stasis And Routine Hematologic Testing. Clin Lab Haem 2006;28(5):327-32.
11. Schalk E, Heim MU, Koenigsmann M, Jentsch-Ullrich K. 2007. Use Of Capillary Blood Count Parameters In Adults. Vox sanquinis 2007;93(4):348-53.
12. Daae LN, Halvorsen S, Mathisen PM, Mironska K. A comparison between haematlogical parameters in „capillary" and venous blood from healthy adults. Scand J Clin Lab Invest. 1988;48(7):723-6.
13. Silva ASR, Santhiago V, Papoti M, Gobatto CA. Hematological parameters and anaerobic threshold in Brazilian soccer players throughout a training program. Int J Lab Hematol. 2008;30(2):158-66.
14. Jones AR, Twedt D, Swaim W, Gottfried E. Diurnal change of blood count analytes in normal subjects. Am J Clin Pathol 1996; 106(6):723-7.
15. Bryner MA, Houwen B, Westengard J, Klein O. The spun micro-haematocrit and mean red cell volume are affected by changes in the oxygenation state of red blood cells. Clin Lab Haematol 1997;19(2):99-103.
16. Sipahi T, Koksal T, Tavil B, Akar N. The effects of acute infection on hematological parameters. Pediatr Hematol Oncol 2004;21(6):513-20.
17. Eldibany MM, Totonchi KF, Joseph NJ, Rhone D. Usefulness of certain red blood cell indices in diagnosing and differentiating thalassemia trait from iron-deficiency anemia. Am J Clin Pathol 1999;111(5): 676-82.
18. MachPascual S, Darbellay R, Pilotto PA, Beris P. Investigation of microcytosis: A comprehensive approach. Eur J Haematol 1996;57(1):54-61.
19. Tungtrongchitr R, Pongpaew P, Phonrat B, Tribunyatkul S, Viroonudomphol D, Supawan V, Jintaridhi P, Lertchavanakul A, Vudhivai N, Schelp FP. Leptin concentration in relation to body mass index (BMI) and hematological measurements in Thai obese and overweight subjects. Southeast Asian J Trop Med Public Health. 2000;31(4): 787-94.
20. Böning D, Tibes U, Schweigart U. Red cell hemoglobin, hydrogen ion and electrolyte concentrations during exercise in trained and untrained subjects. Eur J Appl Occup Physiol 1976;35(4):243-9.
21. Spodaryk K. Hematological and iron-related parameters of male endurance and strength trained athletes. Eur J Appl Occup Physiol 1993;67(1):66-70.

Table 1 Deviations of erythrocytes

	Erythrocytes- Er				
	Males		Females		
	Mean (interval)	Mean deviation (%)	Mean (interval)	Mean deviation (%)	*p*-value
Referent values	5.41 (4.69-6.13) 10^{12}/L	-	4.76 (4.04-5.48) 10^{12}/L	-	
Institution A (N=♂ 21) ♀73	5.04	- 6.84 %	4.41	-7.36 %	≤0,001
Institution B (N=♂27) ♀37	4.81	-11.09 %	4.50	-5.46 %	≤0,001
Total (N=♂48) ♀110	4.91	-9.24 %	4.44	-6.72 %	

Table 2. Deviations of haemoglobin

	Haemoglobin – Hb				
	Males		**Females**		
	Mean (interval)	**Mean deviation (%)**	**Mean (interval)**	**Mean deviation (%)**	***p*-value**
Referent values	161 (141-181) g/L	-	142 (122-162) g/L	-	
Institution A	156	-3.11 %	132	-7.04 %	≤0,001
Institution B	153	-4.97 %	138	-2.82 %	≤0,001
Total	154.3	-4.16 %	133.9	-5.7 %	

Table 3. Deviations of haematocrit

	Haematocrit - Hct				
	Males		**Females**		
	Mean (interval)	**Mean deviation (%)**	**Mean (interval)**	**Mean deviation (%)**	***p*-value**
Referent values	48.6 (43.5-53.7) %	-	42.8 (37.7-47.9) %	-	
Institution A	44	-9.47 %	38.6	-9.81 %	≤0,001
Institution B	43.3	-10.91 %	39.5	-7.71 %	≤0,001
Total	43.6	-10.28 %	39.1	-8.64 %	

Table 4. Deviations of MCV

	Mean cell volume - MCV				
	Males		Females		
	Mean (interval)	**Mean deviation (%)**	**Mean (interval)**	**Mean deviation (%)**	***p*-value**
Referent values	88.5 (80-97) fL	-	88.5 (80-97) fL	-	
Institution A	88.0	-0.6 %	87.5	-1.1 %	≤0,05
Institution B	90.3	+2.0 %	88	-0.6 %	≤0,05
Total	89.3	+0.9 %	87.8	-0.8 %	

Table 5. Deviations of MCH

	Mean cell haemoglobin – MCH				
	Males		Females		
	Mean (interval)	**Mean deviation (%)**	**Mean (interval)**	**Mean deviation (%)**	***p*-value**
Referent values	29.1 (27-31.2) pg	-	29.1 (27-31.2) pg	-	
Institution A	31.1	+6.9 %	30.7	+5.5 %	≤0,001
Institution B	32	+10.0 %	30.8	+5.9 %	≤0,001
Total	31.6	+8.6 %	30.8	+5.7 %	

Table 6. Deviations of MCHC

No.	Title	Er	Hb	Hct	MCV	MCH	MCHC
1.	♂ Total N=48	7-11% decrease	3-6% decrease	9-11% decrease	-1do+1%	4-10% increase	4-7% increase
2.	♀ Total N=110	5-7% decrease	3-7% decrease	6-8% decrease	1-3% decrease	3-6% increase	3-5% increase

Table 7. Deviations of haematological indices

	Mean cell haemoglobin concentration – MCHC				
	Males		Females		
	Mean (interval)	Mean deviation (%)	Mean (interval)	Mean deviation (%)	*p*-value
Referent values	336 (318-354) g/L	-	336 (318-354) g/L	-	
Institution A	353	+5.05 %	347	+3.27 %	≤0,001
Institution B	354	+5.36 %	350	+4.17 %	≤0,001
Total	353.6	+5.24 %	347.9	+3.54 %	