Addis Ababa University
College of Health Sciences
Department of Medical Laboratory Sciences

Assessment of Selected Hematological and Biochemical Profile of Trainees at Ethiopian Youth Sports Academy in Addis Ababa, Ethiopia.

By: GutemaJebessa

Advisors: Aster Tsegaye (MSc,Ph.D.)
Diresebachew Haile (MSc, Ph.D.)
RahelAlemu (MSc)

A thesis submitted to the Department of Medical Laboratory Sciences, College of Health Science, Addis Ababa University, in partial fulfillment of Master of Science Degree in Clinical Laboratory Sciences (Hematology and Immunohematology track).

June 2020
Addis Ababa,Ethiopia

Addis Ababa University

School of Graduate Studies

This is to certify that the thesis prepared by GutemaJebessaMuleta, entitled “assessment of Selected Hematological and Biochemical Profile of Ethiopian Youth Sport Academy trainees in Ethiopian Youth Sports Academy Addis Ababa Ethiopia: a cross-sectional study, 2020” and submitted in partial fulfillment of the requirements for the master of science degree in clinical laboratory sciences (Hematology and Immune hematology specialty track) complies with the regulations of the university and meets the accepted standards concerning originality and quality.

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Advisor_____Signature_____Date_____

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Acknowledgment

I would like to express my sincere gratitude to my advisors Dr. Aster Tsegaye, Dr.Diresebachew Haile, Mrs. Rahel Alemu, and my collaborator Mr.Saifu Hailu for their continuous support and constructive advice, professional supports, suggestions, and technical guidance throughout the process of this research thesis.

My grateful thanks also extended to my family who encourages me to study from diploma level to MSc and also cover all school fees, especially my father who initiated me and supported me in different ways.

I am also very grateful to the Department of Medical Laboratory Sciences of College of Health Science, Addis Ababa University for giving me a chance to study and also. I would like also to thank all Ethiopian youth sports academy staff (medical and coach) who shared their knowledge and experience during my research work. My special thanks go to the study participants for their kind participation.

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Abbreviations

µL	micro litter
AAU	Addis Ababa University
ADP	Adenosine diphosphate
ALT	Alanine transaminase
AST	Aspartate aminotransferase
ATP	Adenosine triphosphate
BASO	Basophil
BASO%	Basophil percent
BUN	Blood urine nitrogen
CBC	Complete blood count
CK	creatine kinase
E.C	Ethiopian calendar
EDTA	Ethylenediaminetetraacetic acid
EOS	Eosinophil
EOS%	Eosinophil percent
EYOG	European youth Olympic game
EYSA	Ethiopian youth sport academy
FI	Femto liter
g/dl	Gram per deciliter
G-6-PDH	Glucose-6-phosphate dehydrogenase
GU	genitourinary
HCT	Hematocrit
HDL	High-density lipoprotein
HGB	Hemoglobin
IDA	Iron deficiency anemia
IOC	International Olympic Committee
LCAT	lecithin-cholesterolacyltrans
LDL	Low-density lipoproteins
LYM	Lymphocyte
LYMP%	Lymphocyte percent
MCH	Mean cell hemoglobin

MCHC	Mean cell hemoglobin concentration
MCV	Mean cell volume
mg/dL	milligram per deciliter
Ml	Mille liter
MONO	Monocyte
MONO%	Monocyte percent
NAD	Nicotinamide adenine dinucleotide
NEUT	Neutrophil
NEUT%	Neutrohils percent
PCV	Packed cell volume
Pg	Picogram
PLT	Platelet
PSE	prolonged strenuous exercise
PV	Plasma volume
RBC	Red blood cell
RDW	Red cell distribution width
SD	Standard deviation
Sig	Significant
SLS	Cyanide-free sodium lauryl sulphate
SOP	Standard operating procedure
SPSS	Statistic package for social science
SST	serum separate tube
TG	Triglycerides
TIBC	Total iron-binding capacity
TSH	Thyroid-stimulating hormone
VLDL	very-low-density lipoproteins
WBC	White blood cell

Summary

Background

The main aim of this study to assess the selected hematological and biochemical profile of trainees at the Ethiopian youth sports academy in Addis Ababa, Ethiopia. Taking part in sports at a young age has many important health benefits, even if it may involve some risk. This happens mostly at the elite level given the intensive training programs and high-frequency participation in sports events.The response of this exercise involves changes in the hematological and biochemical profiles of the body, which was inadequately investigated in our set up.

Methods: - Cross-sectional study was donefrom Jan to March 2020 recruiting 230 Ethiopian youth sports academy (EYSA) trainees who were taking training indifferent sports types. Hematological and biochemical profiles weremeasuredfrom whole blood and serum collectedby EDTA and SST, respectively. Sysmex XN hematological and BS 200 Mindraybiochemical analyzeswere used for analysis. Data were analyzed using SPSS version 23softwareand tests including chi-square, preasons correlation, one-way ANOVAs, Games Howells post hoc test. Statistical significance was set at a 95% confidence interval and P-value is less than 0.05.

Results: - The hematological and selected biochemical parameters determined for both male and female RBC male (mean ± SD), 5.52 ± 0.46, 5.14 ±0.39, HGB 15.98 ±1.32, 15.00 ±1.07, PLT 274.20 ± 59.24, 292.24 ±63.30, WBC 5.95 ± 1.72, 6.25 ± 1.69, Creatinine 0.79 ± 0.16, 0.83 ± 0.18, and cholesterol 108.78 ± 24.42, 124.03 ± 31. 33. etc.respectively.In the study, there was a statistically significant association between hematological profile with the year of training experience for HCT, basophils % ($P< 0.05$) others hematological and biochemical parameters did not have significance ($P>0.05$). Variation hematological and biochemical profile between different sport disciplines statistically significant differences for all hematological and biochemical profile ($P< 0.05$) except for MCH, PLT, Monocyte, lymphocyte, basophil absolute numbers, basophils % and GPT whose p-value were (> 0.05).

Conclusion: - Hematological and biochemical profiles were determined for both male and female trainees of EYSA. Association of hematological and selected biochemical profile with years of training experience did not show a significant difference for both parameters except HCT and BASO %. Variation of both hematological and biochemical profile for most parameters had a statistically significant difference between mean group and between differentsports discipline

Recommendation: -It will be useful if clinicians use the determined hematological parameters as a reference until the discipline-specific reference range is stated for them.

Keywords: -Sport, hematological and biochemical profiles, Ethiopian youth sports academy.

1. Introduction

1.1. Background

Sport in its nature is very competitive and performed at different levels by the young. But elite young athletes take over others who are not at the climax of performance level. At the levelof elite, national, and international sporting federations have organized youth competitions in various age classes for athletes competing ranging from 13-21 based on the different types of sports (1).

Taking part in sports at a young age hasmany important health benefits, even if it may involve some risk. This happens mostly at the elite level given the intensive training programs and high-frequency participation in sports events(2).Unconditional increased participation is associated with an increased risk of physical injury, or even sudden death(3). The response of this exercise involves changes in the hematological and biochemical profile of the body. There is a variation in hematological parameters in response to vigorous exercise. Different studies have examined the effects of vigorous exercise upon the following hematologic parameters: white blood count (WBC), platelet count, hemoglobin and hematocrit values, and hemostasis (4-6). Physical exercise induces changes in the number of leukocytes and their subsets in the circulating blood(5).

Leukocytosis first reported by Blake and Larabee in a group of athletes following a marathon race(6). Numerous subsequent studies confirmed the relation of strenuous exercise to leukocytosis, Kratz*eta.l.* (7).Described the mean increase in WBC in a group of 37 male and female athletes, which rose from 5.6 to 7.0 ($\times 10^9$/L) 4 hours after running a marathon which was still persistent twenty-four hours after the race. As was the case in other studies, post-race WBC differentials demonstrated that the elevation in WBC was due primarily to an increase in neutrophils; although a mild monocytosis was also noted. The best explanations of exercise-induced leukocytosis are the emargination of WBCs secondary to augmented blood flow during exercise, an acute inflammatory response due to tissue injury, and exercise-induced increases in epinephrine and cortisol levels (8-10).

The other outcome of exercise upon hematologic parameters is a significant increase in platelet count from baseline, although post-exertion values generally remain within the range of normal. This is caused by the release of platelet from spleen, bone marrow, and lung (8).

However, the effect of exercise upon platelet activation remains undetermined. Several studies h ave shown exercise-induced increases in β-thromboglobulin or platelet factor 4, both markers of platelet activation and degranulation(11-13).

During exerciseChanges in Hct occur rapidly; this is due to a decrease in plasma volume (PV) when fluid replacement during exercise is insufficient(4). Fluid loss due to sweating results in shifting of plasma water into the extracellular space due to the accumulation of osmotically active metabolites, and filtration as a consequence of an increased capillary hydrostatic pressure (9).

On the other hand, the reduction of Hct in athletes has been termed “sports anemia”. even if activated erythropoiesis,during physical exercise could reduce red blood cell mass due to intravascular hemolysis mainly of senescent red blood cells. This is caused by mechanical rupture when red blood cells pass through capillaries in contracting muscles.Other factors like the compression of red cells in foot soles during running or in hand palms in weightlifters also cause the destruction of erythrocytes. Inadditions,this stabilization cause short life span for circulating red blood cell for trained athletes(11, 6).

Foot strike in runners has been the most often reported reason for intravascular hemolysis(10). Many studies showed that Hct tended to be lower in athletes than in sedentary individuals. This was verified by Sharpe *et al*. (2002) in case of determining reference range for HGB and HCT values for athletes.the result shows from 1100 athletes around the world, 85% female and 22% were male have HCT value under 44(11).

The otheretiology of this intravascular hemolysis may also be associated with other non-mechanical non-traumatic factors(12, 13).Physical exercise by itself may cause a morphological change of RBCs and increased fragility, resulting in anisocytosis, poikilocytosis,
and stomatocytosis(14).Thegenitourinary (GU) tract can also be a potential source of blood loss in the athlete and hematuria can occur after exercise(15).

Many studies have found major increases in the serum activities of creatine kinase (CK), alanine aminotransferase (ALT), and aspartate aminotransferase (AST) after acute exercise

(16). also, BUN and serum creatinine are elevated in the athletes. This is due to a decreased blood flow to the kidneys, such as shock, stress, severe sunburn, or dehydration(17).

Athletes are traditionally encouraged to consume a diet rich in carbohydrates to ensure adequate glycogen stores and improve performance(18).Physical training is known to improve insulin sensitivity, both immediately post-exercise and through multiple long-term adaptations in glucose transport and metabolism(19).However, in contrast, strenuous exercise is known to increase circulating concentrations of catecholamines, such as adrenalin and noradrenaline, to near pathological levels(20). resulting in hyperglycemia and hyperinsulinemia post–intense exercise(21). Athletes commonly display high resting urea concentration, probably as a result of the continual stress of training(22). Urea concentrations are also generally increased after the performance of prolonged strenuous exercise (PSE)(23). An increase in urea concentration may be related to a reduction in renal blood flow (and glomerular filtration rate) secondary to fluid volume deficiency, increased protein catabolism, and/or bleeding into the intestine, all of which may occur after PSE(23).

Strenuous exercise can damage skeletal muscle, a condition known as exertional rhabdomyolysis, this damage is manifested by delayed-onset pain and soreness, weakness, and an increase in the circulation of such muscle protein like creatine kinase(24).

Exercise appears to enhance the ability of skeletal muscles to utilize lipids as opposed to glycogen, thus reducing plasma lipid levels(25). The mechanism may include increases in lecithin-cholesterolacyltrans (LCAT) the enzyme responsible forester transfer to HDL cholesterol(26) which has been shown to increase following exercise training(27).and increases in lipoprotein lipase activity.Endurance exercise induces cellular changes within the body, increasing cytokine levels and bringing about changes in the muscle, liver, and kidneys(24,25,26). Muscles are damaged as a result of metabolic and mechanical factions caused by intense, long time exercise (31). muscle injury induces rhabdomyolysis via structural damage to the myocytes and protein leakage(32). Strenuous exercise that damages skeletal muscle cell structure at the level of the sarcolemma (33). Results in an increase in total CK.

Ethiopia, as a country of champions dominating in distance running events in East Africa, have been giving attention to scientific researches in the area of sports science. Several youth sports academies have been built in different regions of the country that focuses on the scientific training of youths in different sports activities. Exploring the hematological and biochemical

profiles of the youth athletes is of great importance in understanding the physiological and health status of the athletes. As far as the knowledge of the researcher is concerned, no published data have been found that assesses detailed hematological and biochemical profiles of youths athletes in different projects and academies in Ethiopia in general and in Ethiopian Youth Sports Academy (EYSA) in particular. Therefore, the core purpose of the study was to assess biochemical and hematological profiles of youth athletes who are on training in different sports at EYSA.

1.1.2. Hematological profile

The hematological profile includes analysis of blood like WBC, RBC, PLT, HGB, and theirderivatives. WBC is one of the most important cells in the immune system, playing role defiance against foreign substances. There are five types of mature WBC classified into granulocytes (Neutrophils, Eosinophils, Basophils), lymphocytes, and monocytes. The primary role of red blood cells is the transport of respiratory gasses, Hgb is a protein contained in the RBCs, which is circulated by the cardiovascular system. It transports O_2 and Co_2.The Hematocrit or Packed Cell Volume (PCV) represents the percentage of red blood cells as compared to the total blood volume of whole blood in a sample. The test is mostly requested for CBC that enables to diagnose and manage anemia, dehydration, and to know the danger of on way bleeding. indices of RBC are calculated mean value used to categorize weight, size, and content of RBC hemoglobin. They are mainly used to classify anemia. RBC indices consist of MCV, MCH, and MCHC. RDW is another RBC parameter which shows anisocytosis. The smallest type of blood cell is platelets (thrombocytes). Their main role was clotting blood and also, had platelet indices MPV and PDW(34).

1.1.3. Biochemical profile

Biochemical tests are a combination of laboratory tests usually performed by automated methods and designed to evaluate organ systems of the individual. Tests like HDL, LDL, TG, and creatinine tests are among the list of biochemical profilesthat are used to evaluate the presence of muscle injury and function of organs. HDL, High-density lipoprotein (HDL cholesterol, HDL-C), is one of the classes of lipoproteins that carry cholesterol in the blood. It refers to good cholesterol because it removes and transports excess cholesterol from tissues and carries it to the liver for disposal. A high level of HDL-C is usually associated with a low risk of

developing plaques, and lowering the risk of heart attack or stroke, and is responsible for the deposition of fats on different organs.For this reason, it is termed as “bad cholesterol” and isconsidered a major risk for cardiovascular diseases. Triglycerides are found in the tissue in the form of fat and arethe main source of energy for the body. Most triglycerides are carried in the blood by lipoproteins called very-low-density lipoproteins (VLDL). Creatinine which is derived from creatine and phosphocreatineis a major constituent of muscle. Its rate of formation for a given individual is remarkably constant and is determined primarily by an individual’s muscle mass or lean body weight. Creation kinase (CK) is an enzyme present in three plasma isoforms; creatine kinase isoenzyme-3 (CK-MM) (predominantly muscular), CK-MB (prevalently cardiac), and CK-BB (cerebral). Serum CK concentration proportionally increases with physical exercise and tissue damage. The damage reflects sports performance and is evident at the biochemical level with the presence of increased muscle protein levels such as CK (20, 21).

1.1.4. Association of Hematological Variables with Sport Performance

Oxygen delivered to active muscle mainly determined by hemoglobin mass(35). As such, Hbmass is often regarded as a key limiting factor to maximum O2 uptake (V□O2max), which in turn is a strong predictor of endurance performance(36). The oxygen (O2) transport capacity has been found to correlate directly with aerobic performance(37).Likewise, a strong correlation between total hemoglobin (Hb) and maximal O2 uptake (VO2max) has been found in athletes(25, 22). Thus, high O2 transport capacity is a clear advantage for aerobic athletic performance.

Oxygen transporting ability is checked by HGB, HCT, and RBC count values in the system. The total transportedoxygen amount in the bloodis known by HGB and RBC,supplying oxygen to high O2 demand organs besides stabilizing basal oxygen supply lower active tissue(4).Decrement of blood HGB concentration in spite of the circulating blood is normal, cause lower VO2 max and endurance performance, because of the reduction of oxygen-carrying capacity of blood(38). Reversely, a higher HGB amount is related to enhance VO2max and endurance capacity that is equivalent to the increment of oxygen-carrying capacity of blood(38). In another way, WBC is a crucial part of the immune system, this immune system disturbed by the level of activity in which an athlete is involved

On the other hand, white cells are an important part of the immune system(39). Because of many reasons, the immune system could weaken at a time of intense physical activity, and cause in surge risk of illness or infection(40).

1.1.5. Association of triglycerides with sport performance

Endogenoustriacylglycerolrepresents the largest fuel reserve in the body. Most triacylglycerols are stored in adipose tissue, but they are also present in skeletal muscle. The total amount of energy stored as triacylglycerol is>60 times the amount stored as glycogen. Thus, fatty acid oxidation during endurance exercise permits sustained physical activity and delays the onset of glycogen depletion and hypoglycemia. Fatty acids require as fuel for hydrolysis of triacylglycerol's from adipose tissue, muscle, and plasma and the delivery of the released fatty acids to skeletal muscle mitochondria for oxidation(41).

1.2. Statement of the Problem

Recently large numbers of youth athletes are participating in different types of sports and this large number of youth athletes need to be following in structured and demanding programs with training loads(42). The peak height velocity is one major period of the young people's developmental process, which is known by a fast change in the youth body height and mass mostly due to high stimulation of hormones like testosterone and growth hormones. Besides this, in order to adapt the exercise, the sportsperson develops a different kind of stress. During puberty there is a significant change of hormone; in this critical period, any sports exercise that induces hormonal and inflammatory effects may have a great consequence on the growth and development of the person(43).

Regular screening of the young athleteswas necessary to safeguard the athlete's health and simultaneously, determine the implications of the applied training loads on the growth and maturation. A study conducted on football players in Brazil shows that erythrocytes concentration, hemoglobin, and HCT were significantly increased from the beginning to the middle of the football training program(44).

The effects of exercise in hematological values are depending on the type and duration of the exercise. A recent study done in sedentary people shows that HCT level, HGB concentration, RBC, and PLT count are significantly increased after exercise, the values significantly reduced after 3-6 hours of rest(45).

A study was done in <19 years male volleyball players of India revealed that HDL-C and serum urea significantly increased just after training, but there is a significant decrement of LDL-C, TG, and hemoglobin after the conclusion of training(46).

One study conducted in the national center of medicine and science of sports in Tunisia in 2012, to investigate the effect of physical exercise on biochemical markers of football playersrevealedthat biochemical marker of muscle injury and some hematological parameters like WBC and its subpopulation (monocyte, neutrophils, and lymphocytes) have been increased significantly after exercise(47).

Ethiopia, despite being a country of champions dominating in distance running events globally, very limited published studies are available. For example, a cross-sectional study recruited 101 (both male and female) professional athletes of different distance categories

identified that the prevalence of iron overload, anemia, and iron deficiency states were 11.0%, 3.0%, and 2%, respectively(48).Apart from this, published researches related to detailed Hematological and biochemical profiles of athletes particularly attheEthiopian youth sports academy (EYSA), are lacking. Therefore, the aim of this research was to assess the hematological and biochemical profiles of youth trainees at EYSA.

1.3. Significance of the study

Understanding of hematological and biochemical changes accompanied by exercises is very crucial to set an appropriate strategy to control training complications. It also helps to assess the health of the trainees. Furthermore, assessment of hematological and biochemical profiles of the trainee is important to take timely measures in case of some complications related to the health of the athletes. Additionally, it will be important for the coaches to modify the volume and intensity of their training based on evidence. Therefore, the result of this research will help the medical and nutrition staff to take actions timely based on knowledge. In addition, it will help the coaches in designing appropriate training programs. Further, it will help policymakers in the sports science area to practice informed policy. It will also generate additional data for other researchers who want to add knowledge in the area.

2. Literature review

The International Olympic Committee (IOC) consensus statement on periodic health evaluation of Elite Athletes in March 2009 mentioned that hematological assessment of athletes is very important. This is because there is a high prevalence of lower iron stores particularly in female athletes, and hence for assessment of anemia (IDA). Hematological profiles are also used in the screening /monitoring of blood doping (49). In this regard, researches are being carriedout to investigate different hematological and biochemical tests thatare widely used to assess the health and fitness of the intensively training athlete(50). The available literature is diverse in terms of design; some are comparative using controls or assessing pre and post-exercise. Whereasothers compare by sport types a design that is used by the current study at the Ethiopian sports academy.

A cross-sectional study was conducted at the physiology department of Dhaka medical college, in Bangladesh to assess the effect of strong exercise on the hematological parameter of the female athletes. A total of 150 females, 70 are athletes, and 35 non-athletesfor comparisons. The athlete group was further subdivided as runners and cyclists. HGB%, RBC concentration, PCV, serum iron, ferritin, and total iron-binding capacity, were measured in a fasting state after two months of training. The result showed that the athlete group hada significantly low value of mean HGB%, RBC, iron, and ferritin level than the non-athletegroup. And also serum iron and ferritin level of runner is lower than cyclists. TIBC was significantly high in cyclists compared to the runner(51).

AstudydoneinIndia at the Annamalai University to compare the hemoglobin and leukocytes level between athletes and non-athletes recruited a total of 20 subjects aged between 21-25 years. The result revealedthat there is no significant difference between an athlete and non-athletes in the hemoglobin level 14.75 and 14.88 g/dl respectively, but in the leukocyte total cell count, there is a significant difference between an athlete and non-athlete 8.56 and 10.47, respectively(52).

Acomparativestudy was done in Italy during the 2002 world junior speed skating championship. Hematological testing wasperformed before one day of the race, fora total of 116 athletes (60 male and 56 female) to obtain a hematological reference value for the junior athletes. The result was compared with non-athletes matched by their age and sex (14 male 17 female),

the result shows that there is no significant difference between the two groups on the value of hemoglobin and hematocrit,but there was a low number of RBC in the athlete group. The athlete group had a high value of MCV than the non-athlete, but the MCHC was lower in the athlete group. However, there was no significant difference in the levels of erythropoietin and soluble transferrin receptor between the groups(53).

Hematological parameters profileofathletes performing marathons and ultra-marathonsat high altitudewere investigated in Italy in 2004 in order to screen sports anemia. A total of 124 athletes participated in the study. The study found no statistically significant difference in the value of erythrocytes, hemoglobin, and Hctof the study athletes in the pre and post running sample. But the WBC wassignificantly increased. The authors argued that the increase in WBC count is due to immunological involvement during endurance performance(54).

Schumacher and colleagues from the department of prevention, rehabilitation, and sports medicine, at the University of Freiburg of Germany undertook a comparative study in 2002. The study aimed at assessing the influence of exercise in hematological parameters and the alteration of red blood cell and iron metabolism in exercise performance. A total of 851 male subjectsparticipated in the study (741 athletes, 147, controls). A blood sample was collected after 2 days of rest, the result shows that the value of Hgb and Hctdid notshow a significant difference between athlete and non-athletes(55).

A comparative study was conducted in Serbia to determine the hematological profile and to compare the valuesbetween <14, <15, <16 years old Serbian youth national teams and soccer players and non-athletes in 2009. To this effect, 80 young soccer players and 30 non-athletes were included in the study. Hematological parameters like WBC, RBC, HGB, and HCTwere tested. MANOVA was used to determine the significant difference of the group on a multivariate level. The result showed that there were no significant variations in all hematological values except the RBC.The authors explainedthat this variation in the RBC level may be due to age, the effect of androgen on erythropoiesis, field position, and diet(56).

A similar study was done in Serbia to determine biochemical profiles of youth national soccer teams and to collate the values of nine biochemical parameters between three Serbian youth national teams (under 14, 15, and 16 years old), as well as between soccer players and non-athletes. Eighty young soccer players and thirty non-athletes participated in the study. Nine

biochemical parameters (glucose, cholesterol, triglycerides, urea, creatinine, total bilirubin, AST (SGOT), ALT (SGPT), iron) were measured. Statistically significant differences were found between groups (soccer players up to 14, 15, and 16 years of age) on a multivariate level of the applied biochemical variables. Also, there were significant differences i n Creatinine, Total bilirubin, and ALT (SGPT). And also statistically significant differences in the applied variables were found between soccer players and non-athletes in Glucose, Cholesterol, Triglycerides, Creatinine, Total bilirubin, ALT (SGPT) and Iron between soccer players and non-athletes. But therewere no statistically significant differences in other variables (AST and Urea)(57).

To evaluate the effects of marathon runningon hematological parameters, a study was conducted in the University hospital of PatrasMedical School, Department of Internal Medicine, Division of Pulmonology, Greece in 2003. A total of 7 marathon runner (6 male and 1 female) have participated in the study, The study compared laboratory results before 3 daysversusafter 3 daysas well as before and immediately after a cardiopulmonary exercise. The results showed that no statistically significant differences were observed in hematocrit, WBC, and the number of neutrophils, lymphocytes, monocytes, eosinophils, basophils, and platelets ($p < 0.5$)(58).

A study was conducted in the school of physical education and sport, FirtaUniversity, Elazig, Turkey in 2012, to evaluate the effect of long term handball training on the physical and hematological variables in young female handball players. The study recruited 30 females with a mean age of 12.58±0.51 years the result revealedthat no significant differences were noted between pre-training and post-training in the value of some hematological parameters like WBC count, RBC, andHct. But there is a significant difference in AST, ALT, and MCV, RDW, and MPV(59).

In a cross-sectional study from Western cost Africa Congo, Brazzaville hematological values before and immediately after a half-marathon event, and also within 24 hours after completion of the race were determined. The study which was conducted from Aug 10-21, 2018, enrolled a total of 76 male subjects(39 specialists and 37 no specialist of endurance race) in the Brazzaville half-marathon. The participants aged between 19-39 years (average 26.7± 2.6 years) and the result showed that in 12 athletes, mild anemia was detected and mild thrombocytopenia was seen in 7 participants the pre-race blood sample. Hematological values varied significantly

before and after the race, especially for RBC, HB, HCT, PLT, MCV, MCH, MCHC, and neutrophil counts. Within 24 h after the race a progressive and significant increment in MCH and MCHC was noted; however,Hgb, Hct, and WBC values weredecreased(60).

A descriptive study was conducted in the south nation and nationality of Ethiopia to determine the hematological profile of some male Ethiopian soccer players based on their playing position. A total of 28 soccer players from football clubs of Sidama coffee F.C and Hawassa F.C have participated inthe study. Hematological parameters like WBC, RBC, LYMPH, HGB, MCV, MCH, MCHC, PLT,were measured. Only WBC, RBC, and MCH showed significant variation among different playing positions (Goalkeepers, defenders, midfielders, and attackers)(61).

In Ethiopia, published studies on detailed hematologicaland biochemical parameters are limiting. Across sectional study recruited 101 (57 males and 44 females)professional athletes of different distance categories likeMarathon, Long (5 &10 km) distance, Steeplechase (3 km), Middle distance (800 m), and Short (100–400 m). Thestudy revealed that the prevalence of iron overload (Serum ferritin >200 μg/L) was 11 %, whereas that ofanemia (Hb< 12 g/dL) was 3.0%, iron deficiency (ferritin < 12 μg/L) was 2.0%, but none had full-blown iron deficiency anemia. Moderate folate deficiency (<5.9 ng/mL) was detected in 20.8%.There was no B12 deficiency among the studied participants. The performance of the athleteswas associated with their red blood cell count (RBC) at P = 0.03; the high performer athletes exhibited a high meanvalue of RBC(48).

Ethiopia, despite the current dominanceparticularly in distance running events globallywhich are an intriguing phenomenon, very limited published studies are available. Detailed Hematological and biochemical profiles of athletesparticularly atthe Ethiopian youth sports academy (EYSA) are lacking. This is a gap that the current study is trying to address.

3. Objective

3.1. General objective

- To assess selected hematological and biochemical profile of trainers at Ethiopian youth sports academy in Addis Ababa, Ethiopia, from Jan to March 2020.

3.2. Specific objectives

- To determine a hematological profile of Ethiopian youth sports academy trainees
- To determine the selected biochemical profile of Ethiopian youth sports academy trainees
- To determine the association between hematological and biochemical profile with the year of training experience of EYSA trainee
- To assess the variation of hematological and biochemical parameters between different sport discipline

4. Material and methods

4.1. Study area

The study was conducted at EYSA, which is the first national sports academy located in the Bole sub-city around Gerji in front of old Imperial hotel Addis Ababa. The academy starts its work since 2005 E.C. There is around 205 staff; from this 22 are couch staff. The academy gives scientific training for 315 young sportspersons (male 166 and 149 female) who are living in the camp; their age ranges between14-20. The academy trains in 10 types of sports discipline, including Para Olympic, running (short, middle and long), volleyball, box, football, world taekwondo, cycling, jumping, table tennis, and swimming in both sexes. The young trainees are selected from all regions and city administrations based on their skills. All trainees get scientific training for 4 years and then they will graduate and join different sports clubs. And the academy provided different athletes for the national team in different sports fields.

4.2. Study design and period

A cross-sectional study design was conducted to collect data from January to March 2020 to assess the hematological and biochemical profile of trainees at Ethiopian Youth Sports Academy Addis Ababa, Ethiopia.

4.3 Population

4.3.1 Source of population

All trainees who were taking training in the camp of EYSAduring the study period

4.3.2 Study population

The study populations for this study were all trainees who were currently taking their regular training in EYSA at the time of the study period. And trainees who fulfill the eligibilitycriteria were the study population.

4.4. Inclusion and exclusion criteria

4.4.1 Inclusion criteria

- An athlete who lives in EYSA and take his/her training regularly according to the couch's program.

- An athlete who was volunteers to participate in the study.

4.4.2 Exclusion criteria

- An athlete with anyillness (acute fibrilillness).
- Female Athletes who were in the menstrual cycle.

4.5 Study variables

4.5.1 Dependent variable

Hematological profile (WBC, RBC, HGB, MCV, MCH, MCHC, WBC RDW-SD, RDW-CV, PLT, MPV, P LCR, PDW, PCT, NEUT,LYMP, MONO, EOS, BASO, NUET%,LYMP%,MONO%, EOS%, BASO%)

Biochemical profile(Urea, Glucose, GOT, GPT, Creatinine,cholesterol, and triglyceride)

4.5.2. Independent variable

Age

Sex

Yearof training

Type of sport

Height

Weight

Nutritional factors

4.6. Sample size calculation and sampling methods

4.6.1 Sample size calculation

All study participants who fulfill eligibility criteria during the study period were included.

4.6.2. Sampling method

A convenient sampling method was applied to collect a blood sample from volunteers who were fulfilling the eligibility criteria.

4.7 Data collection and sample processing

4.7.1 Data collection

A structured pretested and interviewer-administered questionnaire was employed to obtain data on demographics, type of sport, and year of training. The questionnaire to be used in the study was prepared in English and was translated into Amharic version. The questionnaire was filled with sports trainers.

4.7.2 Blood specimen collection and processing

Blood specimens were collected by disinfecting the phlebotomy site by swabbing the skin in small outward circles with 70% alcohol swab. A total of 10 ml venous blood samples had been drawn from each participant into the Ethylene diaminetetra acetic (EDTA) tube and SST under the sterile condition for complete blood count (CBC). Fourml for EDTA and 6ml was used for SST tube. Hematological and biochemical analyses were conducted by the principal investigator using Sysmex XN and Mindraybs 200 automated chemistry analyzer, respectively. The hematological parameter measurements included; WBC, RBC, HGB, MCV, MCH, MCHC, WBC RDW-SD, RDW-CV, PLT, MPV, P-LCR, PDW, PCT, NEUT,LYMP, MONO, EOS, BASO, NUET%,LYMP%,MONO%, EOS%, BASO%parameters. The selected biochemical parameters included Cholesterol, TG, Urea, and Creatinine, GOT, GPT, and FBS.

4.7.3 Hematological analysis

Complete blood count (CBC) analysiswas performed by Sysmex, which is a quantitative and automated hematology analyzer for *in vitro* diagnostic use in clinical laboratories. Sysmexhematology analyzer operates for whole blood mode for venous blood, and pre-diluted mode for capillary blood. It can test 60 samples per hour. The analyzer produces 5 part differentiation of WBC;24 parameters such as WBC, RBC, HGB, PLT, MCV, etc. The analyzer can display WBC, RBC, and PLT histogram. It also automatically cleaning the sampling probe, dilutes, lyses, mix, rinse, and clog-clear.

Principle of Sysmex hematology analyzer

The device performs hematology analyses based on the hydrodynamically focused impedance measurement, the flow cytometry method (using a semiconductor laser), and the

SLS-hemoglobin method. The device counts and sizes red blood cells (RBC) and platelets (PLT) using hydrodynamic impedance counting (sheath flow DC method). At the same time, the hematocrit (HCT) is measured as a ratio of the total RBC volume to whole blood via the RBC pulse height detection method.

Hemoglobin concentration testing principle

The HGB concentration testing method is colorimetric. In the WBC counting pool, after adding hematologic agent, RBC dissolves and releasing hemoglobin which when combined with the hemolytic agent forms hemoglobin complex. A wavelength of 540nmmonochromatic LED in one end of the WBC counting pool illuminate hemoglobin complex solution, the transmitted light is received through the optical tube. The amplified light intensity signal is converted to a voltage signal. By comparing with the voltage produced by background transmitted light intensity before adding a sample in the WBC counting pool, the HGB concentration of the sample can be obtained. Unit of HGB test result express by g/dl.

4.7.4 Biochemical analysis

The biochemical analysis was done by BS 200 Mindray, the analyzer performs both serum and plasma samples; it can test more than 200 biochemical tests. The analyzer uses different measurement methods such as End-point assay, 2-point assay, Rate-A, Multi-standard, absorbance, and Double-wavelength.

Principle of BS 200 Mindray fully automatic analyzer

The principle of the instrument is based on the phenomenon of different wave bad absorbance from the substance, which is in line with Lambert-bill law.

4.7.6 Measurement methods

Cholesterol esters in the sample are hydrolyzed by cholesterol esterase to release free cholesterol. The free cholesterol is oxidized by cholesterol oxidase to release hydrogen peroxide. Phenol + 4-AAP + hydrogen peroxide, in the presence of peroxidase, produces a quinoneimine dye that is measured at 500nm. The absorbance at 500nm is proportional to the concentration of cholesterol in the sample.

Glucose is analyzed in serum or plasma on the Mindray BS-200 Chemistry Analyzer, using the hexokinase/G6PD method. In this method, glucose is phosphorylated by hexokinase in

the presence of adenosine triphosphate (ATP) and magnesium to form glucose-6-phosphate (G-6-P) and adenosine diphosphate (ADP). G-6-P is then oxidized by glucose-6-phosphate dehydrogenase (G-6-PDH) in the presence of nicotinamide adenine dinucleotide (NAD), producing 6-phosphogluconate and NADH. The formation of NADH causes an increase in absorbance at 340 nm, which is directly proportional to the concentration of glucose in the sample.

Creatinine is measured on the Mindray BS-200 Chemistry Analyzer, using a modified Jaffe assay. In this assay, creatinine reacts with picric acid in alkaline conditions to form a color complex that absorbs at 510 nm. The rate of formation of color is proportional to the creatinine in the sample

Urea is hydrolyzed by urease to produce ammonia and carbon dioxide. The liberated ammonia reacts with α-ketoglutarate in the presence of NADH to yield glutamate. An equimolar quantity of NADH undergoes oxidation during the reaction resulting in a decrease in absorbance that is directly proportional to the urea nitrogen concentration in the sample.

4.8. Data quality assurance

The quality of the data was assured by using a validated and pretested questionnaire. Prior to the actual data collection, pre-testing was done on 5% of the total study subjects in the sports academy medical center. Data collectors were trained for one day intensively on the study instrument and data collection procedure that included the relevance of the study, the objective of the study, confidentiality of the information, informed consent, and interview technique. The data collectors workedunder the close supervision of the supervisors to ensure adherence to correct data collection procedures. The principal investigatorreviewed the filled questionnaires at the end of data collection every day for completeness. Every morning, the principal investigator and the data collectors were conducting a morning session to solve the problem, if encountered, as early as possible, and to take corrective measures accordingly. forHematological three-level controls used and controls (pathological and normal) for biochemical tests were run before testing study samples. All data were carefully entered and cleaned before the analysis.

4.8.1. Pre-analytical

Standard operating procedures were strictly followed during specimen collection and laboratory procedures. Each activity including blood sample collection, transportation, and

storage was based on good laboratory practices (GLP) using standard operating procedures (SOPs) to ensure data quality. Specimen collection was performed in the morning from 07:00AM-09:00AM to avoid diurnal variation. The venous blood sample was collected from the antecubital fossa of the forearm by cleaning with 70% alcohol antiseptic and then was dispensed to the righttest tube.

4.8.2. Analytical

Commercially available low, normal, and high-quality control reagents were used to check the reliability (the accuracy and precision) of the data generated by the hematology analyzer. For chemistry profiles, normal and pathological control samples were analyzed as needed. The standard operating procedurewas followed strictlyin each laboratory procedure.

4.8.3. Post analytical

The accuracy and completeness of the collected data were checked every day by the principal investigator. The remaining blood samples were disposed of safely.

4.9 Data analysis and interpretation

Data werecleaned, coded, and checked for completeness manually and were enteredinto a software package for social science (SPSS) Version 23. After organizing and cleaning the data, frequencies, and percentages were calculated to all variables that are related to the objectives of the study. The extent of biochemical and hematological profile differences between different types of sport filed was checked. The difference between the mean levels of hematological and biochemical profile of the 10 types of sport field trainees was determined one-way ANOVAs and Games Howell post hoc test. Categorical variables were analyzed using the chi-square and continuous variables were analyzed with ANOVA where applicable. Pearsons chi-square correlation was also be used to finda correlation between hematological and biochemical profile with a year of training experiences. The level of statistical significance wasset at a 95% confidence interval. A P-value of less than 0.05 was considered statistically significant. Finally, the result was presented using tables and narrative forms.

4.10. Operational definitions

Hematological profile:WBC, RBC, HGB, MCV, MCH, MCHC, WBC RDW-SD, RDW-CV, PLT, MPV, P LCR, PDW, PCT, NEUT,LYMP, MONO, EOS, BASO, NUET%,LYMP%,MONO%, EOS%, BASO. Reference ranges provided by the company were used in this study.

Elite athlete: a person who is currently or has previously competed as a varsity player (individual or team), a professional player or a national or international level player

Biochemical profile; a series of blood tests used to evaluate the functional capacity of several critical organs and systems, such as liver and kidneys. In this study it refers toUrea, Glucose, GOT, GPT, and Creatinine, cholesterol, and triglyceride.

Hematocrit: the volume of packed red cells. It is expressed in % and reference range in healthy 36%-52%

Hemoglobin: a globular protein found within RBC. It is measured in g/dL and reference range is 13.5 to 17.5 for male and 12.0 g/dL to 15.5 for female g/dL.

Red blood cell count: total number of red blood cells in a microliter of blood. Normal ranges of RBC count in healthy adults is 4.0- 5.8 $10^6/\mu L$) for both gender.

Mean Corpuscular Volume: the average volume of the red blood cells. It is usually calculated by the formula Hct/RBC can be expressed by femtoliter. The normal range for healthy adults is 78-99fL

Mean CorpuscularHemoglobin: a measure of the average hemoglobin content per red cell. It May be calculated using the formula Hgb/RBC and expressed in a pictogram. The reference range in healthy adults is 26-32 pg.

Mean corpuscular hemoglobin concentration: the average concentration of hemoglobin in a given red cell volume. It is being calculated by the formula Hgb/Hct and expressed by g/dL. The normal range for adults is 32-36.0 g/dL.

Red cell distribution width: a red cell measurement that quantitates red cell volume heterogeneity. It is expressed as a percentage coefficient of variation. The normal range for adults is 12-13.6%.

White blood cells count the total number of white blood cells counted in a microliter of blood. The reference value for healthy adults is $3.7\times10^3/\mu L$-13 $\times10^3/\mu L$.

Differential white blood cell count: the percentage of each white blood cell (neutrophils, lymphocytes, monocytes, eosinophils, basophils)

Platelet count: the number of platelets in a microliter of blood. The reference range for adults is 140-385 ($\times 10^3/\mu L$).

Mean platelet volume: measures the mean volume of platelet, it is expressed in fL. In healthy adults, the normal range is 7.6-10.2 fL.

4.11. Ethical consideration:

Thestudy wasconducted after getting ethical clearance from the departmental ethical review committee of the Department of Medical Laboratory Sciences, AAU. And support letter was received from the department. Apermissionletter was obtained from EYSA. Blood sample and demographic data werecollected from volunteering participants after obtaining verbal assent. As the trainees are coming from all over the country and are residing in the camp, permission was obtained from the academy. To ensure confidentiality, the information obtained from the study participants was uniquely identified and coded. In addition, the clinical specimens collected during the study period were stored for further investigation if needed.

4.12 Dissemination of the result

The finding of the study was submitted to the department of medical laboratory sciences, Addis Ababa University. In addition, a copy of this material will begiven to EYSA. The result may be disseminated through publication in peer-reviewed local and international journals and through presenting in relevant workshops and seminars.

5. Results

5.1. Socio-demographic and Dietary pattern of study participants

The study recruited 230 individuals from Ethiopian Youth Sports Academy who were living and take training in different fields in the EYSA compound. All study participants were involved voluntarily and they were apparently healthy with no signs and symptoms for any disease. The age of the trainees ranged from 14 to 20 years and their mean (±SD) agewas16.91 ±1.39 years and 111(48.3) female 119(51.7%) were male (Table 1).

Regarding their sport fields, they were engaged into 10 different sport disciplines; of those basketball 21(9.1%), boxing 8(3.5%), football 80(34.8%), jumping 9(3.9%), running 42(18.3%), swimming 3(1.3%), table tennis 14(6.1%), taekwondo 17 (7.4%), volleyball 23 (10.0%), and cycle 13 (5.7%). In relation to years of training in EYSA first-year trainees were 117 (50.9%), second-year 26 (11.3%), third-year 49 (21.3%), and those in fourth-year were 38 (16.5%). All sports field trainees took six-day per week training for two hours.

Table 1: Sociodemographic characteristics of study participants at the Ethiopian Youth Sports Academy in Addis Ababa, January to March 2020

Parameters	N	Minimum	Maximum	Mean	St. deviation	Mean ±SD
Age (year)	230	14	20	16.91	1.396	16.91±1.39
Duration in EYSA(year)	230	1	4	2.03	1.178	2.03± 1.17
Height(cm)	230	1.32	1.99	1.68	.10912	1.635±.10
Weight(Kg)	230	38	88	55.66	8.113	55.66±8.11

Regarding dietary habits,as shown in Table 2, the majority of the trainees consume vegetables, fruits, meat and meat products, dairy products, and eggs at least 2-3 times per week.

Table 2: Dietary habit of study participants at the Ethiopian Youth Sports Academy in Addis Ababa, January to March 2020

Types of food	Frequency	N	%
Roots and Tuber (Potato, sweet potato, Enset, Cassava)	Once/day	4	1.7
	More than one/day	2	0.9
	2-3/weak	24	10.4
	Occasionally	177	77.0
	Never	23	10
Legumes (Beans, peas, chicken pea, etc)	Once/day	5	2.2
	More than one/day	2	0.9
	2-3/weak	124	53.9
	Occasionally	89	38.7
	Never	10	4.3
Cereals (Corn, Teff, Wheat, sorghum, etc)	Once/day	63	27.4
	More than one/day	6	2.6
	2-3/weak	122	53.0
	Occasionally	35	15.2
	Never	4	1.7
Vegetables (Tomato, cabbage, etc)	Once/day	14	6.1
	More than one/day	7	3.0
	2-3/weak	157	68.3
	Occasionally	50	21.7
	Never	2	0.9
Fruits (Orange, banana, etc)	Once/day	58	25.2
	More than one/day	14	6.1
	2-3/weak	147	63.9
	Occasionally	10	4.3
	Never	1	0.4

Meat (including poultry, fish, etc)	Once/day	5	2.2
	More than one/day	6	2.6
	2-3/weak	209	90.9
	Occasionally	8	3.5
	Never	2	0.9
Milk and Milk products (Butter, yogurt, cheese, etc)	Once/day	6	2.6
	More than one/day	6	2.6
	2-3/weak	184	80.0
	Occasionally	25	10.9
	Never	9	3.9
Egg	Once/day	7	3.0
	More than one/day	9	3.9
	2-3/weak	191	83.0
	Occasionally	22	9.6
	Never	1	0.4
Tea and/or coffee	Once/day	159	69.1
	More than one/day	67	29.1
	2-3/weak	3	1.3
	Occasionally	1	0.4
	Never	0	0

5.2. Hematological and Biochemical profile for study populations

Hematological and selected biochemical profile of trainees at the Ethiopian Youth Sports Academy is summarized in Table 3. As shown in the table the mean values of the following parameters differ significantly between males and females ($P<0.05$). There wasa statistically significant difference between males and females for both hematological and biochemical profiles were as such, RBC, HGB, HCT%, EOS%, BASO%, males are greater females whereas urea, creatinine, and cholesterol females were greater males. Others, hematological and selected biochemical profiles between males and females were not significant differences between them.

Table 3: Hematological and Selected Biochemical Profile for Male And Female trainees at the Ethiopian youth sports academy in Addis Ababa, January to March 2020									
Parameters		**Mean**	**Std. Deviation**	**Std. Error**	**95% Confidence Interval for Mean**		**Minimum**	**Maximum**	**p.value**
					Lower Bound	**Upper Bound**			
RBC ($x10^6/\mu L$)	Male	5.52	.46	.04	5.43	5.60	4.34	6.50	<0.001
	Female	5.14	.39	.03	5.06	5.21	4.10	6.23	
HGB (g/dL)	Male	15.98	1.32	.12	15.74	16.22	12.7	18.6	<0.001
	Female	15.00	1.07	.10	14.80	15.20	12.7	17.9	
HCT (%)	Male	48.43	4.20	.38	47.67	49.20	38.5	57.4	<0.001
	Female	45.49	3.24	.30	44.88	46.10	39.3	54.0	
MCV (fL)	Male	87.90	5.89	.54	86.83	88.97	73.6	101.9	.815
	Female	88.07	5.01	.47	87.13	89.02	73.2	102.0	
MCH (pg)	Male	28.94	1.59	.14	28.65	29.23	24.7	33.3	.392
	Female	29.12	1.44	.13	28.84	29.39	24.8	32.0	
MCHC (g/dL)	Male	32.99	1.58	.14	32.70	33.28	29.6	36.2	.632
	Female	33.08	1.27	.12	32.84	33.32	29.0	36.4	
PLT ($x10^3$)	Male	274.20	59.24	5.43	263.45	284.96	144	477	.027
	Female	292.24	63.34	6.01	280.33	304.16	133	455	
RCDW-SD (fL)	Male	42.03	4.76	.43	41.17	42.90	33.8	53.9	.526
	Female	41.68	3.58	.34	41.01	42.35	34.0	50.8	
RCDW-CV (%)	Male	12.84	.93	.08	12.67	13.01	11.1	15.5	.513
	Female	12.76	.79	.07	12.61	12.91	11.2	16.9	
PDW (fL)	Male	13.17	2.11	.19	12.79	13.56	8.7	19.8	.118
	Female	12.70	2.49	.23	12.23	13.16	8.6	20.3	
MPV (fL)	Male	10.79	.99	.09	10.61	10.97	8.0	13.3	.612
	Female	10.72	1.03	.09	10.53	10.92	8.6	13.6	
P-LCR (%)	Male	31.82	7.08	.64	30.53	33.10	14.3	51.7	.169
	Female	30.39	8.55	.81	28.78	32.00	12.9	51.9	
PCT (%)	Male	.29	.05	.00496	.28	.30	.10	.45	.200
	Female	.30	.06	.00636	.29	.32	.03	.51	
WBC ($x10^3/\mu L$)	Male	5.95	1.72	.15	5.63	6.26	3.15	11.00	.175
	Female	6.25	1.69	.16	5.93	6.57	3.43	11.66	
NEUT ($x10^3/\mu L$)	Male	2.84	1.40	.12	2.58	3.09	.50	7.40	.152
	Female	3.10	1.43	.13	2.83	3.37	.68	8.33	

LYMP (x10^3/µL)	Male	2.32	.57	.05	2.22	2.42	1.20	4.10	.389
	Female	2.39	.58	.05	2.28	2.49	1.27	4.17	
MONO(x10^3/µL)	Male	.50	.31	.02	.45	.56	.20	3.43	.432
	Female	.48	.14	.01	.45	.51	.04	.93	
EOS (x10^3/µL)	Male	.24	.23	.02	.20	.28	.00	1.70	.254
	Female	.21	.18	.01	.17	.24	.00	1.26	
BASO (x10^3/µL)	Male	.05	.03	.00337	.04	.05	.00	.21	.148
	Female	.04	.04	.00452	.03	.05	.01	.50	
NUET (%)	Male	45.74	12.05	1.10	43.55	47.93	15.2	76.1	.176
	Female	47.85	11.55	1.09	45.68	50.03	18.3	73.2	
LYMP (%)	Male	40.96	10.21	.93	39.11	42.81	14.8	69.5	.561
	Female	40.16	10.66	1.01	38.15	42.16	17.2	65.4	
MONO (%)	Male	8.34	2.43	.22	7.90	8.78	3.8	20.3	.191
	Female	7.94	2.09	.19	7.55	8.34	4.4	16.9	
EOS (%)	Male	4.04	3.22	.29	3.45	4.62	.5	23.2	.040
	Female	3.26	2.42	.23	2.80	3.71	.0	12.4	
BASO (%)	Male	.94	.48	.04	.86	1.03	.0	2.8	<0.001
	Female	.66	.30	.02	.61	.72	.1	1.8	
Glucose (mg/dL)	Male	92.61	10.73	.98	90.66	94.55	75	125	.471
	Female	93.71	12.46	1.18	91.37	96.06	70	138	
Urea (mg/dL)	Male	26.18	7.09	.65	24.90	27.47	13	48	.017
	Female	28.70	8.79	.83	27.05	30.36	11	53	
Creatinine (mg/dL)	Male	.76	.16	.015	.73	.79	.46	1.13	.003
	Female	.83	.18	.017	.80	.87	.47	1.29	
AST (GOT) (u/L)	Male	25.49	6.29	.57	24.34	26.63	10	39	.115
	Female	27.02	8.30	.78	25.46	28.58	9	49	
ALT (GPT) (u/L)	Male	18.61	6.13	.56	17.50	19.73	10	55	.880
	Female	18.49	6.61	.62	17.24	19.73	6	40	
Cholesterol (mg/dL)	Male	108.78	24.47	2.24	104.34	113.22	57	182	<0.001
	Female	124.03	31.33	2.97	118.13	129.92	61	195	
Triglyceride (mg/dL)	Male	80.39	24.31	2.22	75.98	84.81	32	168	.908
	Female	80.79	27.82	2.64	75.56	86.03	32	146	

5.3. Hematological profile by year of training at Ethiopian Youth Sport Academy

The study tried to investigate the association of the hematological profile of EYSA trainees with a year of their training experience at the Sports Academy. For categorizing normal and abnormal values, the company derived instrument values were taken as they were flagged low and high as shown in Table 4. The aim of this analysis is to see if the training duration in the Academy has an effect on the profiles. Accordingly, a high proportion of values above the company given upper limit was seen for RBC parameters: RBC 43(18.7%), HGB 50(21.7%), HCT 29(12.6%), and Baso% 55(24.0%). None of the trainees had WBC above the upper limit while 20(8.7%) trainees had WBC count below the lower limit of $3.7x10^9$/L provided by the company. This is also reflected in the Neutrophil count where 47(20.4%) trainees had Neutrophil count was flagged as having values below the lower reference limit of the instrument. For PLT on the other hand, no trainee has values below the lower limit while15 (6.5%) trainees had PLT count above the higher reference limit of the machine which was $385x10^9$/L. The majority of trainees whose results were flagged by the machine as high for RBC and PLT and low for WBC as well as Neutrophils were those who were in their first year of training, though statistically significant only for HCT and Baso% ($P<0.05$) (Table 4)

Table 4: Association of the hematological profile with a year of training experience of Trainees at the Ethiopian Youth Sports Academy in Addis Ababa, January to March 2020

		Year of Training Experience					
Parameters	Range	1	2	3	4	Total	p. value
RBC (10^6/uL)	<4.0 Low	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0.183
	4.0-5.8 Normal	95(81.19%)	25(96.15%)	38(77.55%)	29(76.31%)	187(81.30%)	
	>5.8 High	22(18.80%)	1(3.85%)	11(22.44%)	9(23.68%)	43(18.7%)	
HGB (g/dL)	<11.8 Low	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0.108
	11.0-16.7 Normal	87(74.35%)	25(96.15%)	39(79.59%)	29(76.31%)	180(78.3%)	
	>16.7 High	30(25.64%)	1(3.84%)	10(20.40%)	9(23.68%)	50(21.7%)	
HCT (%)	<36 Low	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0.044*
	36-52 Normal	97(82.90%)	26(100%)	46(93.87%)	32(84.21%)	201(87.4%)	
	>52 High	20(17.09%)	0(0%)	3(6.12%)	6(15.78%)	29(12.6%)	
MCV (fL)	<78 Low	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0.188
	78-99 Normal	110(94.01%)	26(100%)	48(97.95%)	38(100%)	222(96.50%)	
	>99 High	7(5.98%)	0(0%)	1(2.04%)	0(0%)	8(3.5%)	
MCH (pg)	<26 Low	1(0.85%)	0(0%)	0(0%)	0(0%)	1(0.43%)	0.578
	26-32 Normal	115(98.29)%)	26(100%)	48(97.95%)	36(94.73%)	225(97.80%)	
	>32 High	1(0.85%)	0(0%)	1(2.04%)	2(5.26%)	4(1.70%)	
MCHC (g/dL)	<32 Low	31(26.49%)	6(23.07%)	9(18.36%)	7(7.89%)	53(23%)	0.604
	32-36	86(73.50%)	20(76.92%	40(81.63%)	31(51.57	177(77%)	

	NORMAL		)		%)		
	>36 HIGH	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	
PLT (10^3/uL)	<140 LOW	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0.263
	140-385 NORMAL	106(90.59%)	26(100%)	47(95.91%)	36(94.73 %)	215(93.50%)	
	>385 HIGH	11(9.40%)	0(0%)	2(4.08%)	2(5.26%)	15(6.50%)	
RDW CV (fL)	<11.8 LOW	6(5.12%)	4(15.38%)	8(16.32%)	2(5.26%)	20(8.70%)	0.211
	11.8-15.6 NORMAL	110(94.01%)	22(84.61%)	41(83.67%)	36(68.42 %)	209(90.80%)	
	>15.6 HIGH	1(0.85%)	0(0%)	0(0%)	0(0%)	1(0.43%)	
WBC (10^3/uL)	<3.7 LOW	11(9.40%)	2(7.69%)	4(8.16%)	3(7.89%)	20(8.70%)	0.985
	3.7-13 NORMAL	106(90.59%)	24(92.30%)	45(91.83%)	35(92.10 %)	210(91.30%)	
	>13 HIGH	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	
NEUT (10^3/uL)	<1.8 LOW	28(23.93%)	3(11.53%)	8(16.32%)	8(21.05%)	47(20.40%)	0.447
	1.8-8.7 NORMAL	89(76.06%)	23(88.46%)	41(83.67%)	30(78.94 %)	183(79.60%)	
	>8.7 HIGH	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	
LYMP (10^3/uL)	<0.7 LOW	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	Not statistically computed
	0.7-6.5 NORMAL	117(100%)	26(100%)	49(100%)	38(100%)	230(100%)	
	>6.5 HIGH	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	
MONO (10^3/uL)	0.00-1.60 NORMAL	116(99.14%)	26(100%)	47(95.91%)	37(97.36 %)	226(98.30%)	0.432
	>1.6 HIGH	1(0.85%)	0(0%)	2(4.08%)	1(2.63%)	4(1.70%)	

EOS (10^3/Ul)	0.00-1 NORMAL	116(99.14%)	26(100%)	48(97.95%)	37(97.36 %)	227(98.7%)	0.740
	>1 HIGH	1(0.85%)	0(0%)	1(2.04%)	1(2.68%)	3(1.30%)	
BASO (10^3/uL)	0.00-0.30 NORMAL	114(97.43%)	25(96.15%)	49(100%)	38(100%)	226(98.30%)	0.443
	>0.30 HIGH	3(2.56%)	1(3.84%)	0(0%)	0(0%)	4(1.70%)	
NEUT (%)	<40 LOW	38(32.47%)	5(19.23%)	11(22.44%)	8(21.05%)	62(26.90%)	0.286
	40-75 NORMAL	79(67.52%)	21(80.76%)	38(77.55%)	30(78.94 %)	168(73.10%)	
	>75 HIGH	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	
LYMP (%)	<20 LOW	2(1.70%)	1(3.84%)	2(4.08%)	0(0%)	5(2.20%)	0.781
	20-50 NORMAL	92(78.63%)	22(84.61%)	39(79.59%)	32(84.21 %)	185(80.40%)	
	>50 HIGH	23(19.65%)	3(11.53%)	8(16.32%)	6(15.78%)	40(17.40%)	
MONO (%)	< 3 LOW	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0.076
	3-12 NORMAL	117(100%)	26(100%)	47(95.91%)	36(94.73 %)	226(98.70%)	
	>12 HIGH	0(0%)	0(0%)	2(4.08%)	2(5.26%)	4(1.70%)	
EO (%)	<1 LOW	6(5.12%)	2(7.69%)	7(14.28%)	3(7.89%)	18(7.80%)	0.672
	1-7 NORMAL	98(83.76%)	21(80.76%)	37(75.51%)	31(81.57 %)	187(81.30%)	
	>7 HIGH	13(11.11%)	3(11.53%)	5(10.20%)	4(10.52%)	25(10.80%)	
BASO (%)	0.0-1 NORMAL	81(69.23%)	19(73.07%)	43(87.75%)	32(84.21 %)	175(76%)	0.042*
	>1 HIGH	36(33.33%)	7(11.53%)	6(12.24%)	6(15.78%)	55(24.0%)	

5.4. Biochemical profile by year of training at Ethiopian Youth Sport Academy

Table 5 displays biochemical profiles of trainees with their year of training experience at the Ethiopian Youth Sports Academy. As shown in the table, Glucose, Urea, Creatinine, GOT and GPT levels of the trainees lie within the normal range regardless of the trainee's years of experience as a trainee in the academy within reference limit provided by the company (Table 5).

Table 5: Association of Biochemical profiles with a year of training experience of Trainees at the Ethiopian Youth Sports Academy in Addis Ababa, January to March 2020

		Year of training experience					
Parameters	Range	1	2	3	4	Total	p. value
GLUCOSE (mg.dL)	<70 Low	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0.265
	70-120 Normal	116(99.14%)	26(100%)	47(95.91%)	38(100%)	227(98.7%)	
	>120 High	1(0.85%)	0(0%)	2(4.08%)	0(0%)	3(1.30%)	
UREA (mg/dL)	<10 LOW	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0.809
	10-50 Normal	116(99.14)	26(100)	49(100)	38(100)	229(99.6)	
	>50 High	1(0.85%)	0(0%)	0(0%)	0(0%)	1(0.43%)	
CREATININE (mg/dL)	<0.5 Low	5(4.27%)	0(0%)	1(0%)	3(1.30%)	9(3.9%)	0.762
	0.5-1.1 Normal	109(93.16%)	25(96.15%)	47(95.91%)	34(89.47%)	215(93.50%)	
	>1.1 High	3(2.56%)	1(3.84%)	1(2.04%)	1(2.63%)	6(2.60%)	
GOT (u/L)	0-40 Normal	116(99.14%)	26(100%)	49(100%)	38(100%)	229(99.60%)	0.809
	>40 High	1(0.85)	0(0)	0(0)	0(0)	1(0.43)	
GPT (u/L)	0-40 Normal	116(99.14%)	26(100%)	49(100%)	38(100%)	229(99.56%)	0.809
	>40 High	1(0.85%)	0(0%)	0(0%)	0(0%)	1(0.43%)	
CHOLESTROL (mg/dL)	<200 Normal	117(100%)	26(100%)	49(100%)	38(100%)	230(100%)	Not computed
	>200 High	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	
TRIGLYCERIDE (mg/dL)	<150 Normal	116(99.14%)	26(100%)	49(100%)	38(100%)	229(99.60%)	0.809
	>150 High	1(0.85%)	0(0%)	0(0%)	0(0%)	1(0.43%)	

5.5. Variation of Mean Hematological parameters by sport discipline of trainees at Ethiopian Youth Sport Academy

To assess the variation of hematological parameters between different sport disciplines, analytical compare means by one-way ANOVA was applied. Thus, Table 6 displays result from one-way ANOVA analysis by comparing the mean values of different hematological parameters between groups. There was statistically significant difference between groups means for RBC (F (9,220) = 2.725, P = .005), HGB (F(9,220) =3.432, P = .001), HCT (F(9,220) = 3.316, P =.001), MCV (F(9,20) = 6.066), P = .000), MCHC (F(9,220) =7.658,P = .000), RDW-SD (F(9,220) =12.046,P =.000), RDW-CV (F(9,220) =7.514), P =.000), WBC(F(9,220) =2.705, P = .005), Neutrophils (F(9,220) =2.228, P = .021), Eosinophils (F(9,220) =3.907, P = .000), Neutrophils% (F(9,220) = 2.273), P = .019) = 1.941), P = .048)), Lymphocyte% (F(9,220) =1.941), P =.048), monocyte % (F(9,220) = 2.142), P = .027) and Eosinophils% (F(9,220) = 4.347), P = .000). For others hematological parameters, there were no statistically significant difference between groups' means (Table 6).

Table 6:Asessing the variation of Mean hematological parameters between different sport discipline of Trainees at the Ethiopian Youth Sports Academy in Addis Ababa, January to March 2020

		Sum of Squares	Df	Mean Square	F	Sig.
RBC (10^6/u)l	Between Groups	5.14	9	.57	2.72	0.005
	Within Groups	46.12	220	.21		
	Total	51.26	229			
HGB (g/dl)	Between Groups	47.54	9	5.28	3.43	0.001
	Within Groups	338.60	220	1.53		
	Total	386.14	229			
HCT (%)	Between Groups	446.87	9	49.65	3.31	0.001
	Within Groups	3293.96	220	14.97		
	Total	3740.83	229			
MCV (fl)	Between Groups	1366.61	9	151.84	6.06	<0.001
	Within Groups	5506.78	220	25.03		
	Total	6873.39	229			
MCH (pg)	Between Groups	19.86	9	2.20	.94	0.487
	Within Groups	513.98	220	2.33		
	Total	533.85	229			
MCHC (g/dl)	Between Groups	113.61	9	12.62	7.65	<0.001
	Within Groups	362.66	220	1.64		
	Total	476.27	229			
PLT (10^3/ul)	Between Groups	38842.33	9	4315.81	1.13	0.338
	Within Groups	835400.74	220	3797.27		
	Total	874243.08	229			
RDW-SD (fl)	Between Groups	1353.06	9	150.34	12.04	<0.001
	Within Groups	2745.75	220	12.48		
	Total	4098.81	229			
RDW-CV (%)	Between Groups	40.78	9	4.53	7.51	<0.001
	Within Groups	132.69	220	.60		

	Total	173.48	229			
WBC (10^3/uL)	Between Groups	66.98	9	7.44	2.70	0.005
	Within Groups	605.32	220	2.75		
	Total	672.31	229			
NEUT (10^3/uL)	Between Groups	38.74	9	4.30	2.22	0.021
	Within Groups	425.09	220	1.93		
	Total	463.83	229			
LYMP (10^3/uL)	Between Groups	3.33	9	.37	1.12	0.345
	Within Groups	72.36	220	.32		
	Total	75.70	229			
MONO (10^3/uL)	Between Groups	.78	9	.08	1.44	0.171
	Within Groups	13.34	220	.06		
	Total	14.13	229			
EOS (10^3/uL)	Between Groups	1.44	9	.16	3.90	<0.001
	Within Groups	9.04	220	.04		
	Total	10.49	229			
BASO (10^3/uL)	Between Groups	.02	9	.00	1.72	0.085
	Within Groups	.38	220	.002		
	Total	.41	229			
NEUT (%)	Between Groups	2730.40	9	303.37	2.27	0.019
	Within Groups	29364.25	220	133.47		
	Total	32094.66	229			
LYMP (%)	Between Groups	1827.78	9	203.08	1.94	0.048
	Within Groups	23020.31	220	104.63		
	Total	24848.09	229			

EOS (%)	Between Groups	288.52	9	32.05	4.34	<0.001
	Within Groups	1622.56	220	7.37		
	Total	1911.09	229			
BASO (%)	Between Groups	3.01	9	.33	1.87	0.057
	Within Groups	39.39	220	.17		
	Total	42.41	229			

5.6. Variation of Mean Biochemical parameters by sport discipline of trainees at Ethiopian Youth Sport Academy

Also, for assessing variation of selected biochemical parameters between different sports disciplines one-way ANOVA was used. The result is shown in Table 7 by comparing different biochemical parameters between groups means was as follows; Glucose (F(9,220) = 8.315), P = .000), Urea (F(9,220) = 3584), P = .000), Creatinine (F(9,220) = 5.935), P = .000), GOT (F(9,220) = 4.645), P = .000), GPT (F(9,220) = 1.448), P = .169), Cholesterol (F(9,220) = 5.592), P = .000), Triglyceride (F(9,220) = 4.005), P = .000). All selected biochemical profile was statistically significant difference between groups' means had been observed. Except, GPT in which its p value was .169> 0.05 and did not indicate statistically significant difference between groups means.

Table 7:Assessing the variation of mean biochemical parameters between different sport discipline of trainees at the Ethiopian Youth Sports Academy in Addis Ababa, January to March 2020

		Sum of squares	Df	Mean square	F	Sig
Glucose (mg/dL)	Between Groups	7808.69	9	867.63	8.31	<0.001
	Within Groups	22954.85	220	104.34		
	Total	30763.54	229			
Urea (mg/dL)	Between Groups	1894.56	9	210.50	3.58	<0.001
	Within Groups	12920.63	220	58.73		
	Total	14815.20	229			
Creatinine (mg/dL)	Betweenn Groups	1.45	9	.16	5.93	<0.001
	Within Groups	6.00	220	.02		
	Total	7.4	229			
AST (GOT) (uL)	Between Groups	1978.38	9	219.82	4.64	<0.001
	Within Groups	10411.85	220	47.32		
	Total	12390.24	229			
ALT (GPT) (µL)	Between Groups	517.79	9	57.53	1.44	.169
	Within Groups	8741.08	220	39.73		
	Total	9258.87	229			
Cholesterol (mg/dL)	Between Groups	35745.08	9	3971.67	5.59	<0.001
	Within Groups	156250.46	220	710.22		
	Total	191995.54	229			
Triglyceride (mg/dL)	Between Groups	21805.91	9	2422.88	4.00	<0.001
	Within Groups	133075.84	220	604.89		
	Total	154881.76	229			

Table 6 and 7ANOVAs analysis for hematological and selected biochemical parameters between groups means revealed statistically significant difference in group mean for each hematological and biochemical parameters, which indicate most of them had (P <0 .05) that was significant. This was an interesting finding, but we did not know which specific group means were different. Knowing this multiple comparisons tables in one-way ANOVA, which contain Games-Howell post hoc test that mostly applied for unequal sample size or equal variance not assumed was used; this analysis was to confirm where differences occurred between groups. This method was applied since the study did not have an equal sample size for each sport discipline and summarized in Table 8 below.

The result from table 8 looks like as follows for Assessing hematological parameters for statistically significant group means the difference between sport disciplines for RBC, HGB, HCT, MCV, MCHC, RDW-CV, WBC, NEUT, EOS, NEUT%, MONO %, and EOS%. From one way ANOVAs analysis lymphocyte percentage between mean groups has statistically significant difference but in Game Howells post hoc multi comparison test there was no statistically significant difference observed between mean groups for lymphocyte percentage for each sport field.

Table 8: Assessing hematological parameters for statistically significant group means the difference between sport disciplines.

Game Howells	Multiple comparisons						
Dependent variable	**(L) type of sport**	**(j) type of sport**	**Mean difference in (l-j)**	**Std-error**	**sig**	**95% confidence interval**	
						Lower bound	**Upper bound**
RBC ($x10^6/\mu L$)	Basketball	Cycle	-.49	.13	0.039	-.96	-.01
	Football	Cycle	-.44	.11	0.032	-.85	-.02
HGB (g/dL)	Basketball	Cycle	-1.88	.42	0.005	-3.39	-.40
	Football	Cycle	-1.62	.35	0.010	-2.92	-.31
	Cycle	Basket ball	1.88	.42	0.005	.40	3.39
		Football	1.62	.35	0.010	.31	2.92
HCT (%)	Basketball	Cycle	-5.89	1.17	0.001	-9.94	-1.85
	Football	Cycle	-5.87	1.00	<0.001	-9.46	-2.28
	Jumping	Cycle	-6.48	1.39	0.006	-11.51	-1.46
	Running	Cycle	-5.68	1.04	0.001	-9.37	-1.99
	Table teens	Cycle	-5.15	1.30	0.016	-9.66	-.64
	Taekwondo	Cycle	-5.99	1.34	0.004	-10.61	-1.37
MCV (fL)	Basketball	Jumping	6.34	1.63	0.018	.70	11.98
	Football	Jumping	5.92	1.12	0.005	1.63	10.20
		Running	4.35	.88	<0.001	1.46	7.23
	Jumping	Volley ball	-5.88	1.51	0.019	-11.12	-.65
		Cycle	-9.92	2.00	0.003	-17.11	-2.74
	Running	Cycle	-8.35	1.88	0.010	-15.18	-1.52
MCHC (pg)	Basketball	Jumping	-1.75	.37	0.003	-3.06	-.44
		Running	-1.95	.27	<0.001	-2.89	-1.01
		Taekwondo	-1.62	.33	0.001	-2.75	-.49
	Football	Taekwondo	-1.14	.26	0.005	-2.05	-.23
		Jumping	-1.27	.31	0.027	-2.44	-.11
		Running	-1.47	.18	<0.001	-2.08	-.86

	Jumping	Cycle	1.92	.51	0.035	.08	3.76
	Running	Swimming	1.08	.15	0.007	.35	1.82
		Cycle	2.12	.44	0.009	.44	3.80
	Taekwondo	Cycle	1.79	.48	0.043	.03	3.54
RDW-CV (g/dL)	Basketball	Running	1.21	.29	0.009	.21	2.22
	Box	Running	1.29	.25	0.011	.27	2.31
	Football	Running	.96	.12	<0.001	.55	1.37
	Running	Cycle	-1.03	.14	<0.001	-.54	-.52
WBC ($x10^3/\mu L$)	Football	Jumping	2.03	.31	<0.001	.88	3.18
	Jumping	Running	-162	.36	0.005	-2.89	-.35
		Table Teens	-2.06	.52	0.021	-3.91	-.21
		Taekwondo	-1.73	.44	0.020	-3.29	-.18
		Cycle	-2.69	.71	0.042	-5.33	-.06
NEUT ($x10^3/\mu L$)	Box	Jumping	2.04	.45	0.021	.26	3.82
		Swimming	2.08	.44	0.022	.28	3.89
	Football	Jumping	1.65	.27	<0.001	.69	2.62
		Swimming	1.70	.25	0.006	.57	2.83
	Jumping	Running	-1.34	.28	0.003	-2.35	-.34
		Table Teens	-1.58	.41	0.028	-3.07	-.11
	Running	Swimming	1.39	.27	0.015	.26	2.522
EO ($x10^3/\mu L$)	Basket Ball	Football	-.11	.02	0.004	-.122	-.02
NEUT (%)	Box	Jumping	16.40	3.50	0.009	3.40	29.41
	Football	Jumping	13.80	3.12	0.021	1.74	25.86
	Running	Jumping	12.85	3.28	0.037	.58	25.11
MONO (%)	Jumping	Volley ball	3.36	.79	0.019	.42	6.31
		Cycle	3.76	.82	0.009	.74	6.78
EO (%)	Basketball	Foot ball	-1.61	.45	0.021	-.3.10	-.13
		Cycle	-4.34	1.04	0.023	-8.21	-.46
	Running	Cycle	-4.02	1.04	0.039	-7.90	-.14
	Table teens	Cycle	-4.20	1.05	0.030	-8.10	-.29

NB: In multiple comparisons mean the difference in (l-j) and lower bound and upper bound at 95 % CI were inversely related to each other type of sport. Considering this we did not right the reverse one in this table. P. value was statistically significant at 0.05

Table 9:Assessing selected biochemical parameters for statistically significant group means the difference between sport disciplines

Multiple comparisons

Game Howells

Dependent variable	**(L) type of sport**	**(j) type of sport**	**Mean difference in (l-j)**	**Std-error**	**sig**	**95% confidence interval**	
						Lower bound	**Upper bound**
Glucose (mg/dL)	Basketball	Football	14.83	2.99	0.001	4.49	25.17
		Running	13.21	3.12	0.007	2.55	23.88
		Table tense	14.07	3.51	0.011	2.16	25.99
		Taekwondo	18.31	3.15	0.000	7.54	29.10
	Box	Jumping	-25.38	6.31	0.040	-49.87	-.90
	Running	Jumping	-16.96	3.34	0.007	-29.80	-4.12
Urea (mg/dL)	Football	Taekwondo	7.97	1.5	0.001	2.64	13.31
Creatinine (mg/dL)	Basketball	Taekwondo	.19	.04	0.009	.034	.36
	Box	Taekwondo	.20	.04	0.022	.02	.39
	Football	Running	.12	.03	0.004	.02	.22
AST (GOT) (µ/L)	Running	Football	4.74	1.31	0.017	.49	9.04
	Jumping	Taekwondo	10.19	1.92	0.001	3.50	16.89
ALT (GPT) (µ/L)							
Cholesterol (mg/dL)	Basket ball	Taekwondo	34.16	8.14	0.008	6.22	62.11
	Running with	Taekwondo	33.56	5.85	<0.001	14.27	52.86
	Taekwondo	Volley ball	-33.09	5.50	<0.001	-51.59	-14.60
Triglyceride(mg/dL)	Basket ball	Taekwondo	35.78	7.30	0.001	10.83	60.73

The result from Table 9 shows that there were variations of selected biochemical parameters for statistically significant group means the difference between sport disciplines for Glucose, urea, creatinine, GOT cholesterol and triglyceride except for GPT which was not statistically significant.

NB: In multiple comparisons mean the difference in (l-j) and lower bound and upper bound at 95 % CI were inversely related to each other type of sport. Considering this we did not right the reverse one in this table. P. value was statistically significant at 0.05.

6. Discussion

The main aim of this study was to assess the hematological and biochemical profile for Ethiopian youth sports academy trainees. The study also aimed to determine their hematological and selected biochemical profile and assessing variation of hematological and selected biochemical profiles among different sports fields as well as the year of training experience in the Academy. All study participants were apparently healthy during the study period. The participant's ages ranged from 14 to 20 years in which both genders were included. The study population was from 10 sports fields that had been trained in the institutions.

In this study, the hematological and biochemical profile for both male and females were in Ethiopian youth sports academy was determined as such RBC (5.52 ± 0.46, 5.14 ± 0.39), HGB (15.98 ± 1.32,15.00 ± 1.07), HCT (48.43 ± 4.20, 45.49 ± 3.24), PLT (274.20 ± 59.24, 292.24± 63.3)and WBC (5.95±1.72, 6.25 ± 1.69) and biochemical profile Urea (26.18 ± 7.09, 28.70 ± 8.79), Creatinine (0.79 ± 0.16, 0.83 ± 0.18) and Cholesterol (108.78 ± 24.47, 124.03 ± 31.33) respectively for both male and female, and also for others. Hematological profile for Ethiopian youth sports academy determined as such for them in this study. when comparing this study with a hematological profile for RBC and HGB the study conducted in India which was determined for RBC 5.1± 0.58and HGB 15±1.1 was quite similar to this study (62).

Association of hematological profile with EYSA with year training experience reveal there was a higher RBC number for first-year trainees 22(9.5%), third-year 11(4.8%), fourth-year 9(3.9) and lower RBC numbers of in second year 1(.43%). there was no significant difference in year training in relation to RBC number p-value(1.83>0.05). HGB values higher in first years 30(13%) and third 10(4.3%) but no significant difference in year of training p=0.108. HCT values rose for first-year trainees 20(8.7%), third-year 3 (1.3%), and fourth-year 6(2.6) there was a significant difference observed between the year of training with HCT p (.044). MCV and MCH normal for all year trainee, MCHC decreased for first-year trainee31 (13.5%), second-year 6(2.6%), third-year 9(3.9%) and fourth-year 7(3%), PLT increment in the first year 11(4.8) rest were normal no significant difference. In this study RDW-CV, WBC, NEUT, LYMP, MONO, EOS, BASO, and their percent had no significant difference between the year of trainee except BASO % indicated significant difference based on year of trainee P(0.042).A cohort study conducted from Arab origin show significant variations in

hematological variables like HCT and MCV can be evident over the course of an annual training cycle in this age group, the effect size is rarely large, except for MCHC. In some individual sports, such as cycling, running and swimming, declines in HGB and Hct concentrations have been documented with intensive training and competition activities in the adult athlete(63). But, in this study, there were significant variations in HCT because the result revealed in relation to plasma volume was corrected accordingly and significant variations in most variables may occur.Biochemical profiles and year training experience did not have a significant difference in this study.

Assessing the variation of mean hematological parameters between different sport discipline of trainees there were statistically significant difference for RBC, HGB, HCT, specially cycle (5.65±0.38 mean, P = 0.038) with basketball(5.15± 0.40 mean, P = 0.039) and football (5.20± 0.41 mean, P = 0.032) in which there P. value < 0.05. Another study, that was done in India, in the effect of training load of hematological parameters for the male cyclist in different phases shows there wasa statistically significant difference between HGB (p-value 0.000) in their study's (64). In this study WBC and their subset for males and females, there is no significant difference between them,except for EO % and BASO % their P.value was < 0.05. Regarding, sports discipline WBC and subset mean group statistically significant variation among different disciplines. Manly for jumping (4.32± 0.78 mean, P= 0.000) with football (6.36± 1.65 mean P= 0.000), running (5.94± 1.69 mean, P= 0.005), Table tens (6.38 ± 1.68 P= 0.021), Taekwondo (6.06±1.49 mean, P= 0.020) and cycle (7.02± 2.41 mean, P= 0.042) their P. value were <0.05. For NEUT %, Jumping35.16± 8.59 mean, P= 0.009) with box (51.57± 5.68 mean, P= 0.009), football (48.97± 11.11 mean, P= 0.021) and running (48.01± 10.40 mean. P= 0.037), MONO % jumping (10.90± 2.03 mean P= 0.019) with volleyball (7.53± 1.96 mean, P= 0.019) and cycle(7.13± 1.65 mean, P= 0.009), and EOS % basketball(2.38± 1.25 mean, P = 0.021) with football(4.00 ± 3.26 mean, P= 0.012), cycle(6.72± 3.62 mean, P= 0.023), and cycle(6.72± 3.62 mean, P= 0.039) with running(2.70 ±1.83 mean, P= 0.39), and table tense(2.52± 1.26 mean, P= 0.030). a study conducted in Warsaw Poland also reviled there was no significant difference in total WBC count in both gender, but there was a significant difference in total WBC and their subset among different sports types(65). Which was, similar to our study.

In many studies, there was neutropenia in most athletes in different sport types(66),(67). in this study, the occurrence of neutropenia was vivid in jumping (35.16±8.59 mean, P=0.009) this is maybe due to the margination of neutrophils to damaged tissues(68).

Assessing the variation of mean biochemical parameters between different sport disciplines of trainees there wasa statistically significant difference for Glucose, Urea, Creatinine, GOT, Cholesterol, TG except for GPT. Concerning their gender, there were significant differences between males and femalesfor Urea, creatinine, and cholesterol in which females result greater than males,. However, in most selected biochemical profiles the result of females was higher than males. A study which was done in Poland to assess metabolic response to aerobic effort in athletes revealed there was a statistically significant difference between male and female for AST and ALT in their studies in which female AST and ALT activity was statistically significant(69). According to this study, there was a statistically significant difference in ALT betweens females and males. Selected biochemical parameters for statistically significant group means difference between sport types were mainly for glucose basket ball(105.14± 12.58 mean, P= 0.001) with football(90.31± 9.36 mean, P= 0.001), running(91.93±9.92 mean, P= 0.007) , table tense(91.07± 7.92 mean, P= 0.011) and taekwondo(86.82± 5.96 mean, P= 0.000), jumping(108.89± 9.13 mean, P= 0.040) with box(83.50± 15.63 mean, P= 0.040) and running(91.93±9.92 mean, P= 0.007), Urea football(28.80(91.93±9.92 mean, P= 0.007) 9.96 mean P= 0.01) with taekwondo(20.82 ±5.54 mean, P= 0.001), Creatinine taekwondo(0.60± 0.09 mean, P= 0.009) with basket ball(0.79±0.19 mean, P=0.009), and box(0.81±0.11 mean, P=0.002), and football(0.86±0.15 mean P= 0.004) with running(0.73± 0.16 mean, P= 0.004), GOT running(23.50 ± 6.62 mean, P= 0.017) with football(28.26±7.43 mean P= 0.017) and jumping(30.67±3.04 mean, P= 0.001) with taekwondo(20.47±6.74 mean, P= 0.001), Cholesterol taekwondo(80.65±14.24 mean, P=0.008) with, basket ball(114.81±33.82 mean P= 0.008), running(114.21±30.64 mean, P= 0.000) and volleyball113.74± 20.56mean P= 0.000, triglyceride basketball(91.43±29.64 mean P= 0.001) with taekwondo(55.65±14.01 mean P= 0.001). A study conducted in the biochemical profile of the Serbian youth national soccer team shows there wasa statistically significant difference for creatinine, P 0.0001, and ALT(GPT), P 0.0056(57). But, in this study ALT(GPT) was not statistically significant between groups and also, between different sports types.

7. Strength and limitation of the study

7.1 strength

All test was done by the same equipments

7.2 limitation

Sample collection takes three mounths

Shortage of similar study on the a Ethiopian athletes

8. Conclusion and Recommendations

In this study hematological and selected biochemical profile determined for Ethiopian youth sports academy based Mean ± SD for as general and for both gender in specific. Based on gender-based determination there was a slight increase in hematological and biochemical profiles for females in parameters of MCV, MCHC, PLT, NEUT, NEUT%, and cholesterol, respectively.

There was no significant association between years of training experience and hematological and selected biochemical variation for both parameters except for HCT and BASO from hematological parameters. In assessing variation between hematological and selected biochemical profiles between different sport disciplines there was a statistically significant difference between group means and between each sport discipline for most of them. Few statistically not significant differences for hematological and biochemical parameters for PLT, MCH, LYMP, MONO, BASO, BASO%, and GPT for both were observed.

Recommendation

- From this study, one can understand further in-depth study for each sport type needed.
- At most, it will be better if the reference range is determined for the Ethiopian youth sports academy.
- It will be useful if clinicians use the determined hematological parameters as a reference until the discipline-specific reference range is stated for them.

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9. Annex

AnnexI. Participant information sheet

Addis Ababa University, CollegeofHealth Sciences, Department of Medical Laboratory Sciences
E-mail: SMLT@ethionet.et
Tel. +251112-75-51-70

Title of the study: assessment of selected hematological and biochemical parameters profile of trainers at the EYSA in Addis Ababa Ethiopia.

Introduction

This information sheet and consent form are prepared by the principal investigator GutemaJebessa to clarify the study that you are asked to take part in. If there is any lack of clarity,whether you decide to participate or not you can ask freely.

What is expected from the study participant?

You will be requested to give 10 ml of the blood sample. Blood will be collected from your arm using a sterile syringe. If you are agreeing to give a blood sample then you will be also asked to answer for a questionnaire which will take about 10 minutes.

Confidentiality

Any information that we collect about you during this study will be kept confidential. Information about your identity will be put away after recording your file and kept in a secure place. Only the principal investigator will be able to link your identity with the code number.

Benefit

There is no direct benefit that you will obtain from this study, but indirectly the result of the study will be beneficial to put a new strategy for assessment of the selected hematological and biochemical profile of the trainees. Hence you are indirectly benefiting other trainees and the society in this respect.

The risk of this study

You may feel a mild pain while blood samples are collected except that there will be no risk.

Participation and right to refuse from the study

We are asking you and others to voluntarily participate in this study. Since participation in this study is entirely voluntary, you can refuse to participate in this research at any time. And your

refusal to participate in this study will not affect any of the benefits you are supposed to get from the sports academy.

Please direct any questions or problems you may encounter during this study to the principal investigator.

GutemaJebessa
Department of Medical Laboratory Sciences Collegeof Health Sciences Addis Ababa University
Phone +251953993615
E-mail-ID gutemajebe@gmail.com
Dr Aster Tsegaye
+251 911 696085
tsegayeaster@yahoo.com

AnnexII. Amharic version participant information

አዲስ አበባ ዩኒቨርሲቲ ጤና ሳይንስ ኮላጅ የህክምና ላባራቶሪ ት/ክፍል

መግቢያ

የተረናቱርእስ

በኢትዮጵያወጣቶችየስፖርትአካዳሚለሚሰለጥኑሰልጣኞችየሄማቶሎጂእናየባዮኬሚካልፕሮፋይልም ልከታ.

መግቢያ

ይህ መግለጫና የጥናቱ ማረጋገጫ ቅፅ የተዘጋጀዉ በዋናዉ ተመራማሪ ሲሆን በጥናቱ ላይ ለመሳተፍ ከመወሰኖ በፍት ግልጽ ያልሆነልዎትን መጠቅ ይችላሉ፡፡

ከጥናቱ ተሳታፍዎች ምን ይጠበቃል

የጥናቱ ተሳታፊ እደመሆኖ 10 ሚ.ሊ ሊትር የሚሆን ደም እዲሰጡ ይጠየቃሉ፡፡ ደም ከክንዶ በአዲስ መርፊ እና ሲርንጂ የሚቀዳ ይሆናል፡፡ ናሙናዉን መስጠት ፍቃደኛ ከሆኑ ለሚቀርብሎዎ ጥያቂዎች መልስ እዲሰጡ እደገና ይጠየቃሉ፡፡ ይህም 10 ደቂቃያህል ይወስዳል፡፡

የጥናቱ መረጃ ሚስጥራዊነተ

በጥናቱ ዉስጥ የተሰበሰብ ማናቸዉም ግላዊ መረጃዎች ሚስጥራዊነታቸዉ የተጠበቀ ይሆናል፡፡ ከማንነቶ ጋር በቀጥታ ተያያዥነት ያላቸዉ መረጃዎች በሙሉ በዋናዉ ተመራማሪ ሚስጥራዊ በሆነ የመረጃ ጥንቅር ዘዴ ከተቀየሩ በኃላ ብቻ ለምርምር ሂደቱ የሚዉሉ ይሆናሉ፡፡ ዋናዉ ተመራማሪ ብቻ የርስዎን የመረጃ ጥንቅር ዘዴ ይጠቀማል፡፡

የጥናቱ ጠቀሜታ

ከጥናቱ በቀጥታ የሚገኙ ጥቅም የለም፡፡ ነገር ግን በተዘዋዋሪ የጥናቱ ዉጤት በአካዳሚዉ ለሚገኙት የስፖርት ሰልጣኞች የሄማቶሎጂ እና የባዮኬሚካል ፕሮፋይል ለመመልከት ያገለግላል፡፡ በተጨማሪም እርሶ በተዘዋዋሪ ሌሎችን ስፖርተኞችን እና የስፖርቱን ባለድርሻ አካላት እየረዱ ነዉ ፡፡

የጥናቱ ችግር

ከክንድ ወላይ ደም በሚወሰድበት ወቅት መጠነኛ የሆነ ህመም ሊሰማዎትይችላል ከዚህ ዉጭ ምንም ችግር በተሳታፊዎች ላይ አይከሰትም ።

በጥናቱ ላይ የመሳተፍ እና ያለመሳተፍ መብት

በዚህ ጥናት ላይ መሳተፍ በሙሉ ፍቃደኝነት ላይ የተመሰረተ ነዉ ስለሆነም በጥናቱ እዲሳተፉ ፍቃደኝነትዎን እንጠይቃለን። ይህ ጥናት በፍቃደኝነት ላይ የተመሰረተ እደመሆኑ መጠን በማንኛዉም ወቅት በፍቃድዎ ከጥናቱ መዉጣት ይችላሉ።

እባክዎ ይህን ጥናት በተመለከተ ወይም ከዚህ ጋር በተዛመደ መልኩ ስለሚያጋጥሙ ማንኛዉም አይነት ችግር ወይም ጥያቄ ካለዎት በሚከተለዉ አድራሻ መግለጥ ይችላሉ።

ጉተማ ጀቤሳ

የህክምና ላብራቶሪ ሳይንስ ት/ክፍል የጤና ሳይንስ ኮሌጅ አዲስ አባባ ዩኒቨርሲቲ

ስልክ 251953993615

ኢሚል- gutemajebe@gmail.com

ዶ/ር አስቴር ፀጋዬ

+251 911 696085

tsegayeaster@yahoo.com

Annex III. Assent form for children age 12-17 years

Code no ……

Information about the study has been explained to me by the investigator. I have understood that the objective of this study is to assess the selected hematological and biochemical profile of the trainer at the EYSA. A small amount of blood that I will give will not hurt my health. It has also been explained to me that I have the right to stop participation at any time in between and there is nothing I will lose if I refuse to participate.

I voluntarily assent that I would participate in this study provided my couch to give their consent.

Participant couch

Name ……

Signature ……..

Date ……..

Participant

Signature ……..

Date ……..

Investigator

Signature ……

Date …….

Annex IV. ከ12-17 ዓመት ለሆኑ ህፃናት የስምምነት ቅፅ

ቅጽ መለያ ቁጥር.....

ጥናቱን በሚያካሂዱት ሰዎች ስለ ጥናቱ በቂ መረጃ ተሰጥቶኛል፡፡ የዚህ ጥናት አላማም በኢትዮጵያ ወጣቶች ስፖርት አካዳሚ ለሚሰለጥኑ ስፖርተኛ ሜማቶሎጂ እና ባዮኬሚካል ፕሮፋይል ለመመልከት ነዉ፡፡

ከኔ የሚወሰደዉ ደምም በኔ ላይ ምንም አይነት የጤና ጉዳት የማያስከትል መሆኑን ተረድቻለሁ፡፡ እዲሁም በጥናቱ ለመሳተፍ ፍቃደኛ ካልሆኑኩ በጥናቱ ለመሳተፍ እደማልገደድ ነገር ግን በዚህ ጥናት በመሳተፋ ለወደፍት በዚህ ዙርያ ለሚሰሩ ሰዎች መሰረት የሚሆኑ መረጃዎችን መስጠት እደምችል ተረድቻለሁ፡፡ በመሁኑም በዚህ ጥናት ላይ ለመሳተፍ የተስማማሁ መሆኔን በፊርማ የአረጋግጫለሁ፡፡

አሰልጣኘ እስከ ፈቀደልኝ ድርሰ በዚህ ጥናት ለመሳተፍ ተስማምቻለሁ፡፡

የተሳታፊ አሰልጣኝ

ስም.....

ፊርማ.....

ቀን.....

የተሳታፊ

ፊርማ.....

ቀን.....

የጥናት አድራጊዉ

ፊርማ.....

ቀን.....

Annex V. Questionnaire

Addis Ababa University, Collegeof Health Sciences, Department of Medical Laboratory Sciences

For data collectors: for each question please circle the answer or write in the black space don't worry if you make a mistake; simply cross out a mistake and circle the correct one.

Code No

1. Sports discipline (field of sport) ……..
   If you are Runner A, short
   B, middle
   C, long
2. Age……..
3. Sex
   A. Male
   B. Female
4. Weight _____
5. Height _____
6. How long is since you joined sport academy
   A. Years_____
   B. Months_____
7. How many years have you been on training: _____
8. Where do you come from: specify the town_____
   A. urban
   B. rural
9. For how many years you live there?_____

For female participant

Are you currently on the menstruationcycle?

a. yes
b. no

Annex VI.Amharic version questionnaire

አዲስ አባባ ዩኒቨርሲቲ ጤና ሳይንስ ኮሌጅ የህክምና ላብራቶሪ ት/ክፍል

ለመረጃ ሰብሳቢዎች ጥያቄዉን ከጠየቃችሁ በኃላ መልሱን ከተሰጡት አማራጮች አድን ያክብቡት ወይም በባዶ ቦታ ላይ ይጻፉት ምንአልባት ስህተት ቢፈጠር በመሰረዝ በምትኩ ትክክለኛዉን ምላሽ ያስፍሩ።።

የጥናትቁጥር፤_____

1. **የሚሰለጥኑት የስፖርት አይነት፤** _____

   መልሶ ሩዋጭ ከሆነ ሀ. አጭር ርቀት

   ለ. መካከለኛ ርቀት

   ሐ. ረጂም ርቀት

2. **እድሜ፤**_____
3. **ጾታ**

   ሀ. ወድ

   ለ. ሴት

4. **የሰዉነት ክብደት (ኪ..ግ)፤**_____
5. **ርዝመት(ሲ..ሜ)፤**_____
6. **በስፖርት አካዳሚ ዉስጥ ምን ያህል ቆይተዋል ?**

   ሀ. ዓመት_____

   ለ. ወር_____

7. **ለምን ያህል ግዜ ስፖርት ሰርተዋል?**_____
8. **በሳምነት ምን ያህል ቀን ስፖርት ይሰራሉ?**_____
9. **በቀን ለስት ስአት ያህል ስፖርት ይሰራሉ?**_____
10. **የመጡበት አከባቢ ቦታዉን ይፃፉት?** _____

    ሀ. ከተማ

    ለ. ገጠር

ለሴቶችብቻ

በአሁኑ ስአት የወር አበባ ላይ ነሽ?

ሀ. አይደለሁም

ለ. ነኝ

Annex VII. Nutritional habit

How often do you eat the following food? (put a "√ " mark)							
No.	**Food type**	**A Once/day**	**B More than Once/ day**	**C 2-3 times/week**	**D Occasionally (e.g holidays, special ceremonies)**	**E Never**	**Remarks**
1.	Roots and Tuber (Potato, sweet potato, Enset, Cassava)						
2.	Legumes (Beans, peas, chicken pea, etc)						
3.	Cereals (Corn, Teff, Wheat, sorghum, etc)						
4.	Vegetables (Tomato, cabbage, etc)						
5.	Fruits (Orange, banana, etc)						
6.	Meat (including poultry, fish, etc)						
7.	Milk and Milk products (Butter, yogurt, cheese, etc)						
8.	Egg						
9.	Tea and/or coffee						

Annex VIIIAmharic version questionnaire አመጋገብ

የሚከተሉትንየምግብዓይነቶችምንያህልጊዜይመገቧቸዋል ? (“√ “ ይህንምልክትያስቀምጡ)							
ተ/ቁ	የምግብዓይነት	1 በቀንአን ድጊዜ	2 በቀንከአን ድጊዜበላይ	3 በሳምንትከ 2 እስከ 3 ጊዜ	4 አልፎአልፎ (ለምሳሌ፣ለበዓል፣ልዩዝግጅቶ ችሲኖሩ)	5 ተጠቅ ሜአላ ውቅም	ማብራሪያ
1.	ሥራሥር (ድንች፣ስኳርድንች፣እንስት፣ካሳቫወዘተ)						
2.	አባዝርት (Legumes፡ባቄል፣አተር፣ሽንብራወዘተ)						
3.	ጥራጥሬ (በቆሎ፣ጤፍ፣ስንዴ፣ማሽላ)						
4.	አትክልት (ቲማቲም፣ጎመን፣ወዘተ)						
5.	ፍራፍሬ (ብርትኳን፣ሙዝ፣ወዘተ)						
6.	ሥጋ (የዶሮ፣የአሳንጨምሮ)						
7.	ወተትና የወተት ተዋፅዎ (እርጎ፣ቅቤ፣አይብ፣ወዘተ)						
8.	እንቁላል						
9.	ሻይ እና/ወይም ቡና						

Annex IX. Protocol for blood collection, handling, and transportation

Purpose: correctly collected whole blood sample is important to produce a quality and accurate results in the medical laboratory room.

Principle: The EDTA process forms an insoluble calcium salt that prevents coagulation. EDTA is the most commonly used anticoagulant in hematology for tests such as the CBC. And serum separator tube or SST, are used in medical clinical chemistry tests requiring blood serum it containsa gel that separates blood cells from serum, as well as particles to cause blood to clot quickly.

Materials Supplies;

EDTA: Lavender top

SST

Needle

Syringe (10 ml)

A tourniquet

Alcohol prep pads

Non-alcohol-based cleanser

Gauze pads, adhesive bandages, or tape (including hypoallergenic adhesives)

Gloves

Safety box/Sharps container

Personal protective equipment (lab coat)

Sample volume: 10ml

Special Safety Precautions:

Use standard precautions as outlined in the Bloodborne Pathogen Plan.

Place sharps containers close to the collection site.

Wear disposable gloves at all times during the procedure

Wash your hands before you put on your gloves and after you remove your gloves.

Change gloves between each study participant.

The procedure of blood collection

1. Clearing all laboratory bench and preparing all necessary laboratory material and reagents
2. Identify the participant
3. Inform the participant about the procedure
4. Assemble necessary supplies and select appropriate tubes according to test requests.
5. Make the participant in a good position
6. Visually inspect both arms. Choose the arm that has not been repeatedly used for vein punctures and one that is free of bruises, abrasions, and sites of infection.
7. Applying the tourniquet
8. Put on gloves
9. Disinfect /cleanse the vane puncture site.
10. Vane puncture procedure, follow procedure is recommended:

    Gather the needle and syringe.

    Hold the patient's arm firmly distal to the intended puncture site.

    Prepare the donor/patient by informing him or her that the vane puncture is about to occur. Cleanse the skin area of the vane by 70% alcohol with the bevel up, puncture the vein with the needle at an angle of insertion of 30^{o}or less
11. Use the correct order of draw.
12. Release and remove the tourniquet.
13. Add dry cotton pad on the site of the punctured vane
14. Remove the needle
15. Apply pressure to the site, making sure bleeding has stopped, and add wound plastic bandage
16. Label the test tube.
17. Clean up supplies from the work area, remove gloves, and wash hands.

Sample Handling:

In order to prevent possible exogenous contamination, concentration change due to evaporation and spillage a blood spacemen need to keep covered.

Labeling

- First name and last name of the participants
- Identification code which is similar to the questioner sheet

- time, date, month and year of blood collection
- Name of the phlebotomist

Temperature: at room temperature

Storage of the sample: room temperature

Sample retention: 24 hrs.

Annex X.Protocol for Hematology analyzer Operation

PRINCIPLE:

The Sysmex are multi-parameter quantitative automated hematology analyzer for in vitro diagnostic use in determining whole blood diagnostic parameters. Examination of the numerical and/or morphological findings of the complete blood count by the physician are useful in the diagnosis of disease states such as anemias, leukemias, allergic reactions, viral, bacterial, and parasitic infections.

The devices perform hematology analyses based on the hydrodynamically focused impedance measurement, the flow cytometry method (using a semiconductor laser), and the SLS-hemoglobin method.

The device counts and sizes red blood cells (RBC) and platelets (PLT) using hydrodynamic impedance counting (sheath flow DC method). At the same time, the hematocrit (HCT) is measured as a ratio of the total RBC volume to whole blood via the RBC pulse height detection method.

CLINICAL SIGNIFICANCE:

Examination of the numerical and/or morphological findings of the complete blood count by the physician are useful in the diagnosis of disease states such as anemias, leukemia’s, allergic reactions, viral, bacterial, and parasitic infections.

SPECIMEN:

Required specimen; Whole blood anticoagulated with a potassium EDTA is preferred.

Specimen volumes required A minimum of 1 mL of whole blood is required for sampler analysis.

Stored Specimen Stability 4-8oC within 6 hours of collection

Precision Check

Perform routine maintenance on the analyzer and perform a background count to ensure counts are within acceptable limits.

AnnexXI. Protocol for chemistry analyzer

Serum creatinine

- Principle

Serum creatinine reacts with picric acid in alkaline solution yielding a yellow-orange colored compound. The intensity of the color is directly proportional to the creatinine concentration present in the sample.

Urea

- Principle

Urea is hydrolyzed in the presence of water and urease to produce ammonia and carbon dioxide. The ammonia from this reaction combines with 2-oxoglutarate and NADH in the presence of glutamate-dehydrogenase (GLDH) to yield glutamate and NAD+. The test has been optimized so that the GLDH is the rate-limiting enzyme. The decrease in absorbance is proportional to the urea concentration within the given time intervals. As the kinetics is very fast this test is preferably designed for analyzer application.

AST (GOT)

- Principle

AST catalyzes the transamination of L-aspartate to 2-oxoglutarate forming L-glutamate and Oxaloacetate. The oxaloacetate formed is reduced to malate by malate dehydrogenase (MDH) with simultaneous oxidation of reduced NADH to NAD. The change in absorbance with time is due to the conversion of NADH to NAD which is directly proportional to AST activity. The measurement is taken by a spectrophotometer at 340nm using continuous kinetic produced.

ALT(GPT)

- Principle

Kinetic method for the determination of ALT activity according to the recommendations of the Expert Panel of the International Federation of Clinical Chemistry (IFCC).Withoutpyridoxalphosphate activation. ALT is measured by the reagent rate analysis by the coupled reaction with lactate dehydrogenase (LDH) to reduce NADH (measured at a wavelength of 340nm) to NAD+. The rate of decrease in absorbance at 340 nm due to NADH depletion is proportional to the ALT activity in the sample.

Triglyceride

- Principle

The triglycerides are determined after enzymatic hydrolysis with lipase. The indicator is quinoneimine formed from hydrogen peroxide, 4-amino-antiantipyrine, and 4-chlorophenol under the catalytic influence of peroxide, the color intensity is proportional to the concentration of triglyceride in the sample.

Cholesterol

- Principle

The cholesterol is determined after enzymatic hydrolysis and oxidation. The indicator quinoneimine is formed from hydrogen peroxide and4-aminophenazone in the presence of phenol and peroxide. The intensity of the red complex is proportional to the total cholesterol present in the sample

Glucose

- Principle

The glucose is determined after enzymatic oxidation in the presence of glucose oxidase. The formed hydrogen peroxide reacts under the catalysis of peroxidase with phenol and 4-amnophenazone to a red-violet quinoneimine dye as an indicator.

Declaration

I, the undersigned, declare that this M.Sc. thesis is my original work, has not been presented for a degree in this or any other university and that all sources of materials used for the thesis have been duly acknowledged Msc candidate: GutemaJebessa

Signature: _____

Date of submission: _____

This thesis has been submitted my advisors

Advisor: Aster Tsegaye (Msc,PhD)

Signature: _____

Date _____

Advisor Diresebachew Haile (Msc, PhD)

Signature: _____

Date _____

Advisor RahelAlemu (MSc)

Signature: _____

Date _____