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RESEARCH ARTICLE

ASSESSMENT OF PACKED CELL VOLUME AMONG STUDENTS OF FEDERAL COLLEGE OF VETERINARY AND MEDICAL LABORATORY TECHNOLOGY, VOM, PLATEAU STATE

Chidozie, V.N., Okwori, A.E.J., Oluwatayo, B.O., Adekeye, A.M., Kinjir, H., Okeke, C., Abah, I.M. and
Salako Y

Department of Medical Laboratory Science, Federal College of Veterinary and Medical Laboratory Technology,
Vom, Plateau State, Nigeria, West Africa.

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Abstract

Packed cell volume (PCV) measures the proportion of red blood cells in a given whole blood. Usually the test is referred to as PCV if manual method is used in the determination but when automated machine is used in the determination it is referred to as the hematocrit. PCV is expressed as a percentage. It is a laboratory test to check for anaemia or polycythemia. Anaemia is defined as reduction in total red blood cells count while polycythaemia (erythrocytosis), an increase in total red cells count is a proliferative disorder of the red blood cells. The main function of red blood cells is to transport oxygen round the body. Oxygen is indispensable to life as it is needed for respiration and energy. In the human the normal range of PCV for adult males is 40%-50% while that for adult females is 36%-46%. This study was undertaken to assess the PCV of apparently healthy adults in our locality and to check if differences in regions of residence, lifestyle and genetics affect the normal ranges of PCV already established in the literatures from researches done in other regions and races. Reference ranges if established in each locality may better equip healthcare providers and avoid misdiagnosis as a result of using the data obtained from other region and race. The PCV was determined using the manual microhematocrit method. The sample size was 399 and 164 were males. The PCV range for the males is 42%-50% while that of the females is 36%-45%. This study has shown that there is no statistical significant difference between the reference ranges already established in literature and the ones estimated in this study for both males and females participants ($p > 0.05$). The PCV reference range already established can continue to be used in this locality as there is no statistical difference between the already established range and the range obtained in this study.

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Introduction:-

Packed cell volume also called the hematocrit is the volume of erythrocytes/red blood cells in whole blood, that is, the proportion of blood volume that is occupied by RBC. When a known volume of whole blood is centrifuged at a constant speed for a constant period of time the percentage of the total volume of whole blood occupied by the red

Corresponding Author:- Chidozie Vivian Nwatoka Chidozie

Address:- Department of Medical Laboratory Science, Federal College of Veterinary and Medical
Laboratory Technology, Vom, Plateau State, Nigeria, West Africa.

blood cells is referred to as the hematocrit (Ochei, and Kolhatkar, 2000). It is expressed either as a percentage or as a decimal fraction (e.g 41% or 0.41). PCV and hematocrit can be used interchangeably but the international Council for Standardisation in Hematology (ICSH) suggested that PCV be used when manual method is used while hematocrit is used when automated method is used (Dacie, and Lewis, 1994). The measurement depends on the number and size of red blood cells (Britton, 1963). PCV is a part of complete blood count / full blood count (CBC/FBC) requested by doctors alongside haemoglobin concentration, total red cells count, total white cells count, differential white blood cells count, red cells indices, total platelets count etc. The main function of red blood cells is to transfer oxygen from the lungs to body tissues so the result of PCV of a given individual can become a point of reference of his oxygen carrying capacity. PCV levels that are too low or too high can indicate a blood disorder, dehydration, over hydration, or other medical conditions. An abnormally low PCV may suggest anemia. Anemia can be defined as a decrease in the total amount of red blood cells. According to the World Health Organization (2011), anemia is a condition in which the number of red blood cells (RBCs), and consequently their oxygen-carrying capacity is insufficient to meet the body's physiologic needs. Anemia can be as a result of internal or external bleeding, micronutrients deficiencies, over hydration, underlying organ diseases and hemolysis. On the other hand abnormally high values of PCV may be due to severe dehydration, polycythemia (a myeloproliferative disorder with abnormal increase in blood cells), erythrocytosis (excessive red cells production), or hemochromatosis (an inherited iron metabolism disorder). An abnormally high hematocrit is a potentially life-threatening disorder which present with circulatory problems as blood may become too thick that it can block the micro vasculature (John, 2001). High hematocrit is also used as an indicator of excessive intake of erythropoietin which athletes use to enhance performance. The total red cell count which is a major factor in PCV value varies depending on the age and sex of an individual. The mean PCV values are higher in males than in females of the same age grades (Devine, 1967). Also the mean PCV values in males decrease as the age grades increase with the exception of males in the age grade of 18-24 years (Devine, 1967). Devine (1967) also found the mean PCV of females to rise with age with exception of women in the age grade of 55-64 years. PCV values in males ranges from 40-50% and in females 36-46% (Dacie and Lewis, 1994). Some other literatures have normal ranges as 40-54% for males and 37-47% for females (Wintrobe, 1962), 40-50% for males and 38-45% for females (Comrie, 2005), 42-54% for males and 38-46% for females (John, 2001), 40-52% for males and 37-47% for females (Ochei and Kolhatkar, 2000). Other factors apart from age and sex can also affect the reference values of PCV, such as test methods (Linne, 1999). Many methods are available for PCV estimation and these include manual method using centrifugation (e.g microhematocrit method) and automated method using automatic cell count analyser. Manual method is the reference method recommended by ICSH (1980). Dehydration can also affect PCV values. Hematocrit is measured using fresh whole blood and is dependent on plasma volume. Plasma is the liquid portion of blood and is composed mainly of water thus factors such as dehydration as well as over hydration can affect the PCV test results (Walker et al. 1990). High altitude affect PCV values because of the lower oxygen levels at high altitude which stimulate erythropoietin production leading to increased red blood cells or hematocrit. Adaptation takes place in individuals living in high altitude (Zubieta-Calleja et al., 2007).

Pregnancy is also a factor that affects PCV because in normal pregnancies, blood volume increases as a result of increase in plasma volume. This results to hemodilution and hence lower PCV (Fidelma, 2016). Moreover it is an established fact that diets and dietary deficiency affect red blood cells production and hence PCV values. The deficiencies of micronutrients like vitamin B12 or iron or problem in digesting or absorbing them can affect the quality and quantity of red blood cells production (Dacie and Lewis, 2001).

From the foregoing, it may be seen that lifestyle and location can affect PCV values of healthy individuals and hence the need to establish a local normal range of this important parameter (PCV) for better diagnosis and treatment.

Materials:-

Mapienfield microhematocrit capillary tubes (74mm length, 1.1 internal diameter), Hawksley hematospin 1400 microhematocrit centrifuge and reader, candles for flame, cotton wool.

Method:-

The microhematocrit manual method as described by Ochei and Kolhatkar (2000) with a slight modification was used in this study as follows.

2mls of blood was collected and mixed gently in the appropriate EDTA anticoagulant bottle. 2/3 of the microhaematocrit tube was filled with the freshly collected and well mixed blood. Using a clean and dry cotton wool, the outside of the capillary tube was wiped clean and one end sealed using a candle flame. Precaution was taken to avoid air bubbles and also to avoid burning the blood.

The tube was placed into a calibrated microhaematocrit centrifuge with the sealed end touching the rubber ring and the open end facing the centre of the machine.

The lid was placed firmly over the centrifuge head and covered properly. The timer is set at 5 minutes at 15 000g.

The tube was removed and read within two minutes after the centrifuge had stopped.

Using Hawksley's microhaematocrit reader, the haematocrit was determined, by measuring the height of the packed red cells against the height of the total blood column.

The PCV result was recorded.

Results:-

Table 1: Showing the Mean, Standard deviation and range of the students' PCV Values.

Sex	Number	Mean PCV (%)	Standard Deviation	Range (%)
Male	164	46.51	±4.14	42 - 51
Females	235	40.56	±4.78	36 – 45
Total	399	----	----	----

Discussion:-

This work was carried out to assess the packed cell volume of apparently healthy students of the Federal College of Veterinary and Medical Laboratory Technology, Vom in Vwang District of Jos South Local Government Area of Plateau State.

A total number of three hundred and ninety nine samples were processed and the packed cell volume of each sample was determined by the microhematocrit method in Hematology Laboratory of the Federal College of veterinary and Medical Laboratory Technology, Vom.

Out of the samples processed one hundred and sixty four (164) subjects were males with a mean packed cell volume of 46.51% and a standard deviation of ±4.14. For the females a mean PCV of 40.56% with a standard deviation of ±4.78 was obtained (Table 1). As also documented in established literatures male subjects in this study had a higher mean packed cell volume when compared to the females subjects. Males tend to be more muscular and engage in more physical activities than females so nature may be compensating for the needed more oxygen. Adult females also menstruate periodically, regularly losing blood. This could also account for their lower packed cell volume values.

The values of mean packed cell volume obtained in this work, 46.5% in males and 40.6% in females compare favorably to 46.0% in males and 40.0% in females already established by Virgil and Ayalew (2000) in Antwerp, Belgium. Also in a survey in USA, Devine (1967) got a mean PCV of 46.5% for males and 42.4% for females. The normal range of packed cell volume obtained in this study is 42%-51% for males and 36%-45% for females. These compared well to the ranges obtained in literatures, 40%-50% for males and 36%-46% for females as recorded by Dacie and Lewis (1994) in the UK, and 40%-52% for males and 37%-47% for females by Ochei and Kolhatkar (2000) in the USA. In addition, John (2001) in his work got the normal range of packed cell volume of 42%-52% for males and 38%-46% for females in Canada. This study has shown that the reference values of PCV in the literatures although established using subjects living in other parts of the world may continue to be used in our locality since there is no statistical difference at $p > 0.05$ between the values obtained in this study and those already in the literatures for both the males and females subjects.

Conclusion:-

The result shows that apparently healthy students in Federal College of Veterinary and Medical Laboratory Technology, Vom have a PCV range of 42% to 50% for male subjects and for female subjects, 36% to 45%.

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