

CLINICOPATHOLOGICAL STUDY ON COMPARISON OF pH AND HAEMOGLOBIN OF BLOOD

Running Title: Comparison of blood pH and hemoglobin of blood.

ABSTRACT:

AIM: The study aims to compare the pH and hemoglobin of blood on different genders and different age groups.

INTRODUCTION: The full form of pH is the potential of hydrogen. pH is known as the negative logarithm of H⁺ ion concentration. The pH of any solution, including blood, is indicated on the pH scale. The value of pH ranges from 0 to 14. A pH of 7.0 is neutral. Blood is slightly basic, the normal pH level of blood is 7.35 to 7.45. Usually, the body maintains the pH of blood close to 7.40. Hemoglobin is a protein molecule that helps the RBC to transport oxygen. The term heme reforms to the iron-containing porphyrin. This iron-containing hemoglobin is responsible for the red color of the red blood cells.

MATERIALS AND METHODS: 15 blood samples were collected from the lab in Saveetha Dental College and Hospitals. The low sample size is one of the limitations. The pH value is measured using a multi reagent strip and hemoglobin level is measured using an automated counter machine and these values were plotted. The pH value was tabulated and the data were analyzed with SPSS version(23.0).

RESULTS: Mean hemoglobin value between different age groups, 21-30 years the value is 12.95g/dl, 31-40 years the value is 12.08g/dl, 41 to 50 years the value is 13.20g/dl and for age group more than 50 years the value is 14.05g/dl. Mean pH value on comparing with age, the value of pH is 7 for the age group of 21-30 years, 31-40 years is 7, 41 to 50 years is 7.04 and for more than 50 years is 7. Correlation analysis reveals no significant relationship between hemoglobin and pH with increasing age in both males and females.

CONCLUSION: The value of hemoglobin is increased among different age groups and the pH level remains the same and on comparing with gender the hemoglobin level increases with age group and pH remains the same.

KEYWORDS:Haemoglobin , acid base balance, blood, red cells

INTRODUCTION:

The dental disorder is due to the destructive imbalance in the oral cavity causing pain and loss of function. It is due to increased acidity in the mouth (1). Research has stated that the pH of mouth and blood must be balanced, with good circulation down to the cellular level which helps cellular waste products be released from the body. The full form of pH is the potential of hydrogen. pH is known as the negative logarithm of H^+ ion concentration (2). pH describes the concentration of the hydrogen ions in a solution and it is the indicator of acidity or basicity of the solution.

The pH of any solution, including blood, is indicated on the pH scale. The value of pH ranges from 0 to 14. A pH of 7.0 is neutral. Blood is slightly basic, the normal pH level of blood is 7.35 to 7.45. Usually, the body maintains the pH of blood close to 7.40 (3). There are two types of abnormalities in acid-base balance are acidosis and alkalosis. In acidosis the blood has too much acid (or too little base), resulting in a decrease in blood pH. In alkalosis the blood has too much base (or too little acid), increasing blood pH (4). Acidosis and alkalosis are categorized depending on their primary cause as metabolic and respiratory. Metabolic acidosis and metabolic alkalosis are caused by an imbalance in the production of acids or bases and their excretion by the kidneys (5).

Respiratory acidosis and respiratory alkalosis are due to changes in carbon dioxide exhalation caused by lung or breathing disorders. The body uses different mechanisms to control the blood's acid-base balance (6). These mechanisms involve the lungs, kidneys, buffer systems. Acidic food is not only the main cause of low pH in the mouth. Xerostomia or gastroesophageal reflux diseases that cause an increase in acidic level in the oral cavity. Bacteria in the mouth create acids after eating through the oxidation of sugar and food particles in the mouth (7).

Tooth decay occurs due to a fall in pH below 5.5. Bacterial plaques are also involved in causing dental caries(8,9).

Red blood cells are biconcave disc-shaped cells produced from bone marrow. It contains proteins that transport oxygen from the lungs to all the parts of the body(10)The normal red blood cell count for a male is 4.7 - 6.1 cells per microlitre and for females is 4.2 - 5.4 cells per microlitre Average lifespan of RBC is about 120 days. The decrease in RBC count results in anemia. An increase in RBC count causes polycythemia(11). Hemoglobin is a protein molecule that helps the RBC to transport oxygen. The term heme reforms to the iron-containing porphyrin. This iron-containing hemoglobin is responsible for the red color of the red blood cells. Hemoglobin also helps in maintaining the shape of the red blood cells. Hemoglobin is made up of four protein molecules (globulin chains). The normal adult human hemoglobin contains two alpha-globin chains and two beta-globin chains. In infants, hemoglobin is made up of two alpha-globin chains and two - gamma - globulin chains(12,13).

MATERIALS AND METHODS:

The 15 blood samples were collected from patients from the clinical lab, Saveetha Dental College, and Hospitals. The demographic details were collected from the laboratory records. And the collected samples were analyzed for hemoglobin value and pH value by using the automated colter counter method and reagent strip method respectively. The study population was selected randomly, and set with inclusion criteria of patients aged between 21-80 years, married, and with dental complaints. The persons who were not willing to give consent, people under 20 years, unmarried were not included. The pH and Hemoglobin value and the demographic details were entered in an excel sheet and exported to SPSS version 23 and analyzed statistically for correlation analysis, Chisquare analysis, and Descriptive statistics. Finally, results were presented by using bar charts and percentage tables.

RESULTS AND DISCUSSION

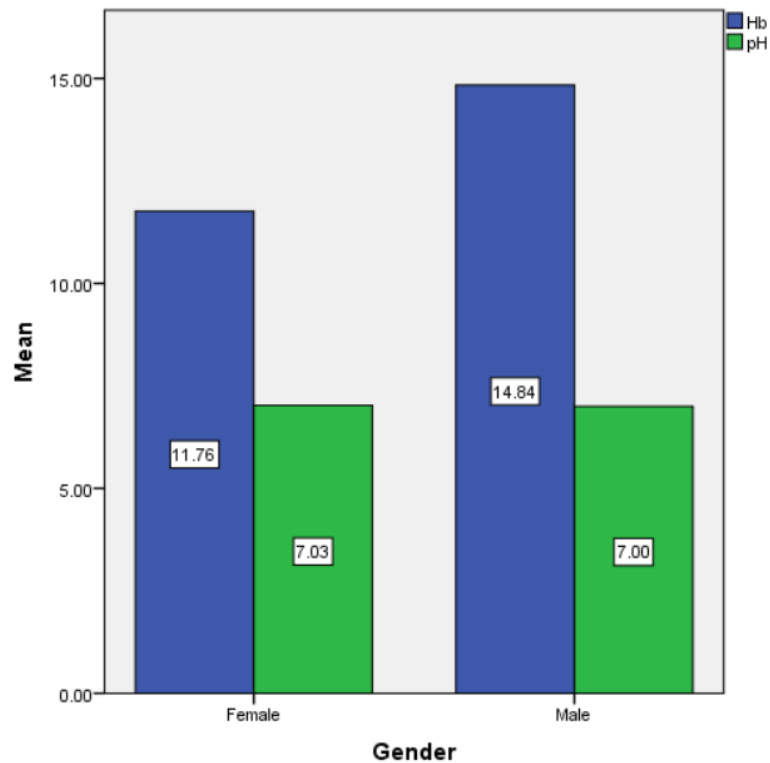


FIGURE 1: Bar graph representing the association between gender and mean hemoglobin and pH values. The X-axis represents gender and Y-axis represents the mean hemoglobin and pH values. In females blue color represents the hemoglobin level is 11.76 and green color represents pH level is 8.02. In males blue color represents the hemoglobin level is 14.84 and green color represents pH level is 7.

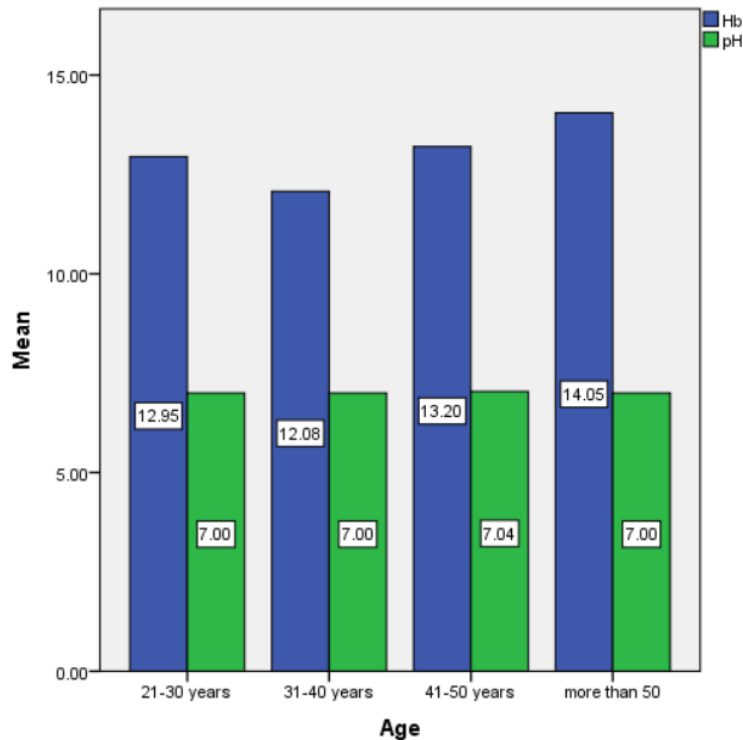


FIGURE 2: Bar graph representing the association between age with mean hemoglobin and pH level. The X-axis represents age and Y-axis represents the mean hemoglobin and pH values. Age group of 21-30 years, the level of hemoglobin was 12.95g/dl (blue) and level of pH was 7 (green). Age group of 31-40 years level of hemoglobin was 12.08g/dl (blue) and level of pH was 7 (green). Age group of 41-50 years level of hemoglobin was 13.45g/dl (blue) and level of pH was 7.04 (green). Age group of more than 50 years level of hemoglobin was 14.05g/dl (blue), the level of pH was 7 (green).

From the samples collected based on age two members (13%) belong to the age group of 21 to 30 years. Four members (27%) belong to the age group of 31 to 40 years. six members (40%) belong to the age group of 41 to 50. One member (7%) belongs to the age group of more than 50 years. From the samples collected based on gender eight (53%) of them were females and six (47%) were males. From the samples collected based on dental complications, seven members (46%) were affected due to caries tooth and two members (13%) were affected due to periodontitis, and

two members(13%) with denture problems, and one(7%) with trauma, and one(7%) with implant diagnosis.

In this study we have compared the mean hemoglobin value based on gender, for females, the value of hemoglobin is 11.76 g/dl and for males, the value is 14.84g/dl. The bar chart shows that males have higher hemoglobin levels than females. Men and women have different mean hemoglobin levels in health in venous blood -women have mean levels approximately 12% lower than men(14). When compared to the mean pH value based on gender, for females, the value of pH is 7.03 and for males, the value is 7. As shown in Figure 1, the females have higher pH than males. Several studies have generally described the existence of differences in skin surface pH according to gender, age, and ethnicity, but these studies have reported inconsistent results, depending on anatomical sites, methods, and time of measurement. Overall, it could be summarized that female sex, younger age, and black skin have a lower skin pH compared to the male sex, older age, and white skin. (15)

In this study we have compared the mean hemoglobin value between different age groups,21-30 years the value is 12.95g/dl and between 31-40 years the value is 12.08g/dl and between 41 to 50 years the value is 13.20g/dl and for age group more than 50 years the value is 14.05g/dl. Figure 2 shows that the hemoglobin level is increasing along with age but the mode of increasing is not significant. The correlation analysis showed that there is no significant relationship between age and hemoglobin after 20 years in both males and females. When compared to children and adults there is a significant relation identified and proved in the previous study that the younger population has a higher hemoglobin level than the older population. (16,17)

In this study we have compared the mean pH value on comparing with age, the value of pH is 7 for the age group of 21-30 years and the value for 31-40 years is 7 and the value for 41 to 50 years is 7.04 and the value for age more than 50 years is 7. Figure 2 shows that there is no significant increase in pH with an increase in age. Based on another article the elderly are more prone to develop acid-base disturbances than young, with age, the kidney undergoes structural and functional changes that limit the adaptive mechanisms responsible for maintaining acid-base homeostasis in response to dietary and environmental changes(18). Our team has extensive

knowledge and research experience that has translate into high quality publications (19).(20–33)
,(34–38)

The limitations of this study were, not considering the sample size, association with other systemic illness which affects the pH and Hemoglobin. Further studies can be done with more sample size and considering the systemic disorders in the future.

CONCLUSION:

From this article we conclude that in comparison with gender, males have a higher hemoglobin level when compared to females and pH is almost the same and on comparison with age. The hemoglobin level is slightly higher in the older population than in young adults and the pH level remains the same for all age groups.

REFERENCE:

1. Boyd LD, Mallonee LF, Wyche CJ, Halaris JF. Wilkins' Clinical Practice of the Dental Hygienist. Jones & Bartlett Learning; 2020. 1170 p.
2. Zandona AF, Longbottom C. Detection and Assessment of Dental Caries: A Clinical Guide. Springer Nature; 2019. 249 p.
3. Sasaki K, Suzuki O, Takahashi N. Interface Oral Health Science 2016: Innovative Research on Biosis–Abiosis Intelligent Interface. Springer; 2016. 277 p.
4. Bovonsantijid Y. Microbial Infections and Elevated PGE2 as Risk Indicators of Adult Periodontitis: A Dissertation Submitted in Partial Fulfillment ... for the Degree of Doctor of Public Health (Oral Epidemiology) .. 1997. 408 p.
5. Malamud D, Tabak LA. Saliva as a Diagnostic Fluid. 1993. 348 p.
6. Jensen WB. The Lewis Acid-base Concepts: An Overview. Krieger Publishing Company; 1979. 364 p.
7. Fejerskov O, Kidd E. Dental Caries: The Disease and Its Clinical Management. John Wiley & Sons; 2009. 640 p.
8. Harsha L, Brundha MP. Prevalence of Dental Developmental Anomalies among Men and

Women and its Psychological Effect in a Given Population. *Journal of Pharmaceutical Sciences and Research*; Cuddalore. 2017 Jun 20;9(6):869–73.

9. Timothy CN, Samyuktha PS, Brundha MP. Dental pulp Stem Cells in Regenerative Medicine--A Literature Review. *Research Journal of Pharmacy and Technology*. 2019;12(8):4052–6.
10. Ingram VM. Gene mutations in human haemoglobin: the chemical difference between normal and sickle cell haemoglobin. *Nature*. 1957 Aug 17;180(4581):326–8.
11. Malik P, Tisdale J. *Gene and Cell Therapies for Beta-Globinopathies*. Springer; 2017. 248 p.
12. Imai K, Morimoto H, Kotani M, Shibata S, Miyaji T. Studies on the function of abnormal hemoglobins. II. Oxygen equilibrium of abnormal hemoglobins: Shimonoseki, Ube II, Hikari, Gifu, and Agenogi. *Biochim Biophys Acta*. 1970 Feb 17;200(2):197–202.
13. Brundha MP, Pathmashri VP, Sundari S. Quantitative Changes of Red Blood cells in Cancer Patients under Palliative Radiotherapy-A Retrospective Study. *Research Journal of Pharmacy and Technology*. 2019;12(2):687–92.
14. Murphy WG. The sex difference in haemoglobin levels in adults - mechanisms, causes, and consequences. *Blood Rev*. 2014 Mar;28(2):41–7.
15. Choi EH. Gender, Age, and Ethnicity as Factors That Can Influence Skin pH. *Curr Probl Dermatol*. 2018 Aug 21;54:48–53.
16. Hawkins WW, Speck E, Leonard VG. Variation of the Hemoglobin Level with Age and Sex [Internet]. Vol. 9, *Blood*. 1954. p. 999–1007. Available from: <http://dx.doi.org/10.1182/blood.v9.10.999.999>
17. Brundha MP, Nivedhita G. Analysis of Papanicolaou stain on peripheral smear compared to Leishman's stain: A prospective study [Internet]. Vol. 4, *International Journal of Clinicopathological Correlation*. 2020. p. 40. Available from: http://dx.doi.org/10.4103/ijcpc.ijcpc_14_20
18. Tareen N, Zadshir A, Martins D, Nagami G, Levine B, Norris KC. Alterations in acid-base homeostasis with aging. *J Natl Med Assoc*. 2004 Jul;96(7):921–5; quiz 925–6.
19. Anita R, Paramasivam A, Priyadharsini JV, Chitra S. The m6A readers YTHDF1 and YTHDF3 aberrations associated with metastasis and predict poor prognosis in breast cancer patients. *Am J Cancer Res*. 2020 Aug 1;10(8):2546–54.
20. Jayaseelan VP, Paramasivam A. Emerging role of NET inhibitors in cardiovascular diseases. *Hypertens Res*. 2020 Dec;43(12):1459–61.
21. Sivakumar S, Smiline Girija AS, Vijayashree Priyadharsini J. Evaluation of the inhibitory effect of caffeic acid and gallic acid on tetR and tetM efflux pumps mediating tetracycline

- resistance in *Streptococcus* sp., using computational approach. *Journal of King Saud University - Science*. 2020 Jan 1;32(1):904–9.
22. Smiline Girija AS. Delineating the Immuno-Dominant Antigenic Vaccine Peptides Against *gacS*-Sensor Kinase in *Acinetobacter baumannii*: An in silico Investigational Approach. *Front Microbiol*. 2020 Sep 8;11:2078.
 23. Iswarya Jaisankar A, Smiline Girija AS, Gunasekaran S, Vijayashree Priyadharsini J. Molecular characterisation of *csgA* gene among ESBL strains of *A. baumannii* and targeting with essential oil compounds from *Azadirachta indica*. *Journal of King Saud University - Science*. 2020 Dec 1;32(8):3380–7.
 24. Girija ASS. Fox3+ CD25+ CD4+ T-regulatory cells may transform the nCoV's final destiny to CNS! *J Med Virol* [Internet]. 2020 Sep 3; Available from: <http://dx.doi.org/10.1002/jmv.26482>
 25. Jayaseelan VP, Ramesh A, Arumugam P. Breast cancer and DDT: putative interactions, associated gene alterations, and molecular pathways. *Environ Sci Pollut Res Int*. 2021 Jun;28(21):27162–73.
 26. Arumugam P, George R, Jayaseelan VP. Aberrations of m6A regulators are associated with tumorigenesis and metastasis in head and neck squamous cell carcinoma. *Arch Oral Biol*. 2021 Feb;122:105030.
 27. Kumar SP, Girija ASS, Priyadharsini JV. Targeting NM23-H1-mediated inhibition of tumour metastasis in viral hepatitis with bioactive compounds from *Ganoderma lucidum*: A computational study. *pharmaceutical-sciences* [Internet]. 2020;82(2). Available from: <https://www.ijpsonline.com/articles/targeting-nm23h1-mediated-inhibition-of-tumour-metastasis-in-viral-hepatitis-with-bioactive-compounds-from-ganoderma-lucidum-a-comp-3883.html>
 28. Girija SA, Priyadharsini JV, Paramasivam A. Prevalence of carbapenem-hydrolyzing OXA-type β -lactamases among *Acinetobacter baumannii* in patients with severe urinary tract infection. *Acta Microbiol Immunol Hung*. 2019 Dec 9;67(1):49–55.
 29. Priyadharsini JV, Paramasivam A. RNA editors: key regulators of viral response in cancer patients. *Epigenomics*. 2021 Feb;13(3):165–7.
 30. Mathivadani V, Smiline AS, Priyadharsini JV. Targeting Epstein-Barr virus nuclear antigen 1 (EBNA-1) with *Murraya koenigii* bio-compounds: An in-silico approach. *Acta Virol*. 2020;64(1):93–9.
 31. Girija As S, Priyadharsini J V, A P. Prevalence of Acb and non-Acb complex in elderly population with urinary tract infection (UTI). *Acta Clin Belg*. 2021 Apr;76(2):106–12.
 32. Anchana SR, Girija SAS, Gunasekaran S, Priyadharsini VJ. Detection of *csgA* gene in carbapenem-resistant *Acinetobacter baumannii* strains and targeting with *Ocimum sanctum* biocompounds. *Iran J Basic Med Sci*. 2021 May;24(5):690–8.

33. Girija ASS, Shoba G, Priyadharsini JV. Accessing the T-Cell and B-Cell Immuno-Dominant Peptides from *A.baumannii* Biofilm Associated Protein (bap) as Vaccine Candidates: A Computational Approach. *Int J Pept Res Ther*. 2021 Mar 1;27(1):37–45.
34. Arvind P TR, Jain RK. Skeletally anchored forsus fatigue resistant device for correction of Class II malocclusions-A systematic review and meta-analysis. *Orthod Craniofac Res*. 2021 Feb;24(1):52–61.
35. Venugopal A, Vaid N, Bowman SJ. Outstanding, yet redundant? After all, you may be another Choluteca Bridge! *Semin Orthod*. 2021 Mar 1;27(1):53–6.
36. Ramadurai N, Gurunathan D, Samuel AV, Subramanian E, Rodrigues SJL. Effectiveness of 2% Articaine as an anesthetic agent in children: randomized controlled trial. *Clin Oral Investig*. 2019 Sep;23(9):3543–50.
37. Varghese SS, Ramesh A, Veeraiyan DN. Blended Module-Based Teaching in Biostatistics and Research Methodology: A Retrospective Study with Postgraduate Dental Students. *J Dent Educ*. 2019 Apr;83(4):445–50.
38. Mathew MG, Samuel SR, Soni AJ, Roopa KB. Evaluation of adhesion of *Streptococcus mutans*, plaque accumulation on zirconia and stainless steel crowns, and surrounding gingival inflammation in primary molars: randomized controlled trial [Internet]. Vol. 24, *Clinical Oral Investigations*. 2020. p. 3275–80. Available from: <http://dx.doi.org/10.1007/s00784-020-03204-9>