

Serum Electrolyte Levels Among Tobacco Users (Cigarette Smokers) In Awka, Anambra State, Nigeria

Eneh, F. U.^{1*}, Nweke, O. S.¹ and Eneh C. I.²

¹ Department of Applied Biochemistry Nnamdi Azikiwe University Awka, Nigeria

² Department of Paediatrics, Enugu State University of Science and Technology and Enugu State University Teaching Hospital, Enugu, Nigeria.

Corresponding author: Eneh, F.U, Email: fu.eneh@unizik.edu.ng

Abstract

Serum electrolytes play important roles in the regulation of pressure, osmotic balance, synaptic transmission of impulses, bone development and cardiac functions. Investigations were carried out on serum potassium, sodium and calcium levels among smokers and non-smokers in Awka, south-eastern Nigeria. The mean levels for potassium, sodium and calcium among smokers were 5.03mmol/L, 139.33mmol/L and 8.90mg/dl respectively. For non-smokers the values were 3.63mmol/L, 139.70mmol/L and 8.83mg/dl, respectively. There was a statistically significant increase in potassium levels among smokers over the non-smokers ($P < 0.05$). However, there was no statistical difference in the sodium and calcium levels among the smokers and non-smokers ($P > 0.05$). The higher level of potassium among smokers over the non-smokers could be the basis of higher incidence of cardiac arrhythmias observed among smokers.

Keywords: Tobacco, Cigarette, Smokers, Serum electrolyte

Date of Submission: 16-12-2022

Date of Acceptance: 31-12-2022

I. Introduction

Cigarette smoking, regrettably, is one of the unhealthy habits which people are still involved in. Cigarette smoke has been shown to contain a lot of harmful chemical substances, which include nicotine, nitrosamine, tar, catechol, phenol, anabasine, Naphthylamine, acrolein, hydrogen cyanide and vinylchloride. The main active agent in cigarette is nicotine which has addictive effects (Jenkins, 2004). Its action is mediated by nictotinic acetylcholine receptors. Cigarette-smoking is known to be responsible for several diseases of the lungs, such as chronic bronchitis and lung carcinomas (Falase and Akinkugbe, 1999). Tobacco smoke also has been found to worsen asthma and increases nasal symptoms in patients with allergic nasal diseases. Smoking is also implicated in emphysema and vascular diseases (Swash, 1995). This investigation is to find the effects of smoking on the electrolyte system of the body.

II. Materials And Method

Blood samples (2ml) were collected once from twelve different men in Awka, Anambra State. Six of them were regular smokers and served as the test while the other six were non-smokers and they were the control. Blood samples- in test tubes were allowed to clot and centrifuged. The clearly separated serum was transferred into separate test tubes for electrolyte analysis. Calcium, sodium and potassium were all analysed spectro-photometrically with reagent Kits manufactured by TECO Diagnostics, Anaheim California USA. Calcium determination is based on complex metric procedure (Gitelman, 1967). Calcium reacts with cresolphthalein complexon in 8-hydroxyquinoline to form a purple coloured complex which absorbs colour at 570nm. Sodium assay is a modification of the procedure (Maruna, 1957) where sodium is precipitated as a triple salt; sodium magnesiumuranylacetate the excess uranium reacts then with Ferro cyanide generating a chromophore whose absorbance varies inversely with the sodium concentration in the sample. Potassium test is based on reaction of sodium tetraphenylboron to produce a colloidal suspension (Terri and Sesin, 1958). The absorbance is read at 500nm and turbidity increases proportionally with potassium concentration. The values obtained were correlated statistically.

III. Results

The serum calcium levels in smokers and non-smokers were almost identical. The value obtained were 8.90mg/dl for smokers (test) and 8.83mg/dl for non-smokers (Figure 1). Although smokers had a higher concentration of calcium in the serum, the difference was not statistically significant ($P > 0.05$). The levels of sodium in serum of smokers (139.33) and non-smokers (139.70) were nearly equivalent but not statistically

significant ($P > 0.05$) (Figure 2). A different trend was observed in potassium, where smokers had a higher mean serum potassium concentration of 5.03 mmol/L over non-smokers with a mean value of 3.63mmol/L (Figure 3); an indication that the value of potassium in smokers was higher than that in non-smokers ($P < 0.05$).

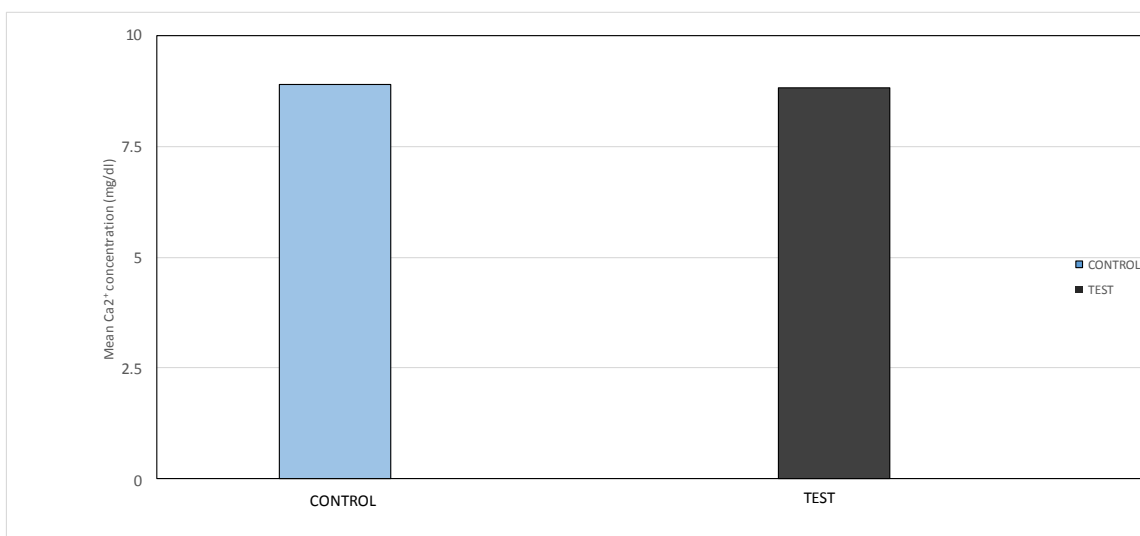


Figure 1: Mean Serum Calcium ion (concentration in smokers and non-smokers)

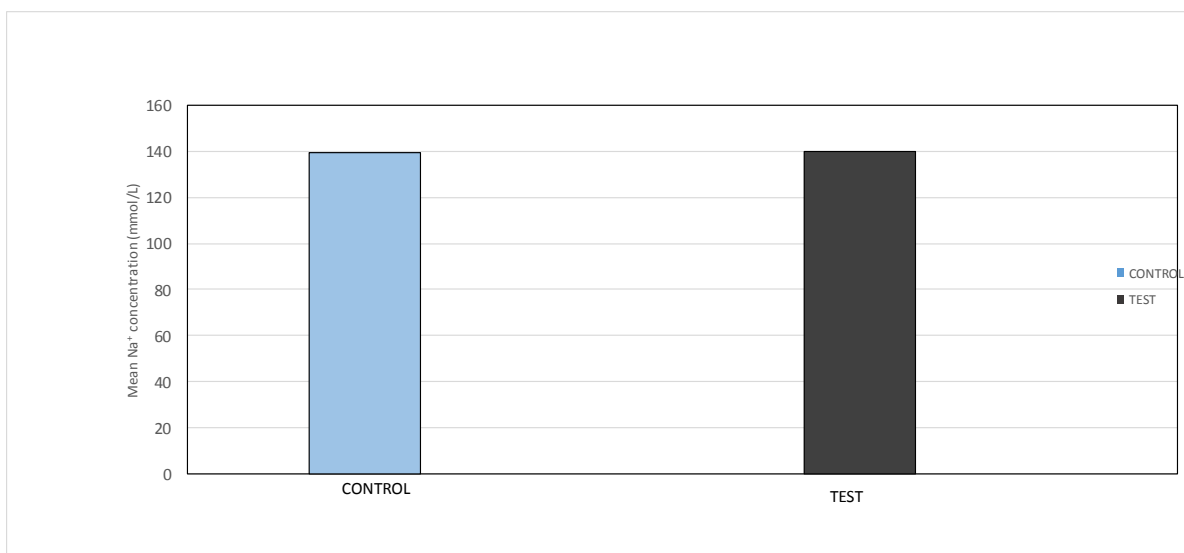


Figure 2: Mean Serum Sodium ion (concentration in smokers and non-smokers)

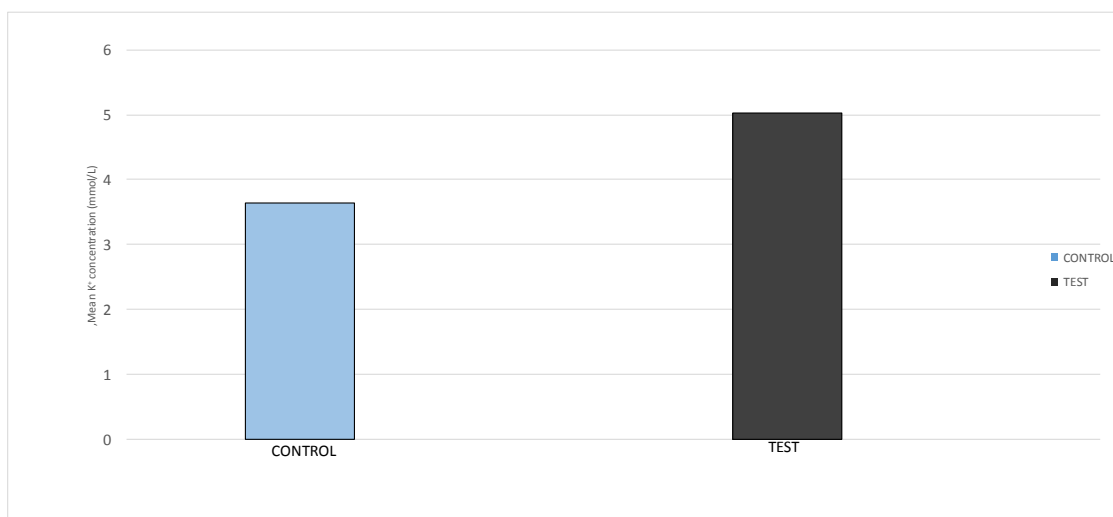


Figure 3: Mean Serum Potassium ion (concentration in smokers and non-smokers)

IV. Discussion

Cigarette (tobacco) smoking has been shown to have harmful effects (Falase and Akinkugbe, 1999). The constituents of tobacco smoke have been reported to cause intrauterine growth retardation, prematurity, sudden infant death syndrome and prenatal complications (Koren, 2004). Teenage pregnancy is a causative factor of intrauterine growth retardation and when it is associated with smoking the tendency becomes higher (Jenkins, 2004). Tobacco smoking has also been shown to be associated with chronic bronchitis, lung cancer and emphysema.

The different electrolytes investigated play important roles in the various biochemical systems of the body. There was no significant difference in the serum calcium levels in both smokers and non-smokers. It has been found that calcium plays a very important role in the formation of bone and teeth. The blood calcium level is about 2.5mmol/l, which is equivalent to 10mg/dl (Nelson and Cox, 2005). The values obtained for smokers (8.90mg/dl) and non-smokers (8.83mg/dl) fall within the expected normal values of 8.50-10.50mg/dl. The process of bone formation and growth as it affects calcium metabolism may not differ significantly between smokers and non-smokers. It is therefore unlikely that there may be much difference in the calcium hormonal regulatory mechanism via parathyroid hormone and calcitonin pathways (Ganong, 2001). Similarly, vitamin D metabolism and renal elimination of calcium between smokers and non-smokers may not differ much since both processes can influence the calcium level.

The sodium electrolyte in the serum of both smokers and non-smokers also did not differ and fell in place with the accepted value of 140 mM (Terri and Sesin, 1958). This shows that neither hyponatraemia nor hypernatraemia can be linked directly to smoking. Sodium is the major cation in the extra cellular fluid (Murray, 2003) and it regulates the total amount of water in the body. It also maintains the osmotic balance of the body. It is, therefore, likely that the aldosterone regulatory mechanism of osmotic pressure balance through the renin-angiotensin pathway was not affected significantly in the two groups (Ganong, 2001). This is because this mechanism plays an important role in the regulation of the level of sodium in the blood.

The normal serum potassium is in the range of 4.00 - 5.00mM (Nelson and Cox, 2005; Onyeneke and Alumanh, 1990). The mean values of this electrolyte obtained for non-smokers (3.63mmol/l) and smokers (5.03mmol/l) indicated a significantly higher value over reported corresponding normal values. Potassium ion is the main cation in the intracellular fluid and its elevation in the serum of smokers is already a pointer to hyperkalemia. This condition can result from shift of potassium out of the cells or by reduction in renal excretion. Under some physiological conditions, the serum potassium level rises. In a study involving five hundred pregnant women from ten different local government areas, Onyeneke and Alumanh (1990) reported a serum potassium level of 5.80 ± 1.50 meq/l for pregnant women while control subjects had a value of 4.86 ± 0.38 meq/l, and observed that the value decreased with maternal age and parity, but increases with gestational age. The social status of the pregnant women may have affected these values, since 5.50 ± 0.10 meq/l and 6.00 ± 0.20 meq/litre were recorded for farmers and civil servants, respectively. The higher potassium level recorded in pregnant women was suggested to be due to increased requirement for this mineral during pregnancy for tissue repairs, fetal growth, and development and protein synthesis (Onyeneke and Alumanh, 1990).

Cigarette smoking is already implicated in tissue degenerative processes (Guyton, 1991). The possible mechanism through which smoking of cigarette leads to hyperkalemia could be through tissue necrosis. Kim and Clausen (Kim and Clausen, 1987) reported that potassium is the principal cation of the intracellular fluid

and a negative nitrogen balance is often associated with loss of potassium that is released from cells when proteins are broken down. Sustained increases in serum potassium level will likely lead to cardiac arrhythmias. In this investigation a value of 5.03mmol/l was already observed in smokers. Cardiac arrhythmias often appear when the plasma potassium concentration rises from the normal value of 4.5meg/l to about 8.00 meg/l (Jenkins, 2004).Smoking causes repeated sharp rises in heart rate during the daytime hours which could increase the risk of cardiovascular events(Palitini et al 2017) and thus could potentiate the adverse effect of raised serum potassium in smokers.The adverse effect of smoking on the cardiovascular systemcan be postulated from Anyfanti et al's report of healthy young men, perceived as free from the long-term cardiovascular effects of smoking in whom antecedent smoking induced greater BP responses during exercise and a delayed recovery.Thus smoking of a single cigarette shortly before exercise could trigger a greater myocardial stress and an exacerbating BRS response during subsequent isometric exercise(Anyfanti 2016).Thus the effect on cigarette smoking on the cardiovascular system could be multifaceted, immediate as well as long term.

V. Conclusion

The serum levels of calcium and sodium for smokers and non-smokers did not vary significantly and both parameters were in the normal and acceptable range for the two groups. This shows that the metabolic pathways involving these two electrolytes and their regulatory mechanism in the body were not significantly affected. However, for the potassium ion there was a significant difference in the two groups with the levels in smokers exceeding the upper limit of the normal range. This indicates that the metabolic pathways involving potassium and the regulatory mechanism were significantly affected in the smokers. It is suggested that the pathological states associated with cigarette smoking led to the efflux of potassium ion, which is mainly an intracellular ion out of the cells due to tissue necrosis thereby leading to hyperkalemia which is a predisposing factor to cardiac arrhythmias.

References

- [1]. Falase, A. O. and Akinkugbe, O. O. (1999). A Compendium of Clinical Medicine, Spectrum Books Ltd. Ibadan.
- [2]. Ganong, W. F. (2001). Review of Medical Physiology 20th ed. McGraw-Hill. New York.
- [3]. Gitelman, H. J. (1967). An Improved Automated Procedure for the Determination of Calcium in Biological Specimens. *Anal. Biochem.* 18: 521 – 530.
- [4]. Cuyton, A. C. (1991). Textbook of Medical Physiology. 8th ed. W. B. Saunders Company. Philadelphia.
- [5]. Jenkins, R. R. (2004). Substance Abuse. In: Nelson Textbook of Paediatrics, 17th edition, Behrman, R. E., Kliegman, R. M. and Jenson, H. B. (Editors). Elsevier. Philadelphia.
- [6]. Kim, F. M. and Clausen, T. (1987). Inadequate Supplies of Potassium and Magnesium in Relief Food: Implication of Counter-measures. *Lancet*, 1421 – 1423.
- [7]. Kooren, G. (2004). Special Aspects of Perinatal and Paediatric Pharmacology. In: basic and Chemical Pharmacology, 9th Ed. Katzung, B. G. (Editor). McGraw-Hill, Boston.
- [8]. Maruna, R. F. L. (1957). Serum Sodium Determination, Critical Study on Colorimetric Determination and Method. *Clinical Chimica Acta*, 2: 581 – 585.
- [9]. Murray, R. K. (2003). Membranes: Structure and Function. In: Harper's Illustrated Biochemistry. 26th ed. Murray, R. K., Granner, D. K., Mayes, P. A. and Rodwell, V. W. (Editors). McGraw-Hill. Boston.
- [10]. Nelson, D. L. and Cox, M. M. (2005). Lehninger Principles of Biochemistry. 4th ed, W. H. Freeman and Company, New York.
- [11]. Onyeneke, E. C. and Alumanh, E. O. (1990). Changes in Serum Potassium Levels During Pregnancy in Nigeria Women. *J. Clin. Biochem. Nutr.*, 8: 61 – 67.
- [12]. Palatini, P.; Saladini, F.; Fania, C.; Mos, I.; Mazzer, A.; Casiglia, E. (2017). Smoking potentiates the risk of cardiovascular disease associated with tachycardia. *Journal of Hypertension* 2017; (35):45doi: 10.1097/01.hjh.0000523094.33698.15
- [13]. Swash, M. (1995) Hutchison's Clinical Methods., Saunders Company Ltd. London.
- [14]. Terri, A. E. and Sesin, P. G. (1958). Colorimetric Method of Potassium Estimation Using Sodium Tetraphenylboron. *Am. J. Clin. Path.* 19:86.
- [15]. Anyfanti, P.; Triantafyllidou, E.; Triantafyllou, A.; Kyparos, A.; Nikolaidis, M.; Vrabas, I.; Zafeiridis, A.; Douma, S.; Dipla, K. (2016) Effect of antecedent cigarette smoking on cardiovascular function during isometric handgrip exercise. *Journal of Hypertension*: September 2016 - Volume 34 - Issue - p e240

Eneh, F. U, et. al. "Serum Electrolyte Levels Among Tobacco Users (Cigarette Smokers) In Awka, Anambra State, Nigeria." *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*, 21(12), 2022, pp. 61-64.