Original Research Article

ALTERATIONS IN SERUM LEVELS OF URIC ACID, UREA, CREATINE, POTASSIUM AND SODIUM IN YOUNG ADULT FEMALES WITH STRIAE DISTENSAE IN SOUTH EASTERN NIGERIA.

ABSTRACT

Background: Striae distensae (stretch mark) is a skin disorder with social and psychological impact on young adult females. Despite its high prevalence in Nigeria, there is scarcity of information on its association with some biochemical indices of kidney function.

Objective: The study was carried out to determine if there is any alteration in serum uric acid, urea, creatinine, sodium and potassium levels in young adult females with striae distensae.

Methods: A total of 80 young adult females were selected for the study. They were divided into two groups; 40 young adult females with striae distensae served as the study group while 40 young adult females without striae distensae served as the control group. Venous blood samples were collected from all participants in plain containers, allowed to clot and was centrifuged to obtain serum which was stored frozen and analyzed within 48hours. Serum uric acid, urea and creatinine levels were determined using spectrophotometric methods, while serum potassium and sodium levels were determined using the flame photometric method. The data generated were subjected to statistical analysis using SPSS version 21.

Results: The young adult females with striae distensae had significantly higher levels of serum uric acid (4.98±1.11mg/dL) compared to the controls (3.76±0.69mg/dL) (p=0.000). There were significantly higher levels of serum urea (26.55±4.22mg/dL) in young adult females with striae distensae compared to the controls (22.90±2.61mg/dL) (p=0.000). There was no significant difference in the serum levels of creatinine in young adult females with striae distensae (0.72±0.10mg/dL) compared to the controls (0.78±0.11mg/dL) (p=0.186). Serum sodium (Na) was significantly lower while serum potassium (K) was significantly higher in young adult females with striae distensae (133.60±5.50mmol/L Na, Versus 138.40±3.87mmol/L Na, p=0.006) and (3.47±0.13mmol/L K Versus 3.29±0.16mmol/L K, p=0.003) respectively. There was a significant positive correlation of serum creatinine with sodium (r=0.490, p=0.028) while there was a significant negative correlation of serum creatinine with potassium (r=-0.595, p=0.006) in young adult females with striae distensae. There was also a positive correlation of serum urea with sodium (r=0.455, p=0.044), while there was non-significant correlation of Serum urea with creatinine (r=0.320, p=0.169) and potassium (r=0.099, p=0.0679) in young adult females with striae distensae.

Conclusion: Higher serum levels of uric acid, urea, and potassium parallels lower levels of serum sodium as observed in young adult females with striae distensae. This may in part contribute to the development of this skin disorder in this environment.

Key Words: striae distensae, uric acid, urea, creatine, potassium, sodium, young-adult-females, Nigeria.

INTRODUCTION

Striae distensae (SD) is dermal scars or stretch marks which result from circumstances where there is gradual but continuous stretching such as gestation, weight loss or weight gain, rapid growth spurt in puberty, and protracted use of corticosteroids. It may also result from the increase stress in the connective tissue due to mast cell degranulation with subsequent damage of collagen, fibrillin, and elastin **[1]**. It can be evident as erythematous reddish or pink-tinged stretched flat or slightly raised skin lesions/ changes aligned perpendicular to the direction of skin tension in early stage, and matures as faded white atrophic, wrinkled, and hypo pigmented linear marks on the abdomen, breasts, buttocks. thighs, knees and calves. The propensity of developing SD maybe associated with a positive family history **[2,3]**

There are a number of pathological and histological changes which occur when SD are formed. Elastolysis of the mid-dermis is evident due to mast cell degranulation and stimulation of macrophages. Other observations include perivascular lymphocytic cuffing, increased glycosaminoglycan, sporadic presence of lymphocytes and oedema in the dermis. Gradual atrophy of the epidermis has been noted including loss of rete ridges **[4]**. Vascular changes occur which contribute to the red and erythematous appearance of striae rubrae.

SD severity has been noted to be worse in Black African women compared to Caucasians, within the same geographical region. The vast majority of SD has been reported in pregnant women and adolescents. They are associated with Cushings syndrome and chronic steroid use **[5]**. The causes of SD are proposed to be due to the mechanical effect of tissue stretching; from growth in

adolescence and rapid increase in the size of certain locations of the body. The most common anatomical locations which are affected by SD are the abdomen, breasts, buttocks and thighs **[6]**. Striae distensae have presented a considerable challenge in terms of both their evaluation and treatment. There are variable responses to therapies, with the main aims being reduction in symptoms and improvement in appearance **[6]**. Various treatment modalities exist, but no single therapy has been advocated to completely eradicate these lesions **[7]**.

However, in order to improve the appearance and reduce the symptoms associated with SD, the following processes should occur; increased collagen production and fibroblastic activity, increase in elasticity and blood perfusion, improvement in cell proliferation, increased skin hydration and anti-inflammatory properties **[8]**.

Abnormal **electrolyte** concentrations may be the cause of or consequence of a variety of medical disorders. Electrolytes are charged low molecular mass molecules that are present in plasma and cytosol; usually ions of Sodium, Potassium, calcium **[9].** Among the physiologically important electrolytes, Sodium and Potassium were majorly focused on for the purpose of this study.

Sodium is the major cation present in the extracellular fluid. The amount of sodium in blood is a much higher amount than intracellular sodium. This asymmetric distribution of sodium ions is essential for human life **[10]**.

Potassium is the most abundant intracellular cation. Only about 20% of the body's potassium is extracellular, and is important for many body functions. Potassium smooths wrinkles and age spots while protecting against UV Rays and naturally moisturize and hydrate skin cells. Another beauty factor of Potassium is its support of new skin cell growth. This helps heal blemishes and scars **[11]**.

Creatinine is a breakdown product of dietary meat and creatine phosphate found in skeletal muscle. Its production in the body is dependent on muscle mass **[12]**.

Uric acid is a waste product found in blood. It's created when the body breaks down chemicals called purines. Most uric acid dissolves in the blood, passes through the kidneys and leaves the body in as component of urine **[13]**.

Urea is generated by the urea cycle enzymes, which are mainly in the liver but are also ubiquitously expressed at low levels in other tissues. The metabolic process is altered in several conditions such as by diets, hormones, and diseases. Urea is then eliminated through fluids, especially urine **[14]**.

Striae distensae affect up to 90% of women on emotional, cognitive and behavioral levels **[15]**. Previous report shows that African women are mainly affected by Striae distensae than Caucasian women **[16]**. The prevalence of Striae distensae in Nigerian women is reported to range from 43% to 88% for pregnant women, 86% for adolescents and 43% for women with obesity **[16]**. Despite the psychological and traditional impact of this skin condition on young adult females in this environment, there is scarcity of information on its relationship with biochemical indices of kidney function generally and particularly from a black African population like Nigeria. A previous report from New Delhi India documented a case of nephrotic syndrome that developed extensive striae Ddistensae while on oral corticosteroid treatment and eventually resulting in bulging of Striae distensae due to preferential accumulation of edema fluid in these weaker skin scars. The renal/kidney function tests; blood urea nitrogen was slightly raised, but serum creatinine was within normal limits. While Urine microscopy showed the

heavy proteinuria **[17]**. Also, another report from India showed a case of striae distenae in a nephrotic syndrome patient **[18**]. However, there is scarcity of information on the renal function indices of striae distensae sufferers globally and particular in a black African population like Nigeria. Thus, this study is geared towards bridging this gap in knowledge. Hence the aim of this study is to evaluate if there are alterations in the serum levels of Uric acid, Urea, Creatinine, Potassium and Sodium in young adult females with Striae distensae.

MATERIALS AND METHODS

Study Area

The study was conducted in Imo State University, Owerri, Nigeria.

Ethical Approval and Informed Consent

This study was approved by the Research Ethics Committee of Medical Laboratory Science Department, Faculty of Health Sciences, Imo State University Owerri, Nigeria. Each of the subjects signed informed consent form after the procedure of the study have been explained to them.

Study Population

By random sampling method, 40 young adult females within the range of 18 to 25 years who had striae distensae were selected from students of Imo State University, Owerri Nigeria. They were age matched with 40 young adult females without striae distensae who served as controls.

Inclusion Criteria:

I) Young adult females with striae distensae.

II) Subjects that gave informed consent.

III) Subjects within the age range of 18 to 25 years.

IV) Apparently healthy students.

3.5. Exclusion Criteria:

I) Subjects having other skin diseases like eczema.

II) Subjects having chronic diseases.

III) Subjects that did not give their informed consent.

Specimen Collection and Processing

Five ml of venous blood was collected from each participant using sterile syringe and needle. It was dispensed into a plain container and allowed to clot and retract. It was then centrifuged at 1500 rpm for 5 minutes. The serum was separated using pasteur pipette into new plain containers. Samples were stored frozen and analyzed within 48 hours.

Analytical Methods

Flame Photometric method was employed in the determination of serum potassium and sodium **[19]**. Potassium and sodium solution under carefully controlled conditions, a very fine spray is supplied to a burner. The solution evaporates and the salt dissociates to give neutral atoms. Some of these moves into a high energy state. When these excited atoms fall back to the ground state, the characteristic wavelength is 770nm and 590nm respectively for K and Na. The light passes through a suitable galvanometer onto a photosensitive element and the amount of current produced is measured.

Serum Uric acid level was determined by the Spectrophotometric methods as previously described by Caraway, **[20]**. The method uses the reducing property of uric acid in alkaline phosphotungstic acid to form tungsten blue whose color is determined at 700nm wavelength.

Serum Creatinine was determined by the Jaffes Reaction via Spectrophotometric method, as described by Bonsnes and Toussky, **[21]**. Creatinine reacts with alkaline picrate solution to give a red color. Reduction of this red color is nonspecific since other non-creatinine substances in the

blood are known to give similar reaction. But the recovery of Creatinine in an acid filtrate helps minimize the reaction at 500nm after 15 minutes standing at room temperature.

Serum Urea was determined Spectrophotometrically employing the Diacetyl Monoxime method as described by Natelson, **[22]**. Proteins in serum were precipitated with trichloroacetic acid. The urea in the supernatant reacts with diacetyl monoxime in the presence of the semicarbonized Cadmium ions under acid conditions. The absorbance of the resulting rose-purple solution is measured at 530nm wavelength.

Statistical Analysis

Statistical analysis was carried out with the aid of IBM SPSS version 21 software and all values were expressed as mean ± standard deviation. The results were analyzed for statistical significance using the student T-test. The values with ($P<0.05$) were considered statistically significant. Pearson's correlation was also performed to evaluate relationship between the variables.

RESULTS

Serum Uric acid, Urea, Creatinine, Sodium and Potassium levels in Young Adult Females with Striae distensae and controls

There was a significantly lower level of Serum Sodium (p=0.006) in young adult females with Striae distensae compared to controls. There was significantly higher level of Serum Uric acid (p=0.000) higher level of Serum Urea (p=0.000) and higher level of Potassium (p=0.003) but non-significant difference in Creatinine (p=0.186) in young adult females with Striae distensae compared to controls (Table 1).

Pearson's Correlation of Serum Creatinine with Uric Acid, Urea, Sodium and Potassium in Young Adult Females with Striae Distensae

There was a significant positive correlation of Serum Creatinine with Sodium (r=0.490, p=0.028) in striae distensae sufferers while there was a significant negative correlation of Serum Creatinine with Potassium (r= -0.595, p=0.006) in young adult females with striae distensae. There was non-significant correlation of Serum Creatinine with Uric acid (r= -0.126, p= 0.597) and Urea (r=0.320, p=0.169) in young adult females with striae distensae (Table 2).

Pearson's Correlation of Serum Urea with Uric Acid, Creatinine, Sodium and Potassium in Young Adult Females with Striae Distensae

There was a non-significant correlation of Serum Urea with Sodium (r= -0.209, p=0.378) in young adult females with striae distensae. There was non-significant correlation of Serum Urea with Creatinine (r=0.320, p=0.169) and Potassium (r=0.099, p=0.679) in young adult females with striae distensae (Table 3).

Table 1: Serum Uric Acid, Urea, Creatinine, Sodium and Potassium Levels in Young Adult Females with Striae Distensae and Controls

Variables	**Young Adult Females with Striae Distensae**	**Control**	***t*-values**	***p*-values**
(Mean ± SD)	**(n=20)**	**(n=20)**		
Uric acid	4.98±1.11	3.76±0.69	5.932	0.000
(mg/dl)				
Lower 95% C.I	4.45	3.43		
Upper 95% C.I	5.50	4.08		
Urea	26.55±4.22	22.90±2.61	4.425	0.000
(mg/dl)				
Lower 95% C.I	24.57	21.67		
Upper 95% C.I	28.52	24.12		
Creatinine	0.72±0.10	0.78±0.11	-1.371	0.186
(mg/dl)				
Lower 95% C.I	0.67	0.72		
Upper 95% C.I	0.76	0.83		
Sodium	133.60±5.50	138.40±3.87	-3.066	0.006
(mmol/L)				
Lower 95% C.I	131.02	136.58		
Upper 95% C.I	136.17	140.21		
Potassium	3.47±0.13	3.29±0.16	3.382	0.003
(mmol/L)				
Lower 95% C.I	3.40	3.21		
Upper 95% C.I	3.53	3.37		

Table 2: Pearson's Correlation of Serum Creatinine with Uric Acid, Urea, Sodium and Potassium in Young Adult Females with Striae Distensae

Variables	N	*r*-value	*p*-value
Uric Acid	20	-0.126	0.597
Urea	20	0.320	0.169
Sodium	20	0.490*	0.028
Potassium	20	-0.595**	0.006

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Table 3: Pearson's Correlation of Serum Urea with Uric Acid, Creatinine, Sodium and Potassium in Young Adult Females with Striae Distensae

Variables	*N*	r-value	p-value
Uric Acid	20	-0.209	0.378
Creatinine	20	0.320	0.169
Sodium	20	0.455*	0.044
Potassium	20	0.099	0.679

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

DISCUSSION

The result also showed higher level of Serum Potassium, but lower level of serum sodium in young female adults with Striae distensae when compared to controls. Higher levels of **potassium** as observed in this present study may damage the skin membrane **[23]**, hence may be consequential to initiation of the process of striae distensae formation. Although potassium has health benefits for the skin but when in excess may have adverse effects on the skin **[24]**.

Extensive Literature search shows that no previous study examined the renal function indices; serum potassium, sodium, urea, creatinine and uric acid in striae distensia subjects. Rather two case reports **[17,18]** show manifestation of striae distensae in nephrotic syndrome patient. Thus, to the best of authors knowledge, this seems to be the first report on the renal function indices of striae distensae subjects globally and particularly from a Black African population like Nigeria.

The observed lower serum sodium in striae distensiae subjects may imply its role in the aetiology and pathogenesis of striae distensae. Though it has not been fully elucidated, sodium may play a beneficiary role in prevention of striae distensae. A current study in year 2021 reported that stretch mark derived fibroblast (SMF) treated with sodium ascorbate and platelet rich plasma (PrP) showed a resumption of their metabolic activity by increase in collagen type 1 production and cell proliferation **[25]**.

The result of this study showed higher levels of Serum Uric acid and Urea in young adult females with Striae distensae when compared to controls. This is related to the fact that accumulated **Uric acid** in skin form small rounded nodules which could lead to rapid stretching

of the skin over weakened connective tissues. It has been previously noted by Watson *et al.,* **[7]** that a stretch in the skin and its tissues brings about skin tension, thus can lead to the formation of striae distensae. **Urea** as a keratolytic agent breaks down protein keratin, skin structure and integrity of the outer layer of skin which can lead to the stretching of the skin and may be consequential to formation of Striae distensae **[26]**.

No significant difference was observed in serum Creatinine levels in young adult females with Striae distensae when compared to controls. Creatinine boosts skin cell turnover and repair and is also produced by the breakdown of creatine in muscles **[27].**

Furthermore, there was a significant positive correlation of Serum Creatinine with Sodium, but significant negative correlation with Potassium in young adult females with Striae distensae. *This indicates that as the creatinine level increases, the potassium decreases, while the sodium increases in young adult females with Striae distensae*.

The role of Uric acid, Urea and Potassium according to various studies may be suggestive that they may be contributing factors especially in already predisposed individuals, rather than major causative factors; regardless, further studies still need to be carried out with respect to evaluation of serum Uric acid, Urea, Creatinine, Sodium and Potassium in Striae distensase patients **[28]**.

CONCLUSION

Elevated serum levels of Uric acid, Urea and Potassium parallels lower levels of Serum Sodium in young adult females with striae distensae. This may in part contribute to the development of this skin disorder among young adult females in this environment.

ETHICAL APPROVAL AND CONSENT

The study protocol was approved by the Department of Medical Laboratory Science, Imo state University, Owerri, Nigeria, Research Ethics Committee with reference number MLS/IMSU/REC/2021/05. Written informed consent was obtained from all study participants prior to their enrolment and collection of blood samples in accordance with the "1964 Helsinki declaration" and its later amendments in 2000.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

REFERENCES

[1] Cohen BE, Geronemus RG, McDaniel DH, Brauer JA. The Role of Elastic Fibers in Scar Formation and Treatment. Dermatol Surg. 2017 Jan;43 Suppl 1:S19-S24.

[2] De Angelis, F., Kolesnikova, L., Renato F. and Liguori, G. (2011). Fractional non ablative 1540nm laser treatment of striae distensae in different skin types: clinical and histological results. *Aesthetic Surgicals*(31):411–419.

[3] Ryu HW, Kim SA, Jung HR, Ryoo YW, Lee KS, Cho JW. Clinical improvement of striae distensae in Korean patients using a combination of fractionated microneedle radiofrequency and fractional carbon dioxide laser. Dermatol Surg. 2013 Oct;39(10):1452-8. doi: 10.1111/dsu.12268. Epub 2013 Jul 29. PMID: 23895146.

[4] Elson, M.L. (2014). Topical tretinoin in the treatment of striaedistensae and in the promotion of wound healing. *Journal of Dermatology.* 12(5):163–165.

[5] Kim, B.J., Lee, D.H. and Kim, M.N. (2008). Fractional photothermolysis for the treatment of striae distensae in Asian skin. *Clinical Dermatology.* 9:33–37.

[6] Ud-Din, S, McGeorge, D.D. and Bayat, A. (2015). Topical management of striae distensae (stretch marks): Prevention and therapy of striae rubrae and albae. Journal of the European Academy of Dermatology and Venereology 30(2):211-222.

[7] Watson, R.E., Parry, E.J. and Humphry J.D. (2018). Fibrillin microfibrils are reduced in skin exhibiting striae distensae. *British Journal of Dermatology.* 138:931–937.

[8] Goldman, A., Rossato, F. and Prati, C. (2008). Stretch marks treatment using the 1,064nm laser. *Dermatologic Surgery.* 9 (34):686–692.

[9] Burtis, A.R., and Burns, K. (2015). The structure and development of skin. In: Freedberg A, Austin L. eds. *Dermatology in general medicine*. NewYork, Ny:McGraw-Hill; pp 120-131.

[10] Banks, P.P. (2010). Sodium in acid-base balance. *Clinical Chemistry*. 40:240-247.

[11] Sayyed, M.O. and Sonttake, P.S. (2013). Food and Chemical Toxicology. *Journal of Biological Chemistry.* 270(22):133-204.

[12] Zuo Y, Wang C, Zhou J, Sachdeva A, Ruelos VC. (2008) Simultaneous determination of creatinine and uric acid in human urine by high-performance liquid chromatography. Anal Sci. 2008 Dec;24(12):1589-92.

[13] Anuradha, C.N. and Begum, A.S. (2016). Neuromuscular activity: Sodium and Potassium. *Journal of Physiology*. 14:111-120.

[14] Wang H, Ran, J. and Jiang, T. (2014). Urea. Sub-cellular Biochemistry 73:7-29.

[15] Barbara, J. and Reif, R.N. (2008). Impact of striae gravidarum. *Clinical Science.* 141(12):411-432.

[16] Nada, E., Sewon, K. and Ted, H. (2009). Differences in clinical features and risk factors for striae distensae. *Journal of the American Academy of Dermatology* . 60:50-62.

[17] Lokhande, A.J., Dhali, T.K., Chaudhary, P., Goel, R. and Rathore S. (2018) Distended striae distensae in a patient with nephrotic syndrome. *Journal of Dermatology and Dermatologic* Surgery. 22(2):82-84.

[18] Patnaik, S.K., Lamoria, S., Sharma, V. (2016) Edematous stria distensae in nephrotic syndrome. J *Health Soc Sci. 1(2):143-148*

[19] Fledman, C. and Rains, T.C. (1964). Flame photometric determination of Potassium and Sodium. *Analytical Chemistry*. 36(2):405-409.

[20] Caraway, W.T. (1955). Standard methods of clinical chemistry. *Clinical Chemistry*. 4:239-247.

[21] Bonsnes, R.W. and Taussky, H.H. (1945). Colourimetric determination of Creatinine by the Jaffe reaction method. *Journal of Biological Chemistry*. 158:581-591.

[22] Natelson, S. (1951). Routine use of ultra-micro methods in the clinical laboratory. *American Journal of Clinical Chemistry*. 21(11):53-72.

[23] Antonio, S., Andrea, S., Roberto, A., Eugenio, L.I., Giuseppe, F., Felix, C. and Domenico, A. (2021). Aesthetics. *Journal of Cutaneous Aesthetic Surgery*. 14(2):222-228.

[24] Weber, F.P. (2019). Idipathic striae atrophicae of puberty. *Pediatrics.* 29:13-47.

[25] Padula SL, Hersant B, Pizza C, Chesné C, Jamin A, Mosbah IB, Errico C, D'andrea F, Rega U, Persichetti P, Meningaud JP.(2021). Striae Distensae: In Vitro Study and Assessment of Combined Treatment with Sodium Ascorbate and Platelet-Rich Plasma on Fibroblasts. 2021; Aesthetic Plastic Surgery 45(2)

[26] Haake, A.R. and Hollbrook, K. (2019). The structure and development of skin. In: Freedberg A, Goldsmith, S. eds. *Dermatology in general medicine*. NewYork, Ny:McGraw-Hill; pp 70-111

[27] Jo-Lewin, R.N. (2020). Creatinine in skin cell turnover. *Medicine*. 40:192-198.

[28] Gayraud, B., Hopfner, B., Jassim, A., Aumailley, M. and Bruckner-Tuderman, L. (2017). Characterization of a 50-kDa component of epithelial basement membranes using GDA-J/F3 monoclonal antibody. *Journal of Biological Chemistry. 272*(14):9531–9538.