Scientific Research Publishing

Open Journal of Endocrine and Metabolic Diseases, 2022, 12, 83-90
https://www.scirp.org/journal/ojemd
ISSN Online: 2165-7432
ISSN Print: 2165-7424

Evaluation of Serum Testosterone, Cholesterol and Plasma Glucose Concentrations in Hirsute Women in Bayelsa State

Waibode Peter Alabrah[1], Mieebi Martins Wankasi[2], Jackson Borobuebi Okutu[2], Eni-yimini Solomon Agoro[3*]

[1]Department of Obstetrics and Gynaecology, Federal Medical Centre, Yenagoa, Nigeria
[2]Department of Medical Laboratory Science, College of Health Science, Niger Delta University, Wilberforce Island, Nigeria
[3]Directorate of Research and Quality Assurance, Federal University Otuoke, Otuoke, Nigeria
Email: *enisagoro@gmail.com

How to cite this paper: Alabrah, W.P., Wankasi, M.M., Okutu, J.B. and Agoro, E.S. (2022) Evaluation of Serum Testosterone, Cholesterol and Plasma Glucose Concentrations in Hirsute Women in Bayelsa State. *Open Journal of Endocrine and Metabolic Diseases*, **12**, 83-90.
https://doi.org/10.4236/ojemd.2022.123006

Received: December 27, 2021
Accepted: March 12, 2022
Published: March 15, 2022

Abstract

Hirsutism is an endocrine disorder where women develop excess growth of terminal hairs in a male pattern. This study evaluated the concentrations of cholesterol, glucose and testosterone in bearded women in the Amassoma metropolis of Bayelsa state. In a view to determining whether hirsutism has an effect/relationship with the biochemical parameters estimated, a total of 50 bearded and 50 non-bearded women were recruited for this study. Based on a cross-sectional study, group A and B were appropriately matched for age and BMI. The concentrations of the biochemical parameters were measured using WHO-approved method. Bearded females had significantly higher ($p \leq 0.05$) cholesterol concentration (4.41 ± 1.09 mmol/L) when compared with the non-bearded (control) women. Furthermore, the mean concentrations of testosterone and glucose were higher in the bearded female group when compared with the non-bearded. The study established that women with hirsutism have associated hypertestosteronemia, hypercholesterolemia and hyperglycemia.

Keywords

Endocrine, Hirsute, Testosterone, Cholesterol

1. Introduction

A condition where women have naturally occurring beards is known as Hirsutism. Hirsutism is a condition defined as excessive hairiness; the common clinical use of the term refers to women with excess growth of terminal hair in a male pat-

tern. Hirsutism is one of the most common endocrine disorders, affecting approximately 10% of women in every country [1]. In these women, the hairiness implies the presence of abnormal androgen action, which may represent a serious or, more likely, a non-serious medical problem. Regardless of the etiology, hirsutism predisposes the woman to mental, emotional and psychosocial trauma due to the gradual change in physical aesthetics. Even mild cases of hirsutism cause the individual distress and others as a presumptive loss of feminity. In more severe cases, hirsutism poses significant cosmetic and management challenges.

Hirsutism is mostly an endocrine distortion affecting a series of biochemical parameters. Testosterone, which is an androgen is mainly a male sex hormone, however, a small amount of this hormone is produced in the ovaries. Testosterone combined with estrogen helps with the growth, maintenance, and repair of a woman's reproductive tissues, bone mass and human behaviors. In women, normal testosterone levels range from 15 to 17 nanograms per deciliter (ng/dL) of blood. Testosterone levels lower than 15 ng/dL may cause changes in breast tissue and fertility problems. An imbalance of testosterone in the female body can have damaging effects on a woman's health and sex drive. Excess concentration of testosterone can also cause symptoms that affect a woman's physical appearance including excess body hair, specifically facial hair, balding, acne, enlarged clitoris, decreased breast size and increased muscle mass. Also, high levels of testosterone in women can cause irregular menstrual cycles, low libido, and mood swings. In more severe cases of testosterone imbalances in women, high testosterone can cause infertility and obesity [2] [3] [4].

Cholesterol is the major sterol in the human body. It is complex alcohol formed of four fused rings and a side chain, it is present in all cells as a structural component of membranes and it is mostly esterified with fatty acids in the bloodstream [5]. About 70% - 80% of the cholesterol in plasma esterifies with long-chain saturated and unsaturated fatty acids. One of the major functions of cholesterol is to serve as a metabolic precursor for the biosynthesis of bile acids, and steroid hormones which include male and female sex steroids (androgens and estrogens) and adrenal steroid hormones (aldosterones and corticosterone). Organs like the liver, ovaries, testes and adrenal glands synthesis these hormones using cholesterol as the main precursor. Glucose is a six-carbon monosaccharide derived from the breakdown of the carbohydrate in the diet or in body stores; it can also be endogenously synthesized from protein or glycerol moiety of triglyceride [6]. Glucose provides the energy for life processes. It is the main end product of carbohydrates digestion.

Beardedness as earlier stated is a hormonal distortion involving series of biochemical alterations. Testosterone, glucose and cholesterol are important and inter-related biochemical agents associated with most endocrine disorders. Aside from the hormonal roles exerted by these biochemical parameters in the body, they also drive metabolic processes that sustain life. Alterations of these biomole-

cules have a concomitant effect on health. Most studies lay emphasis on the impact of these alterations on the reproductive milieu without necessarily looking at the metabolic side. This gap is the basis of this study as the reproductive and metabolic perspectives are deliberately interrogated. Hence, this study is poised at connecting these parameters with the view of critically evaluating the hormonal and metabolic narratives of beardedness in women.

2. Materials and Methods

2.1. Study Area

This research study was carried out in Amassoma which is a semi urban town situated in Southern Ijaw Local Government area of Bayelsa state, Nigeria. It is the second most populated city next to Yenagoa the State capital and home to the famous Niger Delta University, Wilberforce Island.

2.2. Sample Size/Study Population

A total of one hundred subjects were recruited for the study, comprising of control and study group as validated by Araoye [7]. The control group was made of 50 non-bearded women, whereas the study group was made of 50 bearded women. The two groups were age and BMI paired matched.

2.3. Sample Collection

Blood samples were collected for both groups by venepunture. The samples were collected into plain and fluoride oxalate containers. The former was used for the estimation of testosterone and cholesterol, whereas the later for the measurement of glucose. Serum was extracted from the plain containers, whereas plasma from the fluoride containers for the estimations of the studied biochemical parameters. The samples were separated post-collection and immediately send to the laboratory for the indicated biochemical analysis.

2.4. Laboratory Analysis

Cholesterol and glucose were analysed enzymatically using agape reagent, whereas testosterone by Competitive Enzyme Immunoassay (TYPE 7). The essential reagents required for an enzyme immunoassay include antibody, enzyme-antigen conjugate and native antigen. Upon mixing biotinylated antibody, enzyme-antigen conjugate and a serum containing the native antigen, a competition reaction results between the native antigen and the enzyme-antigen conjugate for a limited number of antibody binding sites.

2.5. Statistical Analysis

The statistical package for social science (SPSS) version 20 and Microsoft excel version 2010 was used for all analysis. Values were expressed as mean ± standard deviation. The comparison of the two groups studied biochemical parameters was made using the student's *t*-test. The level of significance was set at 95% confidence

interval.

3. Results

Table 1 shows percentages of the various variables such as sex, religion, subject categories, age and marital status. The results presented in Table 2 shows the comparison of the concentrations of the biochemical parameters such as glucose, cholesterol and testosterone in bearded women and non-bearded women. The values for cholesterol concentration, increased significantly ($p \leq 0.05$) in bearded women, whereas testosterone and glucose were not significant ($p > 0.05$), but increased mean wise.

4. Discussion

The study revealed a significant increase in serum cholesterol concentration in the bearded women when compared to the non-bearded (Table 2). In similar vein, the mean concentration of serum testosterone and glucose were higher in the bearded women when compared with the non-bearded (Table 2). The growth of sexual hair as secondary sexual characteristics is mainly dependent on the

Table 1. Demographics of the study.

Variables	Levels	Frequency	Percentage (%)
Sex	Females	100	100
Religion	Christianity	97	97
	Islam	3	3
	Total	**100**	**100**
Subjects	Non-bearded (control)	50	50
	Bearded	50	50
	Total	**100**	**100**
Age	Adults	100	100
Marital status	Single	96	96
	Married	4	4
	Total	**100**	**100**

Table 2. Comparison of the measured parameters between non-bearded and bearded women.

Parameters	Non-bearded Mean ± S.D	Bearded Mean ± S.D	t-value	p-value
Glucose (mmol/L)	4.65 ± 0.84	4.80 ±1.14	−0.67	0.51
Cholesterol (mmol/L)	3.31 ± 0.89	4.41 ± 1.09	−3.03	0.005
Testosterone (ng/dL)	0.18 ± 0.06	0.22 ± 0.11	−1.14	0.270

Mean ± S.D = Mean ± Standard deviation, Not significant level ($P \geq 0.05$). Significant level ($P \leq 0.05$).

presence of androgens. In response to the increased levels of androgens at puberty, the vellus hairs in pubic and axillary areas of boys and girls develop into terminal hairs that are larger, curlier and darker [8] [9].

The significant increase in serum concentration of cholesterol coupled with the mean increase in serum testosterone support the biochemical basis of hirsutism anchored on elevated androgens. Testosterone synthesis is typically derived from cholesterol. Androgens may be generated via a de novo synthetic pathway from cholesterol to testosterone and dihydrotestosterone (DHT), and/or via a shortcut pathway from circulating dehydroepiandrosterone-sulfate (DHEAS) [10]. The major androgens in the serum of normal cycling women are DHEAS, dehydroepiandrosterone, androstenedione, testosterone and DHT, in descending order of serum concentrations [11]. The finding of this study is in line with the stances of other authors with respect to mean increase in testosterone in the bearded as compared to non-bearded [12] [13].

The significant increase in cholesterol concentration seen in bearded females' predisposes them to cardiovascular disease. Increase in concentration of serum cholesterol has remained a major contributor to heart diseases [14] [15] [16]. Though this stance is now interrogated, the narrative is still patronized in comity of research. The sex steroid, testosterone (T), is synthesized from cholesterol [17]. An increase in serum cholesterol concentration with a concomitant decrease in testosterone has been implicated in heart diseases [18] [19]. This is based on the premise of the inefficient utilization of cholesterol for the synthesis of testosterone. Testosterone concentrations in females are significantly lower when compared to their male counterparts [20]. In this instance, females lack the biochemical loop that easily converts cholesterol to testosterone for other metabolic processes. This might be one of the inefficiencies in the metabolism of cholesterol in females that culminates to a build-up that may be systematically disruptive. This could be the basis of the mean increase in testosterone, coupled with the significant increase in serum cholesterol in bearded females as revealed in this study.

There was also an increase in mean concentration of glucose in the bearded group when compared with the non-bearded. This could possibly point to the predisposition of bearded subjects to hyperglycaemia. Relationship between hirsutism and insulin resistance has been established by Talaei *et al.* [21]. The etiopathogenesis of hirsutism in instigating insulin resistance which is a classic component in diabetes is still unclear, although increased activity of peripheral 5-alpha reductase enzyme [22], androgen receptor gene polymorphism [23], and increased sensitivity of hair follicles to androgens have been proposed [24].

5. Conclusion

From the foregoing, there is the supportive assessment that hirsutism is the result of endocrine abnormality that potentially disrupt metabolic processes ultimately, initiating budding hypertestosteronemia, hypercholesterolemia and hyperglycemia in bearded females.

Author's Contribution

All authors contributed to the conception and design of the work. Conception and design, interpretation of the results and revisions were performed by Prof. M.M. Wankasi. Dr. E.S. Agoro performed data acquisition and analysis, and literature search and gathering. Dr. P.W. Alabrah did the statistical interpretation and case analysis. All authors read and gave final approval of the manuscript and are accountable for the originality of the work.

Source of Funding

The study was funded by the Department of Obstetrics and Gynaecology, Federal Medical Centre, Yenagoa, Nigeria and the Department of Medical Laboratory Science, College of Health Science, Niger Delta University, Wilberforce Island, Nigeria in conjunction with the Directorate of Research and Quality Assurance, Federal University Otuoke, Otuoke, Nigeria.

Ethical Approval

The study protocol was approved by the Directorate of Research and Quality Assurance of the Niger Delta University, Wilberforce Island, Bayelsa State, Nigeria. The ethical principles for medical research involving animal subjects as outlined in the Helsinki declaration in 1975 and subsequent revisions were strictly adhered to in the course of this study.

Acknowledgements

Special appreciation to Ms. Feboke Ebitamboere Abigail for the assistance in sample collection, literature gathering and typesetting. Similarly, an appreciation goes to Eni-Yimini Laboratories (eL), Ltd., Igbogene Epie, Yenagoa, Bayelsa State for the sample analysis and other research supports.

Conflicts of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

[1] Loriaux, D.L. (2012) An Approach to the Patient with Hirsutism. *The Journal of Clinical Endocrinology & Metabolism*, **97**, 2957-2968. https://doi.org/10.1210/jc.2011-2744

[2] Azziz, R., Sanchez, L.A., Knochenhauer, E.S., Moran, C., Lazenby, J., Stephens, K.C., Taylor, K. and Boots, R.L. (2004) Androgen Excess in Women: Experience with Over 1000 Consecutive Patients. *The Journal of Clinical Endocrinology & Metabolism*, **89**, 453-462. https://doi.org/10.1210/jc.2003-031122

[3] Pate, C. (2013) The Story Plot of Living the Embarrassment of Hirsutism. *Archives of Psychiatric Nursing*, **27**, 156-157. https://doi.org/10.1016/j.apnu.2013.02.003

[4] Bode, D., Seehusen, D.A. and Baird, D. (2012) Hirsutism in Women. *American Family Physician*, **85**, 373-380.

[5] Ochei, J. and Kolhatkar, A. (2008) Haematology. In: *Medical Laboratory Science Theory and Practice*, 10th Edition, Tata Mcgraw-Hill Publishing Company Limited, New Delhi, 188 p.

[6] Burtis, C.A., Ashwood, E.R., Bruns, D.E. and Tietz, N.W. (2014) Tietz Textbook of Clinical Chemistry and Molecular Diagnostics. 7th Edition, Elsevier/Saunders, St. Louis, 703-711.

[7] Araoye, M.O. (2004) Sample Size Determination. Research Methodology with Statistics for Health and Social Sciences. 1st Edition, Nathadex Publishers, Ilorin, 115-121.

[8] Reynolds E.L. (1951) The Appearance of Adult Patterns of Body Hair in Man. *Annals of the New York Academy of Sciences*, **53**, 576-584. https://doi.org/10.1111/j.1749-6632.1951.tb31959.x

[9] Marshall, W.A. and Tanner, J.M. (1969) Variations in Pattern of Pubertal Changes in Girls. *Archives of Disease in Childhood*, **44**, 291-303. https://doi.org/10.1136/adc.44.235.291

[10] Chen, W.C. and Zouboulis, C.C. (2009) Hormones and the Pilosebaceous Unit. *Dermato-Endocrinology*, **1**, 81-86. https://doi.org/10.4161/derm.1.2.8354

[11] Longcope, C. (1986) 1 Adrenal and Gonadal Androgen Secretion in Normal Females. *Clinics in Endocrinology and Metabolism*, **15**, 213-228. https://doi.org/10.1016/S0300-595X(86)80021-4

[12] Rosenfield, R.L. (2005) Hirsutism and the Variable Response of the Pilosebaceous Unit to Androgen. *Journal of Investigative Dermatology Symposium Proceedings*, **10**, 205-208. https://doi.org/10.1111/j.1087-0024.2005.10106.x

[13] Carmina, E., Rosato, F., Jannì, A., Rizzo, M. and Longo, R. (2006) A Extensive Clinical Experience. Relative Prevalence of Different Androgen Excess Disorders in 950 Women Referred Because of Clinical Hyperandrogenism. *The Journal of Clinical Endocrinology & Metabolism*, **91**, 2-6. https://doi.org/10.1210/jc.2005-1457

[14] Chen, Z., Peto, R., Collins, R., MacMahon, S., Lu, J. and Li, W. (1991) Serum Cholesterol Concentration and Coronary Heart Disease in Population with Low Cholesterol Concentrations. *British Medical Journal*, **303**, 276-282. https://doi.org/10.1136/bmj.303.6797.276

[15] Bush, T.L., Fried, L.P. and Barrett-Connor, E. (1988) Cholesterol, Lipoproteins, and Coronary Heart Disease in Women. *Clinical Chemistry*, **34**, B60-B70.

[16] Clark, L.T. (1986) Cholesterol and Heart Disease: Current Concepts in Pathogenesis and Treatment. *Journal of the National Medical Association*, **78**, 743-751.

[17] Eacker, S.M., Agrawal, N., Qian, K., Dichek, H.L., Gong, E.Y., Lee, K. and Braun, R.E. (2008) Hormonal Regulation of Testicular Steroid and Cholesterol Homeostasis. *Molecular Endocrinology*, **22**, 623-635. https://doi.org/10.1210/me.2006-0534

[18] Finkle, W.D., Greenland, S., Ridgeway, G.K., Adams, J.L., Frasco, M.A., Cook, M.B. and Hoover, R.N. (2014) Increased Risk of Non-Fatal Myocardial Infarction Following Testosterone Therapy Prescription in Men. *PLoS ONE*, **9**, Article ID: e85805. https://doi.org/10.1371/journal.pone.0085805

[19] Roth, J.A., Etzioni, R., Waters, T.M., Pettinger, M., Rossouw, J.E., Anderson, G.L. and Ramsey, S.D. (2014) Economic Return from the Women's Health Initiative Estrogen Plus Progestin Clinical Trial: A Modeling Study. *Annals of Internal Medicine*, **160**, 594-602. https://doi.org/10.7326/M13-2348

[20] Handelsman, D.J., Hirschberg, A.L. and Bermon, S. (2018) Circulating Testosterone as the Hormonal Basis of Sex Differences in Athletic Performance. *Endocrine Reviews*, **39**, 803-829. https://doi.org/10.1210/er.2018-00020

[21] Talaei, A., Adgi, Z. and Kelishadi, M.M. (2013) Idiopathic Hirsutism and Insulin Resistance. *International Journal of Endocrinology*, **2013**, Article ID: 593197. https://doi.org/10.1155/2013/593197

[22] Serafini, P. and Lobo, R.A. (1985) Increased 5α-Reductase Activity in Idiopathic Hirsutism. *Fertility and Sterility*, **43**, 74-78. https://doi.org/10.1016/S0015-0282(16)48320-2

[23] Sawaya, M.E. and Shalita, A.R. (1998) Androgen Receptor Polymorphisms (CAG Repeat Lengths) in Androgenetic Alopecia, Hirsutism, and Acne. *Journal of Cutaneous Medicine and Surgery*, **3**, 9-15. https://doi.org/10.1177/120347549800300103

[24] Nikolaou, D. and Gilling-Smith, C. (2005) Hirsutism. *Current Obstetrics & Gynaecology*, **15**, 174-182. https://doi.org/10.1016/j.curobgyn.2005.03.006