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Original Article

Dermatology Section

Cutaneous Correlates of Metabolic Syndrome and Its Components In Ogbomoso, Nigeria

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ABSTRACT

Introduction: Metabolic syndrome (MetS) has been associated with some skin disorders including psoriasis, acne vulgaris, hidradenitis suppurativa, androgenetic alopecia, atopic dermatitis and many others. Although metabolic syndrome is not a dermatological entity, but the increasing isolated reports of its association with cutaneous disorders is a reason for a cross sectional study of this nature.

Aim: To examine cutaneous correlates of MetS and its components as defined by National Cholesterol Education Program-Adult Treatment Panel (NCEP ATP) III criteria.

Materials and Methods: A cross-sectional study was conducted in which 197 apparently healthy male and non-pregnant female adults attending the General Outpatient Department (GOPD) of Ladoke Akintola University of Technology (LAUTECH) Teaching Hospital, Ogbomoso, Nigeria were included. MetS was diagnosed using NCEP-ATP III criteria and the participants' skin examined for cutaneous disorders. Univariate and multivariate logistic regression were utilised to demonstrate association between metabolic syndrome, its components and cutaneous disorders.

Results: The prevalence of MetS was 32.9%, of which 86.2% of participants were females. Skin disorders associated with MetS reflected the dominance of central obesity on other components. Flat feet (38.5%, p=0.005), and striae (32.3%, p=0.003) were significantly associated with metabolic syndrome in univariate analysis. Abdominal obesity was significantly associated with flat feet (42.7%, p<0.001), achrocordon and varicose veins (18.0% each, p=0.006), striae distensae (31.5%, p<0.001), candida intertrigo and erythrasma (12.4% each, p=0.001). Participants with Striae and flat feet had significant higher mean waist circumference (p<0.001), mean systolic blood pressure (p=0.022 and 0.034 respectively), diastolic blood pressure (p=0.013 and 0.019 respectively) and higher mean BMI (P<0.001). Flat feet was associated with significant higher mean total cholesterol (4.89±1.34 vs. 4.50±1.14, p=0.046) and LDL-c (3.34±1.25vs. 2.86±1.05, p=0.008). In multivariate analysis, the presence of flat feet predicts the odds of metabolic syndrome by 2.2 (95%CI-1.0-4.7, p=0.039) after adjustment of confounders.

Conclusion: We demonstrated that flat feet could be an indicator of underlying Metabolic syndrome in obese individuals. Striae distensae, flat feet, and candida intertrigo are significant correlates of abdominal obesity. Obese patients with flat feet are recommended for Metabolic syndrome screenings.

Keywords: Abdominal obesity, Flat feet, Metabolic Syndrome, Skin Diseases, Striae distensae

INTRODUCTION

Metabolic Syndrome (MetS) is the conglomeration of risk factors for cardiovascular diseases, of which emerging scientific evidences signify close association with some Skin Diseases (SDs) [1,2]. The scientific links between MetS and SDs is a subject of on-going investigations. The induction of chronic inflammation was initially thought as the bridging gap [2-4], but oxidative stress induction and the role of endocrine abnormalities were lately included as possible links between certain SDs, obesity and other components of MetS [2-4]. The list of cutaneous abnormalities found in this association has transcended the limits of chronic inflammatory diseases and autoimmune connective tissue diseases to include many cutaneous malignancies [2,3].

The induction of chronic inflammation seems to be the most supported hypothesis going by the available evidences [3-7]. Studies have shown similar pattern of pro- inflammatory cytokines elevated both in the setting of some dermatological diseases as well as in MetS [2,3]. Some drugs like methotrexate and TNF-α antagonist that were prescribed for the treatment of certain skin diseases also successfully reduced the levels of cytokines associated with MetS, insulin resistance, and cardiovascular risk factors [5]. The metabolic disequilibrium in the sebum and in certain endocrine organ has been associated with dyslipidemia and MetS [3,7-9].

To this end, inflammatory SDs including psoriasis, Atopic Dermatitis (AD), acne inversa, skin tags, androgenic alopecia, lichen planus, Systemic Lupus Erythematosus (SLE) and skin cancers have been associated with MetS [2,10]. Holzer G et al., in a recent review opined that, although MetS is not a dermatological diagnosis, but several cutaneous manifestations could serve as a clinical indicator of impending MetS and facilitate an early diagnosis, treatment and prevention of long-term consequences [10].

To the best of authors knowledge, no cross sectional study has been conducted to examine cutaneous correlates of MetS. The present study is therefore aimed at the identification of cutaneous markers of MetS and its components. The study was necessary because the findings will be useful in the multidisciplinary approach to the management of morbidities and prevention of related mortality to MetS.

MATERIALS AND METHODS

This cross-sectional study was conducted at the GOPD of the LAUTECH, Teaching Hospital, Ogbomoso, Nigeria between August 2013 and July 2014. The study was approved by the Research Ethics Committee of the LAUTECH Teaching Hospital, Ogbomoso, Oyo State, Nigeria.

Every apparently healthy alternate adult attending the GOPD for non-cutaneous complaints were recruited until the sample size of study subjects was completed. The sample size was estimated

using the Lwanga and Lewoshow equation and the table for case-control studies [11]. A minimum sample size of 63 participants was required for the cases and the control population. Inclusion criteria for subjects included those consenting and apparently healthy, non-pregnant adults (age >18 year) that fulfilled the NCEP-ATP III criteria for the diagnosis of MetS. We included those adults that fulfill the same conditions, but that did not meet NCEP-ATP III criteria as the control population. We excluded non-consenting adults, those with acute medical or surgical illness, known patients with systemic hypertension, diabetes mellitus, and lipid disorders. Adults presently on anti -lipid agents, steroid cream or tablets, individuals with known Chronic Liver Disease (CLD), Chronic Kidney Diseases (CKD) and Acquired Immunodeficiency Syndrome (HIV/AIDS) were excluded.

Clinical Evaluation: The study participants completed a semi-structured questionnaire on socio-demographic characteristics, self-reported their smoking habit and general wellness status. Clinical questions related to morbidities of obesity such as breathlessness, body aches, and arthralgia of large joints was also documented. Anthropometric characteristics of participants were assessed using standard methods defined in Anthropometry Procedures Manual of the National Health and Nutrition Examination Survey (NHANES) [12]. With the aid of a stadiometer, the height of the participants was measured to the nearest 0.1 cm. Weight was checked using a weighing scale and recorded to nearest 0.1 kg. The waist circumference was taken at the midpoint between the lower margin of the last palpable rib and the top of the iliac crest [13]; the hip circumferenceis taken at the widest portion of the buttocks, with the tape parallel to the floor [13]. All measurement was taken using a stretch-resistant tape measure. Body mass index was calculated using the formula weight/ height^2 (kg/m^2). The Blood Pressure (BP) readings were obtained from every participant using the A and D UA 767 electronic manometer validated by the British Hypertension Society [14]. For all the measurements, researchers obtained two recordings, and an average was recorded as the study data. A Dermatologist under clear daylight specifically examined for skin disorders associated with the components of MetS. Most dermatological diagnoses were made clinically. Skin biopsy, scrapings, nail clipping for microscopy, culture, and sensitivity were done as necessary to exclude differentials. Flat feet were diagnosed clinically, participants were asked to remove their shoes and stand on a flat surface in full weight bearing position. The feet were examined from the front and back and participants were asked to stand on their toes. The loss of arches that brings the sole to a complete or near-complete contact with the ground indicated the presence of flat feet [15].

Laboratory evaluation: Five milliliters each of fasting venous blood was taken from participants after 8-12 hours overnight fasting for the analysis of Fasting Plasma Glucose (FPG), Total Cholesterol (TC), Triglycerides (TG), High-Density Lipoprotein cholesterol (HDL-c), and Low-Density Lipoprotein cholesterol (LDL-c).

Diagnosis of Metabolic Syndrome: The diagnosis of metabolic syndrome was made using the guideline of the NCEP-ATP III definition of metabolic syndrome. Abdominal obesity is defined by WC ≥102 cm (40 inch) in men and ≥88 cm (35 inch) in women; Serum TG; ≥150 mg/dL (1.7 mmol/L); HDL-C; <40 mg/dL in men (1.03 mmol/L) and < 50 mg/dL (1.29mmol/L) in women; blood pressure: ≥ 130 mmHg systolic or ≥ 85 mmHg diastolic; FPG level of ≥110 mg/dL (6.1 mmol/L). The presence of any three of the above traits in the same individual was recorded as MetS for the study [1].

STATISTICAL ANALYSIS

All categorical variables were analysed using Chi-Square statistics and same represented in fraction and percentages. Fischer exact statistics was utilized as indicated. The continuous variable of interest was analysed using student t-test and results were presented as means and standard deviations. The association between MetS and its components with striae distensae and flat feet was also examined in univariate analysis. To establish an association between MetS, clinical variables and skin diseases, variables that showed significance in univariate analysis were included in the multivariate models. The presence or the absence of MetS and abdominal obesity were set as dependent variables, and the significant predictors in the corresponding univariate analysis were entered into the regression models. The model for MetS was corrected for age and gender while the model for predictors of abdominal obesity was adjusted for type 2 Diabetes Mellitus (DM), age, and gender. All results of interest were presented in tables. Statistics with p<0.05 was taken as significant.

RESULTS

The study recruited 197 consenting adults, of which 65 met the NCEP ATP III criteria for MetS and were included as study subjects while 132 participants that did not meet the NCEP ATP III MetS criteria were included as the control population.

[Table/Fig-1] shows socio-demographic and clinical characteristics of the study participants. The participants were mostly females 139/197 (70.6%) with a mean age of 53.37±17.8 years. No significant age, education and smoking difference existed between MetS subjects and the control population. The MetS population significantly had joint pains (40.0% vs 20.5%, p=0.004), hypertension (67.7% vs 39.4%, p<0.001), diabetes mellitus (53.8% vs. 21.2%, p<0.001), dyslipidemia (93.8% vs. 62.1%, p<0.001) and abdominal obesity (72.3% vs. 31.8%, p<0.001) compared to the controls. Similarly, participants with MetS have significantly lower mean HDL-c (p<0.001) and higher fasting plasma glucose (p<0.001) compared to the controls.

Two hundred and twenty three Skin Diseases (SDs) were noted among 197 participants with a mean occurrence of skin diseases of 1.13. [Table/Fig-2] shows the prevalence of cutaneous disorders in MetS. Of all the documented SDs in MetS subjects, Striae distensae significantly increased the odds of associated MetS by 2.8, (95% confidence intervals: 1.4-5.8, p=0.003) and flat feet increased the same by 2.5, (95% confidence intervals: 1.3-4.9, p=0.005) in univariate analysis. In multivariate analysis, after correction for age and gender, flat feet remained the only significant predictor of underlying MetS, (OR =2.2, 95% confidence intervals: 1.0 – 4.7, p=0.039).

The prevalence and cutaneous correlates of abdominal obesity are as shown in [Table/Fig-3]. Flat feet (42.7%), striae distensae (31.5 %), acrochordon (18.0%), varicose veins (18.0%), erythrasma (12.4%), and Candida intertrigo (12.4%) were the leading dermatoses. Flat feet was significantly associated with abdominal obesity and increased its odds by 5.4 (95% confidence intervals: 2.7-11.1, p<0.001), striae distensae also was significantly associated with central obesity and increased its odds by 3.7, (95% confidence intervals: 1.7– 7.8, p<0.001), candida intertrigo and erythrasma increase same by 15.1, (95% confidence intervals: 2.0– 119.3, p=0.002 respectively) and achrocordon by 3.7, (95% Confidence Interval:1.4- 10.0, p=0.006). The multivariate model for cutaneous correlates of abdominal obesity that corrected for age, gender and type 2 DM did not fit and was not considered further. There was no cutaneous disorder associated with impaired fasting/type 2 DM and dyslipidemia in univariate analysis.

The cohort of participants with Striae distensae and flat feet were evaluated further to find out the peculiarities of the group in relation to the components of MetS. The prevalence of MetS is slightly higher among patients with Striae distensae (52.2% vs. 49.0%) compared to those with flat feet. The patients with Striae distensae and flat feet were both significantly obese (p<0.001) and had higher mean SBP and DBP (p= 0.022, 0.013 vs. 0.034, 0.019 respectively) compared to those without the disorders. Meanwhile, participants with flat feet were more likely to run a wider waist circumference (p<0.001) and

Variables	Total (197)	Metabolic Syndrome (65)	Control (132)	OR (95%CI)	p-value
Mean Age±SD	53.37±17.8	56.6±16.6	51.8±18.2	-0.6-10.0	0.081
Gender					
Male	58 (29.4)	9 (13.8)	49 (37.1)	0.3 (0.1-0.6)	0.001
Female	139 (70.6)	56 (86.2)	83 (62.9)		
Ethnicity					
Yoruba	191 (97.0)	64 (98.5)	127 (96.2)	2.5 (0.2-2.0)	0.388
Non Yoruba	6 (3.0)	1 (1.5)	5 (3.8)		
Education					
Lower than primary	78 (39.6)	30 (46.2)	48 (36.4)	1.5 (0.8-2.7)	0.216
Primary and higher	119 (60.4)	35 (53.8)	84 (63.6)		
Smoking	12 (6.1)	1 (1.5)	11 (8.3)	0.2 (0.02-1.3)	0.062
Co-morbidities					
Feeling of unwell	71(36.0)	29 (44.6)	42 (31.8)	1.7 (0.9-3.2)	0.079
Breathlessness	30 (15.2)	11 (16.9)	19 (14.4)	1.2 (0.5-2.7)	0.627
Body aches	79 (40.1)	28 (44.6)	51 (38.3)	1.2 (0.7-.2.1)	0.555
Joint pains	53 (26.9)	26 (40.0)	27 (20.5)	2.6 (1.3-5.0)	0.004
Clinical Parameters					
Clinical systemic hypertension	96 (48.7)	44 (67.7)	52 (39.4)	3.2 (1.7-6.0)	<0.001
Abdominal Obesity	89 (45.2)	47 (72.3)	42 (31.8)	5.6 (2.9-10.8)	<0.001
Dyslipidemia	143 (72.6)	61 (93.8)	82 (62.1)	9.2 (3.2-27.1)	<0.001
Impaired Fasting and Diabetes Mellitus (%)	63 (32.0)	35 (53.8)	28 (21.2)	4.3 (2.3-8.2)	<0.001
Mean BMI±SD (kg/m^2)	26.90±6.92	29.97±7.63	25.37±6.02	7.3-15.0	<0.001
Mean WC±SD (cm)	91.10±14.00	98.60±13.44	87.35±12.27	2.6-6.5	<0.001
Mean HC±SD (m)	98.30±13.20	103.75±14.68	95.59±11.47	4.4-11.9	<0.001
Mean SBP±SD (mmHg)	135.02±22.99	146.54±22.33	129.34±21.18	10.7-23.6	<0.001
Mean DBP±SD (mmHg)	82.80±6.92	88.64±9.97	79.89±11.95	5.4-12.1	<0.001
Laboratory Parameters					
Mean TC±SD (mmol/L)	4.60±1.20	4.41±0.98	4.70±1.30	-0.6- 0.06	0.112
Mean TGC±SD (mmol/L)	1.19±0.42	1.25±0.33	1.12±0.46	-0.0-.24	0.055
Mean HDL-c±SD (mmol/L)	1.10±0.48	0.90±0.27	1.21±0.53	-0.4- -0.2	<0.001
Mean LDL-c±SD (mmol/L)	2.98±1.11	2.94±0.93	3.00±1.20	-0.4- -0..3	0.701
Mean FPG±SD (mmol/L)	8.53±4.38	8.27±6.44	5.67±2.48	1.3- 3,9	<0.001

[Table/Fig-1]: Social, demographic and clinical characteristics of study participants.
HDL-c-High density lipoprotein cholesterol; LDL-c-Low density lipoprotein cholesterol; TC-Total Cholesterol; TGC- Triglyceride; FBS-Fasting plasma glucose; SBP-Systolic blood pressure; DBP-Diastolic blood pressure; HC-Hip circumference; WC-waist circumference; BMI-Body mass index; SD-standard deviation. p-value estimated using student t-test for continuous variables and chi square statistics for categorical variables.

Cutaneous Disorders		Total (%) (197)	Metabolic Syndrome (65)	Control (132)	Univariate OR (95% CI)	p-value	Multivariate OR (95% CI)	p-value
Pseudo acanthosis Nigrican	Yes	5 (2.5)	3 (4.6)	1 (1.5)	3.1 (0.5-19.3)	0.334		
	No	192 (97.5)	62 (95.4)	131 (98.5)				
Achrocordion	Yes	22 (11.2)	8 (12.3)	14 (10.6)	1.2 (0.5-3.0)	0.721		
	No	175 (88.8)	57 (87.7)	118 (89.4)				
Striae distensae	Yes	40 (20.3)	21(32.3)	19 (14.3)	2.8 (1.4-5.8)	0.003	1.6 (0.7-3.8)	0.243
	No	157 (79.7)	44(67.7)	113 (85.6)				
Chronic Venous Insufficiency	Yes	2 (1.0)	1 (1.5)	1 (0.8)	2.0 (0.1-33.2)	1.000		
	No	195 (99.0)	64 (98.5)	131 (99.2)				
Plantar Hyperkeratosis	Yes	3 (1.5)	1 (1.5)	2 (1.5)	1.0 (0.09-11.4)	1.000		
	No	194(98.5)	64 (98.5)	130 (98.5)				
Erythrasma	Yes	12 (6.1)	4 (6.2)	8 (6.1)	1.0 (0.3-3.5)	1.000		
	No	185(93.9)	61 (93.8)	124 (93.9)				
Flat feet	Yes	51(25.9)	25 (38.5)	26 (19.7)	2.5 (1.3-4.9)	0.005	2.2 (1.0-4.7)	0.039
	No	146 (74.1)	40 (61.5)	106 (80.3)				
Varicose veins	Yes	23(11.7)	8 (12.3)	15 (11.4)	1.1 (0.4-2.7)	0.846		
	No	174 (88.3)	57 (87.7)	117 (88.6)				
Hyperandrogenism	Yes	7 (3.6)	1 (1.5)	6 (4.5)	0.3 (0.03-2.8)	0.284		
	No	190 (96.4)	64 (98.5)	126 (95.5)				
Candida Intertrigo	Yes	12(6.1)	5 (7.7)	7 (5.3)	1.5 (0.5-4.9)	0.510		
	No	185 (93.9)	60 (92.3)	125 (94.7)				
Folliculitis	Yes	4 (2.0)	3 (4.6)	1 (0.8)	6.3 (0.6-62.1)	0.106		
	No	193 (98.0)	62 (95.4)	131 (99.2)				
Leg ulcers	Yes	3 (1.5)	2 (3.1)	1 (0.8)	4.2 (0.4-46.7)	0.254		
	No	194 (98.5)	63 (96.9)	131 (99.2)				

[Table/Fig-2]: Prevalence and cutaneous correlates of NCEP-ATP III metabolic syndrome.

Cutaneous Disorders	Total (%) (197)	Abdominal Obesity (89)	Control (108)	Univariate OR (95% CI)	p-value
Pseudoacanthosisnigrican Yes No	 5 (2.5) 192 (97.5)	 4 (4.5) 85 (95.5)	 1 (0.9) 107 (99.1)	5.0 (0.6-45.8)	0.177
Achrocordion Yes No	 22 (11.2) 175 (88.8)	 16 (18.0) 73 (82.0)	 6 (5.6) 102 (94.4)	3.7 (1.4-10.0)	0.006
Striae distensae Yes No	 40 (20.3) 157 (79.7)	 28 (31.5) 61 (68.5)	 12 (11.1) 96 (88.9)	3.7 (1.7-7.8)	<0.001
Candida Intertrigo Yes No	 12 (6.1) 185 (93.9)	 11 (12.4) 78 (87.6)	 1 (0.9) 107(99.1)	15.1 (2.0-119.3)	0.001
Erythrasma Yes No	 12 (6.1) 185 (93.9)	 11 (12.4) 78 (87.6)	 1 (0.9) 107(99.1)	15.1 (1.9-119.3)	0.001
Folliculitis Yes No	 4 (2.0) 193 (98.0)	 3 (3.4) 86 (96.6)	 1 (0.9) 107 (99.1)	3.7(0.4-36.5)	0.330
Plantar Hyperkeratosis Yes No	 3 (1.5) 194 (98.5)	 1 (1.1) 88 (98.9)	 2 (1.9) 106 (98.1)	0.6 (0.05-6.7)	1.000
Leg ulcer Yes No	 3 (1.5) 194 (98.5)	 1 (1.1) 88 (98.9)	 2 (1.9) 106 (98.1)	0.6 (0.05-6.7)	1.000
Flat fee Yes No	 51 (25.9) 146 (74.1)	 38 (42.7) 51 (57.3)	 13 (12.0) 95 (88.0)	5.4 (2.7-11.1)	<0.001
Varicose veins Yes No	 23 (11.7) 174 (88.3)	 16(18.0) 73 (82.0)	 7 (6.5) 101 (93.5)	3.2 (1.2-8.1)	0.012
Hyperandrogenism Yes No	 7 (3.6) 190 (96.4)	 5 (5.6) 84 (94.4)	 2 (1.9) 106 (98.1)	3.2 (0.6-16.7)	0.155

[Table/Fig-3]: Prevalence and cutaneous correlates of abdominal obesity.

Variables	Striae distensae			Flat Feet		
	Present	Absent	p-value	Present	Absent	p-value
Mean Age±SD (years)	51.4±17.2	53.9±18.0	0.433	51.5±13.4	54.0±19.1	0.376
Mean TC±SD (mmol/L)	4.63±1.22	4.59±1.20	0.855	4.89±1.34	4.50±1.14	0.046
Mean TGC±SD (mmol/L)	1.14±0.41	1.17±0.43	0.635	1.16±0.41	1.17±0.44	0.890
Mean HDL±SD (mmol/L)	1.02±0.34	1.12±0.51	0.212	1.03±0.41	1.13±0.50	0.206
Mean LDL±SD (mmol/L)	3.09±1.13	2.96±1.12	0.506	3.34±1.25	2.86±1.05	0.008
NCEP Metabolic Syndrome (%)	21 (52.5)	44 (28.0)	0.003	25 (49.0)	40 (27.4)	0.005
Mean WC±SD (cm)	98.5±13.5	89.2±13.5	<0.001	99.92±15.49	87.96±12.02	<0.001
Mean FPG±SD (mmol/L)	7.54±6.55	6.27±3.60	0.646	6.51±4.65	6.54±4.29	0.966
Mean SBP±SD (mmHg)	142.44±20.42	133.13±23.27	0.022	140.87±22.68	132.97±22.81	0.034
Mean DBP±SD (mmHg)	87.0±13.08	81.7±11.57	0.013	86..17±13.06	81.59±11.50	0.019
Mean BMI±SD (kg/m^2)	30.54±7.69	25.96±6.41	<0.001	32.20±8.09	25.03±5.36	<0.001

[Table/Fig-4]: The association between striae distensae flat feet and components of MetS.

had significantly higher mean total cholesterol (p=0.046) and LDL-c (p=0.008) [Table/Fig-4].

DISCUSSION

The present study showed that flat feet are significant predictor of the presence of MetS after correction for age and gender. In addition, Striae distensae, flat feet, and candida intertrigo are a significant associate of central obesity. We found the prevalence of MetS in the present study to be 65/197 (32.9%) and that of its components: dyslipidemia 143/197(72.6%), abdominal obesity 89 (45.2%), systemic hypertension 96(48.7%), and impaired fasting and diabetes mellitus 63(32.0%).

Flat feet, also known as pes planus is a significant predictor of MetS and a correlate of obesity in the present study. Studies have previously documented flat feet as a physical evidence of overweight and obesity which started from childhood [16]. It has been shown that flat feet resulted from pressure effect of weight gain rather than mere accumulation of fat in the feet. Flat feet in the overweight and obese children were not due to mid-plantar fat pad deposition but prolonged weight bearing effect on the plantar arch [16]. In the present study in addition to obesity and MetS, flat feet are associated with dyslipidemia including higher mean serum total cholesterol and LDL-c. Among children of school age, flat feet was associated with age, weight status, and male gender. Obese children with flat feet are more likely to develop flat feet as adults [17]. A previous study documented a of prevalence of 22.0% among school age children [18], a prevalence which is lower compared to both 38.5%, and 42.7% observed among our participants with MetS and obesity. The presence of flat feet in obese individuals could be an indication for screening for underlying MetS and other cardiovascular risk factors

in dark skin population. Other documented disorders related to the pressure effect of obesity include plantar hyperkeratosis, chronic venous insufficiency; lymphedema and adipose dolorosa [18,19]. Disorders such as psoriasis and hidradenitis suppurativa which have been associated with MetS [9], but infrequent in the general tropical population were not documented in association with MetS in this study population.

Striae distensae significantly increased the odds of abdominal obesity by 3.9 when present on the participants' skin. The fact that pregnant women and those adults on all forms of steroid and other bleaching agents that could cause striae distensae were excluded gave further credence to our findings. Studies have shown that the mass effect of fat accumulation in the body areas prone to such collection is responsible for the stretching of the skin along the cleavage lines perpendicular to the direction of greatest force to produce striae distensae [19,20]. Sudden weight gain is important for the development of striae [19,20]. Striae distensae were mostly observed in the arms, gluteal, and the lateral part of the thighs which are fat accumulation prone regions following increase weight gain. Studies have shown that, the location of striae distensae depends on circumstance surrounding their formation. It will be difficult to completely exclude the impact of past pregnancies in the formation of striae distensae documented in our study among the female participants who had completed their family [21-23]. Some of the women had striae distensae in documented regions where striae gravidarum could be present; such locations include the abdomen, the breast, and thighs [20-23]. However, this might not be the case, because study has shown that prior striae distensae in the same area (abdomen, breast, and thighs) is also a known risk factor for the development of striae during pregnancy [20-23]. The prevalence of striae distensae varies with population studied and the location of the survey [20-26]. In present study, the prevalence of striae distensae (32.3%) in MetS is close to an average of 35.0% documented among non- pregnant women by Al-Himdani S et al., [20]. Apart from the association between MetS and striae distensae as shown in this study, striae distensae have been associated with low serum relaxin level, pelvic relaxation [27], prolapsed [28], and poor quality of life [29].

Obesity as a component of NCEP ATP III MetS is associated with some infectious and non-infectious cutaneous diseases in the present study. flat feet (42.7%), striae (31.5%), varicose veins (18.0%), acrochordon (18.0%), erythrasma (12.4%) and candida intertrigo (12.4%) are the six leading dermatoses. The first three cutaneous disorders could be attributed to the mechanical effect of obesity [20], the high prevalence of erythrasma and candida albican are not unconnected with the sub-tropic weather condition that favour growth of organisms, moisture generation, maceration and inflammation in skin creases [24,25,30]. Boza JC et al., also found striae distensae, pseudoacanthosisnigrican and bacterial infection as significant correlates of obesity [25]. The prevalence of skin diseases associated with MetS documented in our study reflect the dominant effect of obesity on other components of MetS. Baselga TE and Torres PM, opined the prevalence of skin diseases in obesity depends on the time elapsed since diagnosis of obesity and diabetes mellitus [26]. Therefore, the longevity of obesity, the severity of obesity and extent of insulin resistance in the sampled population might be responsible for the variations in the proportion of observed skin diseases noted in different studies [24-26].

Concerning evidence of insulin resistance and the cutaneous proof of dyslipidemia in this study, we did show in similarity to Boza JC et al., that central obesity is associated with acrochordon, however, no such association was shown between acrochordon and type 2 diabetes mellitus in the present study [25]. Wali V and Wali VV, also found a correlation between acrochordon, higher levels of TGC, LDL, Very Low-Density Lipoprotein cholesterol (VLDL), leptin, glucose, and glycated haemoglobin [31]. Pseudo acanthosisnigrican is another known evidence of insulin resistance that is usually found in association with achrocordons [24-26], but had no significant association with central obesity and impaired blood sugar and or type 2 DM in this study. Hyperandrogenism although documented, but was not of statistical significance in their association with impaired blood sugar and DM nor central obesity in this study. The explanations for the difference in findings could include the fact that the present study was based in a general outpatient setting and included cases of mild to moderate obesity with an overall mean BMI of 26.90±6.92 kg/m^2. The severity of obesity likely influence the prevalence of impaired fasting glucose/type 2 diabetes and dyslipidemia in the present study in difference to studies conducted among diabetes mellitus patients. Impaired fasting glucose/ type 2 diabetes and dyslipidemia are seen as consequences of obesity. Therefore, it is not strange, that skin evidences of MetS is predominated by obesity prominently in this study.

The prevalence of MetS in this study is 32.9% (65/197). The prevalence of its components: dyslipidemia 143 (72.6%), abdominal obesity 89 (45.2%), systemic hypertension 96 (48.7%), and impaired fasting and diabetes 63 (32.0%) are higher but comparable to findings of Sabir AA et al., in the North Western Nigeria [32]. As found in this study, dyslipidemia was the prevalent component of MetS while impaired fasting blood sugar was the least common. This finding is in agreement with previous studies that sampled apparently normal population [32,33]. The variations in the prevalence of MetS and its components in studies has been attributed to the criteria for diagnosis of MetS [34]. The finding of dyslipidemia of normal triglyceride relative to low HDL cholesterol among the African descent known as triglyceride paradoxseen in this study and demonstrated by others [35] could suggest the need for a different definition for dyslipidemia among dark skin people. A Study of skin markers of MetS is relatively new but could be a necessary, easy and cheaper preventive tool in predicting underlying MetS from cutaneous perspective.

LIMITATION

The study was hospital -based, the sample might not be representative of the population in Ogbomoso, and its broader generalization is therefore limited. The number of cases of metabolic syndrome included in the present study was the minimum required and this has implications on the statistical strength of the study. However, despite these limitations, this kind of study was still relevant in the resource-limited settings.

CONCLUSION

The presence of flat feet was a significant predictor of underlying MetS. Obesity was associated with striae distensae, candida intertrigo, and flat feet. Skin disorders documented in the present study reflected the dominant role of obesity on other components of MetS, and the pattern found in the darkly pigmented skin is similar to the findings documented elsewhere in the world except in those skin diseases not known to be prevalent in our environment. In addition to obesity and MetS, flat feet are significantly associated with higher mean TC and LDL-C. The presence of flat feet in obese individual could be seen as a window to suggest the presence of MetS and screening for the other cardiovascular risk factors.

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