Influence of Anthropometric Variables on the Efficacy of Two Antimicrobial Adjuncts to Non-Surgical Periodontal Therapy in Individuals with Concomitant Hypertension and Periodontitis

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ABSTRACT

Background: Adiposity is an important determinant in the relationship between periodontal and systemic health. Some studies underscored the importance of antimicrobial agents as adjuncts to non-surgical periodontal therapy (NSPT) in managing periodontitis in individuals with concomitant systemic diseases.

Objective: To assess the influence of body mass index (BMI) and waist-to-hip ratio (WHR) on the efficacy of two antimicrobial regimens used as adjuncts to NSPT in hypertensive subjects with periodontitis.

Methods: Sixty participants randomly allocated into two groups were treated with NSPT, but group A had adjunctive amoxicillin/metronidazole while group B had doxycycline. The burden of periodontal and systemic inflammation was assessed using the periodontal inflamed surface area (PISA) and serum high sensitivity capsid-reactive protein (hs-CRP) levels respectively. Systolic (SBP) and diastolic (DBP) blood pressures were also measured.

Results: There was no significant correlation between BMI and WHR and any of hs-CRP, PISA or SBP in both groups at baseline and three months after intervention. However existing relationship between non-obese and obese WHR, as well as between overweight and obese BMI categories and DBP at baseline in group A were gone at three months in both WHR categories and the overweight BMI, but persisted in the obese BMI categories. Conversely, correlations between both the overweight and obese BMI categories and DBP appeared at three months in group B. The significant predictors of BMI were gender and DBP, but only gender for WHR.

Conclusion: The study revealed that BMI had a greater negative influence on the efficacy of adjunctive antimicrobials to NSPT than WHR in individuals with hypertension and periodontitis, which was worse among the doxycycline group.

Keywords: Anthropometric variables, antimicrobial adjuncts, non-surgical periodontal therapy, periodontitis, hypertension

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INTRODUCTION

Periodontitis could be defined as a plaque-induced immuno-inflammatory disease of the dental supporting tissues characterized by destruction of periodontal attachment, alveolar bone loss, periodontal pocket formation, which may also involve recession of the gingiva.[1] The associated inflammation and the immune response to plaque microorganisms in periodontitis are characterized by cytokine release, destruction of the attachment apparatus and influx of bacterial products into the blood circulation.[2] The result is disruption of arterial elasticity, endothelial dysfunction, atheroma formation and thrombosis, which play some roles in the initiation and progression of hypertension.[2]

Studies have revealed that periodontal therapy has beneficial effects not only on the periodontal tissues but also on systemic health, including cardiovascular health.[3,4] Assuming the overspill hypothesis of periodontal inflammation into the general circulation is true, then the resolution of periodontal inflammation that follows successful therapy should reduce the burden of systemic inflammation. This link between periodontal and systemic inflammation is a major factor that links periodontal disease to systemic disorders such as hypertension.[2,4] The use of antimicrobial medications as adjuncts to mechanical therapy, which is the mainstay of non-surgical periodontal therapy, is particularly considered necessary when systemic disease exists along with periodontitis.[5,6] Amoxicillin and metronidazole in combination is the most evaluated regimen in past studies.[1,2,5] The present study is focused on the influence of anthropometric variables, particularly body mass index (BMI) and waist-to-hip ratio (WHR) on the efficacy of the combination of amoxycillin and metronidazole compared with doxycycline alone as adjunct to NSPT.

Obesity has been adjudged the second most important risk factor for inflammatory periodontal disease apart from smoking.[7] This necessitated study to assess the influence of the measures of adiposity (BMI and WHR) on the effects of the studied antimicrobial regimens on the outcome variables-periodontal inflamed surface area (PISA), serum high sensitivity capsid-reactive protein (hsCRP) as well as systolic blood pressure (SBP) and diastolic blood pressure (BDP).

Surgical periodontal therapy with either of the adjunctive antibiotic regimens under study, amoxicillin/metronidazole versus doxycycline, on periodontal inflammation, systemic inflammation and blood pressure was assessed. Periodontal inflammation was represented as PISA while the systemic inflammation was assessed using hsCRP as a marker. The body mass index (BMI) was used as a measure of general adiposity/total body fat and the waist-to-hip ratio (WHR) as a measure of central/visceral adiposity.

MATERIALS AND METHODS

Sixty consecutive participants were recruited from the periodontology clinic of the University College Hospital, Ibadan, Oyo State, Nigeria and allocated into either of two groups, A and B, by block randomization. Only individuals diagnosed with concomitant periodontitis and hypertension, but no other systemic illnesses were recruited. All recruited participants were already on antihypertensives. Participants had full mouth periodontal examination, which was used to calculate PISA and 4mls venous blood was collected for the estimation of serum levels of hsCRP. Blood pressure assessment was done by measuring the SBP and DBP after a minimum of 5 minutes rest while comfortably seated and their feet flat on the floor. Weight and height measurements of participants were done with Hospibrand ZT-120 balance weight scale with height meter. Participants were pre-informed to present to the clinic wearing light clothing and were assessed with no footwear, no wristwatch and nothing in their pockets. Subjects' heights were measured and recorded in meters (M) while their weights were also measured and recorded in Kilograms (Kg).[8] The body mass index (BMI) for each participating subject was derived by dividing the value of their weight by the square of their height,[8] expressed in Kg/M^2.

Measurement of waist-to-hip ratio was done using the world health organization's STEPwise approach to surveillance (STEPS) protocol, simply called the WHO STEPS protocol.[9] Participants were asked to fast overnight or at least eight hours and measurement was taken early the following morning. The advice on fasting was to avoid the

influence of stomach fullness on measurements, especially of waist circumference. The waist circumference was measured by placing the measuring tape around the approximate midpoint between the lower border of the last rib that could be palpated and the summit of the iliac crest. The hip circumference was measured by placing the tape around the widest portion of the buttocks.[9] For either of waist or the hip circumference measurements, subjects were asked to stand, with the upper limbs placed on either side and the feet placed close together to make the weight distributed evenly across the feet. A stretch-resistant measuring tape was snugly placed on participants around the portion being measured, parallel to the floor, without causing any form of constriction. The measurement reading was taken at the end of normal (unforced) expiration, after subject has been allowed to breathe in- and out severally, in a relaxed, unstrained position.[9]

Non-surgical periodontal therapy was then done for all participants within 24-48 hours of taking the baseline measurements of anthropometric, periodontal parameters and blood pressure. Scaling of the teeth was done followed by root planing under local anaesthesia using 2% lignocaine hydrochloride with 1:100,000 adrenaline. Adjunctive antimicrobial medications were given to the participants following NSPT, with group A participants placed on amoxicillin/metronidazole and Group B participants placed on doxycycline.

Statistical package for social sciences (SPSS) version 26 was employed in data analysis**.** Because some anthropometric variables such as WHR are gender-dependent, analysis relating to WHR and to the relationship between it and the outcome variables were done after the WHR data for male and female subjects in each study group had been categorized accordingly. Measure of general adiposity (BMI) was stratified into 3 categories: underweight/normal weight (BMI of <18.5 to 24.9 Kg/M^2), overweight (BMI of 25.0-29.9 kg/M^2) and obese (BMI of 30.0-39.9 kg/M^2). Measure of visceral adiposity (WHR) was stratified into 2 categories: non-obese (WHR of ≤ 0.85 in women and ≤ 0.9 in men) and obese (WHR of >0.85 in women and >0.9 in men. The underweight and normal weight BMI categories were grouped together because only one participant in this study fell into the underweight category and a group for morbid obesity was not considered because none of the study participants was morbidly obese.

Normality tests revealed that the outcome variables: hsCRP, PISA, systolic blood pressure and diastolic blood pressure, as well as the independent variables, namely the BMI and WHR, were all skewed. Independent T-test was used to test for the difference between BMI of the two study groups. Mann-Whitney U test was used for intergroup comparisons, while Wilcoxon Signed Rank test was employed for intragroup comparisons. Spearman's rank test was used for correlations between different variables. Statistical significance was assumed at $p \leq 0.05$.

In addition, stepwise multiple linear regression analysis of the data collected for the study was done. Each of the outcome variables-periodontal inflamed surface area (PISA), high sensitivity C-reactive protein (hsCRP), BMI and WHR were taken in turn as the dependent variable for the regression and were regressed on Age, Gender, Educational status, Income level, Study group patient belonged to (Amoxicillin/metronidazole or Doxycycline group), SBP, PISA, hsCRP, DBP, BMI, WHR, antihypertensive drug(s) used, compliance to drug use, diet and exercise. Ethical approval, numbered NHREC/05/01/2008a was obtained from the joint institutional review committee of the University of Ibadan/University College Hospital (UI/UCH) Ibadan, Nigeria. Written informed consent from each participant was also obtained before commencing the study.

RESULTS

A total of 60 participants, 31 (51.7%) females and 29 (48.3%) males, took part in the study. Age of participants ranged from 25 to 75 years, with a mean (± SD) of 55.8 ± 12.3 years for those in group A (amoxicillin/metronidazole) and 58.7 ± 10.4 years for those in group B (doxycycline). Most of the study participants, 51 (85%) were married, 1 (1.7 %) was single and another 1 (1.7%) was divorced. A considerable number of participants, 35 (58.3%), had tertiary/postgraduate education, while 11 (18.3%) had secondary education, and a few of them, 4 (6.7%), had no formal education (Table 1).

Table 1: Intergroup comparison of the socio-demographic characteristics of participants at baseline (n=60)

	Amoxicillin/metronidazole Group		Doxycycline group		p-value
	N = 30	%	N = 30	%	
Male	16	53.3	13	43.3	0.438
Female	14	46.7	17	56.7	
Age (years)					
25 – 34	2	6.7	0	0.0	
35 – 44	4	13.3	2	6.7	
45 – 54	2	6.7	10	33.3	0.323
55 – 64	17	56.7	8	26.7	
65 – 75	5	16.7	10	33.3	
Educational status					
No formal education	2	6.7	2	6.7	
Primary	5	16.7	5	16.7	0.513
Secondary	3	10.0	8	26.7	
Tertiary	15	50.0	10	33.3	
Postgraduate qualification	5	16.7	5	16.7	
Monthly Income (₦)					
Below 25,000	10	33.3	7	23.3	
26,000-50,000	2	6.7	7	23.3	
51,000-75,000	2	6.7	5	16.7	0.101
76,000-100,000	3	10.0	0	0.0	
Above 100,000	13	43.3	11	36.7	
Marital Status					
Single	1	3.3	0	0.0	
Married	25	83.3	26	86.7	1.000
Widow/Widower	3	10.0	4	13.3	
Divorced	1	3.3	0	0.0	
Socioeconomic class					
I	13	43.3	8	26.7	
II	5	16.7	8	26.7	
III	7	23.3	7	23.3	0.463
IV	4	13.3	7	23.3	
V	1	3.3	0	0.0	
Religion					
Islam	14	46.7	9	30.0	0.288
Christianity	16	53.3	21	70.0	
Ethnicity					
Yoruba	27	90.0	24	80.0	
Hausa	2	6.7	3	10.0	0.623
Igbo	0	0.0	1	3.3	
Others	1	3.3	2	6.7	

All categories of both anthropometric variables BMI and WHR were comparable between groups A and B at baseline, with values almost at par and there was no statistically significant difference between them (Table 2).

The baseline and three months values of the various BMI and WHR categories were very close in either study groups when subjected to Wilcoxon signed rank test and there was no statistically significant intragroup difference between them (table 3).

There were marked statistically significant differences among the three categories of BMI (represented with superscripts A, B, C for the three categories of BMI at baseline; D, E, F for the three

categories at 3 months in group A; and also superscripts G, H, I for the three categories of BMI at baseline in group B; and J, K, L for 3 months BMI categories in group B as shown in table 3) (P<0.0001 for all the tests: Kruskal Wallis test).

There was however no statistically significant difference between the two categories of WHR (non-obese and obese) in any of the two study groups when they were compared at baseline and when compared after three months using Mann Whitney U test (p>0.05) (Table 3).

Body mass index in the overweight category was found to be statistically significantly correlated with DBP in the amoxicillin/metronidazole group at baseline (r=0.748, p=0.013), but not after three months. Conversely in the doxycycline group, there was a statistically non-significant negative relationship between BMI in the overweight category and DBP at baseline, but the relationship was found to have become a positive and statistically significant one (r=0.622, p=0.031), at three months after NSPT.

Body mass index in the obese category was statistically significantly correlated with DBP in the amoxicillin/metronidazole group at baseline (r=0.715, p=0.030) and the statistical significance remained till end of three months (r=0.755, p=0.031). In the doxycycline group, relationship between obese BMI and DBP, just as it was in the overweight category, was not statistically significant at baseline but became statistically significant (r=0.755, p=0.014) at the end of three months.

Waist to hip ratio was statistically significantly correlated with diastolic blood pressure at baseline in both the non-obese (r = -0.732, p=0.039) and obese (r = -0.474, p=0.026) amoxicillin/metronidazole group participants but by the end of three months the statistical significance was no more observed. Conversely, there were no statistically significant correlation between WHR, in either the non-obese or the obese doxycycline group subjects at baseline and at the end of three months. (Table 7).

Table 2: Intergroup comparison of anthropometric variables at baseline

Baseline Parameters		Amoxicillin/Metronidazole Group	Doxycycline Group	p-value
		Median (IQR)	Median (IQR)	
Body Mass Index (Kg/M^2)	Underweight/Normal weight	23.5 (2.1)	23.7 (1.8)	0.939
	Overweight	27.7 (2.7)	27.9 (2.0)	0.409
	Obese	31.9 (5.4)	33.2 (6.0)	0.132
Waist-to-Hip Ratio	Non-Obese	0.9 (0.04)	0.92 (0.04)	0.590
	Obese	0.9 (0.09)	0.92 (0.08)	0.713

Table 3: Intragroup comparison of baseline values of anthropometric variables of participants with three-month values

	Amoxicillin/metronidazole Group			Doxycycline Group		
Body Mass Index (Kg/m^2) ***	Baseline Median (IQR)	3 Months Median (IQR)	P-Value*	Baseline Median (IQR)	3 Months Median (IQR)	P-Value*
Underweight/Normal weight	23.5 (2.1) ^{A}	23.2 (2.0) ^{D}	0.239	23.7 (1.8) ^{G}	23.6 (1.0) ^{J}	0.450
Overweight	27.7 (2.7) ^{B}	26.7 (2.1) ^{E}	0.574	27.9 (2.0) ^{H}	26.8 (2.0) ^{K}	0.866
Obese	31.9 (5.4) ^{C}	35.1 (3.1) ^{F}	0.500	33.2 (6.0) ^{I}	33.3 (3.0) ^{L}	0.063
Waist-to Hip Ratio**						
Non-Obese	0.90 (0.04) $^{\alpha}$	0.92 (0.05) $^{\beta}$	0.352	0.92 (0.04) $^{\gamma}$	0.89(0.10)	0.137
Obese	0.90 (0.09) $^{\alpha}$	0.91 (0.10) $^{\beta}$	0.163	0.92 (0.08) $^{\gamma}$	0.92(0.06)	0.599

***Kruskal Wallis test. **Mann Whitney U test. IQR: Interquartile range.

Table 4: Correlation between anthropometric parameters and High Sensitivity C-Reactive Protein in Amoxicillin/metronidazole group and Doxycycline group at baseline and after three months

		Spearman's rho Correlation coefficient	**High sensitivity C-reactive Protein**			
			Amoxicillin/metronidazole Group(A)		Doxycycline Group(B)	
			Baseline	After 3 months	Baseline	After 3 months
BMI	Underweight/ normal weight	r_s	-0.296	-0.046	-0.577	-0.400
		p-value	0.377	0.894	0.104	0.286
	Overweight	r_s	-0.091	-0.098	-0.308	-0.508
		p-value	0.802	0.774	0.331	0.092
	Obese	r_s	-0.304	-0.190	0.143	-0.017
		p-value	0.931	0.651	0.714	0.965
Waist-to-Hip Ratio	Non-obese	r_s	-0.143	0.326	-0.345	0.081
		p-value	0.736	0.358	0.299	0.803
	Obese	r_s	-0.109	0.180	-0.339	0.007
		p-value	0.628	0.449	0.156	0.979

r_s - Spearman's rank correlation coefficient BMI: Body Mass Index

Table 5: Correlation between anthropometric parameters and PISA in Amoxicillin/metronidazole group and Doxycycline group at baseline and after three months

		Spearman's rho Correlation coefficient	Periodontal Inflammed Surface Area (PISA)			
			Amoxicillin/metronidazole Group		Doxycycline Group	
			Baseline	After 3 months	Baseline	After 3 months
BMI	Underweight/ normal weight	r_s	-0.282	-0.325	-0.300	0.333
		p-value	0.401	0.330	0.433	0.381
	Overweight	r_s	-0.506	0.246	0.119	0.133
		p-value	0.136	0.466	0.713	0.681
	Obese	r_s	-0.610	-0.619	-0.050	-0.136
		p-value	0.081	0.102	0.897	0.727
Waist-to-Hip Ratio	Non-obese	r_s	-0.071	0.332	0.041	-0.228
		p-value	0.867	0.348	0.904	0.477
	Obese	r_s	0.186	0.003	0.086	0.031
		p-value	0.408	0.990	0.725	0.902

r_s - Spearman's rank correlation coefficient BMI: Body Mass Index

Regression analysis revealed that the best predictors of BMI were gender, age, diastolic blood pressure and type of antihypertensive drug used. However, the only significant predictors were gender, (coefficient of -2.3 and P= 0.03) and DBP, (coefficient of 0.19 and P<0.001) (Table 8)

The best predictors for WHR were gender, hsCRP and compliance with medications. However only gender was the significant predictor of the model (coefficient of 0.03 and p-value 0.044), with males having higher WHR values than females. (Table 9).

Table 6: Correlation between anthropometric parameters and systolic blood pressure in Amoxicillin/metronidazole group and Doxycycline group at baseline and after three months

		Spearman's rho Correlation coefficient	Systolic Blood Pressure			
			Amoxicillin/metronidazole Group		Doxycycline Group	
			Baseline	After 3 months	Baseline	After 3 months
BMI	**Underweight/normal weight**	r_s	0.046	0.050	0.154	0.244
		p-value	0.894	0.883	0.693	0.527
	Overweight	r_s	0.024	0.215	0.200	0.441
		p-value	0.947	0.525	0.532	0.151
	Obese	r_s	-0.361	-0.319	0.418	0.536
		p-value	0.339	0.441	0.263	0.137
Waist-to-Hip Ratio	**Non-obese**	r_s	-0.192	-0.238	-0.280	-0.188
		p-value	0.649	0.507	0.403	0.559
	Obese	r_s	0.056	0.021	0.357	0.261
		p-value	0.806	0.929	0.133	0.295

r_s - Spearman's rank correlation coefficient BMI: Body Mass Index

Table 7: Correlation between anthropometric parameters and diastolic blood pressure in Amoxicillin/metronidazole group and Doxycycline group at baseline and after three months

		Spearman's rho Correlation coefficient	Diastolic Blood Pressure			
			Amoxicillin/metronidazole Group		Doxycycline Group	
			Baseline	After 3 months	Baseline	After 3 months
BMI	Underweight/ normal weight	r_s	-0.291	-0.324	0.059	0.026
		p-value	0.385	0.331	0.881	0.984
	Overweight	r_s	0.748	0.567	-0.339	0.622
		p-value	0.013*	0.069	0.905	0.031*
	Obese	r_s	0.715	0.755	0.630	0.755
		p-value	0.030*	0.031*	0.069	0.014*
Waist-to-Hip Ratio	Non-obese	r_s	-0.732	-0.586	-0.128	-0.220
		p-value	0.039*	0.075	0.708	0.492
	Obese	r_s	-0.474	-0.220	0.139	0.188
		p-value	0.026*	0.350	0.570	0.455

*r_s - Spearman's rank correlation coefficient; * Statistical significance; BMI: Body Mass Index*

Table 8: Stepwise multiple linear regressions with BMI as the dependent variable

Characteristic		Beta	95% CI[1]	p-value
	(Intercept)	9.6	-1.2, 20	0.081
Gender	Female	—	—	
	Male	-2.3	-4.7, 0.10	0.030*
	Age	0.09	-0.01, 0.19	0.069
	Diastolic Blood Pressure	0.19	0.09, 0.29	<0.001*
Drug Category	Non_Calcium Blockers	—	—	
	Calcium blockers	-1.9	-4.6, 0.73	0.2

CI[1] = Confidence Interval *=Statistical significance

Table 9: Stepwise multiple linear regressions with WHR as the dependent variable

Characteristic		Beta	95% CI[1]	p-value
	(Intercept)	0.87	0.84, 0.90	<0.001
Gender	Female	—	—	
	Male	0.03	0.00, 0.06	0.044*
	HsCRP	0.00	0.00, 0.01	0.2
Drug Compliance	Compliance	—	—	
	Non-compliance	0.02	-0.01, 0.05	0.2
[1]CI = Confidence Interval	***=Statistical significance**			

DISCUSSION

The non-relationship between BMI and PISA in this study agrees with the findings of Manovijay et al[10] who reported that BMI had no statistically significant influence on periodontal parameters. It is however in contrast with the observations of Olagundoye et al[11] and Akman et al.[12] who reported a linear relationship between BMI and severity of periodontal disease. The non-relationship between WHR and PISA agrees with findings reported by Olagundoye et al.[11] and Yang et al[13] who found no linear relationship between WHR and the severity of periodontitis. This is in contrast with the findings of Manovijay et al.[10] who reported a positive and statistically significant correlation between WHR and periodontal bleeding score and concluded that visceral fat, represented by WHR has more influence on the periodontal tissues than BMI. The lack of observable influence of adiposity on periodontal parameters using PISA in this study agrees with the conclusion from a systematic review and meta-analysis by Papageorgiou et al.[14] that there is inadequate evidence to support the opinion that periodontal therapy in obese individuals give a result on the periodontal tissues different from the same treatment in non-obese individuals.

The absence of any relationship between BMI, WHR and hsCRP in this study agrees with the study by Al-Zahrani et al.[15] and Zuza et al.[16], who found no impact of adiposity on systemic response to periodontal therapy assessed using CRP. They[15, 16] also submitted that obesity does not impair response of the periodontal tissues to therapy. This finding however is in contrast with that of Meisel et al.[17] who found significant association between obesity and CRP. Elevation of CRP is not specific for periodontitis, it rises in cases of periodontitis just as it does in cases of obesity.[18] Periodontitis and obesity have confounding effects on each other, and serum levels of inflammatory cytokines are affected diversely by measures of adiposity, including BMI and WHR.[18] The nature and quantum of contributions from adiposity and periodontitis to systemic inflammation are still largely unknown, whether their mutual contributions are mere coincidence or causal, and if they are to be causal the direction of causality is yet to be deciphered.[17]

The finding in this study of no link between BMI, WHR and systolic blood pressure (SBP) in both study groups at baseline and at the end of 3 months indicates lack of influence of adiposity on SBP. It also implies a negligible influence of adiposity on the relationship between NSPT with the adjunctive antibiotics tested and SBP among the subjects. It could be that the absence of subjects with morbid obesity in the present study probably contributed to this finding, which contrasts with that reported by Kamel et al.[19] who found SBP to be highly correlated with anthropometric measures. The relationship between obesity and hypertension is complex and diverse and some researchers have pointed out that obesity has heterogenous phenotypes such that not all cases of obesity constitute a health risk.[20] They explained that certain obesity phenotypes are compatible with normal metabolic health and that obesity in certain cases has been reported to have a protective effect in individuals having cardiovascular disease, a phenomenon called the 'obesity paradox'[21] They also explained that the quality and function of adipose tissue rather than its mere quantity is paramount with regards to its role in protection of, or predisposition of an individual to disease.[20, 21] These phenomena may have some roles to play in the observed non-significant relationship between SBP and adiposity in the present study. More studies will however be required to have more clues.

Striking about the present study is the pattern of association between BMI, WHR and only diastolic blood pressure (DBP) of all the outcome variables.

Adults with obesity are predisposed to dyslipidaemia, hypertension, and metabolic syndrome.[27] These diseases result from adipose

tissue dysfunction, characterized by production of adipocytokines that leads to a constant inflammatory state that triggers insulin resistance, endothelial dysfunction and atheroma formation from inflamed blood vessels promoting a state of hypertension. [22]

Adiposity is known to influence blood pressure and periodontal therapy is reported to have the benefit of improving the lipid profile of obese individuals.[16] Persistence of obesity after periodontal therapy may be responsible for the lack of positive impact of non-surgical periodontal therapy on periodontal parameters in obese individuals as observed in the doxycycline group subjects.

Some of the findings earlier mentioned are probably indicative of adjunctive amoxicillin/metronidazole regimen being more effective than doxycycline in effecting the known benefits of periodontal therapy on vascular health and in improving lipid profile. The lipid lowering effect of metronidazole might as well have some roles to play.[23]

Regression analysis revealed higher prevalence and severity of periodontal inflammation in males more than in females. Gender differences in the severity of periodontal disease have been observed in various studies by different researchers. Genco [24] in a review affirmed that periodontal disease is more prevalent in males and this was corroborated by other studies and also in systematic review and meta-analysis by Karuveettil et al.[25] Behavioural factors such as smoking, less oral hygiene efforts due to unawareness and less frequency of dental visits were advanced as likely reasons.[24,25] On the other hand, Al-Abdaly et al.[26] reported prevalence and severity of periodontal disease to be more in women than in men in a study done in two regions of Saudi Arabia. They proposed that hormonal changes could be responsible. They explained that although plaque score was more in male participants in their study, the higher prevalence and severity of periodontal disease seen in women in the study may be a result of hormonal fluctuations that constitutes a modifying factor capable of predisposing female individuals to periodontal disease more than their male counterparts.

The finding that participants who consumed unhealthy diets have significantly higher levels of hsCRP than those who consumed healthy diets from the present study agrees with the findings of Alfreeh et al.[27] who reported that poor quality diet (higher intake of cereal, bread, meat and sodium, and lower intake of dairy products compared to recommended levels) was associated with higher hs-CRP levels in a Saudi Arabian study. Kuczmarski et al.[28] also reported an inverse relationship between diet quality and C-reactive protein in urban, low income Americans. High sensitivity CRP is an indicator of adverse health conditions.[27] Kuczmarski et al.[28] explained that the inverse relationship between diet and C-reactive protein is as a result of the benefits of micronutrients present in healthy diets in terms of their antioxidant properties, which helps the body to make a balance between production and elimination of reactive oxygen species to prevent oxidative stress and lower the amount of systemic inflammation. The reverse is the case when unhealthy diet is consumed.

The association between BMI and isolated diastolic blood pressure in this regression analysis was similar to the findings in a study by Visaria and Lo[29] and it also agrees with the findings of Mittal et al.[30] who all reported higher odds of isolated diastolic hypertension (IDH) in overweight and obese persons compared to those with low BMI.

Visaria et al.[29] compared two adult populations-an American and an Indian population in their study and found similar age distribution for IDH in the two groups, with a peak incidence in the fifth decade. Mittal et al.[30] also reported that IDH and BMI has strong association with age, with a reported peak prevalence at 5th decade of life. Obese United States of America adults had more than four times the risk of IDH compared to low/normal BMI adults, resulting in a significant trend in risk of IDH with increasing BMI.[29]

The average age of participants in this study was 57.23± 12.3 years, which is close to the age of participants in the earlier studies cited. This could partly explain why diastolic blood pressure in isolation was strongly associated with BMI ($p<0.001$) among the participants.

The finding of higher proportion of females with high BMI compared to males as revealed in this regression analysis is similar to that reported by Singh and Dubey[31] as well as Canter and Coballero[32] Higher BMI in females than in males has been observed to be related to dietary habits/pattern and sedentary lifestyle. Consumption of refined carbohydrate and other high calorie foods have increased in many populations of the world. The sedentary lifestyle of most women tends to predispose them to the effects of these foods more than it does in men who are usually more physically engaged. Another explanation was that sociocultural views and values about fatness also influence the predisposition of

women to obesity than their male counterparts as some societies, especially in developing countries perceive fatness as a sign of affluence or fertility, which make women in those climes to indulge in lifestyles that promote obesity.[32]

The regression analysis also revealed significantly higher waist-to-hip ratio in males than in the females. This agrees with what is expected in the male gender according to the World Health Organization standard.[33]

CONCLUSION

Body mass index, especially the obese category tends to have more negative impact on the effect of non-surgical periodontal therapy on blood pressure than WHR in hypertensive patients with periodontitis. Severe adiposity as in case of obese BMI overwhelmed the effect of either adjunctive amoxicillin/metronidazole or doxycycline on periodontal and blood pressure parameters following non-surgical periodontal therapy in hypertensive subjects. Adjunctive amoxicillin/metronidazole was more effective than adjunctive doxycycline in attenuating the negative influence of adiposity on the effect of non-surgical periodontal therapy on diastolic blood pressure.

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Conflict of Interest
None declared

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