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Mean arterial pressure, pulse pressure in diabetic and non diabetic male African population: a comparative study

Research Article

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Abstract

Objective: Mean arterial pressure (MAP) and pulse pressure (PP) are important parameters that predict cardiovascular risk both in diabetics and non diabetic population in both genders. Data on this subject area in Nigeria, Africa and worldwide are few. The aim of this paper is to examine the pattern of MAP and PP in a diabetic male population compared to a general population of males in Africans. Is the pattern of MAP and PP the same in both diabetic and non diabetic? Does any significant disparity exist?

Methods: This is a preliminary prospective study. Randomly, the blood pressure of 20 men from the general Lagos population was taken at heart level using a mercurial sphygmomanometer during a free medical screening exercise in surlier. Similarly, the blood pressure of 20 consecutive known diabetic men was taken at heart level using a mercurial sphygmomanometer. The diabetic patients were recruited from the endocrinology clinic of the Lagos State University Teaching Hospital, Ikeja, and Lagos, Nigeria. Individual consent was obtained from both groups of participants. The PP of each individual was computed by subtracting the diastolic blood pressure from the systolic blood pressure. The MAP of each individual was computed by adding one third of the PP to the diastolic blood pressure. The limitation of this study includes the very small size of the study population and Africans are not well represented in the sample size.

Results or case presentation: The age range of the non diabetic was 31 to 70years while the age range of the diabetics was 31 to 82years.The mean(average) pulse pressure among the non diabetic was 46.5mmHg while the average pulse pressure among the diabetics was 67.7mmHg. Among the non diabetic the mean of the MAP was 103.20mmHg while among the diabetics it was 96.97mmHg.The highest MAP among the diabetic group was 133.33mmHg while the highest among the non diabetic was 150mmHg.

Discussion: This paper shows that the average MAP is higher in the general African male population than among diabetic male Africans. This supports autopsy finding in literature that hemorrhagic cerebra vascular accident occurs slightly more commonly in non diabetic compared to diabetics while cerebral infarction occurs more in diabetic subjects compared to non diabetics. Similarly it was noticed in the study that African male diabetics tend to have higher pulse pressure than the general African population.

Conclusion: MAP is lower in male African diabetics compared to the general African male population. Conversely, PP is higher among male African diabetics compared to the general African male population.

Keywords: Mean Arterial Pressure, Pulse Pressure, Diabetics, Non Diabetics

Introduction

Mean arterial pressure and pulse pressure are important parameters that predicts cardiovascular risk both in diabetics and non diabetic population in both gender. Data on this subject area in Nigeria, Africa and worldwide are few. It was estimated that in the United States 30% of inpatient cost (around 22,254 million US dollars) was due to cardiovascular vascular disease (CVD) hospitalization among people with type 2 diabetes in 2012.[1,2] An even greater diabetes-attributable hospitalization cost of 46.5% was found in a major hospital in Cambridge shire, England.[3] A paradoxical finding is that the well-known relationship between CVD and systolic blood pressure in the general population was insignificant in a meta-analysis using data from people with diabetes.[4] Greater use of antihypertensive medicine and a higher prevalence of heart failure than people without diabetes have been proposed as possible reasons for this paradox.[5,6] Mean arterial pressure (MAP) reflects both peripheral resistance and cardiac output. Recently, in the ADVANCE study,[7] a trial among type 2 diabetes patients, MAP correlated with major CVD events: with a 13% increase in risk per 13 mmHg increase in MAP. If MAP is a marker for

CVD risk among type 2 diabetes patients, it should be associated with greater CVD hospitalization. However, the association between MAP and hospitalization in type 2 diabetes has not been investigated, and a dose-response relationship between CVD hospitalization and MAP may exist. Moreover, blood pressure and CVD are influenced by long term glycemic control,[8–12] usually assessed using HbA1c, which also has an association with hospitalization risk.[13]

The pulse pressure is the difference between the systolic and diastolic blood pressure. It is influenced by the stroke volume and vascular resistance. As people age the walls of their arteries become stiffer. This increases the pulse pressure. A high pulse pressure may be associated with reduced coronary perfusion. It may therefore be a predictor of future cardiovascular events, but this has not been confirmed by meta-analysis.[14] Classically, a wide (high) pulse pressure is a sign of aortic valve regurgitation and a narrow (low) pulse pressure is a sign of aortic stenosis. In the absence of valvular disease, a high pulse pressure may be a sign of stiffness in the arterial walls, and is a risk factor for coronary artery disease and myocardial infarction. The aim of this paper is to examine the pattern of mean arterial pressure and pulse pressure in a diabetic male population compared to a general population of males in Africans. Is the pattern of mean arterial pressure, pulse pressure the same in both diabetic and non diabetic? Does any significant disparity exist?

Methodology

This is a preliminary comparative prospective study that looks into the mean arterial pressure and pulse pressure of a diabetic and non diabetic male population in Africa. Randomly, the blood pressure of 20 men from the general Lagos population were taken at heart level using mercurial sphygmomanometer during a free medical screening exercise in surlier Lagos. Similarly, the blood pressure of 20 consecutive known diabetic men was taken at heart level using a mercurial sphygmomanometer. The diabetic patients were recruited from the endocrinology clinic of the Lagos State University Teaching Hospital, Ikeja, Lagos, Nigeria. Individual consent was obtained from both groups of participants. The pulse pressure of each individual was computed by subtracting the diastolic blood pressure from the systolic blood pressure. The mean arterial pressure of each individual was computed by adding one third of the pulse pressure to the diastolic blood pressure. The limitation of this study includes the very small size of the study population and Africans are not well represented in the sample size. The study was analysed using SPSS version 17.0 version.

Statistical analysis

By using descriptive statistics among the non-diabetics male Africans, the mean of the ages was 49.8 years with standard error of the mean of 3.02,the median was 52.5 years with mode of 31 years. The standard deviation was 13.5 with -0.143 Skewness, the least age was 31 and the highest was 70.The range of Mean Arterial Pressure was 110mmHg, the lowest value was 73.33 while the highest was 183.33, the mean was 104.64 while the standard error of the mean was 5.6, the median was 96.67, the distribution was bimodal with values of 93.3mmHg and 96.67mmHg. The standard deviation was 25.29 with a variance of 640.08; the Skewness was 1.81 with standard error of skewness of 0.512 (Table 1). The pulse pressure range was 100mmHg, the least value was 30mmHg while the maximum was 130mmHg.the mean was 50.70mmHg while the standard error of the mean was 5.13, the standard deviation was 22.94 while the variance was 526.53.The Skewness was 2.50 with standard error of Skewness of 0.512. By using Pearson correlation (Table 2), age correlated fairly well with pulse pressure with a value of 0.408 and p-value of 0.075 compared to mean arterial pressure where the correlation was 0.294 with a p-value of 0.209.Similarly,pulse pressure in these non-diabetics correlated significantly well with mean arterial pressure with a value of 0.876 with p-value of 0.0001. By using descriptive statistics among the diabetic Africans (Table 3), the mean of the ages was 67.4 years with a standard error of the mean of 2.61, and the median was 69.5 years with a mode of 65 years. The standard deviation was 11.69 with Skewness of -1.863,the least age was 31years and the highest was 82.The range of the mean arterial pressure was 60mmHg,the lowest value was 73.33mmHg while the highest was 133.33,the mean was 96.96 mmHg while the standard error of the mean was 4.06,the median was 95mmHg,the distribution of mean arterial pressure was bimodal with values of 80mmHg and 96.67mmHg,the standard deviation was 18.17 with a variance of 330.26, the Skewness was 0.67 with standard error of Skewness of 0.512.

Table 1 Statistical analysis of mean arterial pressure (map), pulse pressure (pp) in non diabetics male Africans

		Age	Systolic	Diastolic	PP	MAP
N	Valid	20	20	20	20	20
	Missing	0	0	0	0	0
Mean		49.8	138.45	87.75	50.7	104.649
Std. Error of Mean		3.02411	8.80983	4.24008	5.13097	5.65721
Median		52.5	130	80	41	96.67
Mode		31	130	80	40	93.33[a]
Std. Deviation		13.52425	39.39874	18.96222	22.94639	25.29982
Variance		182.905	1552.261	359.566	526.537	640.081
Skewness		-0.143	2.232	1.372	2.506	1.814
Std. Error of Skewness		0.512	0.512	0.512	0.512	0.512
Range		39	170	80	100	110
Minimum		31	100	60	30	73.33
Maximum		70	270	140	130	183.33

[a]Multiple modes exist. The smallest value is shown

Table 2 Pearson correlation of mean arterial pressure (map) and pulse pressure (pp) in non diabetic male Africans

		Age	Systolic	Diastolic	PP	MAP
AGE	Pearson Correlation	1	0.347	0.227	0.408	0.294
	Sig. (2-tailed)		0.134	0.335	0.075	0.209
	Sum of Squares and Cross-products	3475.2	3510.8	1108	2402.8	1908.816
	Covariance	182.905	184.779	58.316	126.463	100.464
	N	20	20	20	20	20
SYSTOLIC	Pearson Correlation	0.347	1	.927**	.951**	.982**
	Sig. (2-tailed)	0.134		0	0	0
	Sum of Squares and Cross-products	3510.8	29492.95	13160.25	16332.7	18603.89
	Covariance	184.779	1552.261	692.645	859.616	979.152
	N	20	20	20	20	20
DIASTOLIC	Pearson Correlation	0.227	.927**	1	.765**	.981**
	Sig. (2-tailed)	0.335	0		0	0
	Sum of Squares and Cross-products	1108	13160.25	6831.75	6328.5	8940.955
	Covariance	58.316	692.645	359.566	333.079	470.577
	N	20	20	20	20	20
PP	Pearson Correlation	0.408	.951**	.765**	1	.876**
	Sig. (2-tailed)	0.075	0	0		0
	Sum of Squares and Cross-products	2402.8	16332.7	6328.5	10004.2	9662.934
	Covariance	126.463	859.616	333.079	526.537	508.575
	N	20	20	20	20	20
MAP	Pearson Correlation	0.294	.982**	.981**	.876**	1
	Sig. (2-tailed)	0.209	0	0	0	
	Sum of Squares and Cross-products	1908.816	18603.89	8940.955	9662.934	12161.54
	Covariance	100.464	979.152	470.577	508.575	640.081
	N	20	20	20	20	20

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

Table 3 Statistical analysis of mean arterial pressure (map) and pulse pressure (pp) in diabetic male Africans

		Age	Systolic	Diastolic	PP	MAP	FBS
N	Valid	20	20	20	20	20	20
	Missing	0	0	0	0	0	0
Mean		67.4	142.1	74.4	67.7	96.9665	143.1
Std. Error of Mean		2.61514	5.23445	4.28117	4.66628	4.06366	13.54095
Median		69.5	145	70	64	95	126.5
Mode		65.00[a]	120	70	60	80.00[a]	111
Std. Deviation		11.69525	23.40917	19.14598	20.86826	18.17325	60.55698
Variance		136.779	547.989	366.568	435.484	330.267	3667.147
Skewness		-1.863	-0.11	0.493	0.383	0.674	1.203
Std. Error of Skewness		0.512	0.512	0.512	0.512	0.512	0.512
Range		51	80	70	80	60	200
Minimum		31	100	40	30	73.33	73
Maximum		82	180	110	110	133.33	273

[a]Multiple modes exist. The smallest value is shown

Table 4 Pearson correlation of mean arterial pressure (map) and pulse pressure (pp) in diabetic male Africans

		Age	Systolic	Diastolic	PP	MAP	FBS
Age	Pearson Correlation	1	0.077	-0.164	0.237	-0.082	0.056
	Sig. (2-tailed)		0.747	0.489	0.314	0.73	0.815
	Sum of Squares and Cross-products	2598.8	401.2	-699.2	1100.4	-332.392	751.2
	Covariance	136.779	21.116	-36.8	57.916	-17.494	39.537
	N	20	20	20	20	20	20
Systolic	Pearson Correlation	0.077	1	.534*	.631**	.805**	0.05
	Sig. (2-tailed)	0.747		0.015	0.003	0	0.835
	Sum of Squares and Cross-products	401.2	10411.8	4551.2	5860.6	6504.747	1341.8
	Covariance	21.116	547.989	239.537	308.453	342.355	70.621
	N	20	20	20	20	20	20
Diastolic	Pearson Correlation	-0.164	.534*	1	-0.318	.932**	0.034
	Sig. (2-tailed)	0.489	0.015		0.172	0	0.887
	Sum of Squares and Cross-products	-699.2	4551.2	6964.8	-2413.6	6160.248	749.2
	Covariance	-36.8	239.537	366.568	-127.032	324.224	39.432
	N	20	20	20	20	20	20
PP	Pearson Correlation	0.237	.631**	-0.318	1	0.048	0.025
	Sig. (2-tailed)	0.314	0.003	0.172		0.841	0.918
	Sum of Squares and Cross-products	1100.4	5860.6	-2413.6	8274.2	344.499	592.6
	Covariance	57.916	308.453	-127.032	435.484	18.132	31.189
	N	20	20	20	20	20	20
MAP	Pearson Correlation	-0.082	.805**	.932**	0.048	1	0.045
	Sig. (2-tailed)	0.73	0	0	0.841		0.85
	Sum of Squares and Cross-products	-332.392	6504.747	6160.248	344.499	6275.073	946.107
	Covariance	-17.494	342.355	324.224	18.132	330.267	49.795
	N	20	20	20	20	20	20
FBS	Pearson Correlation	0.056	0.05	0.034	0.025	0.045	1
	Sig. (2-tailed)	0.815	0.835	0.887	0.918	0.85	
	Sum of Squares and Cross-products	751.2	1341.8	749.2	592.6	946.107	69675.8
	Covariance	39.537	70.621	39.432	31.189	49.795	3667.147
	N	20	20	20	20	20	20

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

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

The pulse pressure range was 80mmHg, the least was 30mmHg and the highest was 110mmHg, the mean was 67.7 mmHg, with a standard error of the mean of 4.6, the median was 64mmHg, the mode was 60mmHg, the standard deviation was 20.86 while the variance was 435.48.The Skewness was 0.383 with standards error of Skewness of 0.512. The fasting blood sugar range was 200mg/dl, the least was 73mg/dl and the highest was 273mg/dl, the mean was 143.1mg/dl with a standard error of the mean of 13.54, the median was 126.5mg/dl, the mode was 111mg/dl, the standard deviation was 60.55 while the variance was 3667.1.The Skewness was 1.203 with

standard error of Skewness of 0.512. By using the person correlate among these diabetic Africans (Table 4), age was inversely correlated to mean arterial pressure with value of -0.082 with p-value 0.730, it correlated poorly with pulse pressure with values of 0.237 and p-value o.314,age correlation value to fasting blood sugar was not significant with a value of 0.056 and a p-value of 0.815.In diabetics Africans, no significant correlation between pulse pressure with mean arterial pressure and fasting blood sugar with values of 0.048,p-value 0.841 and 0.025,p-value 0.918.Similarly,Mean arterial pressure has no significant correlation with fasting blood sugar with values of 0.045,p-value 0.850.

Results

The cohorts studied consist of 20 male non diabetic Africans and 20 known diabetic males in Nigeria Africa. The age range of the non diabetic is 31 to 70years with a mean age of 49.8years while the age range of the diabetics was 31 to 82 years with mean age of 67.4 years. The mean pulse pressure among the non diabetic was 46.5mmHg while the mean pulse pressure among the diabetics was 67.7mmHg. Among the non diabetic the mean of the mean arterial pressure was 103.20mmHg while among the diabetics it was 96.97mmHg. In both diabetic and non diabetic group, 20% of participants (4 in each group) had mean arterial pressure above 110mmHg.The highest mean arterial pressure among the diabetic group was 133.33mmHg while the highest among the non diabetic was 150mmHg.The lowest mean arterial pressure in the diabetic group was 73.33mmHg.The lowest mean arterial pressure in the non diabetic group was the same figure.

Discussion

This paper shows that mean arterial pressure is higher in the general African male population than among diabetic male Africans, this is probably because other risk factors for higher mean arterial pressure are in the general population. Also this paper suggest that diabetes mellitus is not the worst cause of high mean arterial pressure as the highest mean arterial pressure of 150mmHg was in the general male population studied compared to the highest of 133.33 among the diabetic group. This supports autopsy finding in literature that hemorrhagic cerebrovascular accident occurs slightly more commonly in non diabetic compared to diabetics while cerebral infarction occurs more in diabetic subjects compared to non diabetics since hemorrhagic cerebrovascular accident tend to occur at higher mean arterial pressure (like 150mmHg) while ischemic cerebrovascular accident occurs at lower mean arterial pressure.[15] It was observed that the absolute value of each of the mean, the median and the mode were higher in non-diabetics compared to diabetics. One salient point noted in this study is that while pulse pressure correlated significantly with mean arterial pressure in non-diabetics with value of 0.876 p-value 0.0001, there was a noticeable insignificant correlation between pulse pressure and mean arterial pressure in diabetics with value 0.048, p-value 0.841.The effects of chronic hyperglycaemia on the caliber of vessels overtime in diabetics will probably explain this. Similarly in non-diabetics, pulse pressure correlated significantly with systolic and diastolic blood pressure with values 0.951, p-value 0.0001 and 0.785, p-value 0.0001 whereas pulse pressure correlated significantly only with systolic blood pressure in diabetics with values 0.631, p-value0.003 while it was inversely correlated to diastolic pressure with values -0.318, p-value 0.172. Similarly it was noticed in the study that African diabetic male tend to have higher pulse pressure than the general African non diabetic male population as the absolute value of each of the mean, the median and the mode were higher in the male African diabetics.

Conclusion

Mean arterial pressure is lower in male African diabetics compared to the general African male population. Conversely, pulse pressure is higher among male African diabetics compared to the general African male population. One salient point noted in this study is that while pulse pressure correlated significantly with mean arterial pressure in non-diabetics with value of 0.876 p-value 0.0001, there was a noticeable insignificant correlation between pulse pressure and mean arterial pressure in diabetics.

Acknowledgment

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Conflict of interest

None.

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