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

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

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. An even greater diabetes-attributable hospitalization cost of 46.5% was found in a major hospital in Cambridge shire, England. 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. 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. Mean arterial pressure (MAP) reflects both peripheral resistance and cardiac output. Recently, in the ADVANCE study, 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, usually assessed using HbA1c, which also has an association with hospitalization risk.

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. 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 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 31 years 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 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 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 |
| **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 |

*Multiple modes exist. The smallest value is shown*

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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 | 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 | 0.227 | 0.408 | 0.294 |
|       | Sig. (2-tailed)     | 0.134 | 0.335 | 0.075 | 0.209 |
|       | 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 | 0.408 | 0.765 | 0.981 |
|       | Sig. (2-tailed)     | 0.335 | 0.075 | 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 | 0.951 | 0.765 | 0.876 |
|       | 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 | 0.982 | 0.981 | 0.876 |
|       | 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  |
|       | Missing      | 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*       | 120      | 70        | 60  | 80.00* | 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 |
| Range  | 51           | 80       | 70        | 80  | 60  | 200  |
| Minimum| 31           | 100      | 40        | 30  | 73.33 | 73   |
| Maximum| 82           | 180      | 110       | 110 | 133.33 | 273  |

*Multiple modes exist. The smallest value is shown

Citation: Adegbenga AB. Mean arterial pressure, pulse pressure in diabetic and non diabetic male African population: a comparative study. J Diabetes Metab Disord Control. 2018;5(2):31-36. DOI: 10.15406/jdmdc.2018.05.00135
Table 4 Pearson correlation of mean arterial pressure (MAP) and pulse pressure (PP) in diabetic male Africans

|          | Age          | Systolic | Diastolic | PP     | MAP     | FBS     |
|----------|--------------|----------|-----------|--------|---------|---------|
| 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        | 0.534*    | 0.631**| 0.805** | 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      | 0.534*   | 1         | -0.318 | 0.32**  | 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       | 0.631**  | -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      | 0.805**  | 0.932**   | 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 \(0.314\). Age correlation value to fasting blood sugar was not significant with a value of \(0.056\) and a \(p\)-value of \(0.815\). In diabetic Africans, no significant correlation between pulse pressure with mean arterial pressure and fasting blood sugar with values of \(0.048\), \(p\)-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 70 years with a mean age of 49.8 years 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 46.5 mmHg while the mean pulse pressure among the diabetics was 67.7 mmHg. Among the non diabetic the mean non arterial pressure was 103.20 mmHg while among the diabetics it was 96.97 mmHg. In both diabetic and non diabetic group, 20% of participants (4 in each group) had mean arterial pressure above 110 mmHg. The highest mean arterial pressure among the diabetic group was 133.33 mmHg while the highest among the non diabetic was 150 mmHg.

The lowest mean arterial pressure in the diabetic group was 73.33 mmHg. 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 150 mmHg 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 150 mmHg) while ischemic cerebrovascular accident occurs at lower mean arterial pressure. 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.

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

None.

Conflict of interest

None.

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