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# Age Related Differences In Simultaneous Interarm Blood Pressure Measurements And Its Correlation To Cardiovascular Risk Factors In Rural Population.

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**ABSTRACT**

Blood Pressure is defined as, lateral pressure exerted by blood, on the Vessel wall. Measuring the blood pressure of a patient is the most important part of general examination. It gives us a full idea of the patient's cardiovascular status, Status of the autonomic nervous system and the hydration status of the patient. The blood pressure can be measured by two methods; direct and indirect. There is normal physiological variation in blood pressure, Age, Sex, built, posture, exercise, sleep, emotion, excitement affect the blood pressure.

**Keywords:** interarm blood pressure, rural population, cardiovascular risk.

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## INTRODUCTION

**Interarm blood pressure differences (IABPD's)**

Disparities in bilaterally determined blood pressures have been found in large percentage of apparently healthy individuals [5,6] and in patients [7,8] without apparent pathologic changes in the arteries. The frequency and magnitude of these differences apparently were found increased in hypertensive persons[9]

Bilateral determination of blood pressure is of importance in the physical diagnosis of certain pathologic conditions involving the aortic arch or its tributaries to the upper extremities.

Early studies reported large differences in blood pressure between arms even in normal young subjects[7,8]. This is likely to lead to errors by changing the arm of the patient in subsequent examinations. We are likely to label the same patient once as normotensive and on the other occasion as hypertensive. Similarly it is difficult to judge the effect of antihypertensive drugs if the same arm is not used for serial blood pressure recordings.

It is evident from the above the IABPD's can play an important role in the diagnosis and treatment of cardiac diseases.

In the present study, we decided to determine the prevalence of IABPD's measured simultaneously in both arms, in a rural farming population. During the course of this initial investigation, it also became possible for us to investigate the putative association between both Cardiovascular Risk Factors(CRF's) and Coronary Artery Disease(CAD) and IABPD's.

**Aims and Objectives**

- To find out age related differences in simultaneous interarm blood pressure measurements.
- To determine the prevalence of major Cardiovascular Risk Factors (CRF's).
- To study the co-relation between IABPD's with cardiovascular risk factors.

## MATERIALS AND METHODS

For the purpose of the study 486 adult of both sexes were selected randomly. Using a questionnaire constructed for the study, information was collected on demographic variables such as age, sex, occupation and education status of the subjects. Information was collected on all past illnesses. Detailed information was collected on the major cardiovascular risk factors viz. Tobacco consumption, alcohol consumption, physical activity, diabetes and hypertension.

A thorough physical examination was done with major cardiovascular findings being specially noted.

To measure the blood pressures, 2 standard sphygmomanometers were used simultaneously on the 2 arms with the person sitting on a chair and relaxed. Three such readings were taken for each individual at 5 minute interevals[20].

Electrocardiographic changes were measured using a 12 lead standard instrument.

**Interarm blood pressure differences:**

The mean of the three blood pressure (Systolic and diastolic separately) recordings was calculated for each arm. The pressure differences between both systolic pressures (SBP) and diastolic pressures (DBP) in each arm were calculated. All subjects with interarm SBP differences of $\geq$ 10mmHg and/ or DBP differences of $\geq$ 8 mmHg were classified as subjects having IABPD's.

ECG findings were used to classify subjects into those with and without Coronary Artery Disease, based on ST-T changes, the presence or absence of chamber hypertrophy and left ventricular strain pattern.

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From the collected information, subjects were classified in those with cardiovascular risk factors (CRF) and those without term. Tobacco consumers included all those who either smoked, chewed tobacco or used tobacco as toothpaste(mishri).

**Statistical Analysis**

The data was entered into a computer, after initial cleaning, analysis was done using the SAS (Statistical Analytical System, USA) statistical software.

Summary statistics in the form of frequency tables were derived for major demographic variables viz. age and sex and for the major cardiovascular risk factors. Differences in the interarm blood pressures (both systolic and diastolic) were tested for significance using Student 't' tests.

The associations between the various CRF's and IABPD'S and IABPD'S and CAD were tested using 't' tests for means and chi-square tests for proportions.

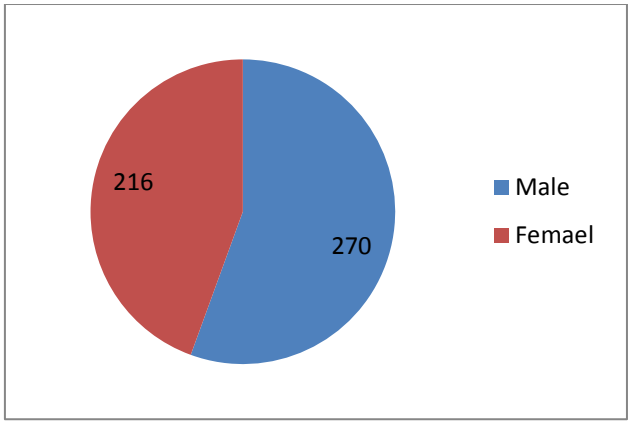
Correlation's between CRF's and IABPD'S were analyzed using Person co-relation co-efficient (r). A value 'r' greater than 50% was indicative of good correlation. This correlation was later tested for significance.

All the analysis were conducted separately for males and females and for SBP and DBP differences. Furthermore, depending on whether blood pressure was higher in the left or the right arm, separate analysis were done to study co-relations between CRF's and IABPD's.

## OBSERVATIONS AND RESULTS

The present study was carried out in Kalawade village in Karad taluka of Satara District in Western Maharashtra. Out of a total population of 486, 270 were males and 216 were females.

**Sex-wise distribution of the population**




The following tables present the salient observations noted in our study.

**Table 1: Age and Sex distribution of the study population**

| | Younger Subjects (15-48 years) | Elderly subjects (>48 years) | Total |
|---|---|---|---|
| Males | 183 (37.6%) | 87 (17.9%) | 270(55.6%) |
| Females | 143 (29.4%) | 73(15.02%) | 216(44.4%) |
| Total | 326 (67.1%) | 160(32.9%) | 486(100%) |

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**Table 2: Prevalence of IABPD's**

| | IABPD's Present |
|---|---|
| SBPD's | 113(23.25% |
| DBPD's | 99(20.4%) |
| Total | 212(43%) |

**Table 3: Association of IABPD's with age**

| | Younger (<48) | Elderly (>48) | Total |
|---|---|---|---|
| IABPD's Present | 149(30.6%) | 63(13%) | 212(43.66%) |
| IABPD's absent | 177(36.4%) | 97(20%) | 274(56.4%) |
| Total | 326(67%) | 160(33%) | 486 |

**$X^2$=1.6, df=1, p>0.05, Nonsignificant**

**Table 4: Association of IABPD's with sex**

| | IABPD's Present | IABPD's absent | Total |
|---|---|---|---|
| Males | 114(23.4%) | 156(32.1%) | 270(55.6%) |
| Females | 99(20.4%) | 117(24.1%) | 216(44.4%) |
| Total | 213 | 273 | 486 |

**$X^2$=0.07, df=1, p>0.05, Nonsignificant**

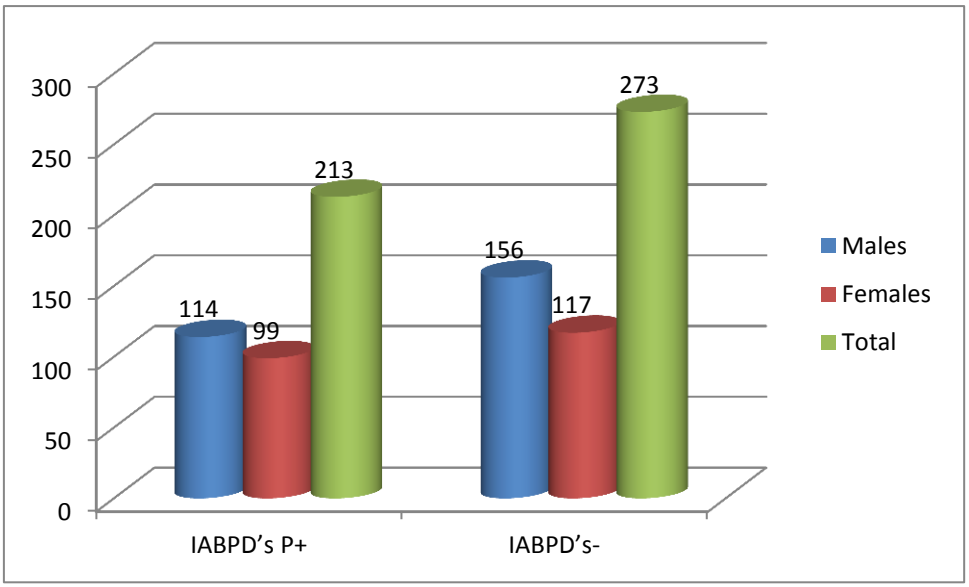


**Table 5: Prevalence of Cardiovascular Risk Factors (CRF's)**

| CRF's | Males | Females | Total |
|---|---|---|---|
| Tobacco Consump | 184(68%) | 80(37%) | 264(54.3%) |
| Alcohol consum | 50(18.5%) | - | 50(10.3%) |

**Table 6: Association of IABPD's with CAD in males**

**A: Systolic differences**

| | CAD Present | CAD Absent | Total |
|---|---|---|---|
| IABPD's Present | 26(9.6%) | 36(13.3%) | 62(22.9%) |
| IABPD's absent | 150(55.55%) | 58(21.5%) | 208(77.1%) |
| Total | 176 | 94 | 270 |

**$X^2$=0.07, df=1, p>0.05, Nonsignificant**

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**B: Diastolic differences**

| | CAD Present | CAD Absent | Total |
|---|---|---|---|
| IABPD's Present | 36(13.13%) | 16(5.9%) | 52(19.3%) |
| IABPD's absent | 140(51.9%) | 78(28.9%) | 218(80.7%) |
| Total | 176 | 94 | 270 |

**$X^2$=0.07, df=1, p>0.05, Nonsignificant**

**Table 7: Association between IABPD's and CAD in Females**

**A: Systolic differences**

| | CAD Present | CAD Absent | Total |
|---|---|---|---|
| IABPD's Present | 29(13.4%) | 22(10.2%) | 51(23.6%) |
| IABPD's absent | 113(52.3%) | 52(24.1%) | 165(76.4%) |
| Total | 142 | 74 | 216 |

**$X^2$=0.04, df=1, p>0.05, Nonsignificant**

**B: Diastolic differences**

| | CAD Present | CAD Absent | Total |
|---|---|---|---|
| IABPD's Present | 32(14.8%) | 16(7.4%) | 48(22.2%) |
| IABPD's absent | 110(50.9%) | 58(26.9%) | 168(77.8%) |
| Total | 142 | 74 | 216 |

**$X^2$=0.05, df=1, p>0.05, Nonsignificant**

**Table 8: Association of IABPD's with tobacco consumption in males**

**A: Systolic differences**

| | Tobacco Consumers | Non-Consumers | Total |
|---|---|---|---|
| IABPD's Present | 36(13.3%) | 26(9.6%) | 62(23%) |
| IABPD's absent | 105(38.9%) | 103(38.1%) | 208(77%) |
| Total | 141 | 129 | 270 |

**$X^2$=1.2, df=1, p>0.05, Nonsignificant**

**B: Diastolic differences**

| | Tobacco Consumers | Non-Consumers | Total |
|---|---|---|---|
| IABPD's Present | 26(9.6%) | 26(9.6%) | 62(18%) |
| IABPD's absent | 115(42.6%) | 103(38.1%) | 208(77%) |
| Total | 141 | 129 | 270 |

**$X^2$=1.2, df=1, p>0.05, Nonsignificant**

**Table 9: Association of IABPD's with tobacco consumption in Females**

**A: Systolic differences**

| | Tobacco Consumers | Non-Consumers | Total |
|---|---|---|---|
| IABPD's Present | 17(7.9%) | 37(15.7%) | 51(23.6%) |
| IABPD's absent | 46(21.3%) | 119(55.1%) | 165(76.4%) |
| Total | 63 | 153 | 216 |

**$X^2$=1.3, df=1, p>0.05, Nonsignificant**

**B: Diastolic differences**

| | Tobacco Consumers | Non-Consumers | Total |
|---|---|---|---|
| IABPD's Present | 16(7.4%) | 32(14.8%) | 48(22.2%) |
| IABPD's absent | 47(21.8%) | 121(56%) | 168(77.8%) |
| Total | 63 | 153 | 216 |

**$X^2$=1.6, df=1, p>0.05, Nonsignificant**

In our study(Table 1) majority of the subjects were in the younger age group (< than 48 years old) i.e about 67.1%. The division into younger and elderly subjects was based on the suggestions of Fotherby et al (1993)[20].

The prevalence of IABPD's(Table 2) in our study was around 43% with systolic differences constituting about 23% and diastolic differences about 20.4%.

The table 3 shows the association between Age (as a categorical variable) and IABPD's. About 30.6% of the younger subjects and 13% of the elderly subject had IABPD's.

The table 4 and the graph, describes the relationship between IABPD's and Age. About 23.4% of the Males and 32.1% of the Females had IABPD's.

Sixty eight percent of the males and 37% of the females consumed tobacco, whereas 18.5% of the males consumed alcohol(Table 5).

In males of the 62 subjects who had SBPD's, CAD present in 9.6%(Table 6A)
Of the 52 males who had DBPD's, 13.13% also had associated CAD.(Table 6B)
Of the 51 Females who had SBPD's CAD was Present in about 13.4%(Table 7A)
Of the 48 females who had DBPD's about 14.8% had associated CAD.(Table 7B)
In males of the 62 subjects who had SBPD's about 13.3% consumed tobacco (Table8A)
In those males who had DBPD's about 9.6% consumed tobacco.(Table 8B)
In those females who had SBPD's about 7.9% consumed tobacco(Table 9A)
In those females who had DBPD's about 7.4% were consumers of tobacco.(Table 9B)

**DISCUSSION**

The present study investigating the interarm BP differences (IABPD's), in a population in Kalawade, Karad is the first of its kind in India. Use of simultaneous, rather than sequential BP measurements has the advantage of reducing variations in BP other than those due to interarm differences. The clinical importance was first pointed out by Southby in 1935[7] and later by Ruger in 1951[6]. Later studies by Harrison et al (1961)[21] and Fotherby et al (1993)[20] again brought out the significance of simultaneous recording of IABPD's. The present study besides being the first of its kind in India was also novel in the sense that the relationship between Cardiovascular risk factors and IABPD'S was studied, something not explored in details previously.

In our study (Table 2) we found that 43% (212/486) of the Population had differences in blood pressure between the 2 arms (> than 10 mmHg for systolic and > than 8 mmHg for diastolic). This prevalence was substantially higher than that reported by Harrison et al[21] (5%) and Fotherby et al[20] (23%). This high prevalence is unlikely to be accounted for by random variations and by measurement errors. Three recordings were taken on each arms simultaneously which are known to reduce such variations.

When considering systolic and diastolic BP differendes separately Harrison et al[21] recorded systolic differences in 5% of his patients and diastolic differences in 4% whereas Fotherby et al[20] reported differences of 10% and 3% respectively. In our study SBPD differences were recorded in 23.25% and DBPD were noted in 20.4% of the subjects (Table2).

Age did not seem to be associated with these IABPD's (Table 3) . using age both as a continuous and as a categorical variable did not change the relationship (Table 10). Similar findings were reported by Fotherby et al[20], Harrison et al[21] and Frank et al[23].

When considering the relationship between sex and IABPD'S, Males did not seem to have higher prevalence of IABPD'S (Table 4) compared to females, findings in concordance with those reported by other authors[20,21,23].

**Prevalence of Cardiovascular risk Factors (CRF's)**

Tobacco consumption & alcohol consumption were the CRF's studied (Table 5). The prevalence of tobacco consumption in males was higher than in females, which is expected considering the fact that the prevalence of smoking is higher in males.

More than 50% of the subjects reported used of tobacco in some form, a very high prevalence in the farming population.

History of alcohol consumption could be elicited only from males. More than 18% of the males reported use of alcohol either occasionally or on a regular basis.

**IABPD's and risk of Coronary Artery Disease (Tables 6,7)**

Increased blood pressure is an independent risk factor for CAD, but whether differences in blood pressures between the two arms can increase the risk for CAD is a possibility not explored before. Many of the causes of IABPD's can possibly increase a subjects risk for CAD.

In our study ECG changes suggestive of CAD, were used to classify the subjects into those with and without CAD. Based on these criteria no increase in risk for CAD was seen in patients who had IABPD's. An association was also not seen on controlling for confounding by sex.

Nevertheless it is possible that age was confounding the relationship as majority of the subjects in the study were in the younger age group (15-48 years) we could not examine such possible confounding.

**Cardiovascular risk factors (CRF's) and IABPD's**

It has been predicted that, cardiovascular risk factors will be the most important cause of mortality in India by 2015. Studies by Dewar et al (1992)[24] and Gupta et al (1996)[29,38] suggest a high prevalence of CAD in both urban and rural populations of India. Although rural populations have shown a lower prevalence compared to the urban, a rising trend is seen in them too.

These reports prompted us to study whether CRF's were associated with IABPD'S. Tobacco consumption, alcohol consumption and physical activity were the main risk factors studied.

Tobacco consumption in our sample was not associated with IABPD's (Table 8 and 9). Smokers, Tobacco chewers and users of tobacco as tooth paste (Mishri) were all classified as being tobacco consumers. This is likely to have led to misclassification. Use of a composite index for use of tobacco in all forms, might suggest a different association.

Most of the subjects in the study were sugar cane farmers and reported high level of physical activity. Thus it was not possible to analyze its statistical relationship with IABPD's. A composite index which classifies physical activity into both work related and leisure time physical activity will be needed to examine this relationship.

## CONCLUSIONS

The following conclusions could be drawn from the results of the study:

- The prevalence of IABPD's amongst the rural population was high (43%)
- Most of the subject who had IABPD's, the differences were due to higher pressures on the right side.
- The prevalence of CRF's such as tobacco and alcohol consumption was high.
- No significant associations were seen between IABPD'S and CAD although confounding due to age could not be ruled out.
- No significant association was seen between IABPD'S and CRF's such as smoking, alcohol consumption.

**Limitations**

The study was limited in a number of ways. Although we determined the prevalence of IABPD's we could not evaluate the causes for these differences due to lack of available resources. Being a one time prevalence study, the future significance of such differences could not be evaluated. A longitudinal follow-up study will be necessary.

We did not find any association between IABPD's and CAD, although such could be expected considering that many of the causes of IABPD's such as atherosclerosis, syphilitic aortitis and coarctation of the aorta are likely to lead to CAD. It is possible that the lack of association in our study was due to inadequate criteria (only ECG findings were used) used for Determining CAD. Further studies need to use specific diagnostic measures for determining CAD.Although we determined the prevalence of major CRF's we could not completely evaluate presence of risk factors such as physical inactivity. At the same time, lipid profiles of the subjects were not determined. To make adequate recommendations adequate indices need to be used.

We studied the relationship between IABPD'S and CRF's on reports by some authors that, incidence of IABPD's was higher in subjects with CAD, compared to controls. If an association exists, reduction in prevalence of CRF's will naturally lead to reduction in the IABPD's and also a reduction in CAD. Our study did not find any associations. As we could not evaluate the relationship between IABPD's and CAD completely, our findings are likely to be incomplete.

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