

**TWENTY FOUR HOUR AMBULATORY BLOOD PRESSURE
MONITORING IN GENERAL PRACTICE**

by

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ABSTRACT

Objectives: To assess the role of ambulatory blood pressure monitoring in the diagnosis of hypertension in general practice.

Background: Hypertension is usually diagnosed by casual office blood pressure readings. However, ambulatory blood pressure monitoring has shown that a significant proportion of patients diagnosed as hypertension in fact do not have hypertension.

Method: Sixty four Indian patients diagnosed as having mild to moderate hypertension by casual measurements were subjected to a twenty four hour ambulatory blood pressure monitoring. A blood pressure load of $>35\%$ was classified as true hypertension and $< 35\%$ as white coat hypertension. White coat hypertensives were compared to the hypertensive group with respect to various demographic characteristics, and to correlate ambulatory blood pressure monitoring and casual blood pressure readings.

Results: A prevalence of 23.44% white coat hypertension was found. In addition, the demographic profile of such patients show a preponderance of non-obese females (73.33%), the majority of whom are on concomitant medication (60%). A poor correlation was found between the casual office blood pressure readings and the twenty four hour ambulatory blood pressure readings in the white coat hypertensives as compared to the hypertensive group.

Conclusion: White coat hypertension is common in patients diagnosed as having mild to moderate hypertension by casual blood pressure readings. There are no reliable clinical indicators to identify patients with white coat hypertension. Ambulatory blood pressure monitoring has been shown to be a useful method for differentiating white coat hypertensives from true hypertensives.

PREFACE

This study represents original work by the author and has not been submitted in any form to another university . Wherever previous work done by other authors was used, it has been duly acknowledged in the text.

The research described in this commentary was carried out in urban general practices and the result analysed by Ms Eleanor Gouws, Senior Statistician of the Medical Research Council, and under the supervision of Dr S. Vythilingum, Cardiologist in private practice.

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GLOSSARY

N	-	Total Sample
n	-	Small sample of total sample
BP	-	Blood pressure
BMI	-	Body mass index
WCH	-	White coat hypertension
HPT	-	Hypertension
ABPM	-	Ambulatory blood pressure monitoring
SD	-	Standard deviation
ABPMS	-	Mean systolic blood pressure as per ABPM
ABPMD	-	Mean diastolic blood pressure as per ABPM
MSYST	-	Mean systolic blood pressure as per casual measurement
MDIAS	-	Mean diastolic blood pressure as per casual measurement.

TABLE OF CONTENTS

	Page
Abstract	i
Preface	ii
Acknowledgements	iii
Glossary	iv
CHAPTER ONE : INTRODUCTION	1
1.1 Purpose	3
1.2 Objectives	3
1.3 Definitions	4
CHAPTER TWO : REVIEW OF RELEVANT LITERATURE	5
CHAPTER THREE : METHOD	11
3.1 Subject	11
3.2 Sampling	11
3.3 Data Collection	12
3.4 Materials	12
3.5 Statistical Methods	14
CHAPTER FOUR : RESULTS	15
4.1 Patient Characteristics	15
4.2 Prevalence of White Coat Hypertension	16
4.3 Comparative Data of White Coat Hypertension and Hypertension	17
4.4 Comparative Blood Pressure Measurements	20
4.5 Correlation of Casual and Ambulatory Blood Pressure Measurements	22

	Page
CHAPTER FIVE : DISCUSSION	27
CHAPTER SIX : CONCLUSION	31
REFERENCES	32
APPENDIX	36

LIST OF TABLES

		PAGE
Table I	Clinical Indications for which Ambulatory Blood Pressure Monitoring may be useful	9
Table II	Table of Group By Sex	17
Table III	Table of Variable Demographic Data in the WCH and HPT group	18
Table IV	Table of Descriptive Statistics	19
Table V	Table of Blood Pressure Measurements	20
Table VI	Differences Between Casual Blood Pressure Measurement and 24 hour Ambulatory Blood Pressure Measurements	21

LIST OF FIGURES

		PAGE
FIGURE 1	Distribution of sample by Gender	15
FIGURE 2	Distribution of sample: Age by Gender	16
FIGURE 3	Distribution of sample into White Coat Hypertensives and Hypertensives	17
FIGURE 4	Association between Mean Casual Systolic and Mean ABPM Systolic Blood Pressure in the WCH group	23
FIGURE 5	Association between Mean Casual Diastolic and Mean ABPM Diastolic Blood Pressure in the WCH group	24
FIGURE 6	Association between Mean Casual Systolic and Mean ABPM Systolic Blood Pressure in the HPT group	25
FIGURE 7	Association between Mean Casual Diastolic and Mean ABPM Diastolic Blood Pressure in the HPT group	26

CHAPTER ONE

INTRODUCTION

Hypertension has long been dubbed the silent killer amongst the medical fraternity. This morbid description is quite apt because of the asymptomatic presentation of this condition, and the devastating and long term consequence of untreated hypertension on the cardiovascular, cerebrovascular and renal systems (Hansson X, 1995).¹

Hypertension is a condition that knows no bounds, as it affects people all over the world, ignoring geographical boundaries, in developed and underdeveloped countries alike, affecting all race groups, both young and old, rich and poor, males and females, employed and unemployed, raging through generation upon generation and electing to vary in its degree of risk and long term sequelae in individual patients.

Therefore early detection of this condition is of prime importance. Moderate to severe hypertension can be diagnosed with ease and confidence in general practice by its arbitrary measurements of persistently high levels of blood pressure and associated target organ damage. However mildly elevated blood pressure readings often present a clinical dilemma whether to treat or not, as the definitive diagnosis of hypertension in these cases is difficult to make when one considers all the factors that cause variation in blood pressure readings, especially the high prevalence of "white coat" hypertension (20% according to O'Brien E. et al., 1991).²

On the other hand, the introduction of non-invasive ambulatory blood pressure monitoring (ABPM) allows one to evaluate the blood pressure profile over a twenty four hour period in the patients natural environment (Carl J Lavie et al., 1988).³ It also permits day and night blood pressure to be observed and quantified in individuals in their true environment i.e. work , home

and during sleep (Pickering T.G., 1995).⁴

Over the last three decades, improvements in technology has increased the importance and role of ABPM, and has resulted in a reappraisal of our approach to the diagnosis and management of mild hypertension. It has been shown to be useful in the therapeutic assessment of patients with mild hypertension with or without target organ damage, assessment of anti-hypertensive drug resistance, assessment of episodic hypertension and in patients with hypotensive symptoms during anti-hypertensive therapy (Sheps S.G. et al., 1994).⁵ Another indication to consider would be in the early detection of hypertension in pregnancy.

A prospective study was conducted on Indian patients, both males and females between the ages of 25 to 49 years , who had mild to moderate high blood pressure readings (Systolic 140 - 179 mm Hg and diastolic 90 - 109 mm Hg) for the first time as measured on a casual basis in the doctors rooms on 3 different occasions, whereby these patients were subjected to a twenty four hour ambulatory blood pressure monitoring (ABPM) and the results were analysed and collated, and are presented in this paper.

1.1 PURPOSE

To determine the role of Twenty Four Hour Ambulatory Blood Pressure Monitoring in the confirmation of hypertension in Indian patients attending urban general practices in the greater Durban area.

1.2 OBJECTIVES

- a. To determine the correlation between casual blood pressure measurements and the twenty four hour ambulatory blood pressure monitoring.
- b. To identify patients with "white coat" hypertension.
- c. To determine the demographic profile of patients presenting with "white coat" hypertension.
- d. To determine an accurate profile of patients blood pressure measurements when the diagnosis of hypertension has been made.
- e. To make recommendations to general practitioners of the value of using ambulatory blood pressure monitoring in respect of the findings of the study.

1.3 DEFINITIONS

Hypertension :

A persistently elevated blood pressure reading of systolic > 140 mm Hg and diastolic > 90 mm Hg., in an adult age 18 years and older.

Casual Blood Pressure Measurements :

Blood pressure measurements obtained on different occasions on the same patient in the doctors consulting rooms.

Ambulatory Blood Pressure Monitoring (ABPM) :

Blood pressure measurements that are recorded and stored by means of an automated device at present intervals over a certain period of time - usually 24 hours.

Urban :

A suburb or borough of a town or city.

General Practice :

A general practice by a medical practitioner where patients attend for treatment of various ailments.

Blood Pressure Load :

The percentage of blood pressure values above 140/90 mm Hg for a given period of time.

White Coat Hypertension (WCH) :

A condition in which blood pressure is elevated in the presence of a doctor but falls when the subject leaves the medical environment.

Body Mass Index (BMI) :

Calculated as body weight in kilograms divided by the height squared in metres - normal value regarded as 20-25. A value of >25 is regarded as indicating obesity.

CHAPTER TWO

REVIEW OF RELEVANT LITERATURE

Hypertension affects approximately 6.5 million South Africans,⁶ and about 50 million Americans,⁷ necessitating years of drug treatment. It has been recognised as one of the major diseases that must be given priority in South Africa, as stated in the Reconstruction and Development programme issued by the central government in 1995, and it remains a major health challenge to the health care professionals.⁸

Hypertension as defined by Geoffrey Rose is the "Level of Blood Pressure where treatment does more good than harm". According to the Joint National Committee on the Detection, Evaluation and Treatment of High Blood Pressure,⁹ the arbitrary definition of hypertension in adults (18 years and older) is based on the casual measurement of blood pressure, whereby there is a persistently elevated blood pressure reading of systolic > 140 mm Hg and diastolic of > 90 mm Hg on 3 different occasions. Hypertension can be classified as mild (systolic 140 - 159 mm Hg and diastolic 90 - 99 mm Hg), moderate (systolic 160 - 179 mm Hg and diastolic 100 - 109 mm Hg), severe (systolic 180 - 209 mm Hg and diastolic 110 - 119 mm Hg), and very severe (systolic > 210 mm Hg and diastolic > 120 mm Hg).

Several factors make hypertension a particular challenge to the Family Physician. These include its high prevalence, the fact that it does not produce any symptoms unless the blood pressure is malignantly high, and the need for individual and personalised management over a long period of time.¹⁰ Because hypertension remains a major risk factor for cardiovascular, cerebrovascular and renal complications,¹ its early detection and treatment are an essential and important element in reducing the associated morbidity and mortality and to enhance the quality of life.

Blood pressure is a physiological measurement with great variability among individuals and within the same individual, from day to day and hour to hour.¹⁰ Although high casual blood pressure measurements on 3 or more different occasions remain the basis for the diagnosis of hypertension, detection of mild hypertension by such a method may be inaccurate because such a method is not a true reflection of the average blood pressure in an individual. This is because of the wide variation in blood pressure levels in an individual over a 24 hour period, whereby there is a natural circadian blood pressure variation characterised by a morning peak in blood pressure, followed by a fall during the day and a second smaller peak in the afternoon, followed by a further pronounced fall during sleep.¹¹ Night time blood pressure levels are approximately 20% lower than daytime levels. Therefore casual blood pressure measurements are merely snap shots of the true blood pressure in an individual, depending on what time it was taken.

Since the measurement of blood pressure may decide whether or not a patient is to be classified as hypertensive, even an inaccuracy of 4 mm Hg may be serious in misdiagnosing and labelling a patient as hypertensive or not.¹²

On the other hand, 24 hour ambulatory blood pressure monitoring permits day and night blood pressure to be observed and quantified in individuals in their true environment, i.e. work, home and during sleep.¹³

The first ambulatory system for the non-invasive measurement of blood pressure was described in 1962 by Hinman, Engel and Bickford.¹⁴ Since then there has been the development of many devices to measure blood pressure over a period of time. Over the last three decades improvements in technology has increased the importance and role of ambulatory blood pressure monitoring and has resulted in a reappraisal of our approach to the diagnosis and management of hypertension. The clinical use of 24 hour ambulatory blood pressure monitoring is proceeding at a rapid pace, especially from research into clinical practice.²

However at present these monitors should not be regarded as an alternative to the traditional approach, but rather as an additional tool to be employed in selected situations as a complement to the routine clinical and laboratory evaluation of hypertensive patients.¹⁵

Ambulatory monitors measure blood pressure either by detecting Korotkoff sounds (auscultation) or by measuring brachial artery vibrations (oscillometry). Some monitors perform both these functions.⁴ Currently the most common monitors in use are small, lightweight, portable and are battery powered and fully automatic, and allows the doctor to programme it to inflate and deflate at preset intervals and the patient to wear them during normal daily activities. These monitors have a computerised memory chip that records the blood pressure measurements and the heart rate of the patient for the specified period, which is then subsequently downloaded into a computer for analysis and display. Normally it is acceptable to have 50 to 100 such blood pressure measurements over a 24 hour period. The display and subsequent printout of the readings gives the doctor a record of the patient's diurnal blood pressure variation and heart rate patterns, and permits analysis of the differences in blood pressure during sleep and wakefulness, as well as the variation that occur during different daytime activities.⁴ These measurements can also be analysed against the background of the influence of stress and environmental factors at home and work.

Of clinical importance is the accuracy of ambulatory blood pressure measuring devices. Presently there are about thirteen different systems commercially available and a need to validate these blood pressure measuring devices arose. The two bodies that conducted validation studies on these devices were the American Association for the Advancement of Medical Instrumentation (AAMI) and the Working Party on Blood Pressure Measurement of the British Hypertension Society (BHS). It was shown that the best devices with the BHS grading system are the Spacelabs 90207 and the DIASYS 200 and by the AAMI criteria, the recommended devices are the Spacelabs 90202 and 90207 , the DIASYS 200 and Medilog.¹⁴

It has been shown that ambulatory blood pressure monitoring values are lower than casual office systolic and diastolic cuff measures by 20 mm Hg and 10 mm Hg respectively in normotensive patients, thereby implying the ease with which doctors can misdiagnose and classify patients as hypertensive, if the associated factors of blood pressure variation have not been considered.

Because of the numerous blood pressure readings and the variability thereof, an analysis of the data must be made in simplified terms for the doctor to understand and interpret the results. Although there are ongoing studies to provide a more accurate assessment, the present recommendation is that the blood pressure values over a 24 hour period be expressed as blood pressure load, i.e. the percentage of blood pressure values for a given period that are higher than the normal for that period.

Because of the variability of the blood pressure readings associated with the various factors that influence it, the blood pressure load is calculated for 3 different periods. They are as follows: The percentage of blood pressure readings $> 140/90$ mm Hg while awake, the percentage of blood pressure readings $> 120/80$ mm Hg during sleep hours, and the 24 hour blood pressure load, i.e. the percentage of waking and sleeping readings over 24 hours $> 140/90$ mm Hg and $120/80$ mm Hg respectively. Normal blood pressure load is quantified as $< 20\%$.¹⁶ 20 to 35 % is regarded as borderline blood pressure load and $> 35\%$ is regarded as hypertension.

Ambulatory blood pressure monitoring is a precise and responsible technique for the diagnosis of hypertension. It has special value in the evaluation of those patients in whom hypertension is difficult to diagnose. The most important clinical indication for a 24 hour ambulatory blood pressure monitoring is in detecting normotensive patients who otherwise present with high casual blood pressure measurements in doctors rooms - the so called "white coat" hypertensive. It is also useful in assessment of patients with mild hypertension with target organ damage, assessment of anti-hypertensive drug resistance, assessment of episodic hypertension and in

patients with hypotensive symptoms during anti-hypertensive therapy.⁵ Another indication to consider would be early detection of hypertension in pregnancy. Guidelines for use of ambulatory blood pressure monitoring have been included in the Fifth Report of the Joint National Committee on Detection, Evaluation and Treatment of High Blood Pressure(JNC V),⁹ as outlined in table I.

TABLE I

CLINICAL INDICATIONS FOR WHICH AMBULATORY BLOOD PRESSURE MONITORING MAY BE USEFUL
Borderline hypertension severe hypertension refractory to antihypertensive therapy "Office" or "White Coat " hypertension Symptomatic patients (from excessively low or high blood pressure) Episodic hypertension Evaluation of blood pressure changes in nocturnal angina and pulmonary congestion Autonomic dysfunction syndrome Certain forms of syncope (the carotid sinus syndrome , the pacemaker syndrome)
From the Joint National Committee on Detection , Evaluation and Treatment of High Blood Pressure

These guidelines are valuable in general practice when confronted with a difficult diagnosis of hypertension.

Not only anxiety in the presence of the doctor increase the patients blood pressure, but poor communication can do the same on a long term basis.¹⁷ Hypertensive labelling can lead to a

previously stable blood pressure becoming self - perpetuating, due to chronic anxiety and thereby the hypertensive state.

The labelling and treatment of hypertension in a patient when it is misdiagnosed has many ill effects and dangers. These include the psychological impact of having been diagnosed as having an illness or sickness in an otherwise healthy individual and the cost and side effects of the drugs, a reduced quality of life and "hypertension neurosis", whereby the patient interprets vague symptoms such as "headaches" and "dizziness" as symptoms of hypertension. It has also been shown that telling patients that they have hypertension has led to increased absenteeism, low self esteem and poor marital relationships (Hayes et al , 1978). Therefore, one should not make a diagnosis of hypertension unless the blood pressure readings are persistently elevated and have been confirmed to be so. In mild hypertension, the single most valuable procedure is an ambulatory 24 hour blood pressure reading to eliminate "white coat" hypertension and to help clarify whether the blood pressure as taken routinely, is really valid or not.¹⁷

Ambulatory blood pressure monitoring can be considered a mature, clinically applicable technology for the management of selected patients with hypertension. Although Staessan and Associates¹⁷ have given recommended mean values for ambulatory blood pressure measurements to be used as a guideline of normality, studies are still in progress to fully evaluate the normotensive blood pressure profile.

CHAPTER THREE

METHOD

3.1 SUBJECTS

The total sample in this study (N=64) consisted of urban Indian patients who attended urban general practices in Durban, South Africa. These practices were established more than ten years ago and are situated in middle to lower socio-economic areas of Phoenix , Newlands West and Effingham Heights. These areas were previously reserved for Indians under a law up until 1990 that promoted racial segregation. Four general practitioners, including myself, participated in the study. The three other general practitioners were chosen because of their prior experience with the usage of twenty four hour ambulatory blood pressure monitoring, their predominantly Indian population patient base and their urban location. The patients were from the doctors own practice and were, therefore, familiar with the general practitioner.

Indian patients were selected so as to obtain a homogenous group for the study to eliminate the inter-racial differences that exist in hypertension.

Informed consent was obtained from all patients participating in the study (appendix A).

3.2 SAMPLING

All Indian patients, both male and female, between the ages of 20 to 50 years who had high casual blood pressure measurements on 3 different occasions (systolic 140 - 179 mm Hg and diastolic 90 - 109 mm Hg) as measured in the consulting room with a wall

mounted mercury sphygmomanometer and not on treatment for hypertension, were selected for the study. All blood pressure measurements were taken after a period of rest of at least 5 minutes. These patients were subjected to a 24 hour ambulatory blood pressure monitoring. Patients that were included in this study had a 24 hour ambulatory blood pressure monitoring and had readings which were suitable for analysis.

A total of 78 patients were screened and 14 patients were excluded because of incomplete monitoring period.

In consultation with a statistician, it was decided to obtain a minimum sample size of 62, which was calculated in such a way that the estimate of percentage of white coat hypertension would fall within 10% of the population figure with 95% confidence.

3.3 DATA COLLECTION

All medical records of the selected patients was included in the study . The computer analysed and summarised results of the 24 hour blood pressure monitoring was also included in the study. An information inventory was filled in to extract the relevant information from both the patients records and the 24 hour ambulatory blood pressure recordings (appendix B).

3.4 MATERIALS

The relevant information inventory, designed by the author for the purpose of this study was used to obtain the necessary information in a standardised way. The inventory was designed to elicit various demographic and diagnostic correlates and variables associated with hypertension .

A wall mounted mercury sphygmomanometer with a Littman Classic II stethoscope was used to obtain the casual blood pressure readings. At the beginning of the study, the wall mounted mercury sphygmomanometer of all four practices were calibrated by a technician from Protea Medical Supplies, so as to obtain accuracy. The participating general practitioners were briefed on the method of taking the blood pressure with the wall mounted mercury sphygmomanometer so as to reduce inaccuracy between practices. The briefing was as follows:

- a) The use of correct size cuff for each patient. When the arm circumference is less than 33cm, a regular size cuff (12 x 23cm) is to be used, a larger cuff (15 x 33cm) if the arm circumference is 33-41cm and a thigh cuff (18 x 36cm) if the arm circumference is greater than 41 cm.
- b) The correct positioning of the patient during measurement. The blood pressure is to be measured with the patient lying on a bed or couch on the right side at 30 degrees of lateral tilt with the sphygmomanometer cuff and heart at the same level.
- c) The use of the correct phase of the Korotkoff sounds in measuring diastolic pressure. Phase 1 of the Korotkoff sounds defines systolic pressure. Phase V (disappearance of sounds) is to be taken as diastolic pressure.

A small portable 24 hour blood pressure monitoring device manufactured by Spacelabs (Spacelabs 90207), and supplied to me for usage in this study by Zeneca Pharmaceuticals, was used to obtain the 24 hour blood pressure readings. A highly skilled representative of the company, Mr Enver Moolla, who has vast experience in obtaining twenty four hour ambulatory blood pressure readings in patients for general practitioners and specialists in the Durban area, carried out the ambulatory monitoring. He personally attached the apparatus, with pre-test calibration, on all the patients from all four practices.

A summary of the contribution of the four practices are as follows:

Practice 1(myself)- 49 patients

Practice 2 - 5 patients

Practice 3 - 3 patients

Practice 4 - 7 patients

3.5 STATISTICAL METHODS

A computer with the SAS System software package was used to analyse and correlate the data.

Descriptive statistics consisting of means and standard deviations or frequencies and percentages were calculated for all the parameters of interest. "White coat" hypertensives were compared to the hypertensive group using Student's unpaired t-test for continuous data and chi- square test for categorical data . A p - value < 0.05 was regarded as statistically significant.

Pearson Correlation Coefficients were calculated to assess the extent of the correlations between the different blood pressure measurements. Differences were calculated between the average casual BP measurements and the ABPM measurements and the paired t-test was used to assess the significance of the difference . The 95% confidence intervals for the differences between casual BP and the 24 hour ABPM give an indication of the level of agreement (also referred to as the limits of agreement). Pearson Correlation Coefficient is expressed as r , whereby $r > 0.7$ indicates a strong association, $r > 0.3$ but < 0.7 a moderate association and $r < 0.3$ a poor association.

CHAPTER FOUR

RESULTS

The results and findings of the questionnaires are presented in this chapter.

4.1 PATIENT CHARACTERISTICS

The sample consisted of 36 (56.25%) males and 28 (43.75%) females, as illustrated in Figure 1.

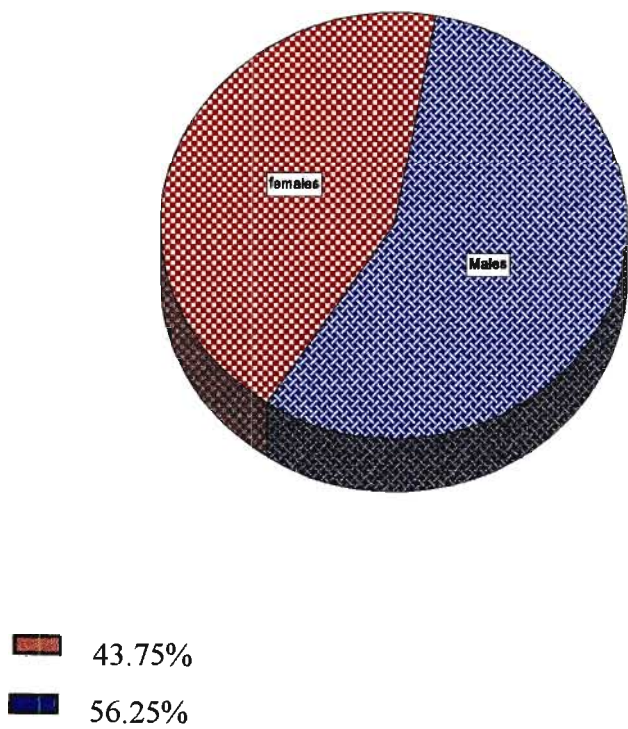


Figure 1 Distribution of Sample By Gender

The ages of the patients in the study ranged from 25 to 49 years with a mean of 38.35 years
See Figure 2 for the distribution of ages by gender.

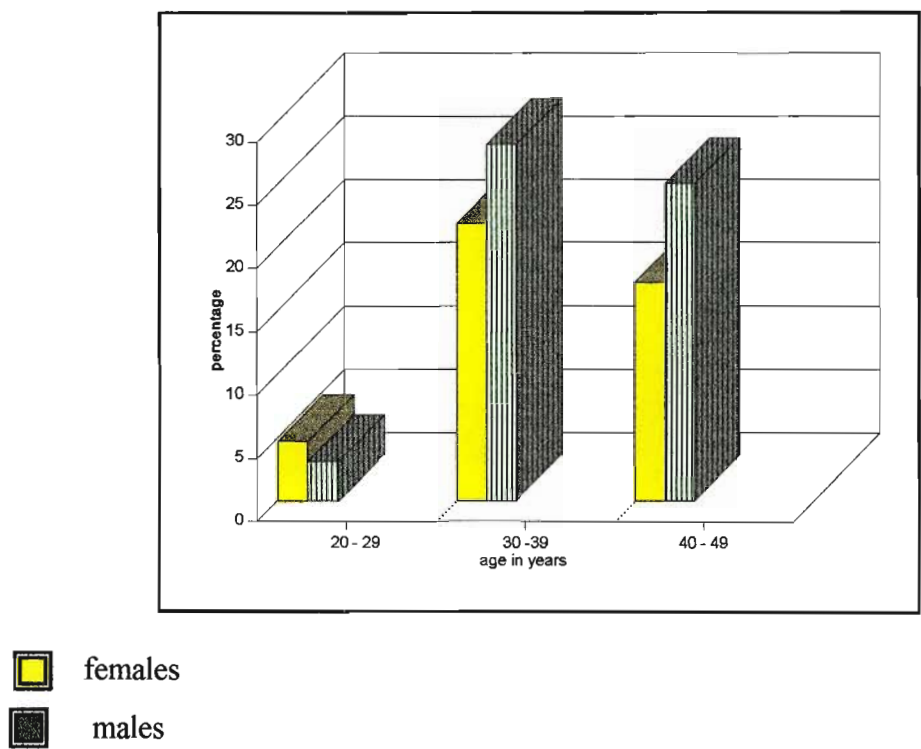


Figure 2 : Distribution of sample : Age by Gender

4.2 PREVALENCE OF WHITE COAT HYPERTENSION

The total sample(N=64) was divided into 2 groups based on the result in respect of the 24 hour ABPM. Those who had a normal BP load in the 24 hour ABPM result were classified as white coat hypertension(WCH) and those with a high BP load were classified as hypertension (HPT). Of the total sample (N=64), 15 were found to have white coat hypertension, representing 23.44% (figure 3).

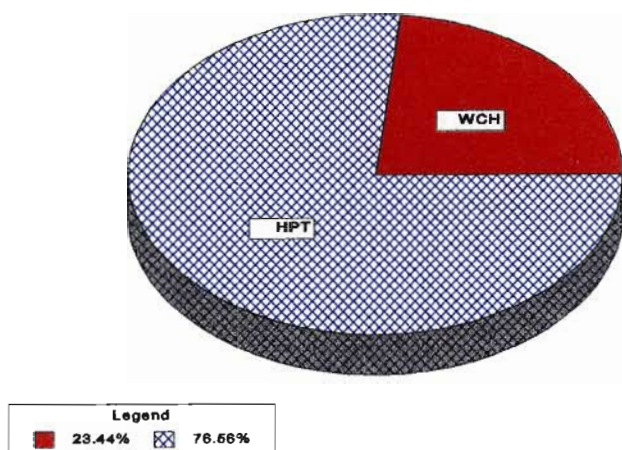


Figure 3: Distribution of sample into white coat hypertensives(WCH) and hypertensives(HPT)

4.3 COMPARATIVE DATA OF WHITE COAT HYPERTENSION AND HYPERTENSION

Comparison of male and female showed a higher preponderance of females with white coat hypertension (73.33%) (table 2).

TABLE II

Table of group by sex

	MALE	FEMALE	TOTAL
WCH	4 (26.67%)	11 (73.33%)	15 (23.44%)
HPT	32 (65.30%)	17 (34.70%)	49 (76.56%)
TOTAL	36 (56.35%)	28 (43.75%)	64 (100%)

p = 0.010

TABLE III**Demographic data in the WCH and HPT group**

VARIABLE	WCH (n=15)	HPT (n=49)	p -value
Family history of hypertension	12 (80%)	26 (53.06%)	0.063
Family history of diabetes mellitus	5 (33.33%)	13 (26.53%)	0.608
History of smoking	5 (33.33%)	21 (42.86%)	0.511
History of alcohol intake	4 (26.67%)	27 (55.10%)	0.054
History of sedentary lifestyle	11 (73.33%)	30 (61.22%)	0.392
History of concomitant medication	9 (60%)	10 (20.41%)	0.003

There were no significant difference between hypertensive and white coat hypertensive patients with regard to the family history of hypertension ($p = 0.063$), family history of diabetes mellitus ($p = 0.608$), history of smoking ($p = 0.511$), history of alcohol intake ($p = 0.054$) or a sedentary lifestyle ($p = 0.392$)(table III).

However, a significant difference was found with regard to concomitant medication($p = 0.003$). In the white coat hypertension group 60% were on concomitant medication compared to 21% in the hypertensive group(tableIII).

The type of concomitant medication that the white coat hypertension group were on, consisted of anti-depressants and anxiolytics (66%), non-steroidal anti-inflammatories and analgesics (22%). 12% of the patients were on hormone replacement therapy and migraine prophylaxis.

Table IV

Table of descriptive statistics

VARIABLE	WCH (n=15)	HPT (n=49)	p-value
AGE	36.73 (6.92)	39.98 (5.75)	0.073
HEIGHT	161.73 (5.56)	165.98 (6.86)	0.033
WEIGHT	57.80 (14.34)	71.92 (9.77)	0.002
BMI	22.02 (4.33)	26.08 (2.87)	0.003

There were no significant difference in the ages between the 2 groups. The WCH mean age was 36.73 years(+ 6.92) and the HPT mean age 39.98 years(+5.75), with a p-value of 0.073.

However, it was interesting to note that there were significant differences seen in the variables of height, weight and body mass index (BMI) in the two groups. The white coat hypertension group had a lower height ($p = 0.033$), weight ($p = 0.002$) and body mass index ($p = 0.003$), as compared to the hypertension group(table IV).

4.4 COMPARATIVE BLOOD PRESSURE MEASUREMENTS

TABLE V

Table of Blood Pressure Measurements

Blood Pressure	WCH (n=15)	HPT (n=49)	p-value
CASUAL SYST 1	154.40 (6.47)	152.55 (5.40)	0.272
CASUAL SYST 2	153.07 (5.77)	151.71 (5.60)	0.420
CASUAL SYST 3	152.67 (5.42)	151.39 (6.45)	0.489
CASUAL DIAS 1	97.87 (3.80)	97.41 (4.21)	0.707
CASUAL DIAS 2	94.87 (4.70)	97.12 (4.81)	0.115
CASUAL DIAS 3	96.00 (4.14)	96.59 (4.73)	0.664
MEAN SYSTOLIC	153.40 (4.55)	151.76 (5.15)	0.271
MEAN DIASTOLIC	96.73 (2.49)	97.00 (4.20)	0.817
MEAN ABPM SYST	122.47 (6.38)	134.41 (8.94)	0.0001
MEAN ABPM DIAS	77.40 (4.55)	88.88 (7.17)	0.0001

Casual systolic, diastolic and mean blood pressure were similar in the white coat hypertension and the hypertension group. However, ambulatory blood pressure monitoring showed a significantly lower mean systolic and diastolic blood pressure measurements in the white coat hypertension group as compared to the hypertension group ($p = 0.0001$)(table V).

The paired t-test was used to assess the significance of the difference between the average casual BP measurement and the ABPM measurement

TABLE VI

Differences between casual blood pressure measurements and 24 hour ambulatory blood pressure measurements

a) SYSTOLIC BLOOD PRESSURE:

Group	Mean Casual	Mean ABPM	Mean Diff.	p-value	95% CI
WCH (n=15)	153.4 (4.55)	122.5 (6.38)	30.9 (5.12)	0.0001	(28.3 ; 33.5)
HPT (n=49)	151.7 (5.15)	134.4 (8.94)	17.3 (6.29)	0.0001	(15.6 ; 19.1)
Total (n=64)	152.1 (5.03)	131.6 (9.79)	20.5 (8.35)	0.0001	(18.5 ; 22.6)

b) DIASTOLIC BLOOD PRESSURE:

Group	Mean Casual	Mean ABPM	Mean Diff.	p-value	95% CI
WCH (n=15)	96.7 (2.49)	77.4 (4.55)	19.3 (5.04)	0.0001	(16.8 ; 21.9)
HPT (n=49)	97.0 (4.19)	88.9 (7.17)	8.12 (4.41)	0.0001	(6.9 ; 9.4)
Total (n=64)	96.9 (3.85)	86.2 (8.23)	10.75 (6.59)	0.0001	(9.1 ; 12.4

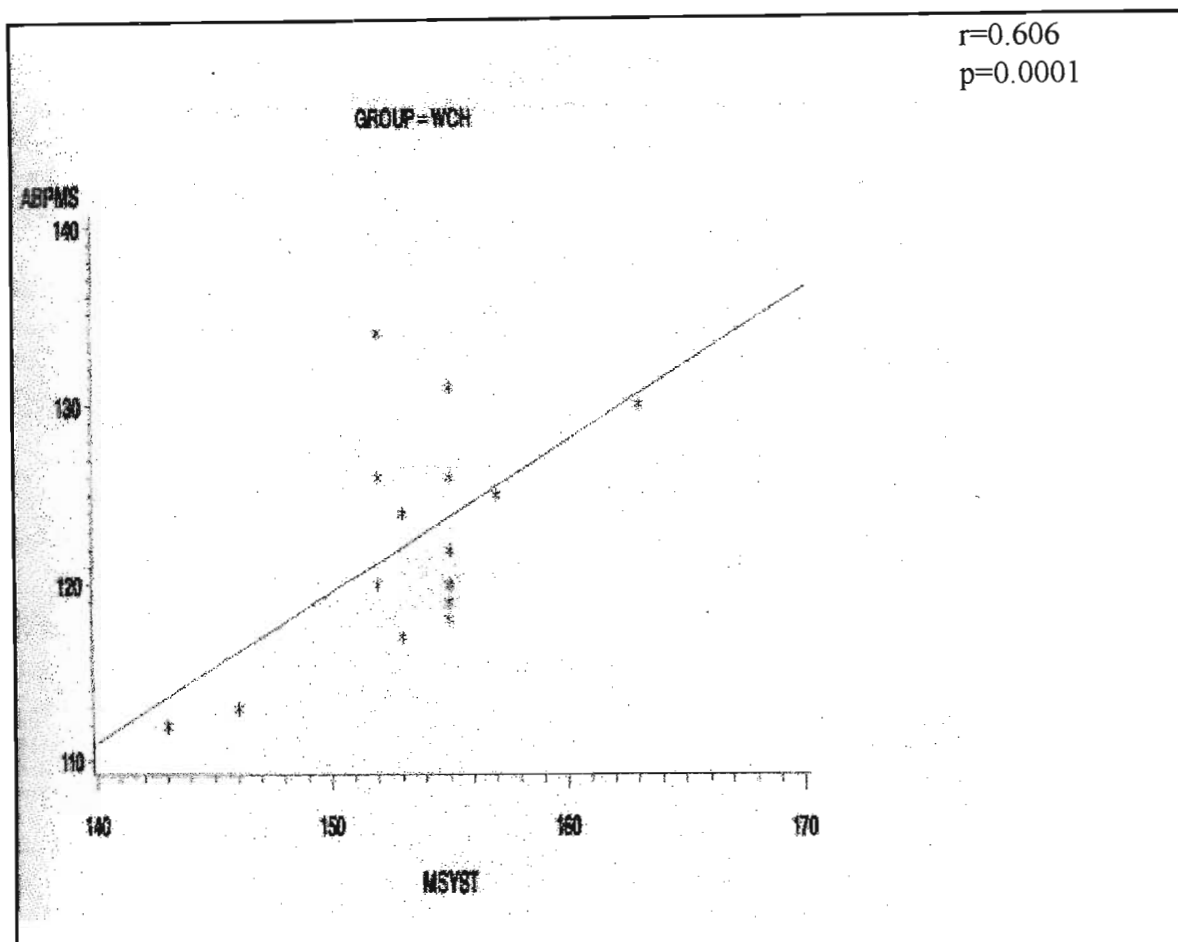
In the WCH group(n = 15), the mean casual systolic BP was 153.4(\pm 4.55) and the mean ABPM systolic BP was 122.5(\pm 6.38), with a mean difference of 30.9(\pm 5.12), a p-value of 0.0001 and 95% confidence interval of 28.3 - 33.5. The mean casual diastolic BP was 96.7(\pm 2.49) and the mean ABPM diastolic BP was 77.4(\pm 4.55), with a mean difference of 19.3(\pm 5.04), a p-value of 0.0001 and a 95% confidence interval of 16.8 - 21.9.

In the HPT group($n = 49$), the mean casual systolic BP was $151.7(\pm 5.15)$ and the mean ABPM systolic BP was $134.4(\pm 8.94)$, with a mean difference of $17.3(\pm 6.29)$, a p-value of 0.0001 and a 95% confidence interval of 15.6 - 19.1. The mean casual diastolic BP was $97.0(\pm 4.19)$ and the mean ABPM diastolic BP was $88.9(\pm 7.17)$, with a mean difference of $8.12(\pm 4.41)$, a p-value of 0.0001 and a 95% confidence interval of 6.9 - 9.4.

4.5 CORRELATION OF CASUAL AND AMBULATORY BLOOD PRESSURE MEASUREMENTS

The assessment of the extent of the correlation between the average casual blood pressure measurements and the ambulatory blood pressure measurements were calculated using the Pearson Correlation Coefficient. An indication of the level of agreement is shown by the 95% confidence interval.

In the WCH group, moderate correlation was found between casual systolic BP measurement and ABPM measurement ($r = 0.606$) (Figure 4).

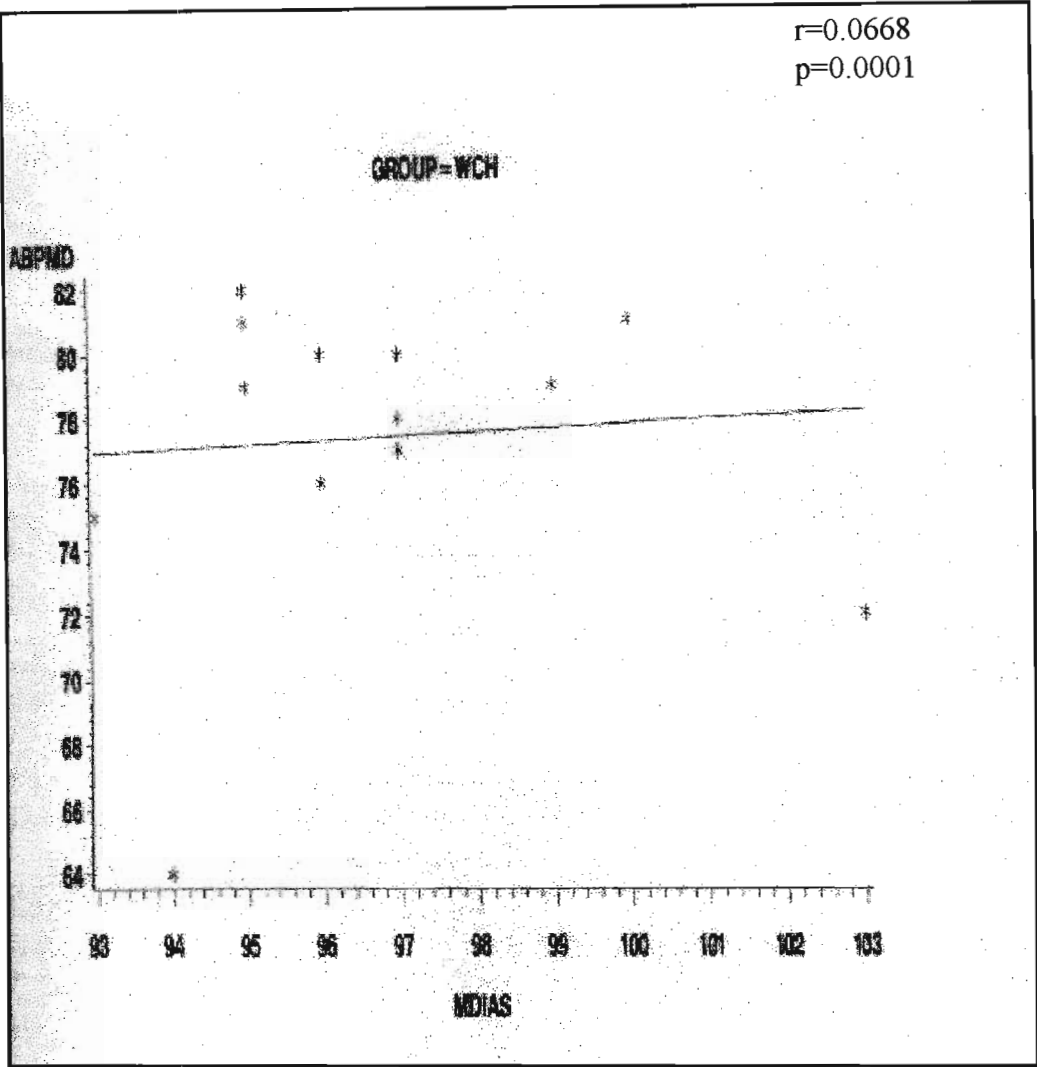


ABPMS = Mean Systolic Ambulatory Blood Pressure Measurement

MSYST = Mean Systolic Casual Blood Pressure Measurement

**Figure 4: Association between Mean Casual Systolic and Mean ABPM
Systolic Blood Pressure in the WCH group**

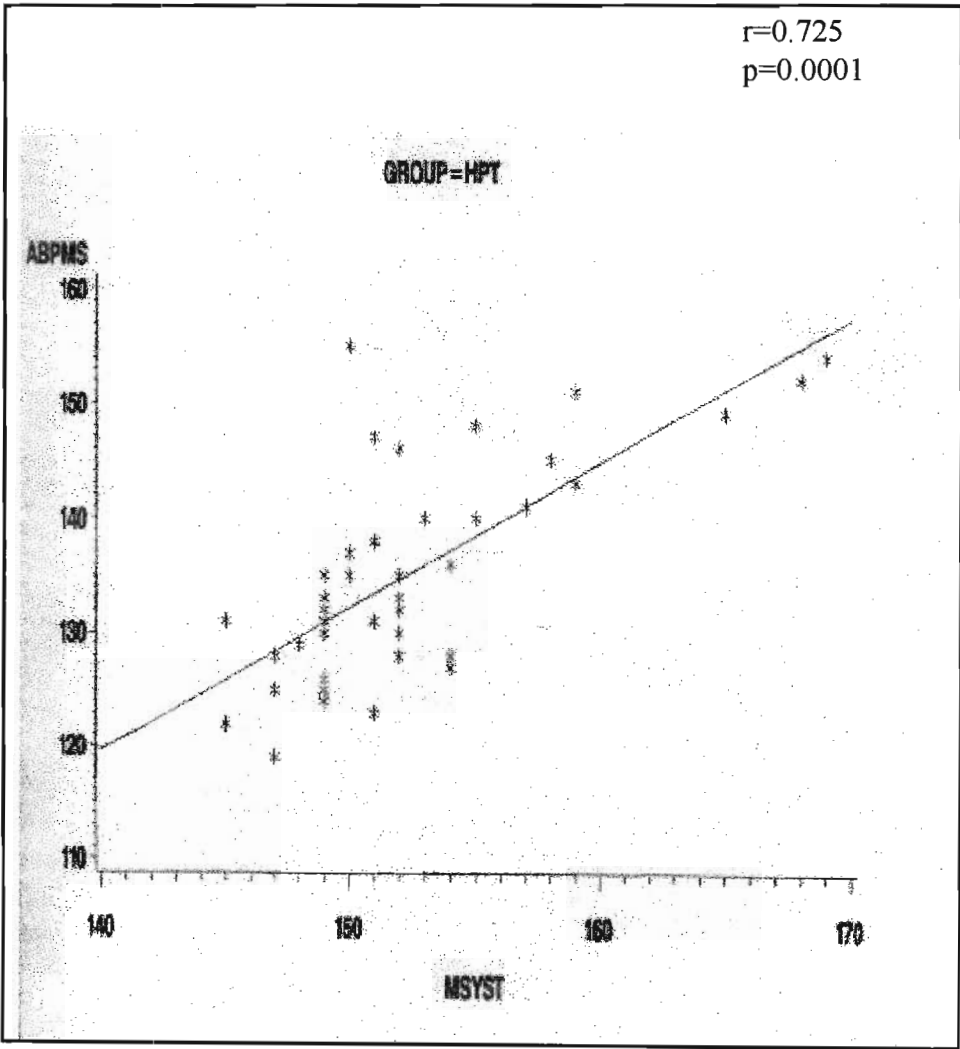
There was a poor correlation between casual diastolic blood pressure measurements and ABPM diastolic measurements (figure 5).



ABPMD= Mean Diastolic Ambulatory Blood Pressure Measurement
MDIAS = Mean Diastolic Casual Blood Pressure Measurement

Figure 5: Association between Mean Casual Diastolic and Mean ABPM Diastolic Blood Pressure in the WCH group

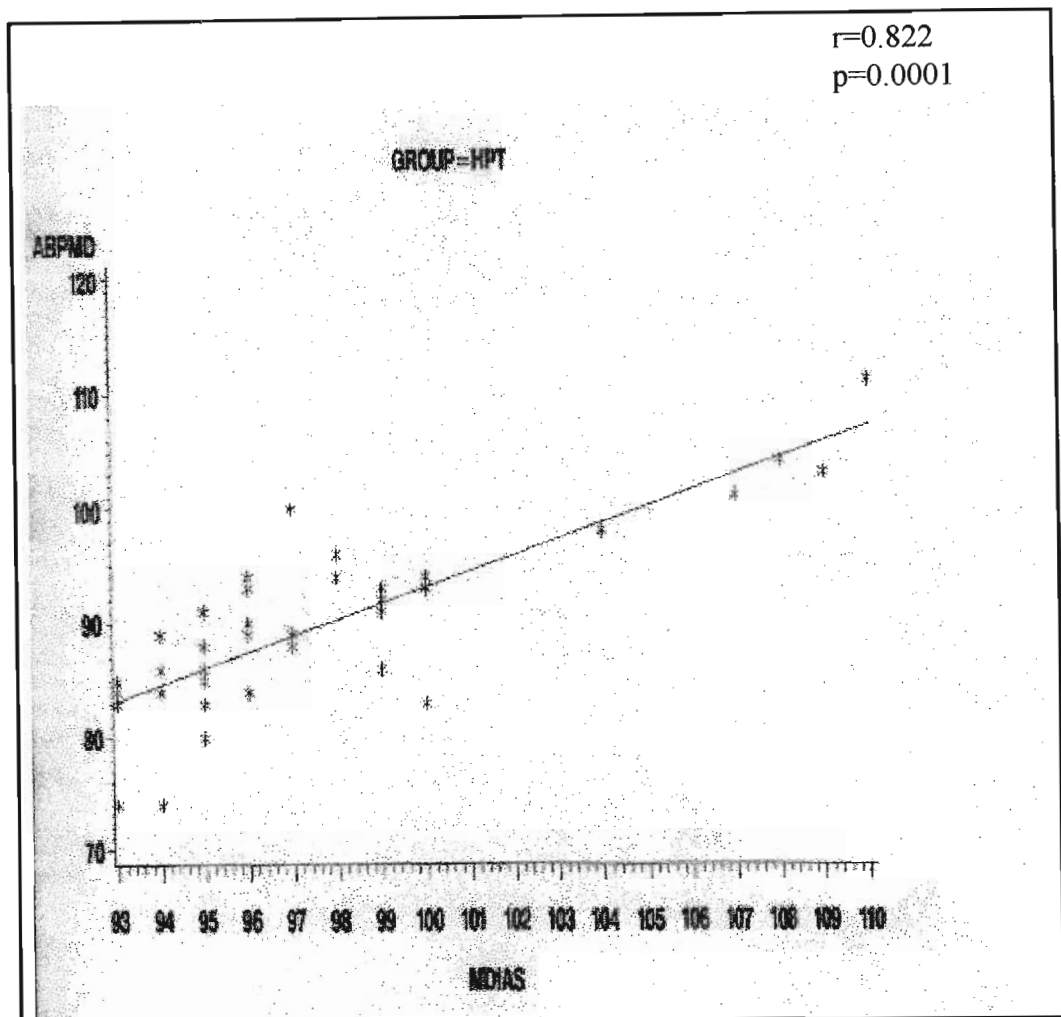
In contrast, in the hypertension group there was moderate to strong correlation between the casual blood pressure measurements and ABPM measurements for both systolic blood pressure ($r = 0.725$) and diastolic blood pressure ($r = 0.822$) (figure 6 and 7).



ABPMS= Mean Systolic Ambulatory Blood Pressure Measurement

MSYST = Mean Systolic Casual Blood Pressure

Figure 6: Association between Mean Casual Systolic and Mean ABPM Systolic Blood Pressure in the HPT group



ABPMD = Mean Diastolic Ambulatory Blood Pressure Measurement

MDIAS = Mean Diastolic Casual Blood Pressure

Figure 7: Association between Mean Casual Diastolic and Mean ABPM Diastolic Blood Pressure in the HPT group

A summary of the results of the four practices are as follows:

Practice 1(myself)- 49 patients: 37 true hypertensives and 12 white coat hypertensives.

Practice 2 - 5 patients : 4 true hypertensives and 1 white coat hypertensive.

Practice 3 - 3 patients : 3 true hypertensives

Practice 4 - 7 patients : 5 true hypertensives and 2 white coat hypertensives.

CHAPTER FIVE

DISCUSSION

A confounding factor in the diagnosis of hypertension is the inherent variability of blood pressure, which depends on the time of the day and the mental and physical stressors of the individual.¹⁹ Research by O' Brien et al. in 1991² showed that ambulatory blood pressure measurement is passing from research to clinical practice at a rapid rate and is valuable in distinguishing white coat hypertension from true hypertension. Therefore, it has become necessary to identify circumstances in which such a measurement is beneficial and to evaluate the role of such monitoring. This study concerned the role of twenty four hour ambulatory blood pressure monitoring in general practice.

This study showed a prevalence of 23.44% white coat hypertension. This figure is in keeping with the findings of Phillip Goose et al. in 1994,²¹ whereby their study suggested a true prevalence of about 20% of white coat hypertension in the population. There are various hypothesis one can consider as a cause for the elevated office blood pressure readings compared to the 24 hour ABPM. In the office setting, there is a possibility of the alert reaction in the patient in the presence of their physician leading to an increased BP reading, as suggested by Ingrid Bidlingmeyer et al. in 1996.¹⁸ The other hypothesis as suggested by Pickering et al. in 1990¹⁹ is a habituation response by the patient on visiting the physician. This is based on the hypothesis that the pressure response in the patient becomes perpetuated through classical conditioning. Thus these patients will respond to the office setting with aversive emotional response, thereby elevating their blood pressure.

White coat hypertension was found to be more frequent in females ($p = 0.01$). In the WCH group 73.33% were females. This is in keeping with the findings by Pickering T.G. & James G.D., in 1994²⁰ and Bidlingmeyer I. et al. in 1996,¹⁸ whereby there was a relative preponderance

of females in the group with white coat hypertension. There are no clear clinical indicators as to the reason for this phenomenon.

White coat hypertension could not be predicted by age ($p = 0.073$), family history of hypertension ($p = 0.063$), family history of diabetes mellitus ($p = 0.608$), history of smoking ($p = 0.511$), history of alcohol intake ($p = 0.054$), or a sedentary lifestyle ($p = 0.392$). This is in keeping with the finding of Thomas G. Pickering et al. in 1990,¹⁹ where it was shown that WCH can occur in both sexes, with a preponderance of females, at any age, and that family history of hypertension did not appear to be a major factor.

However, patients who were on concomitant medication, were more likely to have white coat hypertension ($p = 0.003$). In the WCH group 60% were on concomitant medication, compared to only 20.41% in the HPT group. This suggests that a significant number of patients who are diagnosed as white coat hypertension are on concomitant medication for other illnesses.

The majority of the white coat hypertensive patients were on treatment for cervical muscle spasm, stress and anxiety related disorders. Therefore, if one takes into consideration that stress and anxiety related disorders can elevate the blood pressure, then it is possible that these patients can be misdiagnosed as hypertensive by casual blood pressure measurements.

Body mass index was significantly lower and within the normal range in the white coat hypertension group ($p = 0.003$) compared to the hypertension group. These findings are in agreement with Pickering T.G. et al. in 1990.¹⁹

As expected, casual blood pressure measurements were unable to distinguish between white coat hypertension and true hypertension as the systolic and diastolic blood pressure measurements were similar in the two groups when the patients initially presented. However, the twenty four ambulatory blood pressure monitoring was useful in distinguishing between white coat hypertension and true hypertension.

There was a significant difference between the mean systolic and diastolic values obtained in the two groups by the two methods of BP measurement. In the WCH group, the systolic BP difference was 30 and diastolic BP difference 19, while in the HPT group, the systolic BP difference was 17 and diastolic BP difference 8. This finding is in keeping with the literature by Phillippe Gosse et al. in 1994.²¹

In the WCH group, moderate correlation was found between the systolic blood pressures of the casual and ABPM readings ($r = 0.6$), and poor correlation was found between the diastolic blood pressure ($r = 0.06$).

In the HPT group, moderate to strong correlations were found in both the systolic ($r = 0.725$) and diastolic ($r = 0.822$) blood pressures of the casual and 24 hour ABPM readings. This is in keeping with the literature by Carl J Lavie et al. in 1988 ($r = 0.6$).³

During the study, certain advantages to the usage of 24 hour ABPM have been identified and these include its ease of usage, its practical use, its non-invasive technique, its one off specified time usage, its overall cost effectiveness, and its patient friendly method of usage for excellent compliance. The disadvantages identified are the cost of the machine to the physician or institution (approx. R 30 000.00), and proper patient care required whilst the machine is in operation, for example, during bathing and when changing clothing.

Cost factor in general practice is an important element in health care. Careful management of resources of the medical budget of the patient is essential. If one considers that the present cost of 24 hour ABPM is about R60, then 100 such patients will cost R6 000. Taking into consideration that 23% of such patients have white coat hypertension, then the saving will be on the unnecessary prescribing of anti-hypertensive medication. The cost of diuretics is R22 per month or R264 per year. For 23 such patients, the cost will be R6 072 per year. Similarly, for 23 patients, the cost of beta-blockers will be R16 284 per year (at a cost of R59 per month), and of ACE inhibitors R24 564 per year (at a cost of R89 per month). These figures represent the nominal cost and do not include the cost of misdiagnosis, inappropriate therapy and the

psychological effects on the patient. Therefore, it is evident from the cost analysis that 24 hour ABPM is a cost effective procedure.

However, presently medical aid societies do not pay for 24 hour ABPM, as no tariff code for this procedure exists with the Representative Association of Medical Aid Societies (RAMS).

The misconceptions amongst the general practitioners about the use of the 24 hour ABPM are that it is a specialist tool, its main use is for "white coat" hypertensives, it is not necessarily accurate, it is a sales gimmick, it is intolerable for patients and that it is very expensive to carry out.

This study provides useful information to the general practitioner and other doctors to the role of 24 hour ABPM in general practice. It supports the view that there is a prevalence of about 23% of white coat hypertension in Indian patients in the urban area around Durban, South Africa and that general practitioners must take note of this. Furthermore, it highlights the demographic profile of white coat hypertension being higher in females that are not obese (BMI=22.02), majority of whom are on concomitant medication(60%), and that there is a poor correlation between casual BP readings in the doctors office and 24 hour ABPM in the white coat hypertension group.

The prevalence of white coat hypertension in patients diagnosed as having mild to moderate hypertension by casual blood pressure measurements suggest that twenty four hour ambulatory blood pressure monitoring should be considered, if not routine, in such patients before instituting anti-hypertensive therapy. It is recommended that ambulatory blood pressure monitoring be used in conjunction with the conventional method to confirm the diagnosis of hypertension in such patients, especially in non-obese females who are on medication for other illnesses.

CHAPTER SIX

CONCLUSION

This study, which focused on the role of 24 hour ambulatory blood pressure monitoring in general practice, provides valuable information for health care practitioners.

This study supports the view that the prevalence of white coat hypertension in urban societies around Durban, South Africa is about 23% and that there is a preponderance of females who are not obese (BMI=22.02), the majority of whom are on concomitant medication(60%). It also shows the poor correlation that exists between the casual office blood pressure readings and the 24 hour ABPM readings in white coat hypertension as compared to the true hypertension group.

Hypertension is a common condition amongst urbanised Indian South Africans, and this study informs the attending general practitioner of the guidelines recommended for the use of the 24 hour ABPM, its advantages, disadvantages and misconceptions. It is hoped that it would benefit the general practitioner in his approach to treating hypertension and to avoid unnecessary referrals, specialised investigations and the unnecessary usage of expensive anti - hypertensive medication.

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APPENDIX

APPENDIX A

CONSENT TO PARTICIPATE IN RESEARCH

I, the undersigned, do hereby consent to participate in the research to evaluate the role of 24 hour blood pressure monitoring in general practice. The following information has been provided to me regarding my participation in the study :

A study is being conducted to verify the high blood pressure readings found on patients on routine examination in the consulting rooms. Known as the 24 hour ambulatory blood pressure monitoring, this assessment will give a precise indication of the way blood pressure changes over 24 hours.

The procedure for the monitoring is as follows :

1. An assistant will fit a cuff over your arm similar to that used for standard blood pressure measurements. The cuff is linked to a small monitor which is fastened to your belt.
2. The cuff will automatically inflate every 20 minutes during the day and hourly at night. Occasionally the cuff may inflate twice within 2 minutes: Do not worry - this is quite normal.
3. It is important to keep the arm with the cuff relaxed and still during inflation
4. Continue with your normal activities during the day. At night, place the monitor under the pillow or next to the bed.
5. Remove the cuff only for bathing.
6. If the cuff does not inflate, contact the doctor immediately.
7. Do not touch the buttons on the monitor .

For your own comfort and for accurate measurements, kindly ensure that you wear a loose short sleeved garment. You will also need to wear a belt, so that the monitor can be attached to it. You may find the first few readings a little uncomfortable, but you will soon become accustomed to them. The monitor will be worn for a period of 24 hours. It would be grateful if you could be punctual for the fitting of the cuff and the monitor.

A questionnaire of relevant information will be filled in from your medical records.

Please note that you are free to decline to participate or to withdraw at anytime from the study without suffering any disadvantage or prejudice to you as a patient or to your treatment.

I declare that I have read and understood the above information.

Thus signed at _____ **on this the** _____ **day of** _____ **19** ____ .

Witness 1 _____

Signature of Participant

Witness 2 _____

APPENDIX B

RESEARCH PROGRAMME

" TWENTY FOUR HOUR AMBULATORY BLOOD PRESSURE MONITORING IN GENERAL PRACTICE "

QUESTIONNAIRE

GENERAL

1. PATIENT INITIALS _____
2. AGE _____
3. SEX M ☐
F ☐
4. OCCUPATION _____
5. FAMILY HISTORY HYPERTENSION ☐
DIABETES ☐
OTHER _____
6. SMOKER Yes ☐ No ☐
7. ALCOHOL Yes ☐ No ☐
8. LIFESTYLE SEDENTARY ☐
ACTIVE ☐
9. CONCOMITANT MEDICATION YES ☐
NO ☐

IF YES _____

CLINICAL EVALUATION

1. HEIGHT _____ cm

2. WEIGHT _____ kg

3. URINE _____

4. BLOOD SUGAR _____

5. B.P. READINGS

1st VISIT

DATE _____

B.P. _____

2nd VISIT

DATE _____

B.P. _____

3rd VISIT

DATE _____

B.P. _____

24 HR ABPM EVALUATION

DATE :

MONITOR TYPE :

TOTAL LOAD :

SYSTOLIC _____

DIASTOLIC _____

DIURNAL LOAD

SYSTOLIC _____

DIASTOLIC _____

NOCTURNAL LOAD :

SYSTOLIC _____

DIASTOLIC _____

INDICATION FOR ABPM

1. WHITE COAT ☐
2. ASSESS THERAPY ☐
3. OTHER ☐

OUTCOME : DID IT CHANGE MANAGEMENT : _____