A CROSS SECTIONAL STUDY ON SYSTEMIC HYPERTENSION AND IT'S RELATIONSHIP WITH WAIST TO STATURE RATIO IN AN URBAN POPULATION IN CHENNAI

Dissertation submitted to
The Tamil Nadu Dr.M.G.R. Medical University
in partial fulfilment of the regulations
for the award of the degree of

M.D. (Community Medicine) - Branch XV

GOVERNMENT KILPAUK MEDICAL COLLEGE

THE TAMIL NADU DR. M.G.R. MEDICAL UNIVERSITY

CHENNAI, TAMILNADU

APRIL 2016

BONAFIDE CERTIFICATE

This is to certify that this dissertation entitled **"A CROSS SECTIONAL STUDY ON SYSTEMIC HYPERTENSION AND IT'S RELATIONSHIP WITH WAIST TO STATURE RATIO IN AN URBAN POPULATION IN CHENNAI "** submitted by **Dr.VELMURUGAN . A** , post graduate student, Department of Community Medicine for partial fulfillment for the award of the degree , Doctor of Medicine in Community Medicine by The Tamilnadu Dr.M.G.R. Medical University, Chennai is a bonafide work done by him at GOVERNMENT KILPAUK MEDICAL COLLEGE, CHENNAI, during the academic year 2013-2016.

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DECLARATION

I, **Dr.VELMURUGAN A**, solemnly declare that this dissertation, entitled "**A CROSS SECTIONAL STUDY ON SYSTEMIC HYPERTENSION AND IT'S RELATIONSHIP WITH WAIST TO STATURE RATIO IN AN URBAN POPULATION IN CHENNAI"**, has been prepared by me, under the expert guidance and supervision of **Prof.Dr. K. Mary Ramola , M.D.,** Professor and HOD, Department of Community Medicine , Government Kilpauk Medical College Hospital, Chennai and submitted in partial fulfilment of the regulations for the award of the degree M.D.(Community Medicine) by The Tamil Nadu Dr. M.G.R. Medical University and the examination to be held in April 2016.

This study was conducted at T.P. Chathram, the Field Practice area of Government Kilpauk Medical College, Chennai. I have not submitted this dissertation previously to any university for the award of any degree or diploma.

Place: Chennai **(Dr.VELMURUGAN .A)**

Date:

DECLARATION

I, **Prof.Dr. K. Mary Ramola , M.D.,** Professor and HOD, Department of Community Medicine , Government Kilpauk Medical College Hospital, Chennai declare that this dissertation, entitled "**A CROSS SECTIONAL STUDY ON SYSTEMIC HYPERTENSION AND IT'S RELATIONSHIP WITH WAIST TO STATURE RATIO IN AN URBAN POPULATION IN CHENNAI"**, has been prepared under my expert guidance and supervision by **Dr.VELMURUGAN . A,** for his partial fulfilment of the regulations for the award of the degree M.D.(Community Medicine) by The Tamil Nadu Dr. M.G.R. Medical University and the examination to be held in April 2016.

Place: Chennai **Prof.Dr. K. Mary Ramola , M.D.,**

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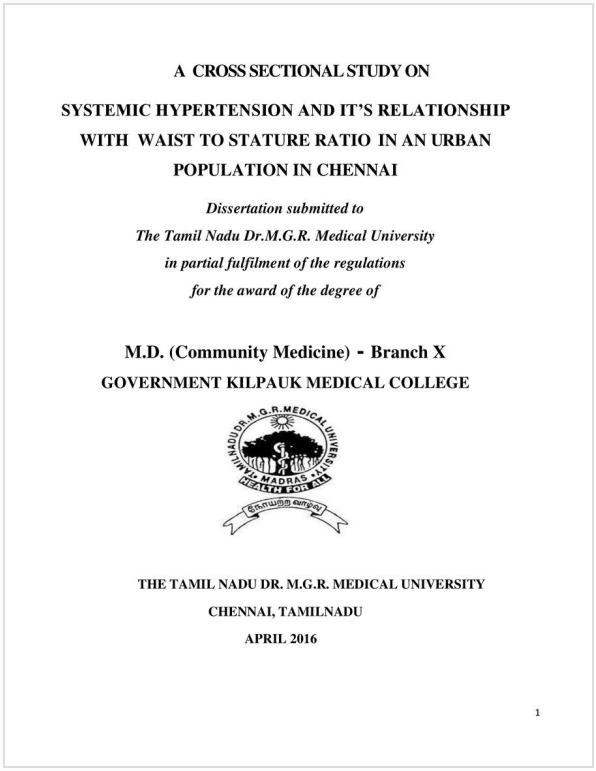

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CONTENTS

ANNEXURES:

List of Abbreviations

WSR- Waist to Stature Ratio

WHR- Waist Hip Ratio

BMI- Body Mass Index

S.D. - Standard Deviation

C.I. – Confidence Interval

ROC Curve – Receiver Operating Characteristic Curve

AUC – Area Under the Curve

CVD- cardiovascular diseases

NCD- non-communicable diseases

DALY's- disability adjusted life years

WHO- World Health Organization

ISH- International Society of Hypertension

SBP- systolic blood pressure

DBP- diastolic blood pressure

***HYPERTENSHELL*- Hypertension Study in General Practice in Hellas**

Greek EPIC study- Greek component of the European Prospective Investigation into Cancer and nutrition

InterASIA- International Collaborative study of Cardiovascular Disease in ASIA

NHANES- National Health and Nutrition Examination Survey

INTERSALT- International study of electrolyte excretion and blood pressure

ARIC- Atherosclerosis Risk in Communities Study

CUPS- Chennai Urban Population epidemiological Study

SHEP- Systolic Hypertension in the Elderly Program

CVS – Cardio Vascular System

RS – Respiratory System

SPSS-Statistical Package for Social Sciences

JNC-Joint National Committee

CDC- Centre for Disease Control

MRSI – Market Research Society of India

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A CROSS SECTIONAL STUDY ON SYSTEMIC HYPERTENSION AND IT'S RELATIONSHIP WITH WAIST TO STATURE RATIO IN AN URBAN POPULATION IN CHENNAI

ABSTRACT:

OBJECTIVES:

1) To study the Distribution of Systemic Hypertension and Waist-to-Stature ratio (WSR) in an urban Chennai population.
2) To estimate the predictability (screening potential) of Waist-to-Stature ratio as an indicator for Systemic Hypertension and comparing it with other anthropometric indices.

BACKGROUND:

Hypertension is a Silent Killer disease. Worldwide , the most frequent disease causing Cardiovascular morbidity and mortality is Systemic Hypertension . Overall in the year 2000 , about 26.4% of the world's population had Systemic Hypertension. It is expected that approximately 1 in 3 adults aged above 20 years will have the disease by the year 2025 . Hypertension is an iceberg disease. It can be described as the sleeping snake which bites when it wakes up.

METHODS:

A total of 440 study participants aged 20 to 60 years selected by two stage Simple Random sampling from T.P.Chathram, an urban locality in Chennai, the field practice area attached to Govt. Kilpauk Medical College were administered a semi structured Questionnaire for Socio demographic data and basic anthropometric measurements such as Height ,Weight ,Waist and Hip Circumference were taken including Blood pressure using a mercury sphygmomanometer with standard procedures.

RESULTS:

The Overall prevalence of hypertension was 27.5% with 95% C. I. of 23.33% to 31.67% . The Mean Waist to stature Ratio was 0.506 (±0.03) with 95% C.I. of 0.503 to 0.509. The Receiver operating Characteristic (ROC) Curve analysis done revealed area under the curve (AUC) of WSR > Waist Hip Ratio > Body Mass Index. The Maximum Sensitivity of 96.7% and Specificity of 26.6% of WSR as a predictor of Hypertension was established at 0.502 .

CONCLUSION:

The prevalence of hypertension was high in the study population which requires comprehensive multimodal approach to treatment .The Superiority of Waist to Stature Ratio as a predictor of Hypertension has been established with greater AUC . So, Waist to Stature Ratio can be used for initial screening for hypertension at the Community level.

KEYWORDS:

Hypertension, Waist to Stature Ratio, Waist Hip Ratio, Area under the Curve (AUC) , Receiver operating Characteristic (ROC)Curve.

1.**INTRODUCTION:**

Hypertension is a Silent Killer disease. Worldwide , the most frequent disease causing Cardiovascular morbidity and mortality is Systemic Hypertension [1]. Overall in the year 2000 , about 26.4% of the world's population had Systemic Hypertension. It is expected that approximately 1 in 3 adults aged above 20 years will have the disease by the year 2025 [2]. Hypertension is an iceberg disease. It can be described as the sleeping snake which bites when it wakes up. Hypertension is one of the most leading cause of mortality and morbidity among the older age group [3]. Prevalence of Systemic hypertension in India, for the last three decades has increased by 30 times among residents in urban area[4].

Hypertension is a major risk factor for cardiovascular disease which are typically related to obesity . In many cross sectional studies , the relationship of the different measurements of fat distribution with the prevalence of disease has been extensively evaluated[5,6] . Some authors [7] are of the opinion that body mass index (BMI) and waist circumference (WC) are equal indicators of obesity related outcome like Hypertension and cardiovascular disease, and on the contrary others believe Waist Circumference to be a better indicator. Waist to Stature ratio (WSR) as an anthropometric indicator of risk of Hypertension and Cardiovascular diseases has emerged as a new option that is more feasible, practical and attractive when compared to other indices [8] .

2. JUSTIFICATION:

2.1. NEED FOR THE STUDY:

In developing countries like India, several epidemiological studies to assess the prevalence of hypertension are needed for determining the baseline against which future trends in risk factors can be assessed and henceforth preventive measures can be planned . Tamil Nadu is a highly populated state with Chennai as its capital. Amidst a background of increasing prevalence of Hypertension, compounded by increasing mortality and morbidity from cardiovascular diseases, we were interested to investigate the prevalence of Systemic Hypertension along with important Risk factors and various screening anthropometric measurements among adults of 20 to 60 years of age in our field practice area T.P.Chathram, Ward no.59, attached to Department of Community Medicine, Government Kilpauk Medical College, Chennai . Our aim here is to differentiate and estimate the screening potential of Waist to Stature Ratio (WSR) for adult Hypertension and to compare it with other anthropometric indices.The association of obesity and Systemic Hypertension is well known. While Body mass index (BMI) has been always considered as the reliable indicator of obesity, BMI does not take into account the muscle mass, which could incorrectly indicate obesity. Abdominal obesity has been recognized as a better predictor for cardiovascular disease. The 1998 National Institute of Hypertension guidelines had defined obesity in terms of Body mass index and waist circumference (WC) .

Now, Waist-to-Stature ratio (WSR) has emerged as new anthropometric indicator that is more useful than other indices [8].

Several Interventional studies have shown that weight reduction with lifestyle modification can reduce Blood pressure. A Valid Criteria for defining obesity using various anthropometric indices will be useful in predicting hypertension at the population level. But , there is a huge debate on which measure of obesity will be more strongly associated with systemic hypertension and to determine the optimal cut-off values.

2.2.GLOBAL SCENARIO:

About 972 million people were affected by Systemic Hypertension throughout the world in 2000. This number is expected to increase to about 1.5 billion by the year 2025 [9,10,2].

Center for Disease Control and Prevention (CDC) estimated that " 43 million people in the United States have hypertension or have been taking antihypertensive medication, which corresponds to almost 24% of the adult population" [9].

According to the World Health Organization, non-communicable diseases constituted by cardiovascular diseases (including hypertension), diabetes, cancers and chronic respiratory diseases are increasing to epidemic levels but are not noticed or little attention is paid to them especially in the middle and low income countries [11].

The Multiple Risk Factor Intervention Trial (MRFIT) in the United States showed that " The relative risk for coronary heart disease mortality varied from 2.3-6.9 times higher for persons with mild-to-severe hypertension when compared to persons with normal blood pressure and the relative risk for stroke ranged from 3.6-19.2. The population attributable risk percentage for coronary artery disease varied from 2.3-25.6%, whereas the population-attributable risk for stroke ranged from 6.8-40% " [12].

2.3. INDIAN SCENARIO:

In the rural and urban south Indian population, the pooled prevalence of Systemic Hypertension was about 21.1% (with 95% confidence interval of 20.1–22.0 %) and 31.8% (with 95% confidence interval of 30.4–33.1), respectively [13]. About 20.6% of men and 20.9% of women from India were suffering from Hypertension in 2005 in an analysis for global burden of Systemic Hypertension [11]. According to the Indian Epidemiological Studies , the prevalence of Systemic Hypertension is 25% in urban and 10% in rural areas [14, 15, 16, 17]. The WHO 2008 estimates showed that the prevalence of Systemic hypertension in India was 32.5% [18]. A multi-center study reported that only 25.6% of treated patients in India had their Blood Pressure under control [19]. A systematic review on Systemic hypertension prevalence in India, reported a range between 13.9 to 46.3% in urban areas of India , for studies which were published between 1969 and July 2011 [20]

2.4. BURDEN OF HYPERTENSION:

Systemic Hypertension is one of the leading causes of the Non Communicable Diseases and a main factor which contributes to the cause of death worldwide [21].The figures from WHO [22] draws great attention to the economic losses due to Non Communicable Diseases in terms of loss from disruptions in the working places and the ever increasing treatment cost which lasts throughout life . An estimate shows that "In India, cardiovascular diseases would result in a loss of 18.4 million disability adjusted life years (DALY's), which is comparable to established market economies (19.4), former Socialist economies (26.1), China (16.3),other Asian countries (15.6), Latin America (13.2), and the Middle Eastern crescent(17.7). High blood pressure (BP) is directly related to about 40% of this cardiovascular disease burden. " [23,24].

3. OBJECTIVES :

1) To study the Distribution of Systemic Hypertension and Waist-to-Stature ratio (WSR) in an urban Chennai population.

2) To estimate the predictability (screening potential) of waist-to-stature ratio (WSR) as an indicator for Systemic Hypertension and comparing it with other anthropometric indices.

4 .REVIEW OF LITERATURE

4 .1. DEFINITION:

" Blood pressure is defined as the force of blood pushing against the artery walls as blood circulates throughout the body. Blood must circulate at an appropriate pressure in order to sustain life ." Hypertension is nothing but elevation of blood pressure above a certain fixed level. Blood pressure is described by two values, the pressure during systole (first value) and the pressure during diastole (second value).

Hypertension in adults aged 18 years and above is defined as " Systolic blood pressure (SBP) of 140 mm Hg or greater and/ or diastolic blood pressure (DBP) of 90 mm Hg or greater or any level of blood pressure in patients taking antihypertensive medication " [25,26,27].

As per the 1999 World Health Organization (WHO) /Guidelines designed for the Management of Hypertension by ISH

"Hypertension is defined as a systolic blood pressure (SBP) of 140mmHg or greater, or a diastolic blood pressure (DBP) of 90mmHg or greater in subjects who are not taking antihypertensive medication" [28].

4.2 . CLASSIFICATION OF HYPERTENSION

The classification of hypertension which is based on data from epidemiological, observational and interventional studies considers the associated risk factors and the target organ damage caused by the disease , provides an easy and reliable method of assessing risk and thereby also allows for identification of populations and groups at increased risk of morbidity ,mortality and also to prioritize interventions for them[29].

Classification of Systemic Hypertension can be done on the basis of

1) Level of Blood pressure

2) Target Organ Damage or Level of Damage caused to Organs or Organs involved and

3) By Etiology

4.2.1. CLASSIFICATION BASED ON LEVEL OF BLOOD PRESSURE

The following table provides a " classification of blood pressure for adults (age 18 and older) [27] who are not taking antihypertensive medication and have no acute illness and is based on the average of two or more blood pressure readings which are taken at least on two subsequent occasions and are taken one to three weeks apart, after the initial screening. When SBP and DBP fall into different categories, the higher category should be selected to classify the individual's blood pressure.

4.2.1.1. CLASSIFICATION OF BLOOD PRESSURE FOR ADULTS [27]

TABLE A : JNC VII criteria for classification of Blood Pressure

CLASSIFICATION OF BP LEVELS[28]	SYSTOLIC BP (in mm Of Hg)	DIASTOLIC BP (in mm of Hg)
NORMAL [27]	<120	and <80
STAGE OF PREHYPERTENSION[27]	120–139	or 80–89
STAGE 1 – HYPERTENSION[27]	140–159	or 90–99
STAGE 2 - HYPERTENSION[27]	≥160	or ≥100

Reference: **"The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure" [151]**

4.2.1.2.WHO-International Society of Hypertension classification 1999

TABLE B: ISH Classification of Hypertension

BLOOD PRESSURE CLASSIFICATION	SYSTOLIC BLOOD PRESSURE (mm Of Hg)	DIASTOLIC BLOOD PRESSURE (mm of Hg)
Optimal	< 120	< 80
Normal	< 130	< 85
High-normal	130-139	85-89
Grade1 hypertension (mild hypertension)	140-159	90-99
Grade 2 hypertension (moderate hypertension)	160-179	100-109
Grade 3 Hypertension (severe hypertension)	≥ 180	≥ 110
Isolated systolic Hypertension	≥ 140	< 90

NOTE : When SBP and DBP fall into different categories, the higher should apply.
Reference: [152]

4.2.2. CLASSIFICATION BASED ON ORGAN DAMAGE

WHO reports that "Although the extent of organ damage often correlates with the level of blood pressure, it is not always the case. The rate of progression of organ damage varies from one individual to another. It depends on many influences, most of which are incompletely understood. Therefore, blood pressure and organ impairment should be evaluated separately, since markedly high

pressures may be seen without organ damage and, conversely, organ damage may be present with only moderate elevation of blood pressure. The classification of hypertension by organ damage uses stages to indicate progression of the severity of the disease with time " [29] .

Stage I – Manifestations of organ changes not present

Stage II –At least one of the following manifestations is seen

• LVH (Left ventricular hypertrophy) which is detected by electrocardiogram, echocardiogram.

• Micro-albuminuria, proteinuria and / or slight elevation of the plasma creatinine concentration (1.2-2.0mg/dl)

• Generalized and focal narrowing of the retinal arteries

• Evidence of atherosclerotic plaque by radiological / Ultrasound techniques (in the aorta or carotid, iliac or femoral arteries)

Stage III – Appearance of symptoms and signs as a result of organ damage. These include

1) Angina pectoris, Myocardial Infraction, heart failure
2) Stroke, Transient ischaemic attack, Hypertensive encephalopathy
3) Retinal hemorrhages and exudates with or without papilloedema in examination of Optic fundus.
4) Plasma creatinine concentration >2.0 mg/dl in Renal failure
5) Dissection aneurysm and Symptomatic arterial occlusive disease [30,31] .

4.2.3. CLASSIFICATION OF HYPERTENSION BY ETIOLOGY

No specific cause can be identified in more than Ninety five (95%) percent of the patients with Systemic Hypertension.

A) Essential or primary hypertension.

No specific cause of Hypertension identified[29]

B) Secondary hypertension

1. Induced by exogenous substances or drugs - Hormonal contraceptives, Corticosteroids, Liquorices and carbenoxolone, Cocaine, Tyramine-containing foods and monoamineoxidase inhibitors, Non-steroidal anti-inflammatory drugs, Cyclosporin, Sympathomimetics, Erythropoietin.

2. Associated with renal disorders - Renal parenchymal disease, Chronic pyelonephritis, Obstructive nephropathy, Polycystic diseases, Acute glomerulonephritis, Connective-tissue disease, Diabetic nephropathy, Hydronephrosis, Chronic nephritis, Congenital hypo plastic kidneys, Trauma, Reno-vascular hypertension.

3. Associated with endocrine disorders - Hypercalcaemia, Hyperthyroidism Adrenal – Cortical Cushing syndrome, Congenital adrenal hyperplasia, Acromegaly , Adrenal – Medullary pheochromocytoma, Carcinoid tumors ,Hypothyroidism, Extra-adrenal chromaffin tumors, ,Primary aldosteronism,

4. Associated with coarctation of the aorta and aortitis

5. Pregnancy induced Hypertension

6. Associated with neurological disorders - Increased intracranial pressure, Sleep apnea , Brain tumor, Encephalitis, Respiratory

acidosis

7. Surgically induced - Peri-operative hypertension **.**

Most of the time hypertensive people show no symptoms in the early stages, symptoms only manifest after end-organ damage. That is why hypertension is described by some clinicians as a 'silent killer'.

4.PREVALENCE OF HYPERTENSION:

4.3.1.GLOBAL :

The World Health Organization statistics for 2012 showed that " Of the 56 million global deaths in 2012, 38 million, or 68%, were due to noncommunicable diseases. The four main NCDs are cardiovascular diseases, cancers, diabetes and chronic lung diseases. The burden of these diseases is rising disproportionately among lower income countries and populations. In 2012, nearly three quarters of noncommunicable disease deaths -- 28 million -- occurred in low- and middle-income countries with about 48% of deaths occurring before the age of

70 in these countries.The leading causes of NCD deaths in 2012 were cardiovascular diseases (17.5 million deaths, or 46% of all NCD deaths), cancers (8.2 million, or 22% of all NCD deaths), and respiratory diseases, including asthma and chronic obstructive pulmonary disease (4.0 million). Diabetes caused another 1.5 million deaths." [32] For example, in a National study **(HYPERTENSHELL)** conducted in Greece, the prevalence of hypertension was 31.1% (in men 33.6%, women 28.4%). [33]

In a retrospective analysis of hypertension prevalence in six European Countries, United States and Canada among adults ≥ 18 years, the prevalence of hypertension was 27.6% in North America while it was 44.2% in Europe. In Europe, the prevalence was highest in Germany (55%).It was followed by Finland (49%), Spain (47%), England (42%) and Sweden/ Italy (38%).[34] Hypertension is not limited to the industrialized countries alone.

The epidemic is also on the rise in developing countries as well. In an extensive cross-sectional survey conducted among individuals aged ≥18-92 years in Korea, they reported the prevalence of hypertension as 33.7%.[35] The WHO Global status report on Non communicable Diseases 2014 reported the Age standardized adjusted estimates of Prevalence of Hypertension in 2014 in adults more than 18 years of age in various countries based on JNC VII Criteria of SBP≥140 and/or DBP≥90 as shown in the next Table.[36]

TABLE C: Age Standardized Prevalence Estimates Of Hypertension Countrywise 2014:

S.NO.	COUNTRY	AGE STANDARDIZED ADJUSTED PREVALENCE ESTIMATE IN PERCENTAGE	CONFIDENCE INTERVAL IN PERCENTAGE
1	BANGLADESH	21.5	15.7–27.3
2	SOUTH AFRICA	25.2	19.5–30.8
3	UNITED KINGDOM	20.3	16.5–24.5
4	UNITED STATES OF AMERICA	17.0	13.2–21.3
5	INDIA	23.0	18.1–28.7

Reference: [36]

4.3.2.NATIONAL

The prevalence of hypertension varied from 20 % to 47.9 % in Urban India according to various studies [37,38, 39, 40, 41,42] . Review of epidemiological studies suggest that the prevalence of hypertension has increased among adults .

TABLE D : RECENT STUDIES (2000 – 2012) ON PREVALENCE OF HYPERTENSION IN URBAN INDIAN POPULATION

S.NO	FIRST AUTHOR	PLACE	YEAR	AGE GROUP (YEARS)	SAMPLE SIZE	PREVALENCE (%)
1	Anand MP [37]	MUMBAI	2000	30-60	1662	34.0
2	Gupta PC [38]	MUMBAI	2004	≥ 35	88653	47.9
3	Prabhakaran D [39]	DELHI	2005	20-59	2935	30.0
4	Reddy KS [40]	NATIONAL	2006	20-69	19973	27.2
5	Mohan V [41]	CHENNAI	2007	≥ 20	2350	20.0
6	Yadav S [42]	LUCKNOW	2008	≥ 30	1746	32.2

The wide variation in prevalence of hypertension in these studies can be explained by criteria used to define hypertension ,the criterion used, , sample size and sampling methods etc. The lower limit of the age group varied in various studies making it difficult for interpretation and comparison.

In the INTERHEART [43] and INTERSTROKE study [44] , hypertension accounted for 17.9% and 34.6% of population attributable risk of various cardiovascular risk factors for coronary artery disease and stroke respectively.The Age-adjusted prevalence of hypertension in Jaipur Heart Watch studies (JHW-1, JHW-2, JHW-3 and JHW-4) in men was 29.1, 29.6, 42.5 and 45.1% and in women it was 21.7, 25.5, 35.2 and 38.2% . [45,46,47,48.]

As per the Registrar General of India and Million Death Study investigators (2001-2003) "CVD was the largest cause of deaths in males (20.3%) as well as females (16.9%) and led to about 2 million deaths annually. Mortality data from CVD in India are also reported by the WHO. The Global Status on Non-Communicable Diseases Report (2011) has reported that there were more than 2.5 million deaths from CVD in India in 2008, two-thirds due to coronary artery disease and one-third to stroke. These estimates are significantly greater than those reported by the Registrar General of India and shows that CVD mortality is increasing rapidly in the country." [49]

According to Directorate General of Health Services, Ministry of Health and Family Welfare, Government of India, " The overall prevalence of hypertension in India by 2020 will be 159.46/1000 population." [49] Results of any single study cannot be generalized to the whole population due to a variety of cultural, economic, social and dietary factors prevailing in different parts of the country.

Two studies for identification of regional differences of CVD risk factors in India are

1) **The India Heart Watch study**[50]

India Heart Watch27 has centers all over the country and they highlight the prevalence of hypertension and its regional variations

2) **PURE studies**[51]

PURE26 is a prospective study which was localized to 5 urban and 5 rural locations.

4.4. PHYSIOLOGY OF BLOOD PRESSURE

The first recorded observations on Hypertension was made probably 4000 years ago [52] . Then Stephen Hales[53] , Riva Rocci[54] , N C Korotkoff [55] made significant contibutions .

4.4.1.BLOOD PRESSURE - PHYSIOLOGICAL ASPECTS:

" *Blood Pressure* is the lateral pressure exerted on the walls of the blood vessels by the contained blood while flowing through it" [56]

The peak pressure in arteries during systole is the *Systolic pressure*. The lowest pressure in the arteries during diastole is the *Diastolic pressure* . The *Pulse pressure is the difference between the two pressures*. The average pressure throughout the cardiac Cycle is the Mean arterial pressure. Since the systole is

shorter than diastole, the mean arterial pressure is slightly less than the value that is halfway between systolic and diastolic pressure.

Mean Arterial Pressure = Diastolic Pressure + 1/3 (Pulse Pressure)

Mean Arterial Pressure = 1/3 (Systolic Blood Pressure) + 2/3 (Diastolic Blood Pressure)

The following aspects will be briefly described below.

I. Determinants of Normal Blood Pressure.

II. The Cardiovascular regulatory mechanisms

III. The Factors affecting Blood Pressure.

IV. The Methods of recording Blood Pressure.

I. THE DETERMINANTS OF BLOOD PRESSURE

1. The Inotropic state of the heart

2.The Quantity of blood in the vascular system.

3. The Peripheral resistance.

4. Blood Viscosity.

5. The Elasticity of vessel wall.

The Cardiac output is controlled by factors such as the heart rate, inotropic state,preload and after-load. These factors in turn are dependent on both neural and humoral influences, from both the sympathetic and para sympathetic nervous system and also from the vasoactive agents[57.] The cardiac output is also influenced by the peripheral factors that influence venous return . Renal mechanisms such as sodium excretion (pressure natriuresis) and the renin - angiotensin system influence the Intravascular volume. Neural factors also influence the Peripheral resistance , primarily the sympathetic nervous system's vasodilator and vasoconstrictor mechanisms. Peripheral vascular resistance is also influenced by a variety of humoral factors such as prostaglandin's, angiotensin, bradykinin and catecholamines, and it is also importantly affected by auto-regulation in local vascular beds [57] .

II. CARDIOVASCULAR REGULATORY MECHANISM

1. Baroreceptors
2. Chemoreceptors
3. Role of skeletal muscles
4. Nervous control
5. Hormonal mechanism

III. THE FACTORS AFFECTING BLOOD PRESSURE.

IV. BLOOD PRESSURE MEASUREMENT

Since a number of factors which cause physiologic variations of blood pressure exist and some of which cannot be controlled are operative .The best measurement of blood pressure is an estimate rather than the precise Determination of it.The Systolic blood pressure varies diurnally ,with a low point during early morning and a high point during early evening. The systolic pressure decreases during sound sleep.

GENERAL PRECAUTION

The Errors in measurement may be in any of the following.

i. The subject

ii. The examiner

iii. The technique [58]

iv. The instrument

The factors that can affect the accuracy of BP measurement [59]

a. width and length of the Cuff bladder
b. Type of Sphygmomanometer used
c. Stethoscope head and placement
d. Number and frequency of BP measurement
e. Time and place of measurement
f. Temperature

g. Surroundings

h. Demographics

i. Subject posture and arm position

j. Fasting or non-fasting state of the subject

k. Choice of phase of Korotkoff sounds used to define diastolic BP

Among all the above mentioned factors, the cuff bladder size and the position of the subject are very important. The cuff bladder size is selected according to the mid-arm circumference.

METHODS OF RECORDING BLOOD PRESSURE

a. Direct intra-arterial method

b. Indirect methods

i. Palpatory method

ii. Auscultatory method

iii. Oscillometric method (automated devices)

iv. Doppler method

v. Flush method

A. Direct Arterial Method

In this method, a catheter is inserted directly into an artery, which is filled with saline and the pressure wave form is transmitted from the catheter tip. This wave form is recorded electronically by means of a transducer.

Blood Pressure recorded through such a catheter transducer system are usually subject to some artifact from the micro bubbles in the catheter/ transducer .These must be removed carefully before use.

B. Indirect Methods

i.Palpatory Method

By palpatory method, only the systolic blood pressure which is usually 10mm Hg less than the auscultatory method can be recorded.

ii.Auscultatory Method

The majority of blood pressure nomogram is mainly based on auscultatory method. An appropriate sized cuff is placed on the right upper arm. The Pressure in the cuff is initially inflated above the level of systolic pressure in the aorta ,which collapses the artery, and no sound is heard as one listens over brachial artery in the arm with the help of a stethoscope and no radial pulse is felt in the arm.

Then the cuff is slowly deflated at the rate of 2-3 mm of mercury per second and as soon as the level of systolic pressure is reached, during each systole, a small spurt of blood passes beneath the cuff Which produces a snapping sound which is the Phase I of Korotkoff sounds, due to turbulence and the closure of the vessel. The systolic blood pressure is noted ,as soon as this sound is audible.

Characteristics Of Auscultatory Method Of Measuring Blood Pressure

The sounds change in character and intensity, as the cuff is then further deflated, and the flow becomes continuous, at which point the sound (Phase V of Korotkoff sound) disappears and the diastolic pressure is recorded.As per the latest recommendation of working group, National High Blood Pressure Education Program (2004), Phase I is the index of systolic pressure and Phase V, diastolic pressure.

iii.Oscillometry

This method was introduced in 1964 based on the visualization of oscillations,transmitted by the arterial pulse to the mercury column in the manometer.

iv.Flush Method

It is usually used to measure BP in newborn. Appropriate sized cuff is applied to the arm and the corresponding forearm, and fingers are compressed with elastic bandages or a rubber glove. Wrapping should begin with tip of the digits working proximally to the lower edge of the cuff.Following compression, the cuff is inflated to 100mm Hg and the wrapping removed. The point at which the flushing appears is noted. This reading gives the mean arterial pressure.

v.Doppler Method

Doppler principle is used to measure BP and cardiovascular abnormalities in Newborn Nursery.

Since blood pressure varies throughout the day, home measurements should be taken at the same time of the day. "A joint scientific statement from the American Heart Association , American society of Hypertension, and Preventive Cardiovascular Nurses association on home monitoring in 2008 , recommended that 2 to 3 readings should be taken in the morning (after awakening, before washing/dressing, taking breakfast/drink, or taking medication) and another 2 to 3 readings at night, each day over a period of 1 week. It was also recommended that the readings from the first day should be discarded and that a total of $\geq$ 12 readings (i.e. at least two readings per day for the remaining 6 days of the week) should be used for making clinical decisions."

4. 5. DETERMINANTS (RISK FACTORS) OF HYPERTENSION:

A search for risk factors for Hypertension should be done at an early age since it would be too late in the natural history of the disease in people with established high blood pressure because of the modifications caused by the disease itself and the interventions.

In such a setting furthermore cause and effect relationship cannot be established. Hence major epidemiological evidence on risk factors for

Hypertension have come from observational studies of prospective cohorts and the intervention trials with ecological studies of inter-population differences and time trends generating hypotheses or providing other supplementary evidence. The risk factors or determinants for Systemic Hypertension can be grouped as modifiable factors and non-modifiable factors.

TABLE E: RISK FACTORS FOR HYPERTENSION

S.NO.	MODIFIABLE RISK FACTORS	NON-MODIFIABLE RISK FACTORS
1.	Obesity	Age
2.	Smoking	Sex
3.	Alcoholism	Heredity
4.	Lack of Physical Activity	Ethnicity
5.	Psychosocial Stress	Genetic Factors
6.	Socioeconomic Status	

4.5.1.NON-MODIFIABLE RISK FACTORS:

4.5.1.1. Age : A positive association between age and blood pressure has been demonstrated in all studies [60] . Cross-sectional surveys have clearly demonstrated a positive relationship between age and blood pressure in most populations with diverse characteristics. Systolic blood pressure (SBP) tends to rise progressively throughout childhood, adolescence and adulthood to attain an average value of

140mmHg by the seventh or eighth decade. Diastolic blood pressure (DBP) tends to increase with age at a slower rate than for SBP, and the average value tends to remain flat or decline after the fifth decade. However in some isolated populations (e.g. Yanamamo Indians in Brazil and Kenyan nomads) this age related rise in blood pressure is not evident. This is especially true of populations with low salt intakes.[60] . There is evidence to believe that age-related rise of blood pressure is not an inevitable process and is not always a normal biological accompaniment of the aging process.[61]

A study on the National Health and Nutrition Examination Survey **(NHANESIII)** database in United States concluded that the prevalence and severity of hypertension increases with age.[62] Another study on the elderly found that hypertension was more frequent in people aged 65 years or older, among whom isolated systolic hypertension is particularly common.[63] With increasing age, the prevalence of isolated systolic hypertension was about 5% at 60 years, 12.6% at 70 years and 23.6% at 80 years. A review of Systolic Hypertension in Europe Trial also came to a similar conclusion.[64] These findings were also confirmed in a study in 2008 which showed that age was strongly associated with hypertension [65] and also the Greek EPIC study.[66] and other studies. [67,68]**.** Almost all surveys showed that blood pressure rises with age in both men and women.

4.5.1.2. Sex : There is no difference in blood pressure between sexes in childhood; But the average BP is usually higher in males from adolescence .However, after

women attain the age of 50 years, this difference narrows down and thereafter, it may even get reversed **.** However, another study showed that in adult women the pressure is lower than in men of comparable age, but the rise is steeper thereafter and around middle age the pressures are about the same; in late life pressures are higher in women.[69] In different studies across the country conducted by various investigators have found that the prevalence of hypertension in females was lower than that of males [70,71,72] whereas another study reported that the opposite is true.[73,74] Another study hypothesized that the difference is due to hormonal milieu in the body being different in male and female and demonstrated its effect on hypertension.[75]

4.5.1.3. Heredity : History of elevated blood pressure in the family is a strong indicator for future development of hypertension. In the Bergen Blood Pressure Study[76], Norway, in subjects with a family history of hypertension, BP was found to have been elevated on a permanent basis. Another study in Mumbai among elderly aged 60-65 years found family history of hypertension was an important determinant of hypertension.[77] A similar view was shared by **Stamler et al.**[78] and **Miall et al.**[79]

4.5.1.4. Genetic factors : Although some monogenic hypertensive disorders in humans have been described such as polymorphism of ACE-II and

Angiotensinogen gene , for the most part, hypertension has been regarded to be a "polygenic" condition.

4.5.1.5. Ethnicity : Subjects from Black races had higher risk of hypertension compared to the white [80]. More recent research indicates that South Asian populations including Indians, may be more predisposed to developing hypertension and metabolic syndrome. In the **A**therosclerosis **R**isk **i**n **C**ommunities Study **(ARIC)** 41% of African American women and 43% of African American men had hypertension when compared to 14% of white women and 19% of white men [88]. Rosner et al [80] also found difference in Blood pressure values among Adolescent boys and girls of Various ethnic groups.

4.5.2. MODIFIABLE RISK FACTORS

4.5.2.1.Dietary salt : There is substantial and convincing evidence that intake of dietary salt above the physiological needs is a risk factor . It has been estimated that a reduction in intake of sodium by 100 mmol everyday over the lifetime would result in smaller rise in SBP of 9 mm of Hg compared to usual intake between 25 to 55 years of age, which would ultimately translate to a reduction in mortality in IHD by 16% , 23% for stroke and 13% deaths from all causes. Well established public health recommendations indicate that dietary salt consumption, from all sources should not exceed 5 to 6 grams a day for an adult [81,82].

Similarly, Another study revealed that the urban Japanese consuming more salt (600mmol) were suffering from hypertension while the primitive Japanese who were consuming less salt (400mmol) were immune to hypertension.[83]

4.5.2.2. Overweight : There is strong and consistent evidence that overweight / obesity is associated with hypertension, with the RR being 2 to as much as 6 times. The proportion of hypertension attributable to obesity has been estimated to be 30 to 65% in western countries. It is also estimated that for every 10 Kg increase in weight (with all other risk factors held constant) the SBP would increase by 2 to 3 mm and DBP by 1 to 3 mm [84]**.** Besides obesity, central obesity due to excessive intraabdominal (visceral) fat, as measured by waist circumference or WHR has been a risk factor , independent of whether generalized obesity is present or not. Hypertension and obesity / central obesity, in addition, are factors which cluster together in metabolic syndrome.

Various longitudinal studies have proved that individuals with more weight gain show higher increase in blood pressure and they can be mitigated through diet and weight control. [85]

In a National cohort study in USA it was found that independent of age, body mass index was a risk factor for hypertension**.**[87] In another extensive study on Bi-ethnic population called **A**therosclerosis **R**isk **i**n **C**ommunities Study **(ARIC)** Obese people had higher odds of hypertension.[88] Similarly in a National

blood pressure survey in Eritrea there was a strong positive correlation between BMI and systolic, diastolic and mean arterial blood pressure.[89]

The **INTERSALT study** [90] also showed more than age, body weight has strongest correlation with blood pressure. The **Framingham Heart Study** [91] in United States showed as compared with those men with normal weight, there was a dramatic increase in sudden death among men who were more than 20 % overweight.

Other studies [93,94,95,96,97,98] also reported increase in the risk of hypertension as BMI increased. Almost all the surveys indicated a positive correlation with BMI.[92]

4.5.2.3.Lack of Physical Activity : It has been proved by epidemiological and clinical data that lack of physical activity is an important modifiable risk factor for hypertension. [99,100]**.** A study showed that there is an inverse relation relationship between blood pressure and aerobic physical activity in leisure time and it persists even after adjustment for age, sex, body-mass index and workplace activity.[101,102,103]**.**

A cross-sectional survey of 314 middle-aged individuals in india found that occupation that involved moderate or greater physical activity was inversely associated with systemic hypertension.[104] Another study among rural population screened 4045 individuals aged 20 and above showed that level of physical activity had strong association with hypertension.[73] **.** Similarly the **C**hennai

Urban **P**opulation **S**tudy (CUPS) found a similar association.[94] **Deshmukh et al.** in his study found that in occupations involving sedentary work, risk of hypertension increased.[68]

4.5.2.4.Alcohol : Consumption of Alcohol has been consistently related to blood pressure in different epidemiological studies. The risk effects of drinking alcohol are independent of obesity, lack of physical activity, age ,sex and smoking. On an average , When two or more drinks are consumed daily, Systolic blood pressure increases by 1 mm and Diastolic blood pressure increases by 0.5 mm; daily drinkers have Systolic and Diastolic BP levels ,which are higher by 6.6 mm and 4.7 mm respectively when compared to those who drink only once a week [105].

According to WHO Reports from various studies , alcohol consumption has consistent association with risk of Hypertension.[31]

The INTERSALT study [106] found daily drinkers were observed to have SBP and DBP levels of 6.6 and 4.7 mmHg higher than once a week drinkers, independent of the total weekly quantity. Another study showed that reducing alcohol intake by 80-85% resulted in an SBP/DBP reduction by 5.0/3.0 mmHg in hypertensives and 3.8/1.4 mmHg in normotensives [107] A three year follow-up study among adults showed alcohol intake as an independent determinant of hypertension.[108]

4.5.2.5.Tobacco use : When Hypertension and Tobacco use were present together, they interacted and greatly increased the cardiovascular risk compared to when

either of them would have been alone. The direct effect of tobacco in causing an increase in blood pressure has not been very clear , since chronic use may cause decrease in appetite.

The study among 1015 individuals aged 30 years in Assam observed smoking was not associated with hypertension.[109]. **Deshmukh et al.** in their study among adults aged 18 years and above reported that risk of hypertension did not differ significantly in smokers.[68]

On the other side, Gupta R et al. found that smoking was independently associated with Risk of hypertension in both sexes. [110] .

4.5.2.6.Psychosocial Stress : There is evidence that with increase in acute mental stress ,there was an increase in blood pressure. A systematic review on psychosocial stress and hypertension found that five out of seven observational studies showed a positive association between measures of chronic stress and hypertension, with risk ratios ranging from 0.8 to 11.1. [111]

The data from another study carried out in Japan[112] estimated that mental stress maintains elevations of blood pressure levels longer than physical exercise, and this may explain for the role of stress in the development of hypertension. However, there was not enough evidence to prove that long term stress causes chronic increase in blood pressure.

4.5.2.7. Early Childhood Experiences : " The Barkers Research Group has undertaken a large amount of research in various settings and strongly hypothesized that foetal malnutrition (in form of low birth weight) and malnutrition during infancy and early childhood may be a strong risk factor for subsequent development of hypertension, diabetes, obesity, dyslipidaemia and metabolic syndrome in later adult life [113]." While these observations raise interesting possibilities of "foetal programming", further prospective studies are needed to substantiate .

4.5.2.8. Dietary Potassium : In contrast to sodium, dietary potassium offers protection against risk of Hypertension; increasing levels of potassium intake are protective. It is the ratio of dietary sodium to potassium which is more relevant. Thus, at a given level of dietary salt intake, BP could be lowered by increasing intake of potassium. The case is therefore quite strong to encourage consumption of fresh fruits and vegetables , which are rich sources of potassium [82,90] .

4.5.2.9. Socio-economic Status : In developed countries, consistently higher levels of BP with a higher prevalence of hypertension have been noted in lower socio-economic groups in a number of populations. Contrarily, in those countries whose economies are improving, higher prevalence is seen in higher socio-economic groups. Thus, in developing countries, this higher prevalence in higher socioeconomic strata may probably represent the epidemic of cardiovascular diseases in initial stages; This has led to the perception that there is a need to

determine these relationships. It is also not much known how social class and blood pressure are related in developing countries. But in many studies socio-economic status has been closely associated with average blood pressure levels for example in the White hall study conducted in British Civil servants, Variations in Systolic BP from 133.7 mmHg in the highest grade of employment to 139.9 mmHg in the lowest grades were seen.[114]. A study in a rural south Indian community revealed higher prevalence of hypertension in the higher socio-economic groups (22.5 %) while it was quite low (8.8 %) in the lower socio-economic group showing a significant association. From the data they also reported that prevalence of hypertension in the highest socio-economic group was more than twice that in the lowest.[115] These findings were echoed in a cross-sectional survey among 1935 subjects in a rural North Indian population aged ≥ 25years which showed that the prevalence of hypertension was higher among social class I and II .[116]

In this study in addition to the routinely used Modified Kuppusamy socio-economic scale, we used another type of scale called The MRSI scale - THE MARKET RESEARCH SOCIETY OF INDIA SCALE [117] **, (see ANNEXURE IV)** for socio economic status classification.

4.6. HYPERTENSION , OBESITY AND ANTHROPOMETRIC MEASURES:

4. 6.1. DEFINITION:

The word "Obesity" is derived from "OBESITAS", a Latin word , which means "stout, fat, or plump".

" Obesity is defined as a condition of abnormal or excessive fat accumulation in the adipose tissue to the level that health may be impaired. Overweight is defined as excess weight for height."

Hypertension and obesity are closely linked. Obesity predicts the subsequent development of hypertension and less commonly recognized, hypertension increases the subsequent risk of obesity.[118]

Both hypertension and obesity are complex regulatory disturbances that are poorly understood from the pathophysiological standpoint. It is clear that trivial attributions such as cuff artifact, excessive salt intake and purely hemodynamic considerations, cannot account for the association of obesity with hypertension[119]

4. 6.2. CLUES FROM BODY FAT DISTRIBUTION

Epidemiological studies from China[120] and Qatar [121] have used waist Hip ratio as a marker for body fat distribution, and they established a relationship between upper body obesity and cardiovascular risk.

Cardiovascular risk along with hypertension thus tracks with upper body or abdominal form of obesity. In addition insulin levels began to emerge as an

independent risk factor for Hypertension.[122,123] . The relationship between Insulin and Hypertension, although strongest in the obese , but was also found in the non obese as well.

4.6.3. RISK FACTOR CONSTELLATION: THE INSULIN RESISTANCE SYNDROME:

Obesity, insulin resistance , hypertension and a characteristic dyslipidemia have been noted to occur together with such frequency that this constellation has been recognized as a distinct syndrome.[124]

Referred to as the Metabolic syndrome , these abnormalities impart considerable cardiovascular risk. Other abnormalities including Microalbuminuria [125], Salt sensitivity, Type II diabetes mellitus, Small and Dense Low density lipoproteins, and Hyperuricemia have been noted with increasing incidence in this group. Not all individuals show all the manifestations of this syndrome although insulin resistance appears to be a critical factor, other factors need not all be present.

4.6.3.1. According to National Cholesterol Education Program (NCEP) Adult Treatment Panel (ATP) III [126],

Three of the following five criteria should be present :

1. Central obesity,

2. Hypertension,

3. High triglyceride level,

4. Low HDL level,

5. High fasting glucose

4. 6.3.2.International Diabetic Federation (IDF) criteria :

High waist circumference plus any of the following two,

1) Triglycerides > 150mg/dl

2) Level of HDL cholesterol < 40 mg/dl, <50mg/dl

3) Blood pressure ≥130/85 mm Hg

4) Fasting plasma glucose >100mg/dl

4. 6.4.METHODS TO MEASURE BODY FAT

1) **DENSITY BASED [127]**

i. Hydrodensitometry

ii. Air displacement plethysmography

2) **IMAGING BASED[127]**

i. CT scan

ii. MRI scanning

iii. DEXA scan

3)**BIO-ELECTRICAL IMPEDANCE ANALYSIS** [128] and

4)**ANTHROPOMETRIC BASED**

i. Waist circumference,

ii. Waist Hip Ratio,

iii. Waist to Stature ratio

4.6.5. ANTHROPOMETRIC MEASURES TO PREDICT HYPERTENSION :

4.6.5.1.BODY MASS INDEX (BMI):

BMI = Weight (in kgs) ÷ Height (in meters) ^{2}.

TABLE F :WHO BMI classification in adults

BMI	CLASSIFICATION
< 18.50	**Underweight**
18.50 – 24.99	**Normal**
25.00 – 29.99	**Pre obese/ Overweight**
30.00 – 34.99	**Obese I**
35.00 – 39.99	**Obese II**
≥ 40.00	**Obese III**

Source: World Health Organization [129]

As recommended by the WHO ,for Asian population, persons with BMI ≥ 23.00-24.99 were also considered to be at increased risk of Systemic Hypertension.[129]

4.6.5.2. WAIST-HIP RATIO (WHR)

Waist-Hip ratio = Waist circumference ÷ Hip circumference (in cms).

As recommended by WHO males with WHR less than 0.9 were considered to be within "normal limits" and males with WHR 0.9 and above were considered to be "high".Females with WHR less than 0.85 were considered to be within "normal limits" and females with WHR 0.85 and above were considered to be "high".[130]

Feldstein CA et al in their study had indicated that the Waist Hip Ratio gives additional information about predicting the risk of Systemic Hypertension beyond that can be offered by BMI or Waist Circumference .[131]

In the Atherosclerosis Risk in Communities (ARIC) Study, Harris [132] examined the relation between high blood pressure and fat and concluded that BMI and Waist Hip Ratio had slightly greater explanatory power than models that only included BMI on predicting the risk of Hypertension.

Many studies in favour of Waist Hip ratio over BMI as predictor of cardiometabolic risk suggested that the major disadvantage with BMI is that while considering Obesity, it does not consider lean body mass, bone density or muscle [133]**.** Thus there is a misclassification of muscular individuals as overweight although their body mass is mainly made of muscle and not fat. **Deurenberg** et al considering the variations in body composition with race suggested that there

should be ethnic specific database [135] from more than 173,000 participants in the Asia–Pacific region from 19 cross-sectional studies. The highest discriminatory capability based on the Area Under the Curve , for the four anthropometric indices was with Waist Stature Ratio, but without statistical significance in the order of WSR > WC > WHR > BMI. Lee's meta-analysis also ranked WSR with highest discriminatory capability from 10 published studies [136] including data from 88,000 individuals. Lee's meta analysis also showed that a cut off of 0.5 was optimal to predict Cardio metabolic risk .

BMI cutpoints [134].

4.6.5.3. WAIST TO STATURE RATIO:

It is the ratio of the Waist Circumference in centimeters divided by the height in centimeters. "No anthropometric variable was systematically better than others at the discrimination of hypertension" was the conclusion made by The Obesity in Asia Collaboration meta-analysis after analyzing raw data collated specifically in a large database [135] from more than 173,000 participants in the Asia–Pacific region from 19 cross-sectional studies. The highest discriminatory capability based on the Area Under the Curve , for the four anthropometric indices was with Waist Stature Ratio, but without statistical significance in the order of WSR > WC > WHR > BMI. Lee's meta-analysis also ranked WSR with highest discriminatory capability from 10 published studies [136] including data from 88,000

individuals. Lee's meta analysis also showed that a cut off of 0.5 was optimal to predict Cardio metabolic risk .

METHODOLOGY

5.METHODOLOGY

The objective was to find out the prevalence and the major risk factors of hypertension among adults aged twenty years and above up to 60 years in the study area so that it can help in initiating a specific community based risk factor intervention **.** An analytical cross-sectional study was carried out in the urban population of Chennai during February 2015 to May 2015.

5.1. Study design:

Cross sectional study

5.2. Target population :

The results are intended to be applied to the Urban population of Chennai.

5.3. Study population and Inclusion criteria :

Study population comprised of 1200 families in 24 streets of T.P.Chathram (an urban locality in Chennai) , Zone VIII of Chennai Corporation . Adults in the age group of 20 years and above upto 60 years of age, living in T.P.Chathram constituted the Study population, with an average family size of 4 and an average size of 2/ family in the age group of 20 to 60 years.

5.4. Exclusion criteria

If an adult of a household was non-cooperative or he/she could not be contacted even after 2 visits, he/she was excluded from the study. Those unable to stand erect, Pregnant women were also excluded .

5.5. Sample size estimation :

Sample size is 440 (Z_α pq/L^2)

For an expected prevalence (p) of 20% with Z value of 1.96 at 95% confidence interval, and with limit of accuracy (L) at 20 % of p (Relative precision) , the sample size required was 440 study participants.

q = 1-p (proportion of people without hypertension) = 0.8

The sample size required for the study was calculated as follows

$$n = \frac{1.96 \times 1.96 \times 0.2 \times 0.8}{0.2 \times 0.2 \times 0.2 \times 0.2} = \frac{0.6146}{0.0016} = 385$$

With an expected non response rate of 20%, the required sample size was estimated as 440 adults aged 20 years and above.

5.6. SAMPLING PROCEDURE:

To achieve a sample size of 440, with an average size of 2 members between 20 and 60 years of age in a family, an estimated 220 families were required to be sampled.

If more than 2 members of study age group (20 years to 60 years) were present in a family, they were sampled by simple random sampling using lottery method.

A two stage random sampling method was used to select the 220 households of the study participants from the 24 streets of T.P.Chathram.

In first stage, 10 streets were selected from the list of 24 streets of the field practice area.

In second stage, 22 families were selected from each street using Family registers maintained by Urban Health Nurses at the urban health centre of T.P. Chathram as the sampling frame. simple random sampling was employed to select Families by Random number Tables from each street .

A house-to-house visit was made in the morning and in the evening time to enroll all members of the family. The objectives of the study and the benefits to the people being examined were explained to the adults and their oral informed consent was obtained.

5.7.. DATA COLLECTION :

5.7.1: DATA COLLECTION INSTRUMENTS:

I) Physical instruments

The physical instruments used in this study included a mercury Diamond Sphygmomanometer , a littman stethoscope ,a portable stadiometer , flexible measuring tape and a digital salter weighing machine. All these instruments and techniques were initially standardized during pilot study and were regularly calibrated throughout the period of data collection.

II) Pre tested structured Survey Questionnaire (see Annexure II) which contains

A. Demographic information

B. Physical measurements

III) MRSI Socio economic Status Scale (see ANNEXURE IV)

IV) KUPPUSWAMY Socio economic status scale (see ANNEXURE V)

Data collection was done only by the Principal Investigator. The selected family was approached . After getting permission from the Head of the Family or the next decision maker in the family, if the head of the family is not available at that time, the objectives of the study were explained to the Participants and Informed consent was taken from them for their participation after clarifying all their doubts.

This study was approved by the Institutional Ethical Committee and data collection was done during the months of February and March 2015.

Using a structured Questionnaire, Sociodemographic data regarding Non modifiable risk factors such as Age, Sex and Modifiable risk factors such as Alcoholism, Smoking, Physical activity was collected and entered by the investigator besides Name, Residential address, Hypertension status, Occupation and Education.

Both MRSI scale and Modified KUPPUSWAMY Scale (All india consumer price index – November 2014 – see ANNEXURE V) were used to assess the Socio economic status of the family. Anthropometric indices were measured as follows with the help of the Urban Health Nurse using standard procedures.

5.8. OPERATIONAL DEFINITIONS:

1)SYSTEMIC HYPERTENSION:

In this study, a person, either male or female aged 20years and above is considered hypertensive if " his/ her systolic blood pressure (SBP) is 140 mmHg or greater, diastolic blood pressure (DBP) is 90 mmHg or greater or taking any antihypertensive medication. **(JNCVII criteria**)." To measure the blood pressure of participants to the nearest 1millimetre of mercury **,** a mercury-in-glass

sphygmomanometer calibrated in millimetres of mercury from 0 - 300 mmHg will be used with the aid of a Littman stethoscope (USA) and classified using JNC VII criteria.

2)WAIST TO STATURE RATIO (WSR):

To measure the waist and hip circumferences by standardised methods,**Inelastic tape** graduated in centimetres (0-150) will be used . To measure the height of the participants,a vertical wooden bar (**Stadiometer**) calibrated in centimetres (0-200) with a movable horizontal bar which could be adjusted to touch the vertex of the participant's head will be used. It will be categorised as less than 0.5 and above.

3)BMI (kg/m2) :

Body mass index (BMI) was used as a measure of obesity. BMI was calculated by dividing the weight of an individual (in kg) by the square of the height in metres (m2).

To measure body weight to the nearest kilogram,**a portable bathroom weighing scale** calibrated from 0-120 kg will be used. WHO standards was used for BMI classification[137] with modification for Asian population.The BMI groups were categorised into <18.5, 18.5 – 23, 23 – 25, 25 - 30, 30 and above and overweight as BMI of 25 – 30 and Obese more than 30.

4)WAIST-HIP RATIO (WHR)

Waist-hip ratio was calculated using the formula,

Waist-Hip ratio = Waist circumference ÷ Hip circumference (in centimeters).

As recommended by WHO males with WHR less than 0.9 were considered to be within "normal" and males with WHR 0.9 and above were considered to be "high".Females with WHR less than 0.85 were considered to be within "normal" and females with WHR 0.85 and above were considered to be "high".[130]

5)OCCUPATION, EDUCATION AND SOCIOECONOMIC STATUS will be assessed using MRSI scale as followed in marketing researches. (ANNEXURE IV).As MRSI scale is a new scale, we also used Modified KUPPUSWAMY scale (See ANNEXURE V) for comparison and correlational purposes.

6)SMOKING: The definition recommended by Indian Heart Journal in 2006 will be followed.

1)Smoker (Current): " Anyone smoking at least one cigarette per day for the past six months will be considered as smoker"

2)Past smoker (Former): "Those who are not smoking for more than six months will be considered as past smokers."

3)Non smoker (Never): "All others will be classified as non smoker."

7)ALCOHOLISM: The definition recommended by Indian Heart Journal in 2006 will be followed:

1)Non alcoholic (Never): " who never consumed alcohol."

2)Past alcoholic (Former): "Who never consumed alcohol for past 12 months."

3)Current drinker: "Who consumed alcohol at least once in past 12 months."

8)PHYSICAL ACTIVITY:

The definition recommended by Exercise Physiology "Energy, Nutrition and Human Performance" will be followed to grade physical activity:

1)Bedridden

2)Sedentary activity: Person doing daily routine activities and /or doing less than 2 hours of moderate activity per day.

3)Moderate activity: Person doing activities like that of office work, walking, cooking, cleaning, cycling, lifting and transporting light weight objects, operating motorized equipment etc. for 2-8 hours and /or doing less than 2 hours of rigorous activity per day.

4)Rigorous activity: Person doing activities like manual labour without the help of motorized equipment, lifting and transport of heavy weight

objects, etc. for more than 2 hours per day or doing moderate activity for more than 8 hours per day.

All measurements were done by one qualified person to reduce inter-observer variability.

5.8.1. Height measurement

Height was measured using a portable stadiometer (Bioplus^{TM}). It was a wall mountable type of stadiometer which has measurement markings up to 200cm. The height of the participants was measured by asking them to stand barefoot by facing the back adjacent to the wall and keeping a scale straight on the head. Initially the body of the stadiometer is placed on the floor against the wall and the tape measure is pulled out far enough for the zero to line up exactly with the red stripe in the read off area on the body of the stadiometer. The upper end of the tape measure is then attached to the wall using a cello tape and the body of the stadiometer is pushed up on the wall. The person whose height has to be measured stands under the body of the stadiometer in an erect position without shoes with their back against the wall and also asked them to put their feet together and move back until their heels touch the bottom of the wall, the person was also asked to look straight, measuring tip is lowered to the head. The height appears in the read off area .[130] The study participant was made to stand on bare foot with his/her heels, buttock, occiput and shoulders touching the surface (of the wall/ floor) and looking straight ahead. The

chin should be straight i.e. the **Frankfurt Plane** or the auriculoorbital plane which is a plane that passes through the inferior border of the orbit and upper border of the external auditory meatus should be straight. With the hair made completely flattened , measurements were read to the nearest accuracy of 0.5 cm.

5.8.2. Weight measurement

After removing the shoes with the possible minimal clothing, weight was measured using electronic digital weighing machine (SALTER) with accuracy to the nearest 0.1Kg. The weighing machine was checked and corrected, if required, for zero error before the start of study. It was also checked and corrected whenever required, after every 10th reading during the study period using Calibration weights of 2 and 4 kg.

5.8.3. Waist Measurement

Waist circumference was measured using a non stretchable tape in the midway between lower margin of rib cage and upper border of iliac crest to nearest accuracy of 0.5 cm at minimal respiration. According to the WHO Stepwise Approach to Surveillance (STEPS) protocol, " the Waist Circumference should be measured at the midpoint between the top of the iliac crest (hip bone) and the lower margin of the last palpable rib (WHO 2008)" , which is the method most commonly used. Mean of two readings was taken as WC.The most consistently used site was World

Health Organization (WHO) definition [137] of "halfway between the lower rib margin and the iliac crest".

5.8.4. Hip Circumference:

With the subject standing erect with the arms at the sides and the feet together, the measurer sitting at the side of the subject so that the level of maximum extension of the buttocks can be seen, the measurer places the measuring tape around the buttocks in the horizontal plane. The tape is snug against the skin but does not compress the soft tissues. A recording was made to the nearest 0.1cm. [130]

5.8.5. Blood Pressure Measurement

After explaining the procedure in a language understandable to the study participant, care was taken to reduce the anxiety. Females were examined in the presence of Urban health nurse. Auscultatory method was used to record blood pressure with a standard Diamond mercury sphygmomanometer. The accuracy of the instrument was periodically checked and compared with another mercury sphygmomanometer.

In order to determine BP in basal conditions the patient should have rested in a quiet room for 15minutes. He should not have consumed coffee or tea for the preceding one hour or smoked for the preceding 15 minutes. He should not be on adrenergic stimulants (eg. Bronchodilators) and there should be no bladder

distension . The right brachial artery pulse was routinely palpated and used for recording blood pressure as it is a direct continuation from the ascending aorta.

The length of the Bladder of BP cuff should be approximately twice that of width. The subject was also asked to avoid wearing anything with tight sleeves. A standard adult size cuff of 13x30 centimeters was applied evenly on the exposed right arm. The average length of rubber bag should be 25cm. The air bag within the cuff should extend for at least two thirds of the arm length and circumference.The midpoint of the rubber bag within the cuff should lie over the brachial artery.

After 15 min rest, and excluding the intake of coffee or smoking in the last one hour, the study participant was seated comfortably in a chair with back rest and with the elbow supported at the heart level and foot on the floor, the cuff was inflated at a pressure approximately 20 mm Hg higher than at which the radial pulse disappears.

The bell of the stethoscope was placed over the brachial artery proximal to the cubital fossa below the lower edge of the cuff and the cuff was deflated at a rate of 2 - 3 mm Hg/sec.

The appearance of `tapping' first korotkoff sound and complete disappearance of sound fifth korotkoff sound was taken as systolic and diastolic blood pressure respectively. [29] Three readings were taken at the interval of 30 min - 1 hr and the study participant detected to be hypertensive referred for further evaluation, after cross checking with another similar apparatus. Any untowards reading or Outlier

was excluded and the procedure was repeated. The average of three readings was taken.

5.9. DATA ANALYSIS:

The Prevalence of hypertension in the field practice area and Prevalence in Males and Females and in Different categories of Age, Occupation, Education and Socio economic status will be expressed as Proportion with 95% confidence intervals. The Mean Systolic and Diastolic Blood pressure, Mean Waist circumference, Waist Hip ratio and Waist Stature ratio will also be expressed with 95% confidence intervals. The Risk of Hypertension for each risk factor was estimated by Univariate analysis with logistic regression model (SPSS 20.0 trial version software) . To adjust for all the risk estimates , we then used the Multivariate logistic regression model. The covariates considered were age, sex, education, occupation, Socio Economic status status, smoking, alcohol, level of physical activity, Waist Hip Ratio, Waist Stature Ratio and Body Mass Index. Then ROC curve (Receiver Operator Characteristic Curve) analysis will be done to determine the capacity of Waist Stature Ratio as a predictor of Systemic Hypertension compared to Waist Hip ratio and BMI.

5.10. SERVICE TO SUBJECTS

After collecting the information and doing the physical examination of the individuals aged ≥20 years and above from a household, health education regarding risk factors, investigations, treatment, complications and

preventive measures for hypertension was given. The importance of regular treatment was told to the subjects on anti-hypertensive drugs and newly detected cases. All the subjects detected to be hypertensives were referred to the nearest health center for further investigations, management and follow-up.

TABLE G: ANTHROPOMETRIC MEASURES AND DATA ENTRY:

MEASUREMENT	CALCULATION	PRECISION
AGE	YEARS SINCE BIRTH AS PER THE STUDY PARTICIPANT	DATA ENTRY IN EXCEL AS WHOLE NUMBERS WITHOUT DECIMAL PLACES
HEIGHT	CENTIMETERS USING STADIOMETER	
WEIGHT	KILOGRAMS USING A PORTABLE ELECTRONIC SCALE	
WAIST CIRCUMFERENCE	CENTIMETERS USING A FLEXIBLE NON STRETCHY MEASURING TAPE	
HIP CIRCUMFERENCE	CENTIMETERS USING A FLEXIBLE NON STRETCHY MEASURING TAPE	
BODY MASS INDEX		TWO DECIMAL PLACES
WAIST TO HIP RATIO		THREE DECIMAL PLACES
WAIST TO STATURE (HEIGHT) RATIO		THREE DECIMAL PLACES

RESULTS AND DISCUSSION

6. RESULTS AND DISCUSSION

The present study was undertaken in the urban population of T.P. Chathram, the field practice area attached to the Department of Community Medicine, Government Kilpauk Medical College,Chennai. The study was conducted to find out the prevalence, major risk factors contributing to Systemic Hypertension and association of Systemic Hypertension with the Anthropometric indices especially Waist to Stature Ratio among Urban adults using a structured questionnaire. The Results of the study are presented and discussed here under:

TABLE 1 : DISTRIBUTION OF THE BASIC SOCIODEMOGRAPHIC CHARACTERISTICS OF STUDY POPULATION

STUDY VARIABLE	**NUMBER**	**%**
I. AGE GROUP IN YEARS		
20-29	110	25
30-39	111	25.2
40-49	109	24.8
50-59	110	25
II. GENDER		
Male	218	49.55
Female	222	50.45

STUDY VARIABLE	NUMBER	%
III. EDUCATION		
Professional	6	1.4
Graduate or post graduate	96	21.8
Intermediate or post high school diploma	137	31.1
High school	110	25
Primary school	49	11.1
Middle school	40	9.1
Illiterate	2	0.5
IV. OCCUPATION		
Professional	45	10.23
Semi professional	6	1.36
Clerical,shop owner or farmer	61	13.86
Skilled	65	14.77
Semi skilled	18	4.09
Unskilled	2	0.45
Unemployed	243	55.23

6.1. SOCIODEMOGRAPHIC CHARACTERISTICS :

In this study, as shown in Table 1, there were 222 females and 218 males and were equally distributed among the 4 age groups. About 80% of the population had completed high school as shown in Educational status of the study population in Table 1. About 55.23% of the study population was unemployed ,largely contributed by the House wives.

TABLE 2 : DISTRIBUTION OF THE STUDY POPULATION BY SOCIO ECONOMIC STATUS

S-E Status (Per capita income/month)	MRSI SCALE		MODIFIED KUPPUSWAMY SCALE	
	Number	%	Number	%
Class I	29	6.59	26	5.9
Class II	275	62.5	295	67.05
Class III	86	19.55	72	16.36
Class IV	32	7.27	29	6.59
Class V	18	4.09	18	4.09
Total	440	100	440	100

K (kappa) = 0.869, r = 0.869 (spearman's correlation coefficient)

In our study as shown in Table 2 ,about 62.5% of the study population belonged to Socio economic class II and 19.55% belonged to Socio economic Class III. A New system of Socio economic status

Classification, called MRSI (Marketing Research Society of India) socioeconomic status scale was used in this study, which is commonly used in Marketing Researches. It had strong agreement and correlation with Modified KUPPUSWAMY scale in our analysis with Kappa of 0.869.

Since Modified KUPPUSWAMY scale uses family income as one of the parameters , which could not be ascertained with certainty from the study population , we used this MRSI scale. Information regarding Family Income per month was not reliable and the people were hesitant in revealing the true income.

On the other hand, MRSI scale is based on the Educational status of the Head of the family similar to Modified KUPPUSWAMY scale , but instead of family income, the variable included was Total Number of Durable Items in the Family.It does not take into account the Occupation of the Head of the Family.

Hence the MRSI scale avoids the practical problems of enquiring about the Family income .

6.2. ANTHROPOMETRIC CHARACTERISTICS :

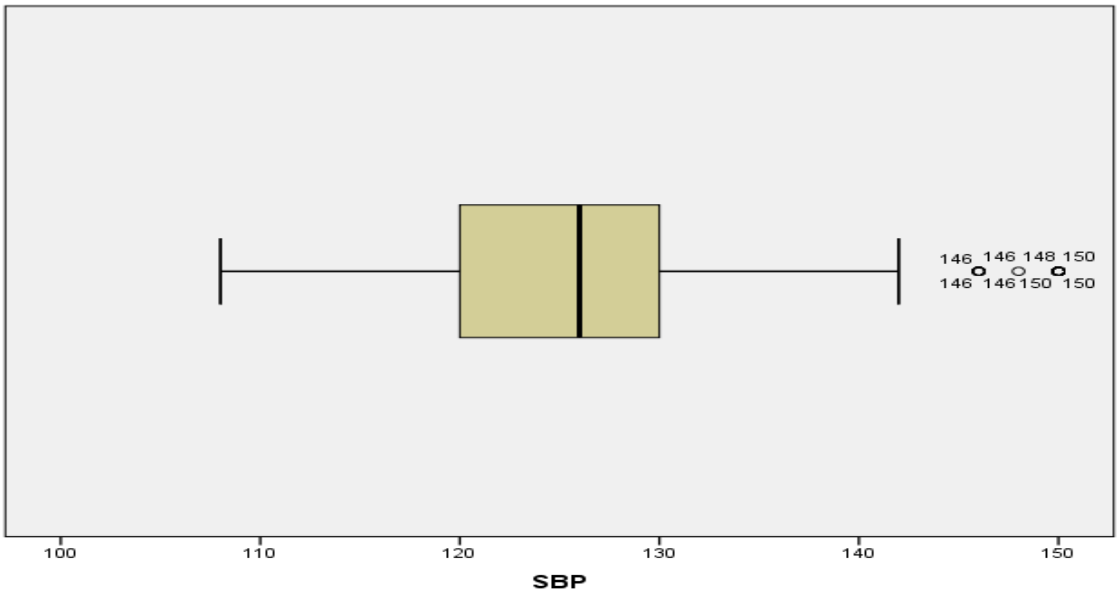
Table 3 shows the baseline anthropometric characteristics of our study population. The Mean Waist to Stature Ratio (WSR) in our study population was 0.506 with standard deviation of 0.03 and 95% confidence interval of 0.503 to 0.509 as shown in Table 3.

The Mean WSR in males was 0.505 (± 0.03) with 95% C.I. of 0.501 to 0.509 and in females was 0.508 (± 0.03) with 95% C.I. of 0.504 to 0.512 as shown in Table 3. The Mean Waist to Hip Ratio in males was 0.937 (± 0.037) with 95% C.I. of 0.932 to 0.942 and in females was 0.927 (± 0.042) with 95% C.I. of 0.922 to 0.933 as shown in Table 3.

TABLE 3: DISTRIBUTION OF ANTHROPOMETRIC MEASURES

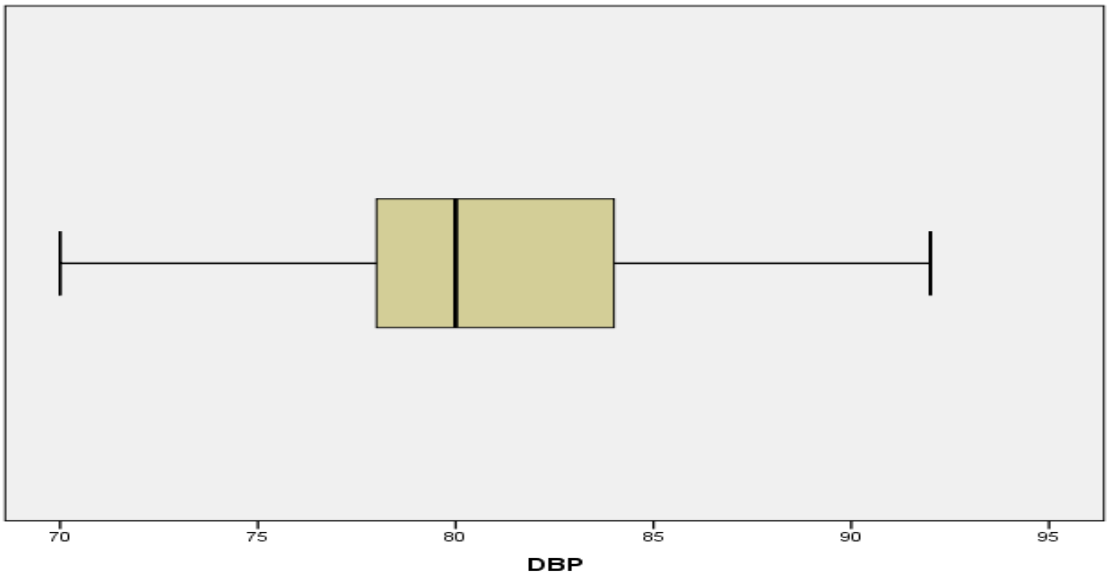
ANTHROPOMETRIC MEASUREMENTS	**MEAN**	**95% C.I. FOR MEAN**		**STANDARD DEVIATION**
		LOWER BOUND	UPPER BOUND	
WAIST CIRCUMFERENCE	83.82	83.36	84.27	4.88
HIP CIRCUMFERENCE	90.01	89.49	90.53	5.58
WEIGHT	63.50	62.5	64.5	10.72
HEIGHT	165.69	165.04	166.35	7.02
BMI	23.18	22.80	23.550	3.96
WAIST HIP RATIO (WHR)	0.932	0.928	0.936	0.039
I. WHR MALE	0.937	0.932	0.942	0.037
II. WHR FEMALE	0.927	0.922	0.933	0.042
WAIST STATURE RATIO (WSR)	0.506	0.503	0.509	0.032
I. WSR MALE	0.505	0.501	0.509	0.033
II. WSR FEMALE	0.508	0.504	0.512	0.030

FIGURE 1: BOX & WHISKER PLOT OF SYSTOLIC BLOOD PRESSURE



MEDIAN: 126.00 mm of Hg , Q1 to Q3 : 120 to 130 mm of Hg

FIGURE 2:BOX AND WHISKER PLOT OF DIASTOLIC BLOOD PRESSURE



MEDIAN: 80.0 mm of Hg, Q1 to Q3 : 78 to 84 mm of Hg

TABLE 4: SEXWISE DISTRIBUTION OF SYSTOLIC AND DIASTOLIC BLOOD PRESSURE IN THE STUDY POPULATION

Gender	Mean Systolic B.P in mm of Hg (SD)	95% C.I. for Mean		Mean Diastolic B.P in mm of Hg (SD)	95% C.I. for Mean	
		Lower Limit	Upper Limit		Lower Limit	Upper Limit
Male	127.05 (10.06)	125.70	128.39	79.50 (5.88)	78.71	80.28
Female	125.78 (10.68)	124.37	127.20	79.86 (5.49)	79.14	80.59
Total	126.41 (10.38)	125.44	127.38	79.68 (5.68)	79.15	80.21

SBP: F= 1.627, p = 0.203, DBP: F= 0.465, p= 0.496 (ANOVA)

The Mean Systolic Blood Pressure in our population was 126.41 mm of Hg and Mean Diastolic Blood pressure in our population was 79.68 mm of Hg as shown in Table 4 and had near normal distribution(Median SBP = 126, Median DBP= 80 mm of Hg as shown in Figure 1 and 2). There was a difference of 1.27 mm of Hg in Systolic Blood pressure between Males and Females in our study population which was not statistically Significant (p = 0.23).

The Interquartile range for Systolic Blood pressure was 120 to 130 mm of Hg as shown in Figure 1, While the Interquartile range for Diastolic Blood pressure was 78 to 84 mm of Hg as shown in Figure 2.

6. 3. PREVALENCE OF HYPERTENSION:

The overall prevalence of Systemic Hypertension in the study population was 27.5% (with 95% C.I. of 23.33% – 31.67%) as shown in Table 5 . The prevalence of hypertension was almost similar among males compared with females (27.5 versus 27.48 %) as shown in Table 5. In our study, the estimates of prevalence of hypertension depend on the JNC VII (Joint National Committee) definition cut-off point of Blood Pressure and history of hypertension.With increasing age groups , the prevalence of Systemic Hypertension also increased, and the maximum prevalence (42.59%) was observed in the older age group of 50 to 59 years . Although overall prevalence of Hypertension in males and females were similar, there was a difference in age wise prevalence of Hypertension between males and females in the different age groups which was not statistically significant as their 95% C.I. overlapped because of small numbers in each group. The increase in prevalence of Hypertension with the increasing age groups was statistically significant. (Chi square test for

TABLE 5: PREVALENCE OF HYPERTENSION BY AGE AND SEX GROUPS

Age group (in years)	Males			Females			Total		
	Examined	Hypertensives		Examined	Hypertensives		Examined	Hypertensives	
		No.	%		No.	%		Number	%
20-29	50	5	10	60	8	13.33	110	13	11.82
30-39	58	13	22.41	53	8	15.09	111	21	18.92
40-49	56	19	33.93	53	22	41.51	109	41	37.61
50-59	54	23	42.59	56	23	50.00	110	46	41.82
Total	**218**	60	27.5	**222**	61	27.48	440	121	27.5

Chi square test for linear trend, p = 0.000

Trend , p = 0.000). The overall prevalence of 27.5% was similar to that of other studies in urban areas by Reddy K S et al [40] (27.2%) which also used the same JNC VII criteria. Mohan V et al [41] reported a prevalence of 20% in his study, lower than the estimated prevalence of systemic hypertension in our study whereas Prabhakaran D et al [39] reported a prevalence of 30% in his study. Prabhakaran D et al [39] in his study conducted at Delhi included study participants from the age of 20 to 59 years similar to our study and the number of study participants were 2935. Reddy KS et al [40] had done a national level study with

19973 participants in the age group of 20 to 69 years and reported a prevalence (27.2%) very similar to our study. In our study the prevalence of systemic hypertension among males was 27.5% and among females was 27.48% as shown in Table 5, whereas it was 23.2% and 17.1% in males and females respectively as reported by Mohan V et al [41] , but lower than that reported by Reddy KS et al [40] 29.3 % and 25.2 % respectively.

FIGURE 3 : PREVALENCE OF HYPERTENSION BY EDUCATIONAL STATUS

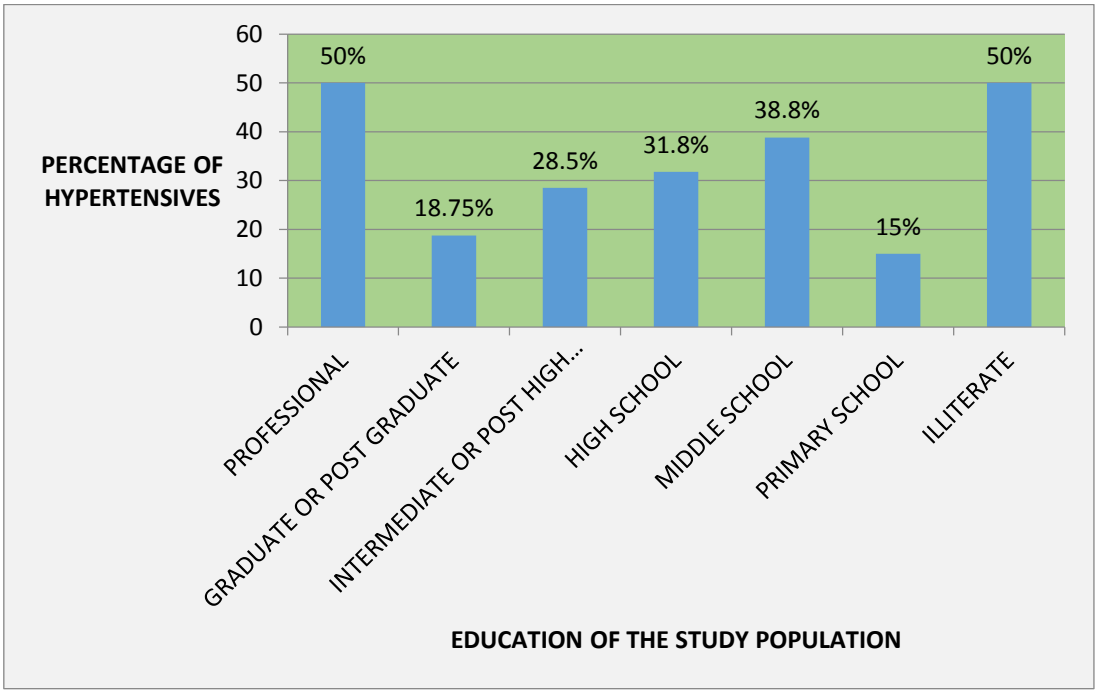
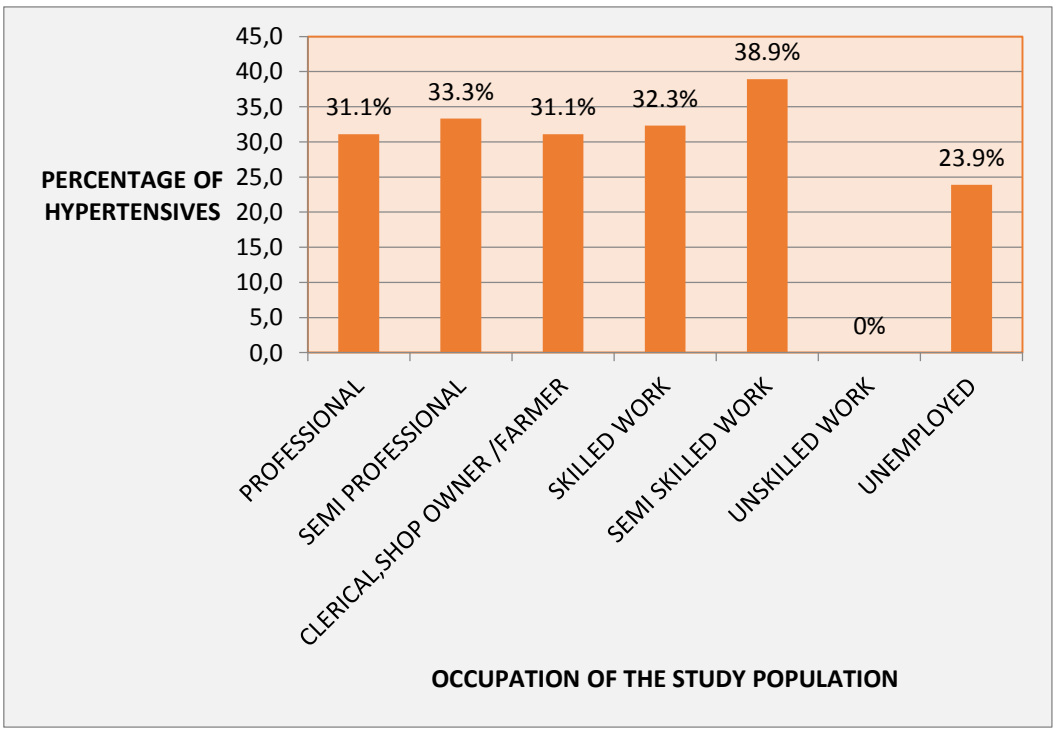


FIGURE 4 : PREVALENCE OF HYPERTENSION BY OCCUPATION



The prevalence of Hypertension , when analysed by the Educational status of the study population showed that about 50% of illiterates and 50% of professionals had Hypertension as shown in Figure 3.

There was no statistically significant association between Educational staus and Prevalence of Hypertension . (chi square, $p \geq 0.05$).

There was also no significant association between Occupation of the study population and Prevalence of Hypertension (chi square, $p \geq 0.05$). About 38.9% of the Semi skilled workers had Hypertension as shown in Figure 4 .

TABLE 6: PREVALENCE OF OVERWEIGHT AND OBESITY BY VARIOUS ANTHROPOMETRIC INDICES WITH HYPERTENSION :

ANTHROPOMETRIC CRITERIA (n = 440)	**OVERWEIGHT AND OBESE INDIVIDUALS**		**HYPERTENSIVES IN OVERWEIGHT AND OBESE INDIVIDUALS**	
	NUMBER	**%**	**NUMBER**	**%**
BMI ≥25	134	30.45	44	32.84
BMI ≥23 (ASIANS)	203	46.14	60	29.56
WSR ≥0.5	234	53.18	120	51.28
WHR ≥ 0.85 Female ≥ 0.9 Male	382	86.81	120	31.41

The Prevalence of Systemic Hypertension in Overweight and Obese Individuls as determined by various anthropometric citeria is shown in Table 6.

We took a

1) BMI of ≥ 25, (WHO STANDARDS[129])
2) BMI of ≥ 23, (WHO Asian Criteria [129] for BMI classification)
3) WSR of ≥ 0.5 ,
4) WHR of ≥ 0.85 in Female s, ≥ 0.9 in Male

as Overweight and Obese and calculated the prevalence of Hypertension .

Of all the Criteria, WHR determined the Prevalence of Overweight and/or Obesity as 86.81%, the highest as compared to WSR (53.18%) and BMI ≥ 23(46.14%).

About 51.28% of the study participants classified as Obese and / or Overweight by WSR Criteria had Systemic Hypertension compared to 31.41% by WHR Criteria. Waist Hip Ratio Criteria , on the other side classified 86.81 % of the study population as overweight and obese, but only 31.4% of those identified had Systemic Hypertension.

6.4. RISK FACTORS CONTRIBUTING TO HYPERTENSION:

Risk factors contributing to Hypertension were analysed independently by finding the association and strength of association.The risk factors which had statistically significant association in univariate analysis in our study were subjected to Multivariate logistic regression modeling to adjust all risk estimates for covariates. Possible covariates considered were either Modifiable or Non Modifiable. The Risk factors such as Age, Sex, Occupation, Education, Socio-economic status, Smoking, Alcohol intake , Level of physical activity, Body Mass Index, Waist Hip ratio, Waist Stature Ratio were subjected to Univariate analysis initially as shown in Table 7.

The Risk factors that had statistically significant association by Univariate analysis were Age, Smoking, Level of Physical activity ,Waist to Stature Ratio and Waist Hip Ratio and were subjected to Multivariate analysis.

TABLE 7: UNWEIGHTED UNIVARIATE ANALYSIS OF RISK FACTORS FOR HYPERTENSION

Variable	Examined (n=440)	Hypertensives		Odds ratio	95%CI		p value
		No.	%				
I. AGE GROUP IN YEARS							
20-29	110	13	11.82	1	Reference		
30-39	111	21	18.92	1.741	0.823	3.681	0.147
40-49	109	41	37.61	4.499	2.242	9.029	<0.001
50-59	110	46	41.82	5.363	2.685	10.712	<0.001
II. GENDER							
Female	222	61	27.48	1	Reference		
Male	218	60	27.5	1.002	0.660	1.523	0.991
III. SOCIO ECONOMIC CLASS BASED ON MRSI SCALE							
Class I	29	7	24.14	0.636	0.174	2.329	0.495
Class II	275	78	28.36	0.792	0.287	2.184	0.652
Class III	86	18	20.93	0.529	0.175	1.605	0.261
Class IV	32	12	37.5	1.200	0.357	4.038	0.768
Class V	18	6	33.33	1	Reference		
IV. ALCOHOLISM							
Non – Alcoholic	397	107	26.95	1	Reference		
Alcoholic **	43	14	32.56	1.308	0.666	2.57	0.435

Variable	Examined (n=440)	Hypertensives		Odds ratio	95%CI		p value
		No.	%				
V.SMOKING							
Non – smoker	400	96	24	1	Reference		
Past Smoker	5	1	20	0.792	0.087	7.168	0.835
Current smoker	35	24	68.57	6.909	3.265	14.621	<0.001
VI. BODY MASS INDEX							
< 18.5	31	5	16.1	0.515	0.189	1.407	0.197
18.5 – 22.99	206	56	27.2	1	Reference		
23 – 24.99	69	16	23.2	0.809	0.427	1.530	0.514
25 – 29.99	108	33	30.6	1.179	0.707	1.966	0.529
≥ 30	26	11	42.3	1.964	0.851	4.534	0.114
VII .LEVEL OF PHYSICAL ACTIVITY							
Sedentary	234	105	44.9	10.081	5.417	18.759	0.000
Moderate	174	13	7.5	1	Reference		
Heavy/rigorous	32	3	9.4	1.281	0.344	4.778	0.712
VIII . WAIST HIP RATIO							
< 0.85(Females) < 0.9 (Males)	58	1	1.72	1	Reference		
≥ 0.85(Females) ≥ 0.9 (Males)	382	120	31.41	26.1	3.57	190.8	<0.001
IX . WAIST STATURE RATIO							
WSR < 0.5	206	1	0.49	1	Reference		
WSR ≥ 0.5	234	120	51.28	215.8	29.7	1565	<0.001

** There were no past alcoholics in our study

The Risk factors were assessed with ODDS RATIO.Those which were statistically significant by Univariate analysis were then subjected to multivariate analysis by Logistic Regression.In addition we also included other covariates such as Body Mass Index which was a significant risk factor for Systemic Hypertension in other studies. So, our final model included age, level of physical activity, smoking , body mass index, Waist Hip Ratio and Waist Stature Ratio.. Analysis was performed using SPSS 20.0 Trial version and Microsoft Excel.

The predictive capacity of our model was 51.6%. ($R^2 = 0.516$ and pseudo $R^2 = 0.746$). In this current study, multivariate analysis revealed 4 factors as significant predictors (Age, smoking, Level of Physical activity and Waist to Stature ratio ≥ 0.5 as significant risk factors) with respect to hypertension. This set of variables show significant correlation to risk of hypertension as has also been shown earlier by Harris et al[132] and Lee et al [136].

TABLE 8: MULTIVARIATE ANALYSIS OF RISK FACTORS FOR SYSTEMIC HYPERTENSION

The individual risk factors that were identified as playing a major role in developing hypertension by univariate analysis from our study were then subjected to a multivariate analysis and the findings are as follows:

Contributing risk factors	Odd's Ratio	95% CI		p value
		Lower	Upper	
1.Age group (in years)				
20-29	1			
30-39	1.838	0.633	5.334	0.263
40-49	6.032	2.157	16.870	0.001
50-59	13.589	4.164	44.339	0.000
2.Level of physical activity				
Sedentary	21.919	9.097	52.809	0.000
Moderate	1			
Heavy/rigorous	1.875	0.390	9.009	0.432
3.BMI (kg/m^2)				
< 18.5	0.461	0.064	3.329	0.443
18.5 – 22.99	1			
23 – 24.99	0.444	0.145	1.366	0.157
25 – 29.99	0.317	0.132	0.764	0.011
≥ 30	1.020	0.235	4.435	0.979
4.Smoking				
Non Smoker	1			
Current Smoker	8.617	1.813	40.947	0.007
Past Smoker	0.677	0.020	22.463	0.827
5.Waist Stature Ratio				
< 0.5	1			
> 0.5	459.156	56.007	3764.270	0.000
6.Waist Hip Ratio				
< 0.85 Female , < 0.9 Male	1			
≥ 0.85 Female , ≥ 0.9 Male	10.691	0.996	114.821	0.050

$R^2 = 0.516$, Pseudo $R^2 = 0.746$

6.4.1. Hypertension and Age :

Age related increase of hypertension is a common but not a universal phenomenon. It is predominantly influenced by environmental factors such as certain non migrant or tribal populations who follow primitive life styles do not develop age related rise of prevalence of hypertension. In this study, the association between age and hypertension was found to be statistically highly significant ($p<0.001$) as shown in Table 8.The study revealed that there is a strong association between the age and the risk of systemic hypertension. These findings compare well with that of other studies.

The Prevalence of Systemic Hypertension was 11.82% in the age group of 20 to 29 years, 18.92% in 30 to 39 years, 31.6 % in 40 to 49 years, 41.8% in 50 to 59 years as shown in Table 7, demonstrating an increasing trend with the age groups. Another study called as Greek EPIC study in Greece in a large sample of the general Greek population found that the prevalence of hypertension increases with age and was higher among men than women before the age of 55 years, but slightly higher among women thereafter.[66]

Ageing is etiologically associated with hypertension due to age dependent changes in arterial blood vessels. Systolic Blood pressure increases with age consistently till almost the seventh or eighth decade of life , while Diastolic Blood Pressure increases till fifth decade and it becomes stationary thereafter which leads to an increase of pulse pressure and ultimately increased incidence of systolic hypertension in the elderly. Many cross-sectional and prospective observational cohort studies, have also consistently documented

a positive relationship between age and blood pressure in most populations with diverse geographical, cultural and socio-economic background. But, this age related rise in BP is not an inevitable one since the blood pressure does not increase with age in some populations who have very low habitual intake of salt [60,61].

In our final Regression model, after adjusting for all other covariates, the risk of Hypertension was 6 times higher [OR: 6.0 (95% CI: 2.2 – 16.9)] among the participants aged 40-49 years and 13.6 times [OR: 13.6 (95% CI: 4.2 - 44.3)] higher among the participants aged 50- 59 years when compared to 20-29 years age group in our study as shown in Table 8 and was statistically significant (p =0.001) .

In CURES 52 study done among 26,001 individuals, Mohan V et al [67] showed that there is a strong association of age with hypertension. In their study they also found that subjects below 35 years of age were 3 times at lesser risk of hypertension compared to subjects between 35 to 49 years of age. Subjects between 50-64 years of age were at >8 times higher risk of Hypertension while those above ≥ 65 years were at >13 times higher risk of hypertension compared to those below 35 years of age. In a study in rural Wardha in Central India, Deshmukh PR et al [68] that the risk of hypertension increased significantly with increase in age and the risk is four times higher in individuals above 60 years.

6.2.2. Smoking and Hypertension:

In our study we explored the association of hypertension with **smoking** and found that the risk of hypertension was 8.6 times higher among current smokers when compared to non-smokers.[OR:8.6 (95%CI:1.8-40.9) (p = 0.007)] as shown in Table 8, when adjusted for other covariates . And on the contrary we found that past smokers had an ODDS ratio almost similar to Non smokers [OR: 0.677 (95%CI:0.02- 22.5) (p = 0.827)] revealing cessation in smoking helps lower risk but without statistical significance.

Gupta R et al. also in their study among 2122 subjects aged 20 years or more found that smoking was independently associated with higher prevalence of hypertension in both sexes. [110] . The direct effects of smoking in causing an increase in blood pressure is not very clear , as some smokers in fact have lower Blood Pressure levels, since chronic use may cause decrease in appetite with consequent low body weight and in turn slight lowering of BP . Although nicotine and smoking raises blood pressure acutely, hypertension does not seem to be more prevalent among smokers, and blood pressure changes little when people quit smoking.[31]

6.2.3. Physical activity and Hypertension:

Regular **aerobic physical activity** is adequate to achieve at least a moderate level of physical fitness.

In our study increased levels of physical activity had protective effect on hypertension in Moderate Workers in Comparison to Sedentary workers. There

were no Bed Ridden Patients in our study. When Compared to Moderate Workers, Sedentary Workers had 21.9 times higher odds of hypertension [OR: 21.9 (95%CI:9.1- 52.8) (p = 0.000)] as shown in Table 8.

Paffenbarger RS. et al showed that, When compared to their fit and more active peers , the Sedentary and unfit normotensive individuals, in the next few years, had 20% to 50% increased risk of developing hypertension [99].Paffenbarger RS. et al in their study showed that people not involved in physical activity had 35% higher incidence of developing hypertension.[100]

Exercise lowers SBP and DBP by 5- 10 mmHg and that dynamic isotonic exercises such as walking is better than static isometric exercise such as weight-lifting. [102]

Participants of the **(US) National High Blood Pressure Education Working Group** (1993) also achieved a mean reduction of SBP of 6.4 mmHg and DBP of 6.9 mmHg through prescribed exercise. [103]

6.2.4. Waist to Stature Ratio (WSR) and Hypertension:

In our model we used the cut off point for Waist to Stature Ratio as 0.5 as used by many authors[136] in previous studies which was also revealed by our ROC curve analysis as shown in Figure 7.

In our Multivariate Regression model ,people with Waist to Stature Ratio ≥ 0.5 had 469 times higher odds of Hypertension than those with WSR < 0.5. [OR: 469 (95%CI: 56 - 3764)] as shown in Table 8 and this observed difference was statistically highly significant (p=0.000).

There are many factors why Waist to Stature Ratio will be the most useful anthropometric index to determine cardiometabolic risk.[8] The results from our study and the meta-analyses done by Lee CM et al [136] , together, justify the use of Waist Stature Ratio as a single screening anthropometric tool for predicting the risk of Systemic Hypertension and Cardiometabolic risk than other indicators.

One of the greatest advantages with Waist to Stature Ratio over BMI is the ability to use only one single cutoff point (0.5) in all ages, both sexes, and all ethnicities.[138] which provides a simple public health message: "Keep your waist circumference to less than half your height." [138]

6.2.5. BMI and Hypertension:

In our study, the association of BMI with Systemic Hypertension was weak. Obese people with BMI ≥ 30 had 1.02 times greater odds of Hypertension compared to those with BMI in the Range of 23 to 24.99 as shown in Table 8 [OR: 1.02(95%CI: 0.235 – 4.435), p = 0.979] which was not statistically significant.The observed difference in risk between the Various categories of BMI was not consistent and was not statistically significant in our study.

Surprisingly we found that people who were Overweight with BMI of 25 to 29.99 had a protective effect with 68% lesser odds **[OR: 0.317 (95%CI: 0.132 – 0.764), p = 0.011]** of Hypertension compared to those with BMI of 23 to 24.99 who were taken as the Reference Category, which was Statistically significant as shown in Table 8.

Epidemiological observations have identified obesity as a risk factor for hypertension. There is evidence that when people with high blood pressure lose weight , blood pressure decreases.[91]

In CUPS study , with increase in BMI , there was increase in prevalence of Hypertension in various age groups .[92]

The **Framingham Heart study** [94] showed that for gain in weight of every 900 gram , there was a rise of one mm of Hg in systolic blood pressure and showed that abdominal obesity accounted for 70% of hypertension in men. A large scale multicentred study "INTERSALT STUDY " [150] from 52 centers and 32 countries with main focus on urinary electrolytes and blood pressure provided an opportunity to determine the association of body weight and blood pressure .

The reason for insignificant association in our study could be because a person with a small skeletal frame could have a BMI that underestimates their true body fat therefore categorizing them as underweight and people with excess weight around the waist face more health risks than those who carry more weight around the hips.[137]

6.2.6. Waist Hip Ratio (WHR) and Hypertension:

In our study, as shown in Table 7, about 99% of the Hypertensives (n = 121) had a waist hip ratio above the defined criteria of **≥ 0.85 in females and ≥ 0.9 in males** . (chi square p = 0.000)

In Multivariate analysis, the odds of Hypertension among those with WHR above the defined criteria was about 10.7 times higher than those with WHR below the defined levels (OR = 10.69 [95% C.I. of 0.996 to 114.821]) at a p value of 0.05 as shown in Table 8.

As the 95% confidence interval includes 1, the significance of Waist Hip Ratio as a Risk Factor for hypertension was lower than Waist Stature Ratio, but was greater than BMI.

In the Atherosclerosis Risk in Communities (ARIC) Study, Harris [132] examined the relation between high blood pressure and fat distribution in 15,063 African American and White participants between the ages of 45 to 64 years in Maryland, Mississippi, Minnesota and North Carolina using BMI, waist-to-hip ratio (WHR), and waist to stature ratio as indices. The Prevalence of Systemic Hypertension was considerably higher in African Americans than Whites. Larger waist circumferences, WHRs and Higher waist to stature ratios were seen in African American women than White women. African American men were similar in weight to white men but had lower WHRs, waist circumferences, and waist to stature ratios . The models that included BMI and Waist Hip Ratio had slightly greater explanatory power than models that only included BMI on predicting the risk of Hypertension.

As Men carry more fat around the waist and in the abdominal areas when compared to women who have majority of their fat distributed in their hips and buttocks, the Waist Hip Ratio tends to be higher for men than women.

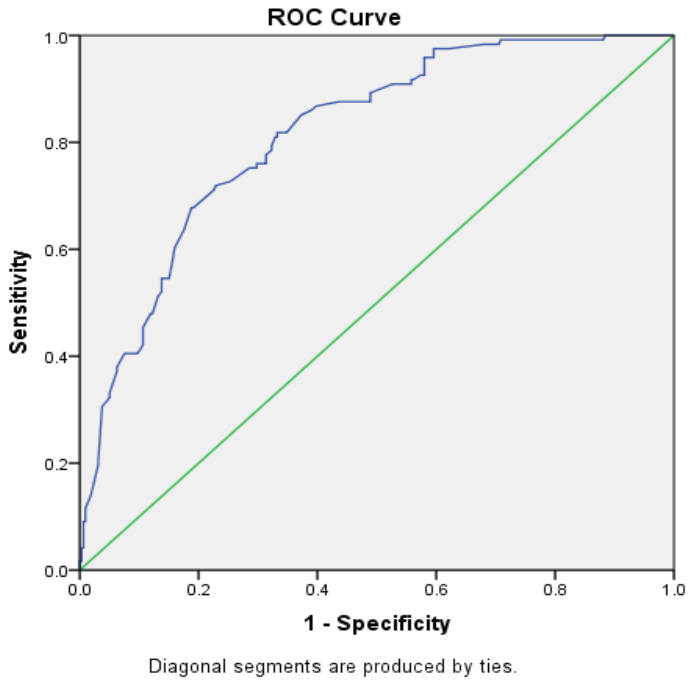
Studies have shown that the fat deposits present centrally in the abdomen, that is the intra abdominal fat, release a huge amount of free fatty acids when compared to the fat deposits which are present peripherally (gluteal fat and the subcutaneous fat), which in turn reduces the hepatic clearance of insulin . Insulin levels had also begun to emerge as an independent risk factor for Hypertension.[122,123] . Since the Waist Hip Ratio can provide information regarding the relative accumulation of intra abdominal fat in comparison to the whole body fat, it is a better predictor of risk of hypertension compared to Waist Circumference or BMI alone.

6.2.7. Other risk factors and hypertension:

Various studies across the Globe and India indicated that Sex [70,71,72] (Male) , **alcohol use** [105,106] and **socio-economic status** [114,115] were risk factors of hypertension. However, in our study Sex, Alcohol use and Socio-economic status were not found to be associated with hypertension and the difference was not statistically significant as shown in Table 7.

6.2.8.ROC CURVE ANALYSIS - PREDICTOR OF HYPERTENSION:

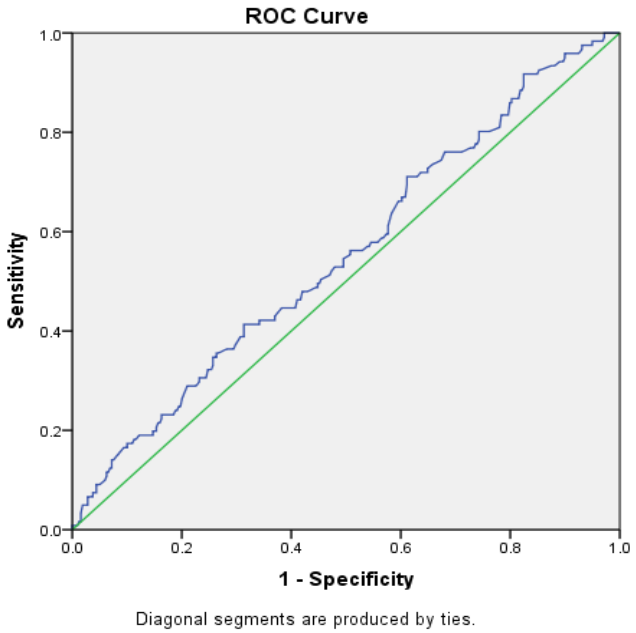
FIGURE 5: WAIST HIP RATIO – ROC CURVE



Area under the Curve: 0.816 (with 95% C.I. 0.774 – 0.858) , p = 0.000

Maximum (97.5% sensitivity and 41% specificity) at Waist Hip Ratio of 0.913511

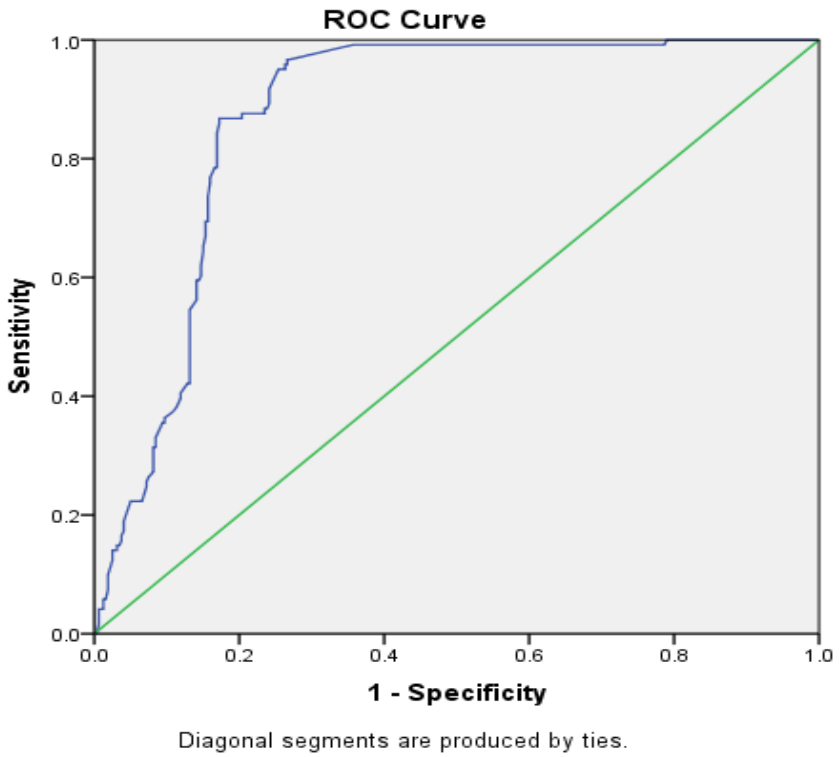
FIGURE 6: BODY MASS INDEX – ROC CURVE



Area under the Curve: 0.541(with 95% C.I. 0.480 – 0.602), p = 0.187

Maximum (71 % sensitivity and 39 % specificity) at BMI of 21.23841

FIGURE 7: WAIST STATURE RATIO – ROC CURVE



Area under the Curve: 0.871(with 95% C.I. 0.838 – 0.904), p = 0.000

Maximum (96.7 % sensitivity and 26.6 % specificity) at WSR of 0.502859.

6.2.8.1: AREA UNDER THE CURVE (AUC) :

Since different arbitrary cut off points give different sensitivity and specificity for Various anthropometric indicators as a predictor of Systemic Hypertension, there is a need for ROC curve analysis to define the cut off points and AUC analysis to determine the screening potential of various indicators.

In our ROC curve analysis we found that area under the curve for different anthropometric indicators as a predictor of Hypertension were in the order of WSR > WHR > BMI.

Area under the Curve for WSR was 0.871 with 95% C.I. of 0.838 – 0.904 , p = 0.000. The Maximum sensitivity and specificity was attained at WSR of 0.502859. A Maximum of 96.7 % sensitivity and 26.6 % specificity was attained at this point as shown in Figure 7.

Area under the Curve for WHR was 0.816 (with 95% C.I. 0.774 – 0.858) , p = 0.000 , (With Maximum 97.5% sensitivity and 41% specificity) at Waist Hip Ratio of 0.913511 as shown in Figure 5.

Area under the Curve for BMI was 0.541(with 95% C.I. 0.480 – 0.602), p = 0.187, (With Maximum 71 % sensitivity and 39 % specificity) at BMI of 21.23841 as shown in Figure 6.

In our study we found that WSR had the Maximum sensitivity of 96.7% although Specificity was low. WSR identifies the Population at cardiometabolic risk with single cut off point of 0.5 unlike Waist Hip Ratio

which has genderwise different cut off points, but at the cost of False positives upto 73.4%.

Hence WSR may prove to be a very good initial screening tool but of very little value in definitive risk of Hypertension when compared with Waist Hip Ratio in terms of Specificity and Sensitivity.

Lee meta analysis [136] also found that the AUC values were ranked in this order: WSR (highest)> WHR > BMI (lowest). WSR is considered to be superior in discriminating cardiometabolic risk because WSR takes into account height, which is important particularly in individuals who are short.[139]

The explanation lies in the fact that high visceral fat depots within the abdominal cavity [140] 138 have high metabolic and inflammatory activity when compared to depots which are subcutaneous in other parts of the body such as the gluteo-femoral region[141] .

The association of Height/ Stature is usually inverse with cardiometabolic morbidity and mortality[142] because Stature besides a genetic component , indirectly explains general early life exposures [139].

But Schneider *et al.* [143] in their DETECT study found that " Shorter subjects had higher levels of risk factors than tall subjects when they were grouped by Waist Circumference , but not if they were grouped by WSR , and these differences could not be due to height alone" . In 2006, Franzosi [144] had questioned "Should we continue to use BMI as a cardiovascular risk factor?"

So, a screening measure to be effective must be effective as well as practical.

Measurement of Body Mass Index requires Weight and Height , While WSR measurement requires Height and Waist Circumference which requires a simple tape rather than a weighing apparatus and also Self-assessment of Weight is less accurate than that of Height [145]. With Waist Circumference being measured at different sites by different authors , it has been demonstrated that there is no alteration in risk prediction[146] . WSR has an important advantage of a simple , single boundary value for men and women of all ethnic groups and may be also for children [8]. The mean proposed boundary value for WSR was 0.5. Within these study populations, there were subjects with various (Caucasian, Afro-Caribbean, Asian and Central American) ethnic backgrounds [138]. This value not only converts into the simple message of "Keep your waist circumference to less than half your height" , but this value of 0.5 provides the value of first boundary for increased cardiometabolic risk on a public health tool – a chart of Waist Circumference against height [147,148,149].

"Keep your Waist to Half of your Height" can turn out to be the Best Health Education Message ever.

CONCLUSION

7. CONCLUSION

- The Overall prevalence of Hypertension was high in the study population, about 27.5% with 95% C. I. of 23.33% to 31.67% . The Mean Waist to Stature Ratio was 0.506 (± 0.03) with 95% confidence interval of 0.503 to 0.509.
- The Superiority of Waist to Stature Ratio as a predictor of Hypertension has been established with AUC of Waist to Stature Ratio > Waist Hip Ratio > BMI with the Maximum Sensitivity of 96.7% and Specificity of 26.6% at a cut off level of WSR of 0.50286 in ROC Curve analysis.
- So, Waist to Stature Ratio can be used for initial screening for hypertension at the Community level.

8. SUMMARY

The main objective of this study was to find out the prevalence of hypertension among adults aged 20 to 60 years of age from T.P.Chathram, the field practice area of Urban Health Center attached to the Department of Community Medicine, Government Kilpauk Medical College.

The prevalence of Hypertension was estimated by a cross sectional study using a structured Questionnaire among 440 study participants whose anthropometric indices were measured. The Categorization of Study participants into Normotensives and Hypertensives was in accordance with the JNC VII criteria and History of Hypertension .

(Normotensives: SBP<140 and DBP<90 mmHg, Hypertensives: SBP ≥140 or DBP≥90 mmHg).

The Overall prevalence of hypertension was 27.5 %. In the current study the prevalence of systemic hypertension among males was 27.5% and among females is 27.48 %.

The other primary objective was to find out the Mean Waist to Stature Ratio in the study population which is the ratio of Waist Circumference to Height. The Mean WSR was 0.506 (0.03) and 95% confidence interval of 0.503 to 0.509.

The Mean Waist to Stature Ratio in males was 0.505 (± 0.03) with 95% C.I. of 0.501 to 0.509 and in females was 0.508 (± 0.03) with 95% C.I. of 0.504 to 0.512.

In our study we used the cut off point for Waist to Stature Ratio as 0.5 as used by many authors in previous studies which was also revealed by our ROC curve analysis as shown in Figure 5.

Our other objective was to find out the contributing risk factors for Systemic Hypertension. The background details of the study population were collected by a structured questionnaire with Basic Sociodemographic information, Risk factors for Systemic Hypertension and physical measurements.

Risk factors that were significantly associated with hypertension by Univariate analysis in our study were age, smoking, sedentary level of physical activity, waist to stature ratio ≥ 0.5, waist hip ratio ≥ 0.85 in females and ≥ 0.9 in Males. However, sex, socio-economic status, alcoholism, body mass index which are known risk factors were not found to be significantly associated with hypertension in our study population .

However on Multivariate analysis with adjusting for covariates , waist hip ratio as a risk factor for Systemic Hypertension was not statistically significant.

So in the final Model , the significant risk factors for Hypertension in our study population were Age, Smoking, Level of physical activity and Waist to Stature Ratio.

Our final objective was to estimate the screening potential of WSR as a predictor of Hypertensin compared to WHR and BMI. The ROC Curve analysis done revealed area under the curve (AUC) of WSR > WHR > BMI. The

Maximum Sensitivity of 96.7% and Specificity of 26.6% of WSR as a predictor of Hypertension was established at 0.502859 . Being a single cut off point for both males and females and various ethnic groups as reported by previous studies, there is great scope for the use of WSR as an initial screening tool for not only Hypertension, but for estimating Cardiometabolic risk as a whole.

9. LIMITATIONS OF THIS STUDY

- Since this study was a cross sectional study , the measurements of exposure and disease were collected at the same time, and so a temporal sequence was not established.
- Blood pressure may be affected by various factors like Ethnicity, Dietary factors, Salt intake, Psychosocial stress, Family history of Hypertension and previous medication history, which was not taken into account because of time and resource constraints and practical feasibility.
- Blood pressure was measured over a single period of time, therefore we could not say whether patient had persistent hypertension.
- Secondary causes of Hypertension could not be ruled out, which usually requires extensive radiological and biochemical investigations.
- The Classification of Hypertension into Systolic and Diastolic Hypertension could not be done, due to lack of availability of information for which treatment of Hypertension was started on
- Since Blood pressure values vary with intake of antihypertensive drugs, Quantitative Correlation between Blood pressure values and Various anthropometric measures was not done.

10. RECOMMENDATIONS

The prevalence of hypertension was high (27.5%) in the study area, so the following recommendations are being made regarding prevention and control of hypertension

- The approach to Systemic Hypertension and other Cardiometabolic diseases should be Comprehensive involving Lifestyle modifications, Exercise and Smoking cessation .
- An area specific tailor-made intervention program addressing modification of lifestyle as well as need for drug compliance should be designed for the specific needs of the local population.
- Waist to Stature Ratio is a simple, age and sex independent index and could be used for initial screening for hypertension and obesity with evidence from further studies in Indian Population.
- A prospective longitudinal follow-up study should be done in order to determine the predictive capacity of Waist to Stature Ratio for Risk of Hypertension.

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12. ANNEXURES:

S.NO.	TITLE
I.	INSTITUTIONAL ETHICAL COMMITTEE APPROVAL CERTIFICATE
II.	QUESTIONNAIRE
III.	INFORMATION TO PARTICIPANTS AND PATIENT CONSENT FORM
IV.	MRSI SOCIOECONOMIC SCALE
V.	KUPPUSWAMI SOCIOECONOMIC SCALE
VI.	KEY TO MASTER CHART
VII.	MASTER CHART
VIII.	TAMIL CONSENT FORM

ANNEXURE I : INSTITUTIONAL ETHICAL COMMITTEE APPROVAL

INSTITUTIONAL ETHICAL COMMITTEE
GOVT.KILPAUK MEDICAL COLLEGE,
CHENNAI-10
Ref.No.5098/ME-1/Ethics/2014 Dt:10.07.2014.
CERTIFICATE OF APPROVAL

The Institutional Ethical Committee of Govt. Kilpauk Medical College, Chennai reviewed and discussed the application for approval "A Cross sectional Study on systemic hypertension, and its relationship with waist to stature ratio in an urban population in chennai" – For Project Work submitted by Dr.A.Velmurugan, MD (Community Medicine), PG Student, KMC, Chennai-10.

The Proposal is APPROVED.

The Institutional Ethical Committee expects to be informed about the progress of the study any Adverse Drug Reaction Occurring in the Course of the study any change in the protocol and patient information /informed consent and asks to be provided a copy of the final report.

8/8/14

CHAIRMAN
Ethical Committee
Govt.Kilpauk Medical College,Chennai

8/8/2014

6th Comp.> ME 1 Section Files> Ethical Committee

ANNEXURE II:

QUESTIONNAIRE

S. No. :

Name: Age /Sex:

Occupation: 1. 2. 3. 4. 5. 6. 7.

Educational Qualification: 1. 2. 3. 4. 5. 6. 7.

Socioeconomic status:

a) MRSI Scale 1. 2. 3. 4. 5.

b) Kuppuswami Scale 1. 2. 3. 4. 5.

Residential area:

Known case of Hypertension: 1. 2.

Alcoholism: 1. 2. 3. ----------

Smoking: 1. 2. 3. ----------

Levels of physical activity: 1. 2. 3. 4.

Height(cm): BMI:

Weight(kg): WHR:

Waist circumference (cm): WSR:

Hip circumference(cm):

Blood Pressure: 1)

2)

3)

CVS: RS:

(WHR-Waist Hip ratio, WSR-Waist Stature ratio, BMI - Body Mass index)

ANNEXURE III:

INFORMATION TO PARTICIPANTS

Investigator : Dr. Velmurugan A

Name of the Participant:

Title : A Cross sectional study on Systemic Hypertension and its relationship with waist to stature ratio in an urban population in chennai

You are invited to take part in this research study. We have got approval from the IEC. We would be measuring your Height, Weight, Waist, Hip circumferences, and asking you questions regarding Hypertension, so that appropriate preventive measures could be planned .

Date: Signature of the Investigator:

Place: Signature /thumb impression of the participant:

PATIENT CONSENT FORM

Study detail :

Study centre :

Patients Name :

Patients Age :

Identification Number :

Patient may check ( ) these boxes ✓

I confirm that I have understood the purpose of procedure for the above study. I have the opportunity to ask question and all my questions and doubts have been answered to my complete satisfaction. ☐

I understand that my participation in the study is voluntary and that I am free to withdraw at any time without giving reason, without my legal rights being affected. ☐

I understand that the ethical committee and the regulatory authorities will not need my permission to look at my health records ☐

However, I understand that my identity will not be revealed in any information released to third parties or published, unless as required under the law. I agree not to restrict the use of any data or results that arise from this study. ☐

I agree to take part in the above study and to comply with the instructions given during the study and faithfully cooperate with the study team and to immediately inform the study staff if I suffer from any deterioration in my health or well-being or any unexpected or unusual symptoms. ☐

I hereby consent to participate in this study. ☐

I hereby give permission to undergo complete clinical examination ☐

Signature/thumb impression: Signature of investigator:

Patients Name and Address: Study investigator's Name:

ANNEXURE IV
MRSI SOCIOECONOMIC SCALE

Market Research Society of India Scale:

The New SEC system used to classify Households in india, based on two variables.

1) Education of the chief earner
2) Number of consumer Durables (from a predefined list)- owned by the family. The list has 11 items, ranging from “electrical connection” and “agricultural land” to cars and air conditioners

There are twelve grades in the SEC system , ranging from A1 to E3.

Source: Imbrint.com/research/The-New-SEC-system-3rdMay2011.pdf

As MRSI scale is a new scale, we also used Modified Kuppuswamy scale for comparison and correlational purposes.

ANNEXURE IV - THE NEW MRSI SOCIOECONOMIC SCALE

RECORDING
The grid

01

	Items owned / have access at home	Circle	Tick
1a	Electricity Connection	01	√
	Ceiling Fan	02	√
	LPG Stove	03	√
	Two Wheeler	04	√
	Colour TV	05	√
	Refrigerator	06	√
	Washing Machine	07	
	Personal Computer/ Laptop	08	
	Car/Jeep/Van	09	√
	Air Conditioner	10	
1b	Agricultural Land	11	√
	NUMBER OF STANDARD 11 OWNED		8

10 | THE NEW SEC SYSTEM

Source: http://imrbint.com/research/The-New-SEC-system-3rdMay2011.pdf

ANNEXURE IV - THE NEW MRSI SOCIOECONOMIC SCALE

RECORDING
The grid

o2

No. of Durables (TRANSFER FROM Q1)	Chief Earner: Education (Q2)						
	Illiterate	Literate but no formal schooling/ School- Upto 4 years	School- 5 to 9 years	SSC/ HSC	Some College (incl a Diploma) but not Grad	Graduate/ Post Graduate: General	Graduate/ Post Graduate: Professional
	1	2	3	4	5	6	7
None	E3	E2	E2	E2	E2	E1	D2
1	E2	E1	E1	E1	D2	D2	D2
2	E1	E1	D2	D2	D1	D1	D1
3	D2	D2	D1	D1	C2	C2	C2
4	D1	C2	C2	C1	C1	B2	B2
5	C2	C1	C1	B2	B1	B1	B1
6	C1	B2	B2	B1	A3	A3	A3
7	C1	B1	B1	A3	A3	A2	A2
8	B1	A3	A3	A3	A2	A2	A2
9+	B1	A3	A3	A2	A2	A1	A1

11 | THE NEW SEC SYSTEM

Source: http://imrbint.com/research/The-New-SEC-system-3rdMay2011.pdf

We have 12 grades in the new SEC system, ranging from A1 to E3. They were divided into 5 socioeconomic classes in our study as follows for comparision with Modified Kuppuswamy scale.

GRADES OF MRSI SCALE	SOCIOECONOMIC CLASS
A1,A2,A3	I .UPPER CLASS
B1,B2	II. UPPER MIDDLE CLASS
C1,C2	III. LOWER MIDDLE CLASS
D1,D2	IV. UPPER LOWER CLASS
E1,E2,E3	V. LOWER CLASS

ANNEXURE V - KUPPUSWAMY SOCIOECONOMIC SCALE

ORIGINAL Kuppuswamy socioeconomic scale (Urban, 1976)

	Score
Education	
Profession or honours	7
Graduate or post graduate	6
Intermediate or post high school diploma	5
High school certificate	4
Middle school certificate	3
Primary school certificate	2
Illiterate	1
Occupation	
Profession	10
Semi-profession	6
Clerical, shop-owner, farmer	5
Skilled worker	4
Semi-skilled worker	3
Unskilled worker	2
Unemployed	1
Family income per month (in Rs.)	
≥2000	12
1000-1999	10
750-999	6
500-749	4
300-499	3
101-299	2
≤100	1
Socioeconomic class	
Upper	26-29
Upper middle	16-25
Lower middle	11-15
Upper lower	5-10
Lower	0<5

SOURCE: Bairwa M, Rajput M, Sachdeva S. Modified kuppuswamy's socioeconomic scale: social researcher should include updated income criteria, 2012. Indian J Community Med 2013;38:185-6

ANNEXURE V - MODIFICATIONS IN INCOME CATEGORY:

The family income per month (in rupees) for 1976 was calculated according to base year 1960 = 100 (using the price index for 1976: 296).

- Price index for 1982 by 1960 base = 490
- Price index for 1982 by 1982 base = 100
- Price index for 1976 by 1960 base = 296
- Price index for 1976 by 1982 base = 296 X 490/100 = 60.408
- Price index by old base (1982) for 1998 = 405
- Price index for 2001 by new base (2001) = 100
- Price index by new base (2001) for 1998 = 405 X 458/100 = 88.428
- Price index by new base (2001) for November 2014 = 253.
- All India Consumer Price Index numbers for industrial workers (Base 2001 = 100) shows the current price index as 253 on November 2014
  SOURCE: http://labourbureau.nic.in/indtab.html

  Conversion factor for the year 2014 November can be achieved by dividing the price index (2014 november) by 88.428. CPI-IW (base 2001 = 100) shows reference index numbers as 253 on november 2014 as per Labour Bureau, Government of India. Price index was 88.42 for 1998 and 253 for 2014 november so conversion factor with 2001 as new base will be 2.86 (253 / 88.42)

ANNEXURE V - MODIFIED KUPPUSWAMY SOCIOECONOMIC SCALE

YEARWISE FAMILY INCOME RANGE ACCORDING TO MODIFIED KUPPUSWAMI SCALE:

FAMILY INCOME PER MONTH RANGE	YEARS		
	1976(ORIGINAL)	1998 (MODIFIED)	2014 NOVEMBER (CURRENT)
1.	≥ 2,000	≥ 13,408	≥ 38,347
2.	1000 – 1999	6704 – 13407	19173 – 38346
3.	750 – 999	5028 – 6703	14380 – 19172
4.	500 – 749	3352 – 5027	9587– 14379
5.	300 – 499	2011 – 3351	5751 – 9586
6.	101 – 299	677 – 2010	1936 – 5750
7.	≤100	≤676	≤1935

SOURCE: Bairwa M, Rajput M, Sachdeva S. Modified kuppuswamy's socioeconomic scale: social researcher should include updated income criteria, 2012. Indian J Community Med 2013;38:185-6

ANNEXURE VI - KEY TO MASTER CHART

ITEMS	DESCRIPTION OF CODED ITEMS	
S,NO	Serial No.	
Sex	1. Male , 2.Female	
SES/MRSI	Socio Economic Status by MRSI Scale (see ANNEXURE IV, V for Coding)	
SES/K	SES by Modified Kuppuswami Scale (see ANNEXURE IV, V for Coding)	
Kn. Htn	Known Case of Hypertension 1.Yes 2. No	
SBP	Systolic BP in mm of Hg (whole number)	
DBP	Diastolic BP in mm of Hg (whole number)	
HTN	Hypertension 1. Present 2. Absent	
ALC	Alcoholism	See Operational Definitions in Methodology for Coding
SMOK	Smoking	
PHY.	Level of Physical Activity	
Wt	Weight in kilogram	
Waist	Waist Circumference in centimeter	
Hip	Hip Circumference in centimeter	
Ht.	Height in centimeter	

S,NO	Age	sex	SES/MRSI	SES/K	Kn. Htn	SBP	DBP	HTN	ALC	SMOK	PHY.	Wt.	Waist	Hip	Ht.
1	42	1	1	1	1	130	80	1	1	1	2	82	100	108	178
2	40	2	1	1	1	126	86	1	1	3	2	55	89	90	148
3	20	1	1	1	2	120	80	2	1	3	3	55	76	82	161
4	53	1	3	3	2	110	70	2	1	3	3	50	80	84	155
5	43	2	3	3	1	130	80	1	1	3	2	60	90	94	154
6	20	1	3	3	2	110	70	2	1	3	4	75	85	90	176
7	59	1	5	5	2	136	80	2	1	3	4	76	95	98	165
8	58	2	5	5	2	150	84	1	1	3	2	80	100	106	164
9	33	1	5	5	2	140	90	1	1	1	2	55	80	92	167
10	28	2	5	5	2	130	80	2	1	3	4	50	85	88	155
11	31	1	2	2	2	126	84	2	1	3	4	65	82	83	176
12	44	1	2	2	1	130	80	1	1	3	3	82	95	96	165
13	53	2	1	1	2	110	70	2	1	3	3	65	82	86	157
14	20	1	1	1	2	130	80	2	1	3	3	66	84	88	168
15	22	1	1	1	2	130	70	2	3	3	3	55	94	98	170
16	47	1	5	5	2	126	78	2	1	3	3	55	76	80	157
17	43	2	5	5	1	140	90	1	1	3	2	50	80	82	155
18	23	1	2	2	2	110	70	2	1	3	3	60	90	96	178
19	40	1	2	2	2	130	70	2	3	3	3	75	85	88	170
20	35	2	2	2	2	110	70	2	1	3	3	76	95	98	170
21	21	1	2	2	2	136	86	2	1	3	4	80	100	103	159
22	38	1	5	5	2	150	84	1	3	1	2	70	80	86	155
23	35	2	5	5	2	140	80	1	1	3	2	72	81	86	158
24	23	2	4	3	2	130	80	2	1	3	3	65	83	88	178
25	21	1	3	3	2	126	76	2	1	3	3	100	95	98	186
26	46	1	3	3	2	130	80	2	1	3	3	65	86	92	157
27	55	2	3	3	2	110	70	2	1	3	3	80	100	112	164
28	22	1	3	3	2	130	86	2	1	3	2	55	80	88	167
29	21	1	3	3	2	136	80	2	1	3	4	50	85	88	155

30	48	2	2	2	2	150	90	1	1	3	2	65	83	88	165
31	59	1	2	2	2	140	90	1	1	3	2	100	95	98	176
32	42	2	2	2	2	130	80	2	1	3	2	65	80	88	157
33	44	1	2	3	2	140	84	1	1	3	2	82	100	110	178
34	23	2	2	3	2	130	78	2	1	3	2	55	90	94	165
35	21	1	2	3	2	130	80	2	1	3	3	55	76	80	171
36	30	1	2	3	2	126	84	2	1	3	3	65	80	86	155
37	45	1	3	3	2	130	80	2	1	3	3	60	90	96	164
38	42	2	3	3	2	110	70	2	1	3	3	55	80	84	159
39	21	1	3	3	2	130	80	2	1	3	3	50	85	92	155
40	55	1	2	2	2	130	70	2	1	3	3	65	83	86	166
41	50	2	2	2	2	126	80	2	1	3	3	58	78	86	166
42	23	2	2	2	2	140	82	2	1	3	3	65	82	88	170
43	21	2	2	2	2	110	70	2	1	3	3	55	80	86	164
44	27	1	2	2	2	130	70	2	1	3	3	66	84	90	170
45	40	2	2	2	2	110	80	2	1	3	3	50	85	88	155
46	40	1	2	2	2	120	76	2	1	3	2	65	83	89	176
47	45	2	2	2	1	130	84	1	1	3	2	46	80	87	154
48	55	1	1	1	1	146	90	1	3	1	2	60	84	90	168
49	20	2	1	1	2	130	78	2	1	3	3	59	82	88	170
50	30	2	1	1	2	126	80	2	1	3	3	68	86	96	168
51	34	1	2	2	2	116	70	2	1	3	3	56	88	92	162
52	48	2	2	2	2	120	80	2	1	3	3	60	90	94	165
53	32	1	3	3	2	130	70	2	3	3	4	63	88	94	176
54	42	2	3	3	2	120	80	2	1	3	3	60	82	90	154
55	44	1	3	3	2	110	78	2	1	3	3	58	88	92	168
56	20	1	3	3	2	108	70	2	1	3	3	48	78	84	159
57	25	2	3	3	2	114	80	2	1	3	3	55	82	85	160
58	34	2	1	1	2	120	78	2	1	3	3	48	78	84	164
59	32	2	1	1	2	116	80	2	1	3	2	64	86	90	158
60	29	1	2	2	2	124	80	2	1	3	3	66	83	86	172

61	40	1	2	2	1	130	86	2	3	1	3	57	90	96	170
62	47	1	2	2	2	120	84	2	1	3	3	58	84	90	164
63	49	2	4	4	2	126	88	2	1	3	3	45	80	90	150
64	58	1	4	4	2	130	78	2	1	3	3	74	88	94	178
65	43	2	4	4	2	120	80	2	1	3	4	45	80	85	162
66	58	1	4	4	2	134	86	2	1	3	4	68	76	80	162
67	45	1	4	4	2	120	80	2	1	3	4	56	78	82	165
68	34	1	2	2	2	126	84	2	1	3	3	64	82	86	176
69	48	1	2	2	2	120	86	2	3	2	3	50	80	84	160
70	46	1	2	3	2	124	78	2	1	3	3	72	84	88	166
71	59	1	2	3	2	116	86	2	3	1	2	64	82	90	158
72	22	2	2	3	2	130	80	2	1	3	4	45	80	86	154
73	45	2	2	2	2	130	80	2	1	3	3	62	90	96	164
74	32	2	2	2	2	124	80	2	1	3	3	52	84	90	164
75	20	1	2	2	2	120	78	2	1	3	3	58	82	88	170
76	58	2	2	2	2	126	80	2	1	3	3	70	88	94	165
77	58	1	5	5	1	132	86	1	3	2	2	75	86	92	170
78	59	2	5	5	2	124	78	2	1	3	3	66	82	88	166
79	25	1	5	5	2	120	84	2	1	3	3	64	82	88	176
80	33	2	5	5	2	130	80	2	1	3	3	64	84	90	168
81	37	1	5	5	2	128	76	2	3	3	3	72	92	96	164
82	36	1	5	5	2	116	74	2	3	3	3	68	86	92	172
83	28	2	5	5	2	120	86	2	1	3	3	58	84	88	164
84	36	2	5	5	2	126	80	2	1	3	3	52	80	88	160
85	38	1	5	5	2	120	86	2	1	3	3	82	96	102	178
86	29	2	5	5	2	126	80	2	1	3	3	55	88	94	165
87	30	1	3	3	2	110	78	2	1	3	3	52	76	82	171
88	29	2	3	3	2	136	86	2	1	3	2	61	80	84	157
89	36	1	3	3	2	110	80	2	1	3	4	86	93	99	178
90	45	2	3	3	2	130	90	1	1	3	2	48	80	86	154
91	46	1	3	3	1	120	76	1	1	1	2	62	90	98	164

92	28	2	2	2	2	116	80	2	1	3	3	52	84	90	164
93	35	2	2	2	2	120	86	2	1	3	3	58	82	90	170
94	38	1	2	2	2	126	80	2	1	3	4	64	84	88	165
95	58	2	2	2	1	126	78	1	1	3	2	75	90	96	170
96	35	1	2	2	2	136	84	2	3	3	3	66	78	86	166
97	32	2	4	4	2	110	80	2	1	3	2	64	88	92	168
98	30	2	4	4	2	120	84	2	1	3	3	68	92	94	164
99	32	1	3	4	1	126	76	1	3	1	2	72	90	94	172
100	36	1	3	4	1	136	86	1	1	3	2	58	88	86	164
101	50	2	2	2	1	124	80	1	1	3	2	52	86	88	156
102	57	1	2	2	1	130	84	1	3	1	2	66	87	89	168
103	27	2	2	2	2	124	78	2	1	3	4	56	86	88	154
104	33	1	2	2	2	130	80	2	1	3	3	62	86	90	170
105	29	2	2	2	2	128	76	2	1	3	3	62	84	86	158
106	34	1	2	2	2	116	70	2	1	3	3	62	84	86	164
107	33	2	2	2	2	110	88	2	1	3	3	64	86	90	170
108	43	1	2	2	1	126	80	1	3	1	4	64	85	88	160
109	52	2	2	2	2	120	80	2	1	3	3	75	90	94	160
110	30	1	2	3	2	126	86	2	1	1	3	66	78	88	166
111	25	2	3	4	2	122	78	2	1	3	3	54	80	86	164
112	45	2	3	4	1	136	86	1	1	3	2	48	82	84	158
113	26	2	2	2	2	124	80	2	1	3	4	62	88	90	164
114	20	1	2	2	2	136	80	2	1	3	3	56	84	88	164
115	57	2	2	2	2	122	78	2	1	3	4	58	84	88	174
116	50	2	2	2	1	120	74	1	1	3	2	61	85	86	168
117	40	1	2	2	1	120	80	1	3	1	2	69	89	90	170
118	30	2	2	2	2	110	80	2	1	3	2	66	78	82	166
119	35	1	2	2	2	120	78	2	3	3	3	64	88	92	168
120	37	2	2	2	2	122	84	2	1	3	3	63	92	96	158
121	28	2	2	2	2	120	74	2	1	3	3	70	86	87	170
122	27	2	2	2	2	136	86	2	1	3	3	56	75	80	164

123	57	1	1	1	1	130	80	1	1	3	2	72	86	88	166
124	47	2	1	1	2	126	78	2	1	3	3	60	76	83	164
125	33	2	2	2	2	140	70	1	1	3	2	58	85	90	165
126	53	2	2	2	1	110	80	1	1	3	2	66	87	90	168
127	45	1	2	2	2	130	78	2	3	3	3	56	82	88	154
128	35	2	2	2	2	110	80	2	1	3	3	62	86	92	170
129	31	2	2	2	2	120	80	2	1	3	3	62	80	86	158
130	41	1	2	2	2	122	86	2	1	3	3	62	82	86	164
131	54	2	2	2	1	120	84	1	1	3	2	64	88	90	170
132	23	2	2	2	2	120	88	2	1	3	3	64	76	82	160
133	35	1	2	2	1	126	78	1	3	3	2	75	90	96	160
134	52	2	2	2	2	116	80	2	1	3	3	66	78	80	166
135	50	2	2	2	2	120	78	2	1	3	3	54	80	82	164
136	29	2	2	2	2	130	84	2	1	3	3	48	78	84	158
137	38	2	2	2	2	120	74	2	1	3	3	76	84	98	172
138	23	2	2	2	2	110	86	2	1	3	4	80	82	88	164
139	34	2	2	2	2	108	80	2	1	3	3	55	78	80	160
140	31	2	2	2	2	114	78	2	1	3	3	50	78	86	178
141	49	2	2	2	1	120	70	1	1	3	2	65	85	86	165
142	55	2	2	2	1	116	80	1	1	3	2	58	86	88	171
143	50	2	2	2	2	124	78	2	1	3	3	66	80	88	157
144	25	2	2	2	2	110	84	2	1	3	3	56	84	88	178
145	26	2	1	2	2	120	74	2	1	3	3	62	76	88	154
146	45	2	1	2	2	130	86	2	1	3	3	62	82	88	164
147	48	2	2	2	1	146	80	1	1	3	2	56	81	82	158
148	46	2	2	2	2	130	78	2	1	3	3	58	90	96	170
149	21	1	2	2	2	126	70	2	1	3	3	61	78	80	160
150	49	2	2	2	1	116	80	1	1	3	2	69	80	82	160
151	32	2	2	2	2	120	78	2	1	3	2	66	82	86	166
152	22	1	2	2	2	130	80	2	1	3	2	64	88	90	176
153	54	1	3	3	1	146	80	1	3	1	2	63	84	86	158

154	34	1	3	3	2	126	86	2	3	3	2	70	86	96	172
155	20	2	3	3	2	110	84	2	1	3	2	56	84	84	164
156	21	2	3	3	2	120	88	2	1	3	2	72	80	82	160
157	29	2	3	3	2	120	78	2	1	3	3	60	88	96	178
158	36	2	3	3	2	116	80	2	1	3	2	58	80	86	165
159	26	2	3	3	2	124	78	2	1	3	3	66	76	78	164
160	42	2	3	3	2	110	84	2	1	3	3	56	78	86	170
161	26	2	3	3	2	120	74	2	1	3	2	62	82	84	155
162	35	2	3	3	2	130	86	2	1	3	3	62	80	90	176
163	55	2	3	3	2	146	80	1	1	3	2	60	84	80	154
164	27	2	3	3	2	126	78	2	1	3	3	75	82	86	168
165	48	2	3	3	2	110	70	2	1	3	2	76	80	85	170
166	26	2	2	2	2	120	80	2	1	3	2	80	90	96	168
167	28	2	2	2	2	126	70	2	1	3	2	55	84	88	162
168	58	2	2	2	2	110	80	2	1	3	2	50	82	86	165
169	45	2	2	2	1	120	70	1	1	3	3	65	88	90	176
170	33	1	1	1	2	126	80	2	3	1	2	90	92	96	154
171	27	2	1	1	2	130	80	2	1	3	2	65	82	84	168
172	42	1	1	1	2	110	70	2	1	3	2	66	82	84	159
173	37	2	1	1	2	130	70	2	1	3	2	55	90	96	160
174	42	1	2	2	2	130	80	2	1	3	2	55	78	82	164
175	50	2	2	2	2	126	76	2	1	3	2	50	80	84	158
176	45	2	3	3	1	140	84	1	1	3	2	60	85	86	168
177	48	2	2	2	2	110	90	1	1	3	2	75	88	90	167
178	35	2	2	2	2	130	78	2	1	3	2	76	84	86	164
179	38	2	2	2	2	110	80	2	1	3	2	80	90	92	150
180	46	2	2	2	1	120	70	1	1	3	3	55	84	88	166
181	40	1	2	2	2	130	80	2	3	3	2	66	80	86	162
182	21	2	2	2	2	136	70	2	1	3	3	58	88	90	162
183	35	1	2	2	2	136	80	2	3	3	3	48	78	80	165
184	59	1	2	2	1	150	78	1	3	1	2	55	82	86	160

185	21	1	2	2	2	120	70	2	1	3	3	48	78	80	160
186	20	2	2	2	2	130	80	2	1	3	3	64	86	88	160
187	56	1	2	2	2	130	78	2	1	3	3	66	83	86	166
188	40	2	2	2	2	126	80	2	1	3	4	57	90	92	164
189	37	1	2	2	2	110	76	2	1	3	3	58	84	90	158
190	40	1	2	2	2	130	84	2	1	3	3	45	80	88	172
191	27	2	2	2	2	136	80	2	1	3	2	74	88	90	164
192	50	2	2	2	2	150	80	1	1	3	2	45	83	86	160
193	56	2	2	2	1	140	86	1	1	3	2	68	83	84	162
194	58	2	3	3	2	130	80	2	1	3	3	56	78	82	165
195	32	2	2	2	2	126	70	2	1	3	3	55	82	88	164
196	49	2	2	2	2	140	80	1	1	3	2	66	86	88	170
197	49	1	2	2	2	130	70	2	3	3	3	58	84	92	169
198	39	1	2	2	2	126	80	2	1	3	4	48	84	88	176
199	43	1	3	3	2	130	84	2	3	2	4	55	76	86	154
200	36	1	2	2	2	110	90	1	1	1	2	55	88	92	168
201	21	2	2	2	2	130	80	2	1	3	3	64	82	86	168
202	24	2	2	2	2	130	80	2	1	3	3	50	80	84	164
203	45	1	2	2	1	126	78	1	1	1	2	72	90	96	172
204	27	2	2	2	2	130	80	2	1	3	3	64	80	84	164
205	30	1	2	2	2	110	76	2	1	3	4	60	84	88	170
206	45	1	2	2	2	130	80	2	1	3	3	62	83	90	168
207	25	1	2	2	2	110	86	2	1	3	3	52	74	86	154
208	58	1	2	2	2	120	84	2	1	3	4	58	82	87	170
209	56	2	2	2	2	130	88	2	1	3	3	70	78	85	158
210	29	1	2	2	2	126	78	2	1	1	3	75	80	86	164
211	39	1	2	2	2	130	80	2	1	3	3	66	84	90	170
212	58	2	3	3	2	110	78	2	1	3	3	64	76	85	160
213	58	1	3	3	2	130	84	2	1	3	3	64	78	90	160
214	55	2	3	3	1	136	74	1	1	3	2	68	90	100	166
215	54	2	4	4	2	150	86	1	1	3	2	64	82	84	158

216	51	2	4	4	1	140	80	1	1	3	2	58	86	88	158
217	24	1	4	4	2	130	84	2	1	3	2	52	88	96	170
218	50	1	4	4	1	126	90	1	1	1	2	76	90	95	164
219	47	1	4	4	1	140	80	1	1	1	3	55	85	86	168
220	56	1	4	4	2	130	84	2	1	3	2	52	82	98	168
221	41	1	4	4	2	110	80	2	1	3	2	61	84	94	170
222	58	1	4	4	2	130	70	2	1	3	2	86	78	85	166
223	43	2	4	4	2	110	80	2	1	3	2	48	82	86	168
224	58	1	4	4	2	120	70	2	1	3	3	62	78	90	168
225	45	1	2	2	2	130	78	2	1	3	2	52	86	90	168
226	34	1	2	2	2	146	90	1	1	1	2	58	86	94	164
227	48	1	2	2	1	136	70	1	1	1	2	64	93	96	172
228	52	1	2	2	2	150	70	1	1	1	2	75	86	88	164
229	59	1	2	2	1	140	70	1	1	1	2	68	85	88	156
230	22	2	2	2	2	130	86	2	1	3	2	58	83	90	168
231	45	2	2	2	2	142	84	1	1	3	2	52	86	90	154
232	32	2	2	2	2	126	84	2	1	3	2	82	84	87	170
233	20	1	2	2	2	110	78	2	1	3	2	55	80	88	158
234	58	2	2	2	2	130	80	2	1	3	3	52	81	90	164
235	54	1	3	3	2	120	86	2	1	3	2	61	84	92	170
236	59	2	3	3	2	136	80	2	1	3	2	86	85	96	169
237	25	1	1	1	2	130	70	2	1	3	2	48	82	94	170
238	33	2	2	2	1	126	80	1	1	3	2	62	82	85	157
239	37	1	3	3	1	140	70	1	1	1	3	52	83	86	160
240	36	1	2	2	2	110	80	2	1	3	2	75	82	93	166
241	28	2	3	3	2	130	86	2	1	3	2	76	82	88	164
242	36	2	2	2	2	110	84	2	1	3	2	80	78	88	158
243	38	1	2	2	2	120	88	2	3	1	2	55	83	89	172
244	29	2	2	2	2	122	78	2	1	3	2	50	80	88	164
245	30	1	2	2	2	120	80	2	1	3	3	65	80	90	160
246	29	2	2	2	2	130	78	2	1	3	2	90	82	88	178

247	36	1	2	2	2	130	84	2	1	3	2	65	80	88	165
248	45	2	2	2	2	148	74	1	1	3	2	66	90	94	164
249	48	2	2	2	2	146	86	1	1	3	2	55	86	88	166
250	26	2	2	2	2	130	80	2	1	3	2	55	80	82	164
251	28	2	2	2	2	120	78	2	1	3	2	50	88	94	178
252	49	2	2	2	2	136	80	2	1	3	3	60	80	86	162
253	45	2	2	2	2	150	92	1	1	3	2	75	81	83	156
254	33	1	2	2	2	140	70	1	1	3	2	60	88	90	170
255	27	2	2	2	2	130	70	2	1	3	3	80	82	90	168
256	42	1	1	1	2	126	80	2	1	3	2	55	80	88	162
257	37	2	1	1	2	130	76	2	1	3	2	66	80	96	165
258	42	1	2	2	1	110	84	1	1	3	2	58	86	88	170
259	50	2	2	2	2	130	90	1	1	3	2	48	82	84	154
260	45	2	2	2	2	130	78	2	1	3	2	55	80	92	164
261	48	2	2	3	2	126	80	2	1	3	2	48	76	86	156
262	35	2	2	3	2	140	70	1	1	3	2	56	80	84	156
263	38	2	2	2	2	110	80	2	1	3	2	66	82	94	166
264	46	2	2	2	2	140	70	1	1	3	2	57	80	82	154
265	40	1	2	2	2	146	80	1	1	3	2	58	92	94	165
266	21	2	1	2	2	136	78	2	1	3	2	66	82	90	170
267	35	1	1	1	1	150	70	1	1	3	3	55	82	84	160
268	59	1	2	2	2	140	80	1	1	3	2	55	94	96	160
269	21	1	2	2	2	130	78	2	1	3	2	50	80	88	166
270	21	1	2	2	2	126	80	2	1	3	2	60	80	86	164
271	54	1	2	2	2	130	76	2	1	3	3	75	81	94	162
272	40	2	2	2	2	110	84	2	1	3	3	76	80	82	172
273	37	1	2	3	1	130	90	1	1	3	2	64	82	84	162
274	40	1	2	3	2	136	80	2	1	3	2	55	78	92	160
275	27	2	2	3	2	150	86	1	1	3	3	66	86	90	164
276	39	1	1	1	2	140	80	1	3	3	2	58	86	88	165
277	43	1	3	3	2	142	70	1	1	3	2	61	90	94	164

278	36	1	3	3	2	126	80	2	1	3	3	86	84	96	170
279	21	1	3	3	2	130	70	2	1	3	2	48	76	88	155
280	24	2	3	3	2	130	80	2	1	3	3	62	85	90	176
281	45	1	3	3	2	126	84	2	1	3	2	52	78	88	154
282	27	2	3	3	2	130	90	1	1	3	2	75	95	98	168
283	30	1	3	3	2	110	80	2	1	3	2	76	82	88	168
284	45	1	2	3	2	130	80	2	1	3	3	80	80	90	164
285	25	1	3	3	2	130	78	2	1	3	2	55	84	96	172
286	58	1	3	3	2	126	80	2	1	3	3	50	76	82	164
287	56	2	3	3	1	140	76	1	1	3	2	65	83	84	158
288	29	1	2	2	2	110	80	2	1	3	2	90	80	96	165
289	39	1	2	2	2	122	86	2	1	3	2	65	80	88	161
290	58	2	2	2	2	120	84	2	1	3	3	66	84	98	170
291	59	1	2	2	2	130	88	2	1	3	4	55	80	104	170
292	55	2	2	2	2	130	78	2	1	3	2	55	80	86	170
293	54	2	2	2	2	126	80	2	1	3	2	50	82	88	165
294	51	2	2	2	2	110	78	2	1	3	2	60	80	88	164
295	24	1	2	2	2	130	84	2	3	2	2	75	86	102	176
296	50	1	2	2	2	120	74	2	1	3	2	76	80	88	165
297	47	1	2	2	2	136	86	2	3	3	2	80	90	106	179
298	56	1	2	2	2	150	80	1	1	3	2	55	80	84	156
299	41	1	2	2	2	140	84	1	1	3	2	66	85	88	157
300	58	1	2	2	2	130	90	1	1	3	2	58	83	86	158
301	43	2	2	2	2	126	90	1	1	3	2	48	97	102	170
302	58	1	2	2	2	130	84	2	1	3	2	55	78	90	157
303	45	1	2	2	2	110	80	2	1	3	4	64	90	108	170
304	34	1	3	3	2	130	70	2	1	3	2	63	86	96	178
305	48	1	2	2	2	130	80	2	1	3	2	70	76	82	170
306	52	1	2	1	2	126	70	2	1	3	2	56	80	88	170
307	55	1	2	1	2	140	78	1	1	3	3	72	86	88	159
308	22	2	2	2	2	110	90	1	1	3	4	60	88	92	165

309	45	2	2	2	2	130	70	2	1	3	2	58	84	94	170
310	32	2	2	2	2	110	70	2	1	3	2	66	88	92	178
311	20	1	2	2	2	136	70	2	1	3	3	56	82	96	186
312	58	2	2	2	2	150	86	1	1	3	2	62	83	88	157
313	55	1	2	2	1	140	84	1	1	3	2	62	90	92	165
314	59	2	2	2	2	130	84	2	1	3	3	60	84	86	176
315	25	1	1	1	2	126	78	2	1	3	2	75	78	86	166
316	33	2	2	2	2	130	88	2	1	3	3	76	83	88	168
317	50	2	2	2	1	110	90	1	1	3	2	80	80	84	156
318	57	2	2	2	2	130	74	2	1	3	2	55	82	89	170
319	27	1	2	1	2	136	70	2	1	3	2	50	82	85	164
320	33	2	2	1	2	126	80	2	1	3	2	65	80	89	158
321	29	1	2	2	1	110	82	1	1	3	2	90	90	96	172
322	34	1	2	2	2	130	86	2	3	1	2	65	84	90	170
323	33	1	2	2	2	120	78	2	1	3	2	61	80	84	164
324	43	2	2	2	2	136	72	2	1	3	3	86	82	93	168
325	52	1	2	2	2	150	74	1	3	1	3	48	84	86	160
326	30	2	2	2	2	140	80	1	1	3	2	62	86	90	156
327	25	1	2	2	2	130	80	2	1	3	2	52	78	90	162
328	45	1	2	2	2	126	92	1	1	3	2	75	90	94	165
329	26	2	2	2	2	130	70	2	1	3	2	76	83	87	176
330	20	2	2	2	1	110	70	1	1	3	2	80	90	95	160
331	57	2	2	2	2	126	80	2	1	3	2	55	80	88	166
332	50	2	2	2	2	140	76	1	1	3	2	50	83	86	158
333	40	2	2	2	2	110	84	2	1	3	2	65	81	92	165
334	30	2	2	2	2	122	90	1	1	3	2	90	100	104	164
335	35	1	2	2	2	120	78	2	3	3	2	65	84	100	170
336	37	1	2	2	2	130	80	2	3	1	2	66	76	86	170
337	28	1	2	2	2	130	70	2	1	3	2	55	80	84	165
338	27	1	2	2	1	126	80	1	1	3	4	55	90	98	167
339	57	2	3	3	2	110	70	2	1	3	2	70	85	89	172

340	47	2	3	3	2	130	80	2	1	3	2	74	86	98	176
341	33	1	2	1	2	120	78	2	1	3	2	75	92	104	186
342	53	2	2	1	2	136	70	2	1	3	2	76	77	86	157
343	45	1	2	2	2	150	80	1	1	3	3	80	88	90	168
344	35	1	2	2	2	140	78	1	1	1	2	55	86	88	164
345	31	1	2	2	2	130	80	2	1	3	2	66	88	104	179
346	41	1	2	2	1	126	76	1	1	3	2	58	86	90	160
347	54	2	2	2	1	130	84	1	1	3	2	48	88	90	172
348	58	1	2	2	2	110	90	1	1	3	2	55	94	97	170
349	45	1	2	2	2	130	80	2	1	3	2	82	76	84	170
350	34	2	2	2	2	130	86	2	1	3	2	55	76	88	159
351	48	1	2	2	2	126	80	2	1	3	2	55	84	96	169
352	52	2	4	4	2	140	70	1	1	3	3	50	85	93	158
353	57	2	4	4	1	110	80	1	1	3	3	60	95	102	178
354	22	2	4	4	2	130	70	2	1	3	2	80	92	110	186
355	45	1	4	4	2	110	80	2	1	3	2	76	76	86	157
356	32	1	4	4	2	136	84	2	3	3	2	80	84	90	170
357	20	1	4	4	2	150	90	1	1	3	2	55	83	90	159
358	58	1	4	4	2	140	80	1	1	3	2	50	95	99	165
359	58	1	2	2	2	130	80	2	1	3	3	65	79	90	160
360	59	1	2	2	2	126	78	2	1	3	3	100	88	100	178
361	25	2	2	2	2	130	80	2	1	3	2	65	84	90	186
362	33	1	2	2	2	110	76	2	1	3	2	66	80	88	162
363	50	1	2	2	1	130	80	1	1	3	3	55	90	92	174
364	57	1	2	2	2	136	86	2	1	3	4	55	80	88	186
365	27	1	4	4	2	126	84	2	1	3	2	50	84	98	170
366	33	1	4	4	2	110	88	2	1	3	2	60	82	84	170
367	29	1	2	2	2	130	78	2	1	3	2	75	83	92	166
368	34	2	2	2	2	120	80	2	1	3	2	76	86	98	172
369	33	2	2	2	1	130	78	1	1	3	2	80	84	88	158
370	43	2	2	2	2	136	84	2	1	3	3	55	80	86	178

371	52	1	2	2	2	126	74	2	1	3	2	50	88	95	186
372	30	2	2	2	2	110	86	2	1	3	2	65	80	84	164
373	25	1	2	2	2	130	80	2	3	1	2	100	76	80	159
374	57	2	2	2	2	120	84	2	1	3	2	65	78	84	160
375	47	1	2	2	2	140	90	1	1	1	2	56	86	90	164
376	33	2	2	2	2	110	80	2	1	3	2	72	78	90	158
377	53	1	2	2	2	122	84	2	1	3	2	60	86	98	174
378	45	1	2	2	2	120	80	2	1	3	2	58	84	88	170
379	35	2	3	3	2	130	70	2	1	3	2	66	80	88	164
380	31	2	3	3	2	130	80	2	1	3	2	66	82	94	164
381	41	1	2	2	2	126	70	2	1	3	2	62	84	96	178
382	54	2	2	2	2	110	78	2	1	3	2	62	82	90	165
383	23	1	3	3	2	130	90	1	3	3	2	60	88	92	162
384	35	2	3	3	2	120	70	2	1	3	2	75	80	90	165
485	52	1	3	3	2	136	70	2	1	3	2	76	80	85	176
386	50	2	3	3	2	150	70	1	1	3	2	80	84	88	160
387	29	2	2	2	2	140	86	1	1	3	2	55	86	89	166
388	38	2	2	2	1	130	84	1	1	3	2	50	83	87	158
389	23	2	2	2	2	126	84	2	1	3	2	70	80	94	164
390	34	2	2	2	2	130	76	2	1	3	2	90	80	90	164
391	31	2	2	2	2	110	84	2	1	3	3	65	80	90	164
392	56	1	2	2	2	130	90	1	1	1	2	82	90	94	170
393	55	2	2	2	2	130	80	2	1	3	2	55	80	88	165
394	50	1	2	2	2	126	86	2	3	1	4	55	76	80	170
395	25	2	2	2	2	140	80	1	1	3	2	50	83	85	160
396	26	1	2	2	2	110	70	2	1	3	2	60	80	93	169
397	45	2	3	3	2	130	80	2	1	3	2	75	80	90	165
398	39	2	3	3	2	110	70	2	1	3	3	86	84	99	168
399	46	2	3	3	2	136	80	2	1	3	3	80	84	90	178
400	21	2	2	2	2	150	84	1	1	3	2	60	88	90	170
401	49	2	2	2	2	140	90	1	1	3	2	50	88	92	157

402	32	2	2	2	2	130	80	2	1	3	3	65	83	90	170
403	22	1	2	2	2	126	80	2	1	3	2	90	80	94	169
404	54	2	2	2	2	130	78	2	1	3	3	65	81	88	165
405	23	1	2	2	2	110	80	2	1	3	3	66	78	86	158
406	30	1	2	2	2	130	76	2	3	1	3	55	84	94	178
407	31	1	2	2	2	136	80	2	1	3	4	55	80	90	186
408	47	2	2	2	2	126	86	2	1	3	3	50	78	90	157
409	55	1	2	2	2	110	80	2	1	3	3	60	82	88	178
410	46	2	2	2	2	130	70	2	1	3	3	75	82	94	166
411	25	1	4	4	2	120	80	2	1	3	3	76	80	90	165
412	21	1	4	4	2	140	70	1	1	3	2	80	90	94	158
413	45	2	2	3	2	130	80	2	1	3	3	55	84	90	178
414	39	1	2	3	2	126	84	2	1	3	3	50	85	90	178
415	58	2	2	3	2	130	90	1	1	3	2	65	86	88	170
416	57	1	2	2	2	110	90	1	1	3	2	100	95	102	157
417	55	2	2	2	2	120	80	2	1	3	3	65	82	88	165
418	54	2	2	2	2	122	84	2	1	3	3	66	84	94	176
419	51	2	2	2	2	120	80	2	1	3	3	64	82	98	166
420	23	1	2	2	2	136	70	2	3	2	4	64	76	90	168
421	50	1	2	2	1	130	80	1	1	3	2	72	84	88	159
422	47	1	2	2	1	126	70	1	3	3	2	68	90	98	160
423	56	1	2	2	2	140	78	1	1	3	2	58	88	94	164
424	41	1	2	2	2	110	90	1	1	3	2	52	95	99	158
425	58	1	2	2	2	130	70	2	1	3	3	82	86	102	180
426	43	2	2	2	2	110	70	2	1	3	3	55	80	90	170
427	58	1	2	2	2	120	70	2	1	3	3	52	80	94	164
428	45	1	2	2	2	122	86	2	1	3	4	61	83	90	164
429	34	1	3	3	2	120	84	2	1	3	3	86	90	104	178
430	48	1	3	3	2	120	84	2	1	3	3	64	84	98	170
431	52	1	2	2	2	126	76	2	1	3	3	62	84	96	168
432	59	1	2	2	2	116	84	2	1	3	3	52	79	90	159

433	22	2	2	2	2	120	90	1	1	3	2	58	93	95	176
434	45	2	2	2	2	130	80	2	1	3	2	64	80	90	160
435	32	2	2	2	2	120	86	2	1	3	2	75	88	103	176
436	20	1	2	2	2	110	80	2	1	3	3	68	80	90	166
437	33	1	2	2	2	108	70	2	1	3	3	66	86	98	174
438	27	2	2	2	2	114	80	2	1	3	3	62	80	90	163
439	42	1	2	2	2	120	70	2	3	3	3	82	89	102	178
440	37	2	2	2	2	116	80	2	1	3	3	55	80	90	162

சுய ஒப்புதல் படிவம்(INFORMED CONSENT FORM)

ஆய்வு செய்யப்படும் தலைப்பு : **"A CROSS SECTIONAL STUDY ON SYSTEMIC HYPERTENSION AND IT'S RELATIONSHIP WITH WAIST TO STATURE RATIO IN AN URBAN POPULATION IN CHENNAI."**

பங்கு பெறுபவரின் பெயர்:

பங்கு பெறுபவரின் வயது:

பங்கு பெறுபவரின் எண் :

பங்கு பெறுபவர் இதனை (√) குறிக்கவும்

மேலே குறிப்பட்டுள்ளமருத்துவ ஆய்வின்விவரங்கள் எனக்கு விளக்கப்பட்டது. என்னுடைய சந்தேகங்களை கேட்கவும், அதற்கான விளக்கங்களை பெறவும் வாய்ப்பளிக்கப்பட்டுள்ளது என அறிந்து கொண்டேன். ☐

நான் இவ்வாய்வில் தன்னிச்சையாக தான் பங்கேற்கிறேன். எந்த காரணத்தினாலோ எந்த சட்டசிக்கலுக்கும் உட்படாமல் நான் இவ்வாய்வில்இருந்து விலகி கொள்ளலாம் என்றும் அறிந்து கொண்டேன். ☐

இந்த ஆய்வு சம்பந்தமாகவோ , இதை சார்ந்து மேலும் ஆய்வு மேற்கொள்ளும் போதும் இந்த ஆய்வில்பங்கு பெறும்மருத்துவர் என்னுடைய மருத்துவ அறிக்கைகக்ளை பார்ப்பதற்க்கு என் அனுமதி தேவையில்லை என அறிந்து கொள்கிறேன். ☐

இந்த ஆய்வின்மூலம் கிடைக்கும் தகவலையோ , முடிவையோ பயன்படுத்திக் கொள்ள மறுக்கமாட்டேன். ☐

இந்த ஆய்வில்பங்கு கொள்ள ஒப்புக் கொள்கிறேன். இந்த ஆய்வை மேற்கொள்ளும்மருத்துவ அணிக்கு உண்மையுடன் இருப்பேன் என்றும் உறுதியளிக்கிறேன். ☐

பங்கேற்பவரின் கையொப்பம் : _____இடம் _____தேதி _____

பங்கேற்பவரின் பெயர் மற்றும் விலாசம்:

பெற்றோரின் கையொப்பம் : _____இடம் _____தேதி _____

பெற்றோரின் பெயர் மற்றும் விலாசம்:

ஆய்வாளரின் கையொப்பம் : _____ இடம் _____ தேதி _____

ஆய்வாளரின் பெயர் : _____

டி.பி. சத்திரம்