

# **Impact of Low Sodium Salt on Hypertensives**

BY

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A DISSERTATION SUBMITTED TO THE AVINASHILINGAM INSTITUTE FOR HOME SCIENCE  
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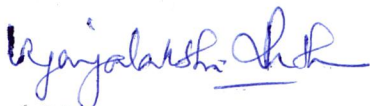
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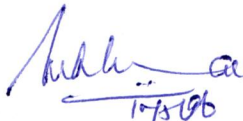
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Certified as bonafide research work



Signature of  
the Head of the  
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Signature of  
the Dean of the  
Faculty



Signature of  
the Guide

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# Introduction

## I INTRODUCTION

Proper diet is the key to good health and vigour. Diet and nutrition are synonymous with health. It provides the necessary nutrients which give energy. Promote growth and sustain the metabolic functions and repair processes that are essential for life. The preventive role of corrective nutrition is an ever evolving process. Inadequate and improper diets are not only responsible for undernutrition, but also contribute to several chronic degenerative diseases such as cardiovascular diseases, diabetes and cancer.

Every one wishes to remain youthful even in old age. Sensible and healthy food habits right from childhood coupled with good life styles can, not only delay aging and increase the life span, but also add to the quality of life. **"Health for all by 2000 A.D."** and **All for Health** should encompass diseases due to inadequate as well as faulty diets. As we move up the ladder of economic prosperity, diet associated chronic diseases begin to assume significance. A changing demographic profile and technological progress can lead to many health problems. Coupled with sedentary life styles, imbalanced diets can contribute to chronic degenerative diseases.

Today coronary artery disease and hypertension have emerged as the most important cause of premature

disability and death all over the world. Genetic susceptibility (heredity) and being a male, makes one more prone to develop these diseases in middle age. It is also known that coronary artery disease is an unavoidable effect of socio-economic development (Ghafoorunissa and Krishnamurthy, 1994).

Non communicable diseases like diabetes mellitus and hypertension are assuming increasing importance in India because of various factors like increasing expectancy of life, improvement in the availability and accessibility of health services. It is a well known fact that best way to combat these ailments is preventing the development of risk factors like smoking, alcoholism, obesity etc. It is ideal but many a times difficult to achieve. second best way is to diagnose these ailments at the earliest and treat adequately. This will definitely prevent the disabilities and mortality resulting due to disastrous complication of these diseases (Dixit and Kulkarni, 1995).

The tragic effects of high blood pressure in hundreds of millions of ordinary people in the other hand are beyond dispute, persons with high blood pressure run the risk of heart and kidney failure, heart attacks and particularly, strokes caused by the bursting or blocking of a blood vessel in the brain.

In most parts of the world 10 per cent to 20 per cent of adults have high blood pressure. Of course not everybody with the condition becomes seriously, ill, but the

higher the pressure and the longer it is elevated the more likely it is that disease will occur. Consequently treatment aimed at reducing high blood pressure is very important (Strasser, 1992).

Hypertension is a disease that has no symptoms but is easily detectable and treatable. If left untreated, it could create several complications later and is likely to reduce the victim's life span by 10 to 20 years (Rewari, 1991).

Essential hypertension is the most common chronic disease in industrialized societies and is a major contributor to the development of cardiovascular disease, stroke, renal failure. Dietary factors have long been the subject of years of investigation to determine their specific roles in prevention and treatment of hypertension (Nutrition Reviews, 1994).

According to Rewari (1991) hypertension is essentially of two types 1. Secondary hypertension - where we can find a cause for it. 2. Primary hypertension - where we can not find a cause for it.

Overweight, particularly fat around the abdomen and excess consumption of alcohol, salt and fat, especially of a saturated nature, are associated with hypertension. In societies where salt intake is about 3g/day, blood pressure does not increase with age and prevalence of hypertension is negligible. Even in India, in tribal areas where salt

intake is about 3g/day hypertension is not observed. Low intakes of potassium, calcium and magnesium also increase the blood pressure. Stress and lack of exercise are contributing factors (Ghafoorunissa and Krishnamurthy, 1994).

Diabetes is also indirectly related to hypertension. Stress and strain, temporary stress leads to a rise in blood pressure, which settles down automatically but continued stress and strain leads to development of persistently high blood pressure.

A high intake of alcohol increases the risk of coronary heart disease, hypertension and stroke can cause myocardial damage.

Excess salt intake - the higher, the salt intake, more is blood pressure. Also when salt is cut out of diet, blood pressure falls accordingly.

The first line of treatment for mild hypertension should be diet and weight control in all patients this may also help in reducing the subsequent requirement for strong and expensive medicines. In people requiring drug therapy the treatment should be as simple and cheap as possible, non-physician health personnel may often help in subsequent supervision. Since resource for control programmes are often limited, there is a need to develop and evaluate low cost methods of effective treatment of hypertension.

Care of hypertensives should involve not only the lowering of blood pressure but also attention to other risk factors of cardiovascular diseases such as smoking and elevated blood cholesterol level (WHO, 1986).

WHO expert committee on prevent of coronary heart disease stressed the importance of weight reduction in many population because of the evidence that it helps to lower elevated levels of blood pressure and blood cholesterol. That expert committee also recognised that the scientific evidence on the nature of the association between physical activity and coronary heart disease was not as strong as for other risk factors. Nevertheless the experimental evidence that regular physical activity leads to a fall in body weight, blood lipids and blood pressure was sufficient to suggest that regular physical activity should be encouraged as an important component of the strategy for risk factor control.

Through out much of the world, mechanisation of work and transport has meant that physical activity has greatly decreased. This must be accepted as a fact of life, particularly in industrialized societies. The recent mass change in life styles has greatly reduced the average population energy expenditure as well as the frequency of vigorous physical activity. Exercise which is important for health, must increasingly be sought, where the possibility exists, as a part of leisure - time activities (WHO Report, 1986).

Diet—A caloric check is essential so much so that in obese persons this alone may reduced blood pressure significantly. A decrease in saturated fat is beneficial. For this avoid butter, desi ghee, energy rich foods, red meat, chocolates etc. Use of sunflower and other polyunsaturated oils (Refined oils) should be encouraged in place of vanaspathi.

Reorientation of patients habits, life style and his outlook towards life is important. Occupational change, through desirable sometimes, may not be possible. But regular annual holidays, adequate rest at night and relaxation at week ends are of considerable help. The patient should be advised to live at a lower tempo and should avoid extra commitments particularly the less important and the like some ones. Mental tension can be reduced by yoga, morning walk, biofeedback, transcendental meditation etc.

Decrease in salt intake is perhaps the single largest factor in the treatment of hypertension. Cutting salt in diet leads to a fall in blood pressure, but cut should be to palatable levels. A daily intake of 3-4 gms is permitted. The best advice is to avoid any extra salt (Table salt) i.e in salad, in curd, soya sauce, certain antacids etc (Rewari, 1991).

A feature of recent media coverage of salt and of certain expert committee recommendations has been the suggestion that a reduction of sodium (salt) intake, possibly coupled with an increase in potassium, may help in reducing the incidence of hypertension in the United Kingdom (Nutrition Bulletin, 1984).

Levey et al., (1995) study results suggest that in the dietary management of hypertension it may be more important to focus on specific changes in a person's diet decreasing sodium intake by 1000 mg/day and increasing calcium intake by 400 mg/day to be consumed.

Having these points in mind, the investigator planned for this study with the following objectives.

1. To elicit information regarding the causes and symptoms associated with high blood pressure
2. Study the effect of supplementation of low sodium salt on hypertension.

# Review of Literature

## II REVIEW OF LITERATURE

Literature pertaining to the study on "Impact of low sodium salt on hypertensives", is reviewed and presented under the following heads :

- A. Prevalence of hypertension
- B. Role of diet in elevating blood pressure
- C. Relationship of sodium on blood pressure
- D. Prevention and control of hypertension
- E. Effect of dietary supplementation in reducing hypertension.

### **A. Prevalence of hypertension**

Strasser (1992) screening programme of the world gives 10 per cent to 20 per cent of adults were suffering from blood pressure.

National high Blood Pressure Education Programme (1992) in the United States estimated that there are 16 million Americans having borderline hypertension.

The Brazilian survey showed a prevalence of high blood pressure ranging from 30 to 34 per cent in men aged 35 to 45 years.

Surveys carried out in China and Chile "typically indicate a prevalence of hypertension of between 10 per cent and 20 per cent" the report says, "with the epidemic becoming apparent over the last two decades or so".

In a survey by premnath (1987) among 570 college

students 4.53 per cent male students and 12.3 per cent female students had systolic blood pressure values greater than 90 mm of Hg.

The incidence of hypertension was 25 per cent in 1980 and it has increased to 38 per cent in 1990 and is expected reach 55 per cent in 2000 A.D. (Rajagopalan, 1990).

Prevalence of hypertension in Rohtak was found out to be 5.9 per cent and in a village in Haryana it was 8.5 per cent. Similarly a study done in Rajasthan showed a prevalence of 6.9 per cent (Dixit and Kulkarni, 1995).

#### **B. Role of diet in elevating blood pressure**

Gerber et al, (1991) found that diet and hypertension is interrelated, mainly leads to obesity there by increasing blood pressure.

Saraswathi (1984) states that faulty diet is considered to be a major cause for hypertension.

Muralikrishna (1996) opines that high saturated fat consumption leads to obesity and increase the level of blood cholesterol. Obesity is directly related to hypertension and coronary heart diseases.

Tandon (1984) indicates that fat from animal foods increase the cholesterol level there by increases blood pressure of the arteries significantly.

Modi (1989) shows that high salt intake in the diet leads to high blood pressure. Baked foods, prepared

foods, processed foods and pickles have too much sodium. Sodium present in the salt increases load on the kidneys there by increase in blood pressure.

Caffeine present in coffee raises blood pressure of normal people an average of 14/10 points (Herald of Health, 1987).

Panda et al., (1990) found that long term adherence to vegetarian diet maylead to a less rise in blood pressure with age and a decrease prevalence of hypertension.

Studies by Anand (1995) concluded that dietary modifications mainly in fat, salt intake, high fibre diet introduced was effective to reduce the blood pressure significantly.

Grandities et al., (1995) revealed that life style changes can cause a significant fall in blood pressure along with dietary modifications.

Taneja (1992) suggests that incidence and prevalence of hypertension can be significantly reduced by low salt intake, vegetarian diet and stress management along with reduction of other risk factors.

Nesovic et al., (1992) found that normal sodium, high sodium (19g), low sodium (2g) intake altered the aldosterone levels and caused a possible change in the blood pressure in patients with essential hypertension.

### C. Relationship of sodium and hypertension

If the amount of sodium within the cell rises water enters the cell. The cell then has more than the usual amount of water which causes it to swell. When cells swell, the tissue becomes water logged (edematous). Water balance can also be upset when people lose sodium. Water then enters the cells to dilute intercellular potassium and the extra cellular fluid decreases. These changes can then result in a drop in blood pressure (Srilakshmi, 1993).

Sodium present in the salt increases the water content in the body increases the blood volume and thus exerts more load on heart, resulting in heart to work with more force to circulate. The increased volume of blood which results in increased blood pressure.

WHO reports (1983) revealed that increased sodium intake leads to increased excretion of sodium by the kidney there by renal arterial pressure were raised for this dietary sodium restriction should be an effective.

Alderman et al., (1994) observed that the consistent and independent correlation between sodium intake and increased myocardial infarction and total cardiovascular diseases.

Rosamond and Fields (1989) found that sodium restrictions appears to be an effective and safe way to lower blood pressure modestly with definity hypertension in older than 40 years.

Kotchen (1994) revealed that the role of sodium in hypertension is interrelated with its sensitivity and it interacts with other cations. When the amount of sodium was increased there was a gradual raise in blood pressure.

A high ratio of sodium to potassium in the diet may be more important in the development of high blood pressure than sodium alone (Herald of Health, 1990).

Halliday (1991) demonstrated that there is a real relationship between salt intake and blood pressure, the effect depending on age and existing blood pressure.

Law et al., (1991) found that the association between blood pressure with sodium intake and that the association increases with age and initial blood pressure. For this moderate salt restriction being effective for patients with diagnosed hypertension.

#### **D. Prevention and control of hypertension**

Bruess and Richardson (1989) give the ways to control bloodpressure, by maintaining ideal body weight, eat low amounts of fat in the diet, controlling stress, not smoking, avoid alcohol, exercising, restricting salt, and rest. These will help to reduce the risk of hypertension and cardiovascular disease in general.

Modi (1989) suggests that eating less will help to cut down weight, will keep blood pressure down. Avoid taking meat and eggs. Cut down on fish and chicken. Twenty per cent of food should come from cereals, milk, nuts, pulses etc. The remaining eighty per cent from vegetables and fruits.

According to Ballentine (1984) processed foods and prepared foods contains relatively high level of sodium and diminished level of potassium. These must be taken in unlimited amount will help to reduce blood pressure.

Davis (1990) opines that coffee consumption should be reduced. Increased intake of coffee leads to raise in blood pressure, cut down coffee from normal intake to keep the pressure at normal level and reduce serum cholesterol level.

According to Mc Carron (1995) dietary calcium intake of 800-1000 mg/day is essential for optimal blood pressure control as well as bone and cardiovascular health.

Lanchet (1985) suggests that weight reduction should be encouraged in patients who weight greater than 115 per cent of their ideal body weight. A considerable fall in blood pressure may occur without reaching ideal body weight. Weight loss accomplished by caloric restriction may result in lower diastolic blood pressure than therapy with a beta blocker.

World hypertension league (1990) studies suggest that weight control along with drug treatment and nonpharmacological measure to hypertension results in reduction of the blood pressure. Weight loss offers several other metabolic and haemodynamic benefits.

Saturated fat intake should be reduced. A decrease in dietary saturated fat alone or combination with

increased polyunsaturated fats includes a modest reduction in blood pressure (Park and Park, 1991).

According to Chinoy (1988) smoking increases the chances of heart attack in hypertensives and pre-hypertensives, because it raises the blood pressure by 15 to 20 points for at least 15 minutes after a cigarette is smoked. Smoking should be avoided.

Haemmingson et al., (1983) reported a decrease in blood pressure following alcohol withdrawal. A peg of alcohol may be permitted occasionally.

According Price "Stress is something that every body experience but nobody can quite define". Nadkarni (1991) indicated that large and frequent increases in the body's stress chemical raise heart beat and blood pressure for real or imagined emergencies and may thus stimulate arterial injuries. Stress and strain should be avoided to prevent blood pressure.

Tandon (1984) showed relaxation and control of tension reduces blood pressure. It is a habit one has to learn and develop. Relaxation may be provided by reading, gardening, playing, games or taking part in other hobbies.

"Early to bed, early to rise, makes you healthy, wealthy and wise" sleeping pattern should be thoroughly followed to prevent from hypertension (Saraswathi, 1984).

Panda et al., (1990) revealed that physical activity is actually a double assert in blood pressure control. The exercise bouts consisted to 40 minutes duration and is of aerophilic isometric type after a long period. Of effective normalisation of blood pressure with treatment. Blood pressure generally returns to normal slowly and redevelopment of hypertension may be prevented by instituting an exercise programme.

According to Ghosh and Mandal (1991) Regular exerciseresults in 5-10 mm of Hg reduction in blood pressure probably related to a fall in sympathetic nervous activity.

Robinson et al., (1989) suggest that sodium restricted diets are used for the prevention, control and eliminationof edema inmany pathologic conditions and occasionally for the alleviation of hypertension.

According to Srilakshmi (1983) moderate sodium restriction 2-3g/day reduces diastolic pressure 6-10 mm Hg and enhances the blood pressure lowering effect of direct therapy.

Mild hypertension respond to a low salt diet by lowering blood pressure to normallevels (Herald of Health, 1987).

Rewari (1991) suggests four ways to control blood pressure

1. Understand that the disease is only controllable and not curable. It is a life long condition and one has to live with it.

2. Certain changes might be required in your day-to-day life and these should be taken sportingly.
3. There might be a lot of friendly suggestions, but remember, "your doctor knows the best", so follow his advice sincerely.
4. Regular blood pressure check up once or twice a month is necessary, just remember the reins of the silent killer are in your hands. Do not let them go.

#### **E. Effect of dietary supplementation in reducing hypertension**

Beilin (1994) suggested that complex vegetarian, low fat, high fiber diet had a blood pressure lowering effect and may help protect against the development of hypertension.

Cobiac et al., (1992) studied that supplementation of fish oil with dietary sodium restriction caused a significant reductions in blood pressure.

Buonopane et al., (1992) studies indicated that skim milk supplementation on serum cholesterol, blood pressure, and triglyceride had a positive correlation and there was response in blood pressure with skim milk.

Ascherio et al., (1992) found that dietary fiber, potassium and magnesium were each significantly associated with a lower risk of hypertension and calcium intake was significantly associated with a lower risk of hypertension only in men with low relative weights.

Janonkar and Ranganath (1988) studied that supplementation with calcium had showed a great decrease in blood pressure and serum ionized calcium increased systolic blood pressure significantly.

Siani et al., (1994) reported that administration of 48 mmol/day of potassium resulted in blood pressure reductions of 14 to 10.5 mm of Hg.

Widman et al., (1993) proposed that a supplement of 40 mmol/day of magnesium may be required to lower blood pressure, this is approximately  $2\frac{1}{2}$  times the recommended dietary allowance for magnesium.

Abraham and Aumadha (1988) found that blood pressure reduction due to the supplementation of calcium, potassium and cereal fibre in a low income group caused significant reduction in diastolic blood pressure and serum cholesterol.

Kesteloot (1992) revealed that dietary cations have a positive relationship with blood pressure on a molar basis one mmol of potassium is about 2.5 times more effective in lowering blood pressure than sodium is in raising it. Magnesium has a slight blood pressure lowering effect and calcium on blood pressure remains controversial.

Intersalt co-operative research group (1989) found that urinary excretion of sodium (0.2 mmol/24 hr) and potassium leads to a low blood pressure. But potassium excretion does not make any change in blood pressure.

Tanji et al., (1991) found that 552 mg calcium/day 1908 mg sodium/day, 910 mg phosphate per day, 176 mg potassium/day and 175 mg magnesium/day was supplemented, there was decrease in systolic blood pressure and diastolic blood pressure.

Levey et al., (1995) indicated that in the dietary management of hypertension it may be more important to focus on specific changes in decreasing sodium intake by 1000 mg/day and increasing calcium intake by 400 mg/day showed a decrease in blood pressure.

Seth and Chug (1988) study revealed that low sodium diet was prepared and supplemented to the hypertensives had highly acceptable and help to reduce the blood pressure. Diet does not added with salt.

Torelm and Becker (1989) study suggested that the decrease of salt intake to 1-2g daily caused a reduction in blood pressure to the considerable limit.

There is a epidemiologic evidence that lower dietary salt intake may result in lower blood pressure or a reduced risk of development of hypertension (Nutrition Reviews, 1994).

Grimm et al., (1990) study indicated that low sodium diet with potassium chloride salt added would reduced a blood pressure to significant level.

Rufolo (1995) opines that the effect of dietary sodium restriction by 50 MEq to 64 + 24 MEq weighed with a concomitant effect on others nutrients had a required reduction in blood pressure.

Grobbee and Hofman (1994) reviewed that reduction in salt intake in the various trials were generally in the area of 80 mmol (2g sodium, 5g NaCl) per day the decreases in blood pressure sure were modest. Reduced salt diet would decrease stroke incidence and ischemic heart disease.

# Methodology

### III METHODOLOGY

The experimental procedure pertaining to the study on "Impact of low sodium salt on hypertensives" is depicted under following heads :

- A. Selection of the venue
- B. Selection of the sample
- C. Formulation of tool and conduct of the study
- D. Assessment of the nutritional status
  - 1. Anthropometric measurements
  - 2. Measurement of blood pressure
  - 3. Food and nutrient intake of the subjects
  - 4. Lipid profile of the subjects
- E. Effect of supplementation of low sodium salt on hypertensives

#### **A. Selection of the venue**

The venue selected for the study was GEDEE WEILER (P) Ltd, a private concern producing machines and its spare parts situated at Podanur, 10 KM away from Coimbatore main city. Management authorities of the above mentioned company are willing to help for the study and also they are very much concern about the health of their workers. Adequate samples were available for the conduct of the study from the same concern and the subjects were willing to co-operate and participate in the study.

## **B. Selection of the sample**

Among the three hundred workers working in the concern one hundred subjects (92 men and 8 women) were selected at random for the study. They were in the age range between 35-65 years. All the subjects selected were doing 8 hours of their activity in the work spot. Out of this hundred subjects 22 subjects are doing sedentary activity (administration officers), 38 are doing moderate activity (working in fitting, scrapping, packing sections) and 40 subjects were doing heavy activities inside the workshop.

Subjects were grouped income wise according to the classification suggested by HUDCO (1994) that is low income group earning Rs.1,000-2,650 per month, middle income group earning Rs.2,651-4,450 per month and high income group earning Rs.4,451 and above per month.

Among the subjects selected one tenth that is ten subjects (7 men and 3 women) having elevated blood pressure were selected as a sub-sample for the supplementation study. Another group of 10 hypertensive subjects were selected as control group who did not used the low sodium salt in their diet.

## **C. Formulation of tool and conduct of the study**

An interview method of collecting data, there is a face to face contact with the persons from whom the information is to be obtained. The interviewer asks them

questions pertaining to the survey and collects the desired information (Gupta, 1994).

An interview schedule was prepared to collect the required information for the study. With the help of an interview schedule information regarding the age, sex, type of family, educational qualification, total family income per month, type of activity, dietary pattern and dietary practices such as consumption of prepared items, family history and exercise schedule were collected from all the subjects.

Risk factors related to hypertension was also recorded. Data regarding coffee/tea consumption, consumption of fats and sodium rich foods, smoking pattern, alcoholic habits and symptoms related to blood pressure, and type of treatment were also recorded from the subjects by using the schedule given in Appendix I.

#### **D. Assessment of nutritional status**

Following methods were adopted for the assessment of nutritional status of the selected subjects :

##### **1. Anthropometric measurements**

Height and weight measurements were recorded for all the hundred subjects and compared with the ICMR (1989) standards. BMI values were calculated using the height and weight measurements and the subjects were grouped according to their grades.

## 2. Measurement of blood pressure

Blood pressure was carefully measured for all the subjects by using the following procedure :

1. The subjects as well as the operator should be seated in a comfortable position, the subject should sit comfortable at a table with arm resting on the table at about the level of the heart.

2. The armband or cuff is placed on the upper arm, the strip of the cloth is wound smoothly but without much pressure around the armband and the end of it is tucked under.

3. The bell of the stethoscope is placed lightly over the bifurcation of the brachial into the radial and ulnar arteries.

4. The rubber bulb is pressed to push the air into the sleeve to raise the pressure in the bag. The pressure on the hand is increased and this is shown on the manometer.

5. By means of release valve, very gradually reduce the pressure.

6. At a certain point a sound is heard with each heart beat. This indicates that the blood pressure is capable of overcoming the outside pressure and that the blood being sent through the artery.

7. Now carefully increase the pressure again. Note the highest pressure at which the sound be heard. This is systolic pressure.

8. Next decrease the pressure gradually. The sound grows louder at a certain point and drops off quiet suddenly. Note the lowest pressure at which the sound can still be heard. This is the diastolic pressure.

As per the latest W.H.O criteria, any reading above 140/90 mm of Hg in adults is considered to be hypertension. provided it has been taken under basal conditions.

i. A person should not be under any undue stress, anxiety, anger, fear. Sometimes even the feeling that you are going to a doctor to have your blood pressure. Checked up may push the blood pressure up.

ii. It should be measured preferably in the morning with the patient resting and relaxed. If one has climbed upstairs, one should rest for sometime before getting one's blood pressure checked.

iii. At least three consistently high readings are a must before a patient is branded as having hypertension (Rewari, 1991).

Blood pressure was measured at different point in a day for all the subjects. It was measured the start of their work and in the middle of the work. Some procedure was repeated to evolve their blood pressure levels-(Plate I).

After measuring the blood pressure the subjects were categorised according to the classification given in Ghafoournissa and Krishnamurthy (1994) as given in Table I.

TABLE I  
BLOOD PRESSURE LEVELS ( mm of Hg)

Category	Systolic mm of Hg	Diastolic mm of Hg
Normal	< 140	< 90
Mild hypertension	140-160	90-105
Moderate hypertension	140-160	105-115
Severe hypertension	> 160	> 115

The 1988 Report of the Joint National Committee, USA on Detection, Evaluation and Treatment of High Blood Pressure.

A sub-sample of ten subjects were having elevated blood pressure was selected for supplementation. blood pressure was regularly measured every week for the supplementation group for a period of 12 weeks.

### 3. Food and nutritional intake of the subjects

In the food weighment method all the raw foods used for the preparation of the meals, the total cooked food, consumed by the individual at each meal, the food leftover, plate waste, all the snakes between the meals and the foods taken away from home were weighed accurately and recorded properly.

After the completion of food weighment survey, the raw equivalents were calculated to find the total

consumption of different foods on a given day, by each individual with the help of the food composition tables (Gopalan et al., 1995), each individual's nutrient intake was calculated for all the three days and average intake arrived at. The mean food and nutrient intake were compared with the Recommended Allowances suggested by the Indian Council of Medical Research (1989) to assess the adequacy of the diet.

Diet is a major link between the individual and environment. It varies between individuals and population groups. The role of diet in the occurrence of heart disease was studied by assessing the diet history of the subjects. A three day food weighing survey was conducted for ten sub samples. The average nutrient intake of these subjects were calculated. A record of their food consumption pattern was also maintained for three days and the mean nutrient and food intake were compared with the recommended dietary allowances.

#### **4. Lipid profile of the subjects**

Lipid profile was analysed for the supplementation group. Blood samples were collected from the subjects during their lunch break. The lipid profile was estimated before and after supplementation with the help of KITS available.

Estimation and analysis of the following lipid profile were done by using suitable methods.

1. Total cholesterol - Enzymatic method suggested by Bucolo et al., (1973) and Werner et al., (1981) - detailed procedure is given in Appendix II.

2. Triglycerides - Enzymatic method suggested by Allain et al., (1974) - detailed procedure is given in Appendix III.

3. High density lipoprotein cholesterol - Enzymatic method suggested by Bucolo et al., (1973) and Werner et al., (1981) detailed procedure given in Appendix IV.

4. Low density lipoprotein cholesterol and very low density lipoprotein cholesterol - These levels were calculated from the above lipid profile values. The formula used for calculation of low density lipoprotein and very low density lipoprotein is given in Appendix V.

#### **E. Effect of supplementation of low sodium salt on hypertensives**

Number of causes are related to the development of hypertension one of the major cause is increased intake of salt (NaCl) in the diet.

Blood pressure rises in response to excess sodium intake have been found to be significantly higher in healthy volunteers with a positive family history of hypertension (WHO Report, 1983).



PLATE I  
MEASUREMENT OF BLOOD PRESSURE



PLATE II  
LOW SODIUM SALT

The low sodium salt was introduced in the market by Dabul India Ltd. The price of the salt was high when compared the common salt. One gram of low sodium salt contains 196 mg of sodium whereas one gram of common salt (Sodium chloride) contains 400 mg of sodium.

Salt is the commonly used ingredient by everybody and it can be easily replaced by low sodium salt available in the market and also to avoid excess intake of sodium the low sodium salt was considered one of the best supplementation in reducing the blood pressure.

Replacement of common salt by a low sodium, high potassium salt could offer a non-pharmacological approach to lowering blood pressure with mild to moderate hypertension (Geleijnse et al., 1995).

Ten subjects (7 men and 3 women) were supplemented with low sodium salt. The amount of salt given was 5g per day contains 980 mg sodium. This was added in their regular meals by replacing the ordinary salt. This was supplemented by the investigator for a period of 90 days to study the effect of low sodium salt of hypertensives. This was distributed to the subjects every week as 5g packets (7 packets each) for a period of 12 weeks to study the effect of low sodium salt on hypertensives (Plate II).

## Results and Discussion

#### IV RESULTS AND DISCUSSION

This results and discussions pertaining to this study is depicted under the following headings :

- A. Background information of the selected subjects
  - 1. Age and sex
  - 2. Activity pattern
  - 3. educational qualification
  - 4. Income levels
  - 5. Family history of diseases
  - 6. Blood pressure levels
  - 7. Symptoms associated with blood pressure
  - 8. Type of treatment taken by the selected subjects
  
- B. Possible factors responsible for altering blood pressure
  - 1. Type of water and salt used for cooking
  - 2. Type and quantity of fats and oils used
  - 3. Consumption pattern of sodium rich foods
  - 4. Consumption pattern of prepared items
  - 5. Consumption of coffee/tea
  - 6. Smoking pattern
  - 7. Alcohol consumption pattern
  - 8. Mode of transport used by the subjects
  - 9. Emotional balance
  - 10. Exercise schedule followed by the subjects
  
- C. Nutritional assessment of the selected subjects
  - 1. Mean weight and height of the selected subjects
  - 2. BMI values of the selected subjects
  - 3. Mean food intake of the selected subjects
  - 4. Mean nutrient intake of the selected subjects

D. Effect of supplementation of low sodium salt on

1. Blood pressure
2. Lipid profile

### A. Background information of the selected subjects

#### 1. Age and sex

The age and sex of the subjects are presented in Table II.

TABLE II  
AGE AND SEX OF THE SUBJECTS

S.No.	Age (in years)	Sex			
		Male		Female	
		Number	Percent	Number	Percent
1.	35-44	31	33.7	4	50.0
2.	45-54	53	57.6	4	50.0
3.	55-65	8	8.7	nil	nil
	Total	92	100.0	8	100.0

Among the 100 subjects selected for the study 33.7 per cent of the males and 50 per cent of the females were in the age group of 35-44 years. While 57.6 per cent of the males and 50 per cent of the females were in the age group of 45-54 years. Eight point seven per cent of the males were in the age group of 55-65 years and no female members was present in this age group.

#### 2. Activity pattern

The activity pattern of the selected subjects are presented in Table III.

TABLE III  
ACTIVITY PATTERN OF THE SELECTED SUBJECTS

S. No.	Activity	Age (in years)						Total			
		35-44		45-54		55-65		Male	%	Fe- male	%
		Male	Female	Male	Female	Male	Female				
1.	Sedentary	10	2	9	1	nil	nil	19	20.7	3	37.5
2.	Moderate	8	2	16	2	10	nil	34	37.5	4	50.0
3.	Heavy	12	1	18	nil	9	nil	39	42.3	1	12.5
Total		30	5	43	3	19	nil	92	100	8	100

Among the 100 subjects 20.7 per cent males and 37.5 per cent females were doing sedentary activities. Thirty seven per cent males 50.0 per cent females were doing moderate activity. Heavy activities were done by 42.3 per cent males and 12.5 per cent females.

Regular physical activity is widely regarded as a protective factor against high blood pressure and cardiovascular diseases (WHO Report, 1991).

### 3. Educational qualification

The following Table IV depicts the educational qualification of the subjects.

TABLE IV  
EDUCATIONAL QUALIFICATION OF THE SELECTED SUBJECTS

S.No.	Educational levels	Male		Female	
		Number	Percent	Number	Percent
1.	Illiterate	nil	nil	8	100.0
2.	Upto high school level	46	50.0	nil	nil
3.	Upto college level	46	50.0	nil	nil
Total		92	100.0	8	100.0

Among the 100 subjects 100.0 per cent of the female subjects were illiterate. Among the male subjects 50.0 per cent had their education upto college level; 50.0 per cent of the males were educated only upto the high school level.

#### 4. Income levels

Table V shows the income levels of the selected subjects.

TABLE V  
INCOME LEVELS OF THE SELECTED SUBJECTS

S. No.	Income in rupees/month*	Number	Percent
1.	1000-2650 (Low income)	33	33.0
2.	2651-4450 (Middle income)	45	45.0
3.	4451 and above (High income)	22	22.0

\* HUDCO classification, 1994

Out of the 100 subjects 33.0 per cent had an income in the range of 1000-2650 and they belongs to low income according to HUDCO. Forty five per cent had an income range of 2651-4450 and they comes under the category of middle income and 22.0 per cent had an income above Rs.4451/- and they belongs to high income group.

#### 5. Family history of diseases

Table VI denotes the family history of the selected subjects.

TABLE VI  
FAMILY HISTORY OF DISEASES IN THE SELECTED SUBJECTS

S.No.	Type of disease	Father Mother		Total
		(in per cent)		
1.	Blood pressure	26.0	12.0	38.0
2.	Diabetes mellitus	8.0	10.0	18.0
3.	Cardiovascular diseases	2.0	nil	2.0
4.	Nil	nil	nil	nil
Total				42.0

Among the subjects selected 38.0 per cent had the family history of blood pressure, 18.0 per cent had a family history of diabetes mellitus and only 2.0 per cent had a family history of cardiovascular diseases 42.0 per cent had no family history of any other diseases. With regard to blood pressure maximum percentage was observed in the case of father's when compared to mothers.

Heredity plays most an important part in production of hypertension. When one of the parents has hypertension, 25 per cent of the children is likely to have it when both parents are hypertensive, 50-90 per cent of children may get hypertension (Rewari, 1991).

#### 6. Blood pressure levels of the subjects

Table VII gives the blood pressure levels of the subjects.

TABLE VII  
BLOOD PRESSURE LEVELS OF THE SUBJECTS

S. No.	Category	Systolic in mm of Hg	Diastolic* in mm of Hg	Male		Female	
				Number	Per- cent	Number	Per- cent
1.	Normal	<140	<90	25	27.2	nil	nil
2.	Mild hypertension	140-160	90-105	52	56.5	3	37.5
3.	Moderate hypertension	140-160	105-115	15	16.3	5	63.5
4.	Severe hypertension	>160	>115	nil	nil	nil	nil

\* The 1988 Report of the Joint National Committee USA on detection, evaluation and treatment of high blood pressure.

Among the 100 subjects 27.2 per cent males had normal blood pressure, 56.5 per cent of the males, and 37.5 per cent of the females had mild hypertension, 16.3 per cent of the males and 63.5 per cent of the females had moderate hypertension, and no subjects seems to have severe hypertension at the time of recording.

#### 7. Symptoms associated with blood pressure

Out of the 100 subjects 23.0 per cent expressed that they are getting head ache, 28.0 per cent felt that they become restlessness at times, 16.0 per cent having fatigue and they felt their inability to do the regular work. Three per cent having perspiration at times and 6.0 per cent having giddiness rarely as symptoms due to elevated blood pressure. Twenty four per cent of the subjects were normal without any symptoms related to elevated blood pressure.

### 8. Type of treatment taken by the selected subjects

Out of the 100 subjects only 10.0 per cent of males and 2.0 per cent females suffering from hypertension were undergoing allopathic treatment.

### B. Factors responsible for altering blood pressure

#### 1. Type of water and salt used by the selected subjects

Table VIII gives the type of water and salt used by the selected subjects.

TABLE VIII  
TYPE OF WATER AND SALT USED FOR COOKING

S.No.	Type	Number	Percent
1.	<u>Source of water</u>		
	a. Soft water	90	90.0
	b. Hard water	10	10.0
2.	<u>Type of salt</u>		
	a. Rock salt	41	41.0
	b. Iodised salt	59	59.0
	c. Low sodium salt	nil	nil

Out of the 100 subjects, 90.0 per cent used soft water and 10.0 per cent used hard water for cooking and drinking. Forty one per cent used rock salt and 59.0 used iodised salt for cooking none of them were using low sodium salt for cooking.

Out of the 100 subjects, 12.0 per cent were vegetarian 38.0 per cent were non vegetarians.

## 2. Type of fats and oils used by the subjects

Table IX shows the type of fats and oils used by the selected subjects.

TABLE IX  
TYPE OF FATS AND OILS USED BY THE SUBJECTS

S. No.	Type of oil*	Amount used/day		
		Below 10g	10-20g	20-30g
1.	Coconut oil	18.0	nil	nil
2.	Ground nut oil	15.0	35.0	3.0
3.	Refined oil	7.0	18.0	3.0
4.	Gingelly oil	7.0	10.0	1.0
5.	Sunflower oil	4.0	nil	nil

\* Multiple response

Groundnut oil and refined oil was frequently used in most of the families of the selected subjects. Groundnut oil was used by 53.0 per cent of the subjects they used 10-30 gm per day. Gingelly oil was used by 28.0 per cent of the subjects they used upto 20 gm per day and sunflower oil was used by only 4.0 per cent of the subjects they used upto 10 gm per day. Eighteen per cent of the subjects used 10-20 gm of refined oil, three per cent used 20 gms and seven per cent used less than 10 gms of the same oil. Since most of the subjects belongs to low income and middle income they did not used fats like butter, dalda, ghee and vanaspathi.

### 3. Consumption of sodium rich foods by the subjects

#### a. Consumption of green leafy vegetables

Table X gives the consumption of green leafy vegetables by the subjects.

TABLE X  
CONSUMPTION OF GREEN LEAFY VEGETABLES\*

S. Green leafy No. vegetables	Number	Percent	Daily		Weekly	
			25g	50g	25g	50g
1. Amaranthus	90	90	15.0	7.0	37.0	31.0
2. Paruppu keerai	78	78	20.0	15.0	23.0	20.0
3. Fenugreek leaves	24	24.0	9.0	nil	9.0	6.0
4. Coriander leaves	20	20.0	4.0	nil	16.0	nil

\* Multiple response

Out of the 100 subjects most of them are consuming green leafy vegetables. Totally 90.0 per cent consumed amaranthus, out of this 37.0 per cent consumed 25g/week, 31.0 per cent consumed 50gm/week and 15.0 per cent consumed 25gm daily, 7.0 per cent consumed 50gm of amaranth. Paruppu keerai was consumed by 78 per cent of the subjects among them 23.0 per cent, 20.0 per cent consumed 25g and 50gm respectively per week while 20.0 per cent and 15 per cent of the subjects consumed daily and the quantity consumed was 25gm and 50gm respectively. Twenty four per cent consumed fenugreek leaves and only 20 per cent consumed coriander leaves among the selected subjects.

### 3.b Consumption of roots and tubers other vegetables and fruits

S. Roots and tubers, other No. vegetables fruits*	Number	Percent	50 gm                      100 gm			
			(in percent)			
			Daily	Weekly	Daily	Weekly
1. Carrot	95	95.0	20.0	71.0	nil	4.0
2. Beet-root	76	76.0	13.0	53.0	nil	10.0
3. Cauliflower	10	10.0	nil	nil	nil	10.0
4. Banana	76	76.0	34.0	nil	42.0	nil

\* Multiple response

Out of the 100 subjects 95.0 per cent consumed carrot, among them 71.0 per cent consumed 50 gm weekly and 20.0 per cent consumed 50 gm daily. Seventy six per cent consumed beet-root, out of this 53.0 per cent consumed 50 gm weekly and 13.0 per cent consumed daily and 10.0 per cent 10 gm weekly. Only 10.0 per cent consumed cauliflower 100 gm weekly. Seventy six per cent consumed banana, out of this 34.0 per cent consumed 50gm daily and 42.0 per cent consumed 100 gm daily.

### 3.c. Consumption of non-vegetarian items

S. Non-vegetarian No. items*	Number	Percent	100 gm                      200 gm			
			(in per cent)			
			Weekly	Monthly	Weekly	Monthly
1. Meat	53	53.0	35.0	14.0	nil	4.0
2. Mutton muscle	3	3.0	3.0	nil	nil	nil
3. Chicken	70	70.0	50.0	10.0	nil	10.0
4. Goat's liver	20	20.0	nil	20.0	nil	nil
4. Fish	36	36.0	4.0	20.0	nil	12.0

\* Multiple response

Out of the 100 selected subjects 53.0 per cent consumed meat, among them 35.0 per cent consumed 100g weekly and 14.0 per cent consumed mutton muscle weekly 100gm. Chicken was consumed by 70 per cent of the subject out of them 50.0 per cent consumed 100gm weekly, 10.0 per cent consumed monthly 100gm and 200 gm. Among the selected subjects 20.0 per cent consumed goats liver and they consumed only hundred grams monthly. Fish was consumed by 36 per cent out of them 20.0 per cent consumed monthly only 100 gm in a month.

#### 4. Consumption of prepared foods

Table XI depicts the frequency of consumption of prepared foods by the selected subjects.

TABLE XI  
CONSUMPTION OF PREPARED FOODS

S. No.	Prepared foods	50gm			100gm		
		Daily	Weekly	Monthly	Daily	Weekly	Monthly
1.	Baked foods	nil	70.0	54.0	nil	20.0	70.0
2.	Fried foods	10.0	nil	78.0	nil	30.0	28.0
3.	Pickles	nil	nil	40.0	nil	nil	nil
4.	Fatty foods	nil	20.0	10.0	nil	nil	40.0

Among the 100 subjects 50g of the baked foods was consumed by 70.0 per cent in a week and 54.0 per cent consumed in a month while 100g was consumed by 20.0 per cent of subjects per week and 70.0 per cent per month with regard to the fried foods 78.0 per cent consumed 50g monthly and only 10.0 per cent consumed daily, whereas 100g of fried foods was consumed by 30.0 per cent and 28.0 per cent of the subjects per week and per month respectively.

Among the subjects pickles was consumed by 40.0 per cent of the subjects monthly and the remaining did not consume pickle at all. With regard to the fatty food consumption 50g was consumed by 20.0 per cent per week, whereas 10.0 per cent per month. Only 40.0 per cent of the subjects used 100g of fatty foods per month. Processed foods and prepared foods contains relatively highlevel of sodium. This may result in increased blood pressure (Mehra and Lashkari, 1990).

#### 5. Tea/coffee consumption pattern of the selected subjects

Table XII highlights the consumption of tea/coffee by the selcted subjects.

TABLE XII  
TEA/COFFEE CONSUMPTION PATTERN

S.No.	Pattern	2 Cups	3-5 cups	Above 5 cups
1.	Tea	37.0	16.0	43.0
2.	Coffee	10.0	7.0	nil

Out of the 100 subjects 37.0 per cent had 2 cups of tea per day 16.0 per cent had 3.5 cups of tea per day 43.0 per cent consumed more than 5 cups of tea per day. Two cups of coffee was consumed daily by 10 per cent of the subjects. Seven per cent consumed 3-5 cups of coffee for a day and nobody consumed more than 5 cups of coffee in a day. Caffeine present in coffee raises blood pressure of normal an average of 14/10 points.

## 6. Smoking pattern of the selected subjects

Table XIII indicates the smoking pattern of the selected subjects.

TABLE XIII  
SMOKING PATTERN OF THE SELECTED SUBJECTS

S.No.	Smoking pattern	Number	Percent
a.	Yes	28	30.4
	No	64	69.6
b.	<u>Type</u>		
	Beedi	6	21.4
	Cigarette	22	78.6
c.	<u>Number per day</u>		
	1- 5	8	28.6
	6-10	17	60.7
	11-15	3	10.7

Out of the 100 subjects, 92.0 per cent were males out of them 30.4 per cent had the habit of smoking and 69.6 per cent did not smoke with regard to the smoking material 21.4 per cent used beedi and 78.6 per cent used cigarette for smoking.

From the above table it was clear that 1-5 number was used by 28.6 per cent 6-10 numbers was used by 60.7 per cent and 11-15 numbers was smoked by 10.7 per cent. None of the women have the habit of smoking.

Systolic and diastolic blood pressure of smokers was higher when compared with non smokers. One cigarette

raises blood pressure by 10-20 mm of Hg and this increase lasts for  $\frac{1}{2}$ -1 hours (Dewan and Rowlands, 1986).

### 7. Alcohol consumption pattern

Table XIV shows the alcohol consumption pattern of the selected subjects.

TABLE XIV  
ALCOHOL CONSUMPTION PATTERN OF THE SUBJECTS

S. No.	Alcohol	Number	Percent	250-500ml		Above 500ml	
				Weekly	Monthly	Weekly	Monthly
a.	Yes	20	21.7				
	No	72	78.3				
b.	<u>Type</u>						
	Whisky	6	30.0	15.0	15.0	nil	nil
	Brandy	4	20.0	nil	20.0	nil	nil
	Beer	10	50.0	nil	nil	nil	50.0

Out of the 92 males 21.7 per cent of the subjects are having the habit of consuming alcohol among the 20 subjects 15.0 per cent consumed whisky that is 250-500 ml weekly and 15.0 per cent consumed whisky 250-500 ml once in a month. Only 20.0 per cent consumed brandy of 250-500 ml monthly and 50.0 per cent consumed 500 ml of beer once in a month.

Alcohol consumption increases the blood pressure there by influence of risk of coronary heart diseases. Systolic pressure is more affected than diastolic blood pressure and the effect begins at about four drinks a day (Muralikrishna, 1996).

### 8. Mode of transport used by the subjects

Out of the 100 subjects 24.0 per cent reacting the workspot regularly by walking, 30.0 per cent using bicycle, 26.0 per cent with the help of the scooter, 19.0 per cent of subjects by bus and only 1.0 per cent by car.

### 9. Emotional balance of the subjects

Table XV gives the emotional balance of the selected subjects.

TABLE XV  
EMOTIONAL BALANCE OF THE SELECTED SUBJECTS

S.No.	Emotional balance	Number	Percent
a.	Yes	30	30.0
	No	70	70.0
b.	Always	2	6.7
	At times	15	50.0
	Rarely	13	43.3

Out of the 100 hypertensives, 30.0 per cent gets easily tensed, out of them 6.7 per cent were always tensed, 50.0 per cent 6.7 were always tensed, 50.0 per cent were always tensed, 50.0 per cent were tensed at times, 43.3 per cent get tension rarely and 70.0 per cent were maintaining their emotions in a balanced way. 71.0 per cent of the subjects felt that there is no connection between blood pressure and mental tension.

Out of the 100 subjects selected 87 per cent expressed that they are taking adequate rest and sleep

comfortable and only 13 per cent said that they are not satisfied with their duration of rest/sleep, however they revealed that it may be due to financial problem/family problem that is present in their families.

#### 10. Exercise schedule followed by the selected subjects

Table XVI presents the exercise schedule followed by the selected subjects.

TABLE XVI  
EXERCISE SCHEDULE

S. Exercise No. programme	Number	Percent	Duration per day	
			$\frac{1}{2}$ hour (in percent)	$\frac{1}{2}$ -1 hour (in percent)
a. Yes	37	37.0	-	-
No	63	63.0	-	-
b. <u>Type</u>				
Yoga	6		16.2	nil
Meditation	2		5.4	nil
Walking	29		40.5	37.8
Swimming	nil		nil	nil
Jogging	nil		nil	nil
c. <u>Reasons</u>				
Good for health	26	70.3	nil	nil
Free from tension	11	29.7	nil	nil

Out of the 100 subjects, 37.0 per cent were regularly following an exercise schedule. Out of this 16.2 per cent were doing yoga for half an hour daily 5.4 per cent were doing meditation for half an hour. Regular walking was also followed 40.0 per cent and 37.8 per cent for  $\frac{1}{2}$  an hour and  $\frac{1}{2}$ -1 hour respectively. Those who are doing regular

exercise gave the reason that it is helping them to get relief from tension and also it is good for health.

### C. Nutritional assessment of the selected subjects

#### 1. Mean weight and height of the selected subjects

Table XVII depicts the weight and height pattern of the selected subjects.

TABLE XVII  
MEAN WEIGHT AND HEIGHT OF THE SELECTED SUBJECTS

S. No.	Sex	Mean weight (in kg)	Reference weight (ICMR, 1988)	Mean height (in cm)	Reference height (ICMR)
1.	Male	64.0	60	165.5	171
2.	Female	52.0	50	153.5	156

Out of the 100 subjects the mean weight of the male was found to be 64.0 kg and females was 52.0 kg. The mean height of the males was 165.5 cm and females was 153.5cm. With regard to the weight both males and female were having excess weight when compared to the reference weight 60 kg and 50 kg for men and women respectively. The mean height of the male and female were lower when compared to the reference height namely 171 cm for male and 156 cm for female.

#### 2. BMI values of the selected subjects

Table XVIII shows the BMI values of the selected subjects which was calculated using height and weight measurement of the selected subjects using the formula

$$\text{BMI} = \frac{\text{Weight in kg}}{\text{Height in m}^2}$$

TABLE XVIII  
BMI VALUES OF THE SUBJECTS

S. No.	Garrow BMI classification (kg/m <sup>2</sup> )	Obesity grade	Male		Female	
			Number	Percent	Number	Percent
1.	17-20	Below normal	17	18.5	1	12.5
2.	20-25	Normal	64	69.6	6	75.0
3.	25-30	Obesity grade I	11	11.9	1	12.5
4.	> -30	Obesity grade II	nil	nil	nil	nil
Total			92	100.0	8	100.0

According to Garrow's BMI classification (1981) the values ranging from 17-20 kg/m<sup>2</sup> is below normal, 20-25 kg/m<sup>2</sup> is normal, 25-30 kg/mg<sup>2</sup> is obesity grade I and 30 kg/m<sup>2</sup> is obesity grade II.

Out of the 100 subjects, 11.9 per cent males 12.5 per cent females belonged to obesity grade I, 69.6 per cent males, 75.0 per cent females having the normal BMI range and 18.5 per cent males and 12.5 per cent females belonged to below normal BMI range. Individual values for height, weight and BMI are given in Appendix VI.

Solanki and Desai (1988) study found that BMI > 21.0 was caused prevalence of definite hypertension and also significant increase in diastolic blood pressure.

### 3. Mean food intake of the selected subjects

Table XIX shows the mean food intake of the selected subjects.

TABLE XIX  
MEAN FOOD INTAKE OF THE SELECTED SUBJECTS

S.No.	Foods (in gms)	RDA ICMR 1984 for moderate activity		Actual intake		Percent excess/deficit	
		Male	Female	Male	Female	Male	Female
1.	Cereals	520	440	450	350	- 13.5	- 20.5
2.	Pulses	50	45	96.4	58.3	+ 92.8	+ 30
3.	Green leafy vegetables	40	100	10	nil	- 75.0	- 100.0
4.	Roots and tubers	60	50	100	41.7	+ 67.0	- 16.6
5.	Other vegetables	70	40	71.4	66.7	+ 2.0	+ 67.0
6.	Fruits	30	30	7.14	16.7	- 76.2	- 44.7
7.	Fats and oils	45	25	62.9	36.7	+ 40.0	+ 47.0
8.	Milk and milk products	200	150	100	66.7	- 50.0	- 55.5

From Table XIX it is clear that the mean intake of cereals by male and female subjects were deficit by 13.5 per cent and 20.5 per cent respectively. Pulse intake was excess by 92.8 per cent and 30 per cent by male and female subjects. Green leafy vegetables intake of male and female was deficit by 75 per cent and 100.0 per cent respectively. Intake of roots and tubers of males was 67.0 per cent excess and female was 16.6 per cent deficit when compared with dietary allowance. Other vegetables intake was excess by 2.0 per cent in male and 67.0 per cent in female respectively. Fruits consumption was deficit by 76.2 per cent and 44.7 per cent in male and female subjects respectively. Fats and oils was excess by 40.0 per cent and 47.0 per cent respectively in male and female subjects. Milk and milk products consumption was deficit by 50.0 per cent and 55.5 per cent of the the diet of the male and female subjects.

From this the subjects were consuming excess amount of pulses, Roots and tubers, and fats and oils. So their fat consumption was higher when compared with recommended dietary allowances.

#### **4. Mean nutrient intake of the selected subjects**

Table XX gives the mean nutrient intake of the selected subjects.

TABLE XX  
MEAN NUTRIENT INTAKE OF THE SELECTED SUBJECTS

S. No.	Nutrient	RDA ICMR 1989 for moderate activity		Actual intake		Percent excess/deficit	
		Male	Female	Male	Female	Male	Female
1.	Energy (Kcal)	2875	2225	2285	1813	- 20.5	- 19.5
2.	Protein (g)	60	50	57	47	- 5.0	- 6.0
3.	Fat (g)	20	20	51	36	+ 55.0	+ 80
4.	Calcium (mg)	400	400	379	299	- 5.5	- 25.3
5.	Iron (mg)	28	30	11.68	6.7	- 58.3	- 77.7
6.	Sodium (mg)			63	48		
7.	Vitamin A ( $\mu$ g)	600	600	277	158	- 53.8	- 73.7
8.	Thiamine (mg)	1.4	1.1	1.543	1.287	+ 10.2	+ 17.0
9.	Riboflavin (mg)	1.6	1.3	0.707	0.651	- 55.8	- 50.0
10.	Niacin (mg)	18	14	19.34	16.23	+ 7.4	+ 16.7
11.	Ascorbic acid (mg)	40	40	83	51	+ 100.0	+ 27.5

From Table XX it is clear that the mean energy intake of male and female was 20.5 per cent and 19.5 per cent deficit when compared to recommended allowance of ICMR (1989). Protein intake was deficit by 5.0 per cent and 6.0 per cent in male and female respectively. Fat intake was excess by 55.0 per cent and 80 per cent in male and female respectively. Intake of calcium was 5.5 per cent and 25.3 per cent deficit in male and female subjects when compared with recommended allowance. Iron intake was deficit when compared with recommended allowance in male and female by 58.3 per cent and 77.7 per cent respectively. Intake of vitamin A was deficit than normal allowance in male and female subjects 53.8 per cent and 73.7 per cent respectively. Thiamine intake was excess by 10.2 per cent and 17.0 in male and female respectively. Intake of riboflavin was deficit by 55.8 per cent and 50.0 per cent in male and female subjects. Niacin intake of male was 7.4 per cent in female and 16.7 per cent was excess. Ascorbic acid intake of male was 100.0 and of female was 27.5 per cent excess than recommended dietary allowance given ICMR (1989).

#### **D. Effect of supplementation of low sodium salt on**

##### **1. Blood pressure level of the subjects**

Table XXI gives blood pressure level of the subject before and after supplementation (Figure I).

TABLE XXI  
BLOOD PRESSURE LEVEL OF THE SUBJECTS BEFORE AND AFTER  
SUPPLEMENTATION

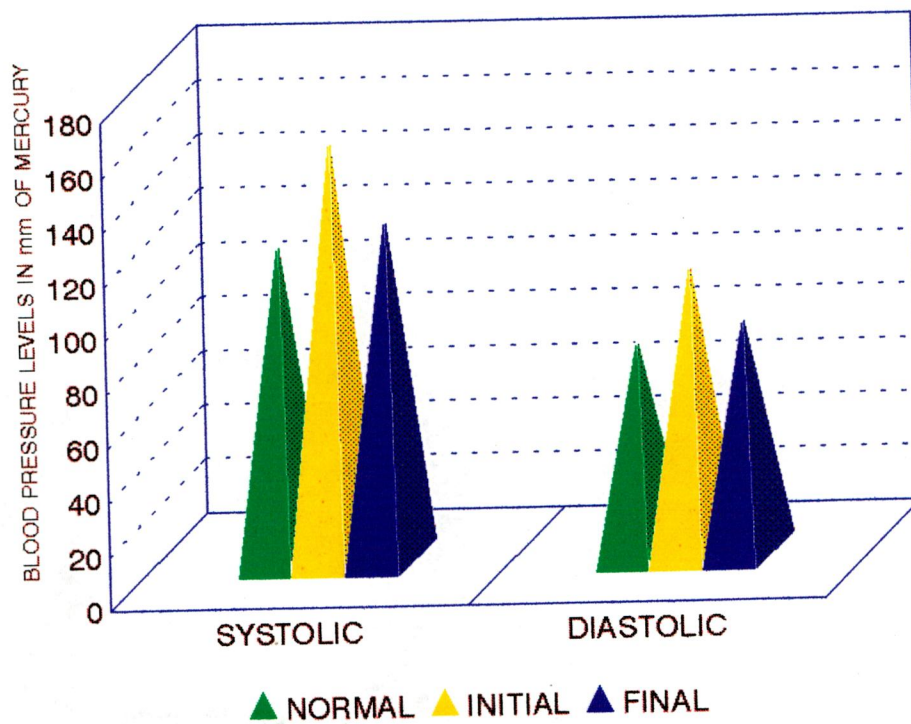
S. No.	Blood pressure	(Mean $\pm$ S.D)		Differ- ence	't' value
		Initial	Final		
<u>1. Systolic</u>					
	Supplemented group	159.4 $\pm$ 1.35	129.0 $\pm$ 1.05	30.4	25.12**
	Non supplemented group	153.0 $\pm$ 2.36	152.4 $\pm$ 2.83	0.6	0.23NS
<u>2. Diastolic</u>					
	Supplemented group	109.0 $\pm$ 1.7	83.4 $\pm$ 1.26	20.6	13.73**
	Non supplemented group	103.2 $\pm$ 2.15	102.7 $\pm$ 2.45	0.5	0.22NS

\*\* (P < 0.01)

NS Not significant

The mean systolic blood pressure of the subjects was 159.4 mm of Hg and it had reduced to 129.0 mm of Hg after supplementation of low sodium salt for a period of twelve weeks. When the difference was statistically analysed these two values showed significant differences at 1 per cent level (P < 0.01).

The mean diastolic blood pressure of the subjects was 109.0 mm of Hg and at the base of the study and it had reduced to 88.4 mm of Hg after the study period of 90 days due to the supplementation of low sodium salt. When the difference was statistically analysed these two values showed significant difference at 1 per cent level (P < 0.01).



**FIGURE 1. SUPPLEMENTATION OF LOW SODIUM SALT**

There was no significant change in the systolic and diastolic bloodpressure of the control group who were not supplemented with low sodium salt.

From the above table it is concluded that the low sodium salt is highly effective in lowering the blood pressure. Eventhough the salt is so costly when compared to the ordinary salt for people suffering from hypertension it is so useful. For hypertensives in reducing the blood pressure as well as to avoid further complications like cardiovascular disorders and stroke it is better to use this salt regularly in their diet till they attain the normal blood pressure.

Levey et al, (1995) study results suggest that in the dietary management of hypertensionit may be more important to focus onspecific changes in a person's diet decreasing sodium intake by 1000 mg/day and increasing calcium intake by 400 mg/day to be consumed.

## **2. Lipid profile of the subjects**

Table XXII gives lipid profile of the subjects before and after the supplementation.

TABLE XXII  
LIPID PROFILE OF THE SUBJECTS BEFORE AND AFTER  
SUPPLEMENTATION

S. No.	Lipids mg/dl	Desirable level NCEP (1988)*	Mean±S.D.		't' value
			Before	After	
1.	Total cholesterol	<200	191±41.29	183.6±38.04	0.19NS
2.	HDL cholesterol	> 50	31.8±8.32	30.6±8.85	0.14NS
3.	LDL cholesterol	<130	123.2±43.86	118.2±44.23	0.11NS
4.	VLDL cholesterol	< 30	35.8±15.97	33.4±16.3	0.15NS
5.	Triglycerides	<150	179±79.87	166.8±81.5	0.15NS

\* NCEP -National Cholesterol Education Programme

NS = Not significant

From the above table XXII it is clear that the total cholesterol level of the subjects before the supplementation was 191.0 mg/dl and it was reduced slight the estimated value after the study period was 183.0 mg/dl. The difference between these two values were not significant when statistically analysed.

The mean HDL-cholesterol of the hypertensive was 31.8 mg/dl at the basis of the study and it was reduced to 30.6 mg/dl. Which was much at border line risk level. The different was found to be not significant statistically.

The mean LDL-cholesterol level of the subject was 123.2 mg/dl before the start of the study and it was reduced to 118.2 mg/dl after the study period but the difference was not significant statistically.

The mean VLDL-cholesterol level was 35.8 mg/dl initially and it was reduced to 33.4 mg/dl finally after 90 days. The mean difference was analysed statistically and found that it was not significant.

With regard to the mean triglyceride level at the base of the study was 179 mg/dl and it was reduced to 166.8 mg/dl after the study period of 90 days. The difference was found to be not significant statistically.

From the above table it is concluded that supplementation of low sodium salt is not effective in altering the lipid profile of the subjects.

## Summary and Conclusion

## V SUMMARY AND CONCLUSION

The present study entitled, "Impact of low sodium salt on hypertensives" has the main objective to study the effects of low sodium salt on hypertension.

Hundred subjects (92 males and 8 females) in the age range of 35-65 years were selected for the study. Basic information regarding socio-economic status, educational status, type of treatment undertaken, dietary habits, smoking and alcoholic habits were obtained from the subjects. Then a sub sample of 10 subjects having elevated blood pressure were selected for supplementation with low sodium salt.

The information regarding blood pressure of the subjects revealed that 56.5 per cent of males have mild hypertension, 63.5 per cent of females have moderate hypertension.

The main observations obtained from the study with regard to the factors altering the blood pressure and effect of low sodium salt on hypertensives are summarised as follows :

1. The majority of the subjects were doing heavy activity inside the workspot.
2. With regard to the type of water and salt used for cooking, 90.0 per cent of the subjects used soft water and 59.0 per cent used iodised salt for cooking.

3. With regard to the type of fats and oils used majority of the subjects were found to be using groundnut oil and refined oil, but the quantity used was below 50g/day.
4. Regarding the consumption of sodium rich foods. Many of them used green leafy vegetables, like amaranthus, paruppu keerai, and fenugreek leaves, and also used roots and tubers like carrot, and beet root daily. Most of them consumed banana daily. Non vegetarian items consumed by majority (38 per cent) of them was 100g per week regularly.
5. Noting the habit of smoking and alcohol consumption, it is heartening to see that the habit of smoking among the subjects was only 30.4 per cent and also alcohol consumption was found only in 21.7 per cent of the subjects.
6. Regarding the weight of the subjects the mean weight of males was 64.0kg and that of females was 52.0kg, which shows their body weights are more by 4 kg and 2 kg respectively when compared with the recommended weight of ICMR (1989). So it clearly reveals that the subjects selected for the study was heavier.
7. With regard to the BMI values of the selected subject, 69.6 per cent of the males and 75.0 per cent of the females were having normal BMI values whereas 13.5 per cent of the males and 12.5 percent

of the females were having their BMI values below the normal level. Only 11.9 per cent of the males and 12.5 per cent of the females were belongs to Grade I obesity.

8. Supplementation with low sodium salt for the hypertensive subjects was found to be very effective. The present study revealed that a marked decrease in systolic blood pressure and diastolic blood pressure level was noticed because of the supplementation. Thus it can be concluded that low sodium salt has a role in lowering the blood pressure.
9. The present study revealed that there is no possibility to either reduce the triglyceride, total cholesterol/other cholesterol levels or increasing the HDL-cholesterol level due to the supplementation of low sodium salt. This concludes that lowering the sodium does not help in changing the blood profile.

### **Conclusion**

Every adult should have blood pressure level estimated at least once in fifteen days and cholesterol level estimated at least once in a year. Individuals with high level of blood pressure and cholesterol should take adequate dietary as well as other life-style precautions and get their blood pressure and cholesterol levels closely monitored at more frequent intervals.

Urban life style patterns like smoking and sedentary habits and increased intake of fast foods (containing higher amounts of saturated fats and salt) all contribute to elevated blood pressure and blood cholesterol levels and obesity. As a result, urban population generally have higher cholesterol levels and higher prevalence of coronary heart disease, diabetes and hypertension than rural population.

By undertaking regular exercise, keeping the body weight within normal units, and restricting the dietary salt, cholesterol and fats particularly saturated fats, one can keep the blood pressure and blood cholesterol within normal limits and prevent heart disease.

#### **Suggestion and Recommendation**

Hypertension is a disease that has no symptoms but is easily detectable and treatable. If left untreated, it could create several complications later and is likely to reduce the victim's life span by 10 to 20 years.

1. Regular blood pressure check-up once or twice a month is absolutely necessary.
2. Decrease in salt intake is perhaps the single largest factor in the treatment of hypertension.
3. A caloric check is essential so much so that in obese persons this alone may reduce blood pressure significantly.
4. Avoid smoking and alcohol.
5. Avoid stress and strain and make the mind and body free from tension.
6. Ordinary salt can be replaced by low sodium salt in order to reduce blood pressure.

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# Appendices

APPENDIX I

AN INTERVIEW SCHEDULE FOR THE HYPERTENSIVES

1. Name of the Interviewee :
2. Address :
  
3. Name of the interviewer : R. SRIVIDYA
4. Age :  
Height:                      cm                      Weight :                      Kg
5. Sex :                      Male                      Female
6. Type of the family :                      Joint                      Nuclear
7. Educational qualification :
  
8. Occupation :  
Monthly Income :                      Rs.
9. Total family income per month :                      Rs.
10. Amount of money spent on food :                      Rs.
11. Whether vegetarian or Nonvegetarian :
  
12. Source of water  
a. Soft water,                      b. Hard water                      c. Any others

13. Consumption of sodium rich foods

Foods	Quantity	Frequency
Green leafy vegetables		
1. Amaranthus		
2. Paruppu-keerai		
3. Fenugreek leaves		
4. Coriander leaves		
Roots and tubers		
1. Radish		
2. Carrot		
3. Beetroot		
Other vegetables		
1. Knol-khol		
2. Lotus stem (dry)		
3. Cauliflower		
Fruits		
1. Melon (musk)		
2. Banana		
Meat, fish, chicken, liver goat, mutton muscle		

14. Type of salt used for cooking

- a. Rock salt
- b. Iodised salt
- c. Low sodium salt

15. Consumption of fried items :

Fried items	Quantity	Frequency
1.		
2.		
3.		
4.		
5.		
6.		
7.		

16. types of fats and oils used for cooking

Type	Quantity	Frequency
Butter		
Dalda		
Vanaspathi		
Ghee		
Coconut oil		
Groundnut oil		
Gingelly oil		
Sunflower oil		
Refined oil		
Mustard oil		
Harvest oil		
Any others		

17. Consumption of prepared items

Items	Quantity	Frequency
(Baked items)		
Cake		
Biscuits		
Chips		
Pickles		
Papad		
Vathal		
Vadagam		
Noodles		
Macroni		
Ready to eat mixer		

18. Do you prefer to consume home made preparation

Yes

No

If yes, Reasons

19. Family History :      Father                  Mother                  Others

- a. Blood pressure
- b. Diabetes Mellitus
- c. Cardio Vascular disorders
- d. Liver disease
- e. Kidney disease

20. Personal History :

Symptoms of elevated Blood pressure	Before the onset	At present
a. Head ache		
b. Tension		
c. Fatigue		
d. Perspiration		
e. Kiddiness		
f. Any others		

21. Is there any connection between elevated blood pressure and mental tension

Yes No

If yes, Reasons

If No, Reasons

22. Do you have adequate rest/sleep regularly

Yes No

If no, reasons

23. How will you reach your work spot

- a. Walking
- b. By scooter
- c. By bus
- d. By train
- e. By auto

24. Do you undergo any treatment

Yes

No

If yes,

Type of treatment	Type of medicine	Duration
a. Allopathic		
b. Ayurvedic		
c. Naturopathic		
d. Homeopathic		
e. Dietary treatment		
f. Any other		

25. Dietary modification

Special foods included at present	Quantity	Frequency
--------------------------------------	----------	-----------

Special foods avoided	Quantity	Frequency
-----------------------	----------	-----------

26. Do you know about the low sodium salt available in the market

Yes

No

If yes,

- a. Have you purchased the salt
- b. What is your opinion about the price of the salt

27. Smoking pattern

a. Do you smoke :                      Yes                      No

b. Type of smoking material

- Beedi
- Cigarettes
- Others

c. Number smoked per day

28. Alcoholism :

a. Do you take alcoholic drinks ?

Yes

No

If yes,

Type	Quantity	Frequency
------	----------	-----------

- a. Arrack
- b. Toddy
- c. Whisky
- d. Brandy
- e. Others

b. Reasons for using :

- a. For company sake
- b. Personal habit
- c. Like the taste
- d. To avoid stress and tension
- e. Good for health
- f. Any others

29. Coffee/Tea consumption

---

	Quantity	Frequency
Tea		
Coffee		
Type of coffee used		
a. Filter		
b. Instant		

---

30. Emotional balance

Do you get easily tensed/worried                      Yes                      No

If yes,

- a. always
- b. at times
- c. rarely
- d. not at all

31. Exercise programme

Are you undergoing any exercise programme

Yes                      No

If yes,

---

Types	Duration per day
a. Yoga	
b. Jogging	
c. Swimming	
d. Meditation	
e. Walking	
f. Others	

---

Reasons :

- 1.
- 2.
- 3.

If no, reasons—

- 1.
- 2.
- 3.

32. Mention the level of following :

a. Blood pressure -

b. Cholesterol -

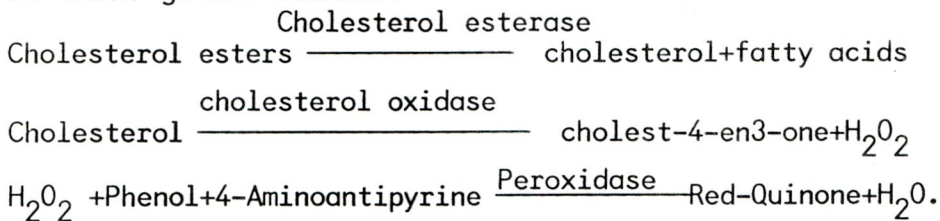
c. Triglycerides -

## APPENDIX II

### QUANTITATIVE ESTIMATION OF SERUM CHOLESTEROL

#### PRINCIPLE

Cholesterol esters are hydrolysed by cholesterol esterase to free cholesterol and fatty acids. Free and liberated cholesterols are oxidised by cholesterol oxidase to cholest-4-en-3-one and hydrogen peroxide is liberated. The hydrogen peroxide produced, couples with 4-amino antipyrine and phenol in the presence of peroxidase to form a coloured compound. The intensity of the colour developed is proportional to cholesterol concentration and is measured photometrically at 500nm wavelength (490-550nm) or with green filter.



Reagents (Supplied in the kit).

Reagent 1 : Buffer : Phenol

Reagent 2 : Enzymes

- a. Cholesterol esterase
- b. Cholesterol oxidase
- c. Peroxidase
- d. 4-Amino antipyrine
- e. Sodium cholate

Reagent 3 : Standard (Cholesterol mg/dl)

### Preparation of working solution

Dissolve contents of one bottle of reagent 2 with contents of one bottle of reagent 1. Mix well and store at 2° - 8°C. This is the chromogen reagent.

### Storage and stability

The reagents are stable till the expiry date indicated on the labels when stored at 2 - 8°C. The chromogen reagent is stable for four weeks at 2 - 8°C when stored in amber coloured vial.

### Procedure

#### A. For automated instruments requiring 1.0 ml volume

---

Pipette into test tubes

	Bank (B)	Standard (S)	Test (T)
Chromogen			
Reagent	1.0 ml	1.0 ml	1.0 ml
Standard	-	0.01 ml	-
Sample	-	-	0.01 ml

---

Mix and incubate at 37°C for 10 minutes or at R.T. (25-30°C) for 20 minutes. Read absorbance of test (AT) and standard (AS) against the reagent (B) at 500 nm wavelength (490-550nm) or with green filter.

**B. For calorimeters requiring 3.0 ml volume**

---

Pipette into test tubes	Blank (B)	Standard (S)	Test (T)
Chromogen			
Reagent	1.0 ml	1.0 ml	1.0 ml
Standard	-	0.02 ml	-
Sample	-	-	0.02 ml

---

Mix and incubate at 37°C for 10 minutes or at R.T. (25-30°C) for 20 minutes.

---

Distilled water	2.0 ml	2.0 ml	2.0 ml
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---

Mix and read absorbance of test (AT) and standard (AS) against the reagent (B) at 550 nm wavelength (499-550nm) or with green filter.

**C. For calorimeters requiring 5.0 ml volume**

For use in this procedure, dilute 0.1 ml of sample and standard by adding 0.4 ml of distilled water or normal saline, mix.

---

Pipette into test tubes	Blank (B)	Standard (S)	Test (T)
Chromogen			
Reagent diluted	1.0 ml	1.0 ml	1.0 ml
Standard diluted	-	0.02 ml	-
Sample	-	-	0.02 ml

---

Mix and incubate at 37°C for 10 minutes or at R.T. (25-30°C) for 20 minutes.

---

Distilled water	4.0 ml	4.0 ml	4.0 ml
-----------------	--------	--------	--------

---

Mix and read absorbance of test (AT) and standard (AS) against the reagent (B) at 500nm wavelength (490-550nm) or with green filter.

The colour developed is stable for one hour at room temperature, if protected from direct light.

**Calculation**

$$\text{Cholesterol concentration (mg/dl)} = \frac{\text{AT}}{\text{AS}} \times 200$$

### APPENDIX III

#### QUANTITATIVE ESTIMATION OF HDL-CHOLESTEROL

Reagents : ( Supplied in the kit)

Precipitating reagent (1.4 mmol/l phosphotungstic acid, 8.6 mmol/l magnesium chloride), 250 ml.

#### Storage

Store between 15°C and 25°C until expiry date.

#### Preparation

1. Precipitating reagent : The precipitating reagent is ready to use.
2. Reaction solution for the determination of cholesterol. Prepare according to the working list for cholesterol.

#### Procedure

##### A. Precipitation

---

Pipette into centrifuge tubes

---

Sample	200 microlitre
Precipitating reagent	500 microlitre

---

Mix well and incubate for 10 minutes, at room temperature, then centrifuge for 15 mins at 4000 rpm. Within 2 hours after centrifugation transfer 0.1 ml of the clear supernatant to the reaction solution for the determination of cholesterol with the enzymatic method.

## B. Photometric measurement

Wavelength : 550 nm, 546 nm

Light path : 1 cm

	Sample	Reagent blank
Pipette into the reaction vessels		
Supernatant	0.1 ml	-
Water	-	0.1 ml
Reaction solution	1.0 ml	1.0 ml

Mix well and incubate for 10 mins. at room temperature or 5 minutes at 37°C. Then measure the absorbance A against the reagent blank value. The absorbance remains stable for 45 minutes.

### Calculation

$$\text{HDL - Cholesterol - Concentration} = \frac{A.F.}{F}$$

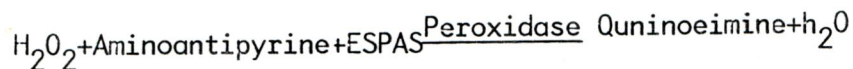
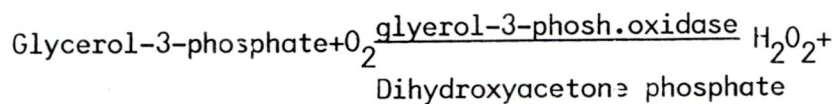
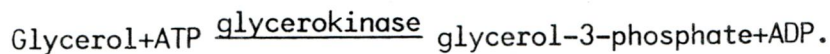
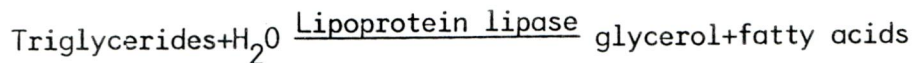
	550 nm F (mg/dl)	550 nm F (mmol/l)	546 nm F (mg/dl)	546 nm F (mmol/l)
	222	5.74	318	8.22

## APPENDIX IV

### QUANTITATIVE ESTIMATION OF SERUM TRIGLYCERIDES

#### Principle

Serum triglycerides are hydrolysed to glycerol and free fatty acids by lipase. In the presence of ATP and glycerokinase, the glycerol is converted to glycerol-3-phosphate. The glycerol-3-phosphate is then oxidised by glycerol-3-phosphate oxidase to yield hydrogen peroxide. Hydrogen peroxide reacts in the presence of peroxidase with ESPAS (N-ethyl-N-sulfoethyl-m-anisidine) and 4-aminoantipyrine to form a coloured complex. The intensity of the colour developed is proportional to triglycerides concentration and is measured photometrically at 546nm (530-570nm) with green filter.



Reagents (supplied in the kit)

Reagent 1 : Buffer: Pipes buffer and ESPAS

Reagent 2 : Enzymes

- a. Lipoprotein lipase
- b. Glycerokinase
- c. Glycerol-3-phosphate oxidase
- d. Peroxidase
- e. 4-Aminoantipyrine
- f. ATP

Reagent 3 : Standard (triglycerides 200 mg/dl)

### Preparation of working solution

Dissolve contents of one bottle of reagent 2 with contents of one bottle of reagent 1. Mix well and store at 2-8°C. This is the chromogen reagent.

### Storage and stability

Reagents are stable till the expiry date indicate on the labels when stored at 2-8°C. The enzyme chromogen reagent is stable for two weeks at 2-8°C when stored in amber coloured vial.

### Procedure

#### A. For automated instruments requiring 1 ml volume

Pipette into test tubes	Blank (B)	Standard (S)	Test (T)
Chromogen			
Reagent	1.0 ml	1.0 ml	1.0 ml
Standard	-	0.01 ml	-
Sample	-	-	0.01 ml

Mix and incubate at 37°C for 5 minutes or at R.T. (25-30°C) for 20 minutes. Read absorbance of test (AT), Standard (AS) and reagent blank (AB) against distilled water at 546 nm wavelength (530-570 nm) or with green filter.

**B. For calorimeters/spectrophotometers requiring 3.0 ml volume**

Pipette into test tube	Blank (B)	Standard (S)	Test (T)
Chromogen			
Reagent	1.0 ml	1.0 ml	1.0 ml
Standard	-	0.02 ml	-
Sample	-	-	0.02 ml
Mix and incubate at 37°C for 10 mins or at R.T. (25-30°C) for 20 mins.			
Distilled water	2.0 ml	2.0 ml	2.0 ml

Mix and read absorbance of the test (AT) and standard (AS) and the reagent blank (AB) against distilled water at 546nm wavelength (530-570nm) or with green filter.

**C. For calorimeters requiring 5.0 ml volume**

For use in this procedure, dilute 0.1 ml of sample and standard by adding 0.4 ml of distilled water or normal saline, mix.

Pipette into these tubes	Blank (B)	Standard (S)	Test (T)
Chromogen reagent	1.0 ml	1.0 ml	1.0 ml
Diluted standard	-	0.2 ml	-
Diluted sample	-	-	0.2 ml
Mix and incubate at 37°C for 10 minutes or at R.T. (25-30°C) for 20 minutes			
Distilled water	4.0 ml	4.0 ml	4.0 ml

Mix and read absorbance of the test (AT), standard (AS) and the reagent blank (AB) against distilled water at 546 nm wavelength (530-570nm) or with green filter.

The colour developed is stable for one hour at room temperature, if protected from direct light.

### **Calculations**

$$\text{Triglycerides concentration (mg/dl)} = \frac{\text{AT} - \text{AB}}{\text{AS} - \text{AB}} \times 200$$

## APPENDIX V

### ESTIMATION OF LOW DENSITY LIPOPROTEIN CHOLESTEROL

The low density lipoprotein cholesterol values are calculated from triglycerides, high density lipoprotein and cholesterol values using the following formula (Diagnostic Advancements, 1980).

$$\text{LDL} = \text{Total cholesterol} - \text{HDL cholesterol} - \frac{\text{Triglycerides}}{5}$$

The above calculations are applicable only if triglyceride concentration is not more than 400 mg/100 ml.

### ESTIMATION OF VERY LOW DENSITY LIPOPROTEIN CHOLESTEROL

The VLDL cholesterol values are calculated from the triglycerides values, using the following formula (Diagnostic Advancements, 1980)

$$\text{VLDL Cholesterol} = \frac{\text{Triglyceride}}{5}$$

5 is a constant factor

## APPENDIX VI

### WEIGHT, HEIGHT AND BMI VALUES OF THE SELECTED SUBJECTS

S.NO.	Weight (kg)	Height (Cms)	BMI = $\frac{\text{Weight (kg)}}{\text{Height (m}^2\text{)}}$
1.	50	150	22.2
2.	46	152	19.9
3.	45	160	17.6
4.	58	152	25.1
5.	56	156	23.0
6.	54	162	20.6
7.	57	168	20.2
8.	55	168	19.5
9.	60	156	24.7
10.	62	168	22.0
11.	50	162	19.1
12.	50	163	18.8
13.	55	165	20.2
14.	49	165	18.0
15.	60	161	23.2
16.	49	159	19.4
17.	49	158	19.6
18.	58	164	21.6
19.	56	162	21.3
20.	56	158	22.3
21.	56	168	19.8
22.	64	170	22.1
23.	60	159	23.7
24.	60	164	22.3
25.	53	159	21.0
26.	52	162	19.8
27.	58	162	22.1
28.	48	158	19.2
29.	55	170	19.0
30.	62	157	25.2
31.	68	169	23.8
32.	51	172	17.2

S.No.	Weight (kg)	Height (Cms)	BMI = $\frac{\text{Weight (kg)}}{\text{Height (m}^2\text{)}}$
33.	50	162	19.1
34.	60	176	19.4
35.	59	165	21.7
36.	57	168	20.2
37.	62	157	25.1
38.	49	159	19.4
39.	51	155	21.2
40.	52	158	20.8
41.	50	160	19.5
42.	50	165	18.4
43.	69	172	28.3
44.	48	164	17.8
45.	50	160	19.5
46.	60	160	23.4
47.	60	165	22.0
48.	62	162	23.6
49.	58	165	21.3
50.	64	172	21.6
51.	49	150	21.8
52.	69	176	22.3
53.	54	162	20.6
54.	64	162	24.4
55.	59	170	20.4
56.	61	160	23.8
57.	60	168	21.3
58.	67	165	24.6
59.	62	160	24.2
60.	51	172	17.2
61.	65	170	22.5
62.	59	157	23.9
63.	51	156	21.0
64.	66	158	26.4
65.	49	164	18.2
66.	65	161	25.1
67.	59	170	20.4
68.	50	162	19.1

---

S.No.	Weight (kg)	Height (cms)	BMI = $\frac{\text{Weight (kg)}}{\text{Height ( m}^2\text{)}}$
69.	45	160	17.6
70.	61	165	22.4
71.	67	162	25.5
72.	59	155	24.6
73.	44	156	18.1
74.	52	165	19.1
75.	52	165	19.1
76.	56	172	18.9
77.	68	172	22.9
78.	68	172	22.9
79.	68	163	24.1
80.	56	170	19.4
81.	56	166	20.3
82.	60	165	22.0
83.	59	155	24.6
84.	52	168	18.4
85.	62	162	23.6
86.	48	164	17.8
87.	60	165	22.0
88.	68	158	27.2
89.	52	160	20.3
90.	54	163	20.3
91.	68	156	27.9
92.	54	162	20.6
93.	46	158	18.4
94.	57	169	20.0
95.	62	152	26.8
96.	59	168	20.9
97.	60	168	21.3
98.	65	150	28.8
99.	54	162	20.6
100.	60	163	22.6

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APPENDIX VIII

NUTRIENT INTAKE OF SELECTED SAMPLES

S.No.	Nutrients	1	2	3	4	5	6	7	8	9	10
1.	Energy (Kcal)	1847	1777	1816	2442	2764	2458	2555	1937	3197	2116
2.	Protein (gm)	50	40	52	61	61	51	63	45	90	52
3.	Fat (gm)	36.2	37	34	60	72	59	45	36	87	51
4.	Calcium (mg)	307	273	308	413	615	341	340	536	479	323
5.	Iron (mg)	7.4	6.2	6.5	10.56	18	18.4	14.03	8.2	17.5	10.2
6.	Sodium (mg)	56	50	39	83.95	96	92	74	46	97	54.2
7.	Vitamin A ( $\mu$ g)	128.6	50.4	292.8	316.68	417	632	304	395	148	115
8.	Thiamine (mg)	1.152	1.098	1.61	1.62	1.836	1.508	1.498	1.238	1.97	1.902
9.	Riboflavin (mg)	0.68	0.515	0.76	0.72	0.725	0.907	0.605	0.503	1.13	0.676
10.	Niacin (mg)	15.95	15.95	16.78	18.39	23.75	23.21	20.4	17.48	23.04	18.315
11.	Ascorbic acid (mg)	60.6	9.75	83.1	138.3	104.5	47.75	10.75	145	81	145

APPENDIX IX

BLOOD PRESSURE LEVEL OF THE SUBJECTS BEFORE AND AFTER SUPPLEMENTATION

S. No.	Initial B.P. mm Hg		B.P. level after 30 days of supplementation		Difference in B.P. after 30 days		B.P. Level after 60 days of supplementation		Difference in B.P. after 60 days		B.P. level after 90 days of supplementation		Difference in B.P. after 90 days	
	Systolic	Diastolic	Systolic	Diastolic	Systolic	Diastolic	Systolic	Diastolic	Systolic	Diastolic	Systolic	Diastolic	Systolic	Diastolic
1.	162	110	143	98	14	12	130	90	32	20	128	90	34	20
2.	160	106	146	100	14	6	130	80	30	18	128	86	32	20
3.	158	108	134	94	24	14	128	88	30	20	128	88	30	20
4.	160	108	144	96	16	12	132	90	28	18	130	88	30	20
5.	158	108	146	100	12	8	130	90	28	18	130	88	28	20
6.	158	110	148	100	10	10	132	94	26	16	130	90	28	20
7.	160	110	144	98	16	12	132	92	28	18	130	88	30	22
8.	160	110	144	96	16	14	130	90	30	20	130	90	30	20
9.	158	108	136	94	22	14	130	90	28	18	128	88	30	20
10.	160	112	146	98	16	14	132	92	28	20	128	88	32	24

APPENDIX X

BLOOD PRESSURE LEVEL OF CONTROL GROUP

S.No.	Initial B.P. (mm Hg)		Final B.P. (mm Hg)	
	Systolic	Diastolic	Systolic	Diastolic
1.	152	102	152	102
2.	150	100	150	100
3.	154	104	152	104
4.	156	106	156	104
5.	150	106	148	106
6.	156	106	156	106
7.	156	102	156	100
8.	152	102	152	102
9.	152	102	150	100
10.	152	102	154	104

## APPENDIX XI

### LIPID PROFILE OF THE SUBJECTS BEFORE SUPPLEMENATION

S.No.	Total Cholesterol mg/dl	HDL- cholesterol mg/dl	LDL- cholesterol mg/dl	VLDL- choles- terol mg/dl	Tri- glycei- de mg/dl
1.	180	32	105	48	240
2.	175	30	106	56	280
3.	260	22	195	33	165
4.	190	30	130	18	90
5.	150	45	80	24	120

## APPENDIX XII

### LIPID PROFILE OF THE SUBJECTS AFTER SUPPLEMENTATION

1.	175	30	101	44	220
2.	180	25	100	55	275
3.	245	22	191	32	159
4.	178	31	124	16	80
5.	140	45	75	20	100