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***EFFECT OF SALT ON HYPERTENSION***

*Y.V Phani Kumari,Mrs. Hannah Jessie Francis T,Dr. Meena Kumari Patangay,Afreen Nuzhath,Mariam Fatima,Syeda Haniya Iqbal,Sara Ahmed,Qudsia Mohammadi,Zoha Samreen Khan*

**Department of Nutrition, St. Ann’s college for Women, Hyderabad**

**ABSTRACT:**

Hypertension is a rising health concern caused by the excessive intake of sodium in the diet. The objective of this study is to understand the pathogenesis of Hypertension, the relationship between salt and hypertension, factors affecting hypertension and the effect of INTERSALT (International Cooperative Study on Salt, Other Factors, And Blood Pressure) study and Dietary Approaches to Stop Hypertension (DASH) diet in lowering the incidence of hypertension. Various methods and materials such as food frequency questionnaires, self administered questionnaires, 24 hour Urine collection, blood sampling, statistical analysis, dietary interventions and observational studies were used in the study. Severe inflammation and organ damage due to an imbalance in the renin-angiotensin system (RAS), increased renal sodium absorption and water retention is seen in Hypertensive patients. Hypertensive Disorders in Pregnancy are caused due to aging, menopause, and declining oestrogen levels. Endothelial dysfunction and oxidative stress, result in hypertension in older women. The DASH–Na trial showed that Na reduction caused dramatic reductions in the incidence of hypertension. The purpose of this study is to keep the patients well informed about the causes and management practices to lower their blood pressure levels by the effective use of salt.

**KEYWORDS:**Hypertension,Salt,Salt sensitive hypertension,DASHdiet,Blood pressure.

**INTRODUCTION:**

Hypertension is a major health challenge affecting around 207 million adults and adolescents in India [12][41]. Ranked third as a cause of ‘disability-adjusted-life-years’, the American Heart Association defines hypertension as blood pressure exceeding 130/80 mm Hg i.e., a condition where blood flows at high rate in the arteries [25][56][62]. It is classified as: primary or essential hypertension where blood pressure soars high due to an interplay of genetics, low physical activity, obesity, high salt intake and insulin resistance; and secondary hypertension which involves renal or endocrine factors [2][63].A newly identified interaction between the brain, gut and bone has been identified as a possible mechanism in the pathogenesis of hypertension [37].

Telmisartan Randomized Assessment Study in ACE intolerant patients with Cardiovascular Disease (TRANSCEND) has shown that systolic blood pressure <120 mm Hg and diastolic blood pressure <80 mm Hg resulted in an increased mortality rate of renal insufficiency, stroke, heart failure, peripheral and coronary artery diseases, which have also been found to be common in the COVID-19 patients [13] [16] [17][23][62].

There are several factors underlying the onset of hypertension - an increased production of superoxide radicals, reduced antioxidant activity of vitamin D and superoxide dismutase, combined action of many genes, risk-conferring behaviours like maintaining higher BMI values and regular consumption of energy drinks which cause sinus, tachycardia and high blood pressure [59].

A clear estimation of dose-response between salt intake and blood pressure exists: the higher the salt intake, the higher the blood pressure [51].An increase in salt intake over 30 years leads to increased systolic blood pressure in both sexes but the features remain different [61]. People with non-comorbid depressive disorder, non-comorbid anxiety disorder, and comorbid depression-anxiety are all prone to have hypertension compared to persons with neither a depressive nor an anxiety disorder [60].

Control of blood pressure in hypertensive patients can markedly reduce morbidity and mortality and effective management includes lifestyle and dietary modifications to prevent adverse conditions like ischemic stroke, myocardial infarction, dementia, renal failure and blindness[2] [46] . Many experts also believe that a decrease of 2 mm Hg in BP can prevent 151,000 stroke-related and 153,000 CAD-related deaths [15].

SALT- The most common flavour enhancer found in a variety of foods like curries, tomato sauce, canned vegetables, bread, crackers, meats and snack foods [15].The human body needs a very small amount of salt from the diet to maintain fluid balance and cellular homeostasis and our current diet contains 238 mmol Na+ (5.5 g)which raises the blood pressure sufficiently[24] [33] [65].Randomized trials demonstrate that excess sodium intake is a risk factor for hypertension and since the ability of sodium chloride to increase blood pressure depends only on its sodium component, reducing sodium from dietary salt is advocated as the first-line treatment [14]. The WHO recommends a maximum intake of 5 g of salt per day as high dietary salt intake is known to contribute to hypertension and cardiovascular diseases.[6] [11] [18].

For instance, humans have been on earth for 3.5 million years; for the first 99.8% of that time, every human on the earth, unless he lived by the sea, was on a low sodium diet and also incidentally on low fat and high potassium [10]. For decades, the only source of salt for human ancestors was that naturally found in foods, making the salt intake below 0.5 g/day [24].

Nowadays there is an increase in the consumption of high salt product without knowledge, due to their preservative properties and their excessive use in food seasoning and mostly due to highly salted processed foods which makes it the most valued and used commodity in the world [21][24][32].

Intake of dietary salt in urban south India is higher than recommended due to changes in food consumption patterns i.e., changing from ‘traditional’ to ‘western’ due to rapid nutritional transition [23].

“Salt” and “sodium” are used interchangeably but salt is only 40% sodium; the remaining 60% of salt chloride which is also an important part of the link between salt and blood pressure [24].

Salt sensitivity refers to the effect of dietary sodium chloride i.e., the salt intake on BP by a process of uniform expansion of extracellular fluid volume and increased cardiac output leading to a rise in BP in certain individuals which is determined by the renal efficiency to excrete salts at higher BP (salt resistance – renal excretion of salt at normal BP) [22][5].

Excess salt intake has been demonstrated to have blood pressure-independent effects on the heart and blood vessels and also causes impairment of cognitive function i.e., increased risk of dementia and cerebrovascular diseases therefore should be included in dysfunctional foods [3][34].

Salt sensitive hypertension is characterized by an increase in blood pressure in response to an increase in dietary salt intake. It is recognized that hypertension is of multifactorial origin and a variety of factors can induce, or prevent, blood pressure responsiveness to the manipulation of salt intake where some people respond quickly with a rise in pressure when their salt intake is increased, whereas in others the changes in pressure may follow a much slower course i.e., their effect on population vary considerably[1][26][27].

Salt induced hypertension can be distinguished into three components.

1. Increase in blood pressure when individuals with acute salt sensitivity of blood pressure consume a high dietary salt intake (reversible and responsive to salt restriction).
2. Increase in blood pressure by a progressive induced worsening of acute salt sensitivity. (reversible and responsive to salt restriction).
3. salt-induced increase in blood pressure (irreversible cannot be changed by acute salt restriction [58].

The pathogenesis of salt-sensitive hypertension is heterogeneous, it is mainly due to an impaired renal capacity to excrete sodium (Na+ ) or may vary such as ageing in which, there is a decreased ability to excrete sodium rather than increase in dietary sodium, changes in body weight; abnormalities in the renin‐angiotensin system, the sympathetic nervous system, transmembrane sodium transport, the vascular endothelium; complex interaction between neuroendocrine factors and the kidney, estrogenic decrease in women [4] [7]

In the case of women, post-menopausal women are more salt-sensitive than pre-menopausal women, indicating that blood pressure becomes salt-sensitive after menopause [47].

Potassium affects the levels of dietary sodium chloride even in normal individuals and sodium retention may contribute to blood pressure elevation during potassium depletion [43].

The increase in blood pressure depends on the amount of sodium intake in the diet, sodium as halide salts, and ethnicity. Sodium bicarbonate and other non-chloride sodium salts may not elevate blood pressure in most ethnic groups, but in severely salt-sensitive blacks, sodium bicarbonate can increase blood pressure. The differential effect of chloride and non-chloride sodium salts may be related also to deficiencies of other ions (e.g., potassium, calcium, magnesium)[9].

The INTERSALT (International Cooperative Study on Salt, Other Factors, And Blood Pressure) conducted on 10,079 women and men, aged between 20-59 years showed significant relations between sodium excretion and blood pressure. [20] Based on this extensive research data, experts have repeatedly made recommendations for population-wide lower sodium intake. [20]

The effects of salt restriction on blood pressure are unpredictable, modest and difficult to determine; also, compliance with a salt-restricted diet is not easily achieved. However, the effect of dietary NaCl restriction appears to be evident only when an extreme dietary Na+ restriction of 10 to 20 mEq/d is applied [28].

A practical method to reduce discretionary salt use during food preparation or dining is to replace regular salt with a “salt substitute,” such as potassium chloride (25–30%) or magnesium sulphate (10–14%). [14].

Certain guidelines recommend lifestyle modifications, including salt reduction, as one of the most effective approaches and weight loss to prevent hypertension and as a first-line treatment for mild hypertension and also lowers BP in normotensive patients [23][40][28]. Reduction of BP in hypertensive patients is also highly cost-effective and cost-saving in reducing CVD and consequently preventing premature deaths [21][24].

However, Higher levels of physical activity and greater fitness are associated with a reduced incidence of HTN [56] along with the diet prescribed in the Dietary Approaches to Stop Hypertension (DASH) which is constructed on the basis of a high intake of fruits, vegetables, nuts and legumes, low-fat dairy products, and whole grains, and low intake of sodium, sweetened beverages, and red and processed meats, it also included lower consumption of red and processed meats and greater consumption of whole grains,lack of physical exercise [53].

**METHODOLOGY:**

Since hypertension is one of the major concern, researchers from all around the world have proposed various methods and materials to know the effect of salt and other factors on the imbalance caused in the rate of blood pressure.

***I.QUESTIONNAIRE METHOD***

A questionnaire is used data is collected through a random ***sampling method*** .A 3-day food records have been commonly used in practical settings that include recording food intake for 2 weekdays and 1 weekend day and its validity reported be acceptable as dietary assessment tool which provided the nutrient intake of sodium. The HPM scale was applied to all the participants, and the demographic characteristics (age, gender, education level, job, and personal and/or familial history of hypertension) were examined.(30)(55)(68).

***FOOD FREQUENCY QUESTIONNAIRE:***

Another conformation of the questionnaire method is that the Participants return a detailed *questionnaire e*very two years documenting numerous health-related factors and medical events. Semi-***quantitative food frequency questionnaires*** (FFQs) were answered every four years; to assess intake of >130 foods and beverages, and similar FFQs were then administered every four years in order to update information about dietary intake. Numerous questions on the FFQ ascertained animal flesh intake encompassing meats (processed meats, bacon, hot dogs, hamburgers, beef, pork, lamb), poultry (chicken and turkey, with or without skin), and seafood (dark meat fish, other fish, shrimp, lobster, and canned tuna).

They also collected updated information about weight, smoking status, and physical activity. Body mass index (BMI) was calculated as the weight (in kg) divided by the height squared (in m). Physical activity, as assessed by a validated questionnaire, was estimated as metabolic equivalent tasks (METs).

Every four years, with the *FFQ*, the collected information is about intake of alcohol and other dietary factors, such as fruits, vegetables and whole grains. The FFQ was also used to compute nutrient intake (eg, intakes of sodium, potassium, magnesium, calcium, and fiber). The study also ascertained the use of non-narcotic analgesics (aspirin, acetaminophen, and nonsteroidal antiinflammatory drugs) in each cohort, post-menopausal status in both female cohorts, and oral contraceptive use in NHS II. Smoking status and quantity of smoking were inquired every two years.(55)(53)(69). There were nine possible answers of consumption frequency for each food item: “never or almost never”, “1–3 times per month” “once per week”, “2–4 times per week”, “5–6 times per week”, “Once per day”, “2–3 times per day”, “4–6 times per day”, “6 or more times per day” and “I have no idea”. Finally, these categories were transformed into a continuous “times per week” .

(57)

***SELF ADMINISTERED QUESTIONNAIRE***

The patients were assessed using a self- administered questionnaire to collect data on history of CVD , diabetes mellitus or other endocrine diseases and its risk factors (15)(42)(47). It also daily alcohol intake over the preceding 7 days, cigarette smoking status, attained educational level, physical activity, adherence to a special diet, dietary supplement use, use of antihypertensive and lipid-lowering drugs or previous use of hormone therapy or nonsteroidal anti inflammatory drugs (19)(20)(47). Information on each individual’s medical history, family history, pregnancy history (e.g., age at first and last delivery, number of children), pregnancy complications such as HDP and gestational diabetes mellitus, and lifestyle factors (e.g., smoking history, alcohol consumption, physical activity) was collected (44)(47).

***Salt Literacy Questionnaire:***

A self-administered questionnaire to assess the salt-health related knowledge and the behaviour concerning salt consumption of the survey participants. This questionnaire includes all multiplechoice close-ended questions to guarantee standardisation and rapid electronic evaluation, The questions were based on the dietary sources of salt intake, food composition and population dietary habits.(72)(38).

1. ***CLINICAL EXAMINATION***
   * ***BASELINE MEASURMENTS:*** After completion of the questionnaire and a personal interview, the patients underwent a general health examination(15). Patients were assessed for age, sex, BMI, waist, hip, and thigh circumferences; and heart rate were recorded(20)(44)(47). For measurements, a portable stadiometer, a portable electronic weighing machine and an anthropometric tape were used. All body adiposity measurements were conducted by trained staff(50). Height and weight were measured at the time of the health examination, and body mass index (BMI) was calculated as the weight divided by the height squared (kg/m2 ). Overweight/obesity was defined as a BMI ≥ 25 kg/m2 , according to the cut-off point recommended by the World Health Organization(12)(20)(42)(44)(50).It also included measurement of blood pressure as well as laboratory blood analyses such as creatinine, haemoglobin , haematocrit, insulin, triglycerides, apolipoprotein B, uric acid ,glomerular filtration rate, total cholesterol, low-density lipoprotein cholesterol, high-density lipoprotein cholesterol and fasting glucose(44)(47)(48).

BP is also measured using an **automated oscillometric** BP device after the patient rested for 5minutes in the sitting position without discomfort and application of medication. The mean of 3 results are recorded, according to JNC 7 guidelines(8)(16).

* + ***24 HOUR URINE***

A 24-h-urine collection was performed over 3 days for all patients using a partition cup (proportional sampling method) that collects 1/50 of the urine over 24 h (15)(19)(20)(70). The precise start and end times for the urine collections were reported by each subject(49). If the 24-h creatinine excretion was within ±30% of the estimated value, the urine collection was considered successful(70). During the sample collection period, subjects were allowed to take routine meals and no dietary restrictions were imposed(49). Urine volumes and urinary creatinine, sodium and potassium concentrations were determined(19)(47).

Creatinine was measured using an **enzymatic method** and sodium and potassium were measured using an **electrode method**(49). 24-h-urinary salt excretion was estimated by measuring sodium (Na) and creatinine (Cr) concentrations and by calculating it from the formula:

Estimated salt intake (g per day) ={21.98 × (Na concentration in a spot urine sample (mEq l−1)/Cr concentration in a spot urine sample (mEq l−1)) × (−2.04 × age+14.89 × body weight (kg)+16.14 × height (cm)−2244.45)}0.392 × 0.0585.(42)

* + ***BLOOD PRESSURE MEASURMENTS***:

In this type , participants were classified as, at risk or without risk of having elevated BP or hypertension according to their SBP and DBP values using the 2017 Clinical Practice Guideline for Screening and Management of High Blood Pressure.

In **Blood sampling method** : the samples were collected after a 10–12 hour overnight fast. General biochemical analyses were done at the Hospitals. Serum triglycerides, total cholesterol, low-

densitylipoprotein cholesterol (LDL-C), high density lipoprotein cholesterol (HDL-C), glucose and insulin were analysed by automatic microparticle analyser (Abbott Laboratories) (**57**)

•BP of participants can also be measured using a random zero mercury column **sphygmomanometer** and an appropriately sized cuff(20,44,45,47,70). Measurements are taken on the right arm resting on a table with participants seated for at least 5 minutes in a quiet room, with bladder emptied and no physical activity, eating, drinking, or smoking in the preceding 30 minutes(20)(45)(48)(50)(70).

1. ***STUDY POPULATION***

This study usually examines association of long term intake of salt with incident hypertension..(8)(55).

1. ***STATISTICAL ANALYSIS:***

Analyses were performed in the total sample, as well as stratifying by pubertal stage and presence or not of overweight/obesity, as indicated. Variables like total cholesterol, serum triacylglycerides, HDL-C, EDSF CF, HSF CF, SSB CF, MDASH score, SBP and DBP were transformed into a logarithm scale for analyses. (15)(20)(52)(55)(57)(53)(72)

Means and standard deviation were calculated for the studied variables, and student’s t-test was used for simple comparisons between pairs of groups. (12)(14)(16)(31)(36)(47)(69)(73)

***METANALYSIS:***

There have been several meta-analyses of randomized salt reduction trials which included Acute and large reductions in salt intake, very short-term salt-reduction and modest salt reduction. (8)(10)(14)(57)(64)

Begg Test and Egger Test were also used in meta analysis and systematic review of the study.(52)(57)(66)

Other methods encompass case studies from hospitals, clinics and universities. The case studies make a record of patients which ranges from months to the past one week. (13)(31)(50)(54)(59)

***LITERATURE SEARCH STUDY*:**

A literature search was undertaken using international data bases covering the period 2014-2020. All the articles included in this integrative review were thoroughly reviewed and analyzed.The review study covers articles coming from major journals related with the topic.The methodology followed during the conduct of this research includes keywords like sodium, potassium, the sodium-to-potassium ratio, and the cardiovascular variables of interest (blood pressure, hypertension, the renin-angiotensin system, arterial stiffness, the augmentation index, and endothelial dysfunction). (1)(4)(52)(13)(14)(17)(29)(30)(31)(35)(18)(19)(25)(71)

1. ***DIETARY INTERVENTIONSAND ASCERTAINMENT*:**

Dietary data are collected by trained, certified interviewers using the in-depth 24-hour recall method; Trained dieticians assessed[macronutrientan](https://www.sciencedirect.com/topics/medicine-and-dentistry/macronutrient)d micronutrient intake during the 24-hour recall method. Portion sizes of foods were estimated using standard household measuring cups, spoons, and ladles. (11)(15)(19)(20).

After the interview2 dietary factors were tested, namely, dietary patterns and sodium levels. (4)(8)(39).

The participants were recommended with DASH diet which emphasized on fruits, vegetables, and low-fat dairy foods with reduced intake of saturated fat, total fat, and cholesterol. The DASH diet included whole grains, poultry, fish, and nuts, and was reduced in red meat, sweets, and sugar-containing beverages.(53)(55)(64)(72)

Both SBP and DBP were recorded before and after the interventions (8)(10)(36)(57)(66)(67)

1. ***INCREASE IN SODIUM AND POTASSIUM*:**

The inbred Dahl/Rapp SS strain and Dahl/Rapp salt-resistant (SR) rats given increased salt intake to check the changes in bp, in peripheral vascular resistance- PVR and also changes in cardiac output. The NGmonomethyl-L-arginine9 (an indicator of NO production) was used for both the strains of rat to monitor the effect of increased salt intake on the NO production which lowers the bp .The same was done on human volunteers belonging to salt sensitive, salt resistant and normotensive class. participants with hypertension at baseline were particularly sensitive to the cardiovascular effects of higher salt intake and therefore were included .Some volunteers were given potassium to check its effect on increased salt intake(11)(22)(29)(34).

***DASH-SODIUM TRIALS*:**

The DASH-Sodium trial was also conducted as a follow-up to the DASH trial to determine the effects of sodium reduction on BP alone and in combination with the DASH diet.(10)(11)(29)

The DASH-Sodium trial compared the effects of consuming 3 different sodium levels in either the DASH diet or a control diet, A modified DASH

(MDASH) score is used to calculate the following components; calculated from FFQ data: fruits, vegetables, nuts and legumes, whole grain, low-fat dairy products, red and processed meat and HSF and

SSBs ;it also included high sugary foods in the “sugars”(35)(67)(57)(64)

A dash diet also, adequately modify their food choices based on their group (e.g., avoiding salt and high sodium foods, increasing fruit and vegetable intake) (66)(53)(55)(72).

**VII. *OBSERVATIONAL STUDIES***

***EPIDEMIOLOGICAL STUDIES*:**

. INTERSALT demonstrated a direct association between salt intake as measured by 24-h urinary sodium and BP.

INTERSALT study was one of the first large international epidemiologic studies on sodium intake and hypertension using a standardized method for measuring 24- hour urinary sodium. .(10)

# ***ANIMAL STUDY***

High Dietary Salt Is Associated with Gut Microbiota in Human Hypertension

To link the Dahl SS with human disease, studies were performed to examine SH2B3, a gene linked to human hypertension and renal disease through genome wide association studies (GWAS) . A ZFN-mediated mutation of SH2B3, predicted to delete 3 amino acids in the SH2 domain, significantly attenuated the infiltration of leukocytes into the kidneys which was accompanied by a reduction of salt-sensitive hypertension and renal disease.(31)

* ***TRIAL ON HUMANS***

***BY INCREASING SALT INTAKE***

2 well-controlled trials where participants were assigned different levels of salt intake: 11.2, 6.4, and 2.9 g/day in one ; and 8, 6, 4 g/day in the other . Both trials demonstrated that BP changes with salt intake, so that the lower the salt intake, the lower the BP.(24)

It has become more convenient to assess depression situation through self-rating scales, such methods may focus on somatic symptoms(52)

* ***RANDOMIZED TRIAL***

A dose-response relationship between salt intake and BP has also been demonstrated perhaps most compellingly by 2 well-controlled trials where participants were assigned different levels of salt intake: 11.2, 6.4, and 2.9 g/day in one; and 8, 6, 4 g/day in the other. Both trials demonstrated that BP changes with salt intake, so that the lower the salt intake, the lower the BP. (8)

**RESULTS AND DISCUSSIONS:**

Numerous studies in the past five decades established the role of immune system in the development of hypertension and end-organ damage. A study on COVID-19 hypertensive patients indicated more severe inflammation and organ damage due to an imbalance in the renin-angiotensin system (RAS), than in patients without hypertension. Evidences from another study demonstrated stronger BP reducing effects in women due to increased renal sodium absorption and water retention compared to men. The prevalence of salt sensitivity was found to be higher after surgical menopause (52.5%) and the loss of ovarian hormones also unmasked a population of 38.7% salt-resistant women who developed salt sensitivity after menopause.

The prevalence of Hypertensive Disorders in Pregnancy (HDP) was higher in the 30s–50s group than in the 60s because aging, menopause, and declining oestrogen levels play an important role in endothelial dysfunction and oxidative stress, resulting in hypertension in older women. High salt diet significantly elevates acetate, propionate, and iso-butyrate and finding methods for accurate measurement of the gut microbiota and its functional pathways could offer improvements in studying the microbiota-BP associations since microbiota affect human health by producing SCFAs to ferment dietary fibre. Faecal microbiota transplantation from hypertensive donors to normotensive demonstrated an increase in BP and induced changes in multiple gut microbial species with *Lactobacillus* susceptible to sodium in salt-induced hypertension.The antihypertensive effect of *Lactobacill* may be enhanced in increased nitric oxide production.

Another study, considering the mean age of participants showed a significant reduction in SBP of both adults (< 65 years old) and elderly (≥65 years old) but the effect of DBP lowering by salt sustitutes was only observed in adult patients. Long-term salt-intake reduction significantly lowered the number of total monocytes indicating a potential relationship between dietary sodium intake, cytokine production, and immune status. The changed BP in response to high salt intake is partly hereditary and partly due to increased potassium intake, elevating mortality due to CVD. Observational studies stated considerable lowering of systolic BP (SBP) by 5.9 mmHg and diastolic BP (DBP) by 3.4 mmHg with adequate potassium consumption of >3500 mg/day as a primary prevention of hypertension.

Urinary 24-hour Na/K excretion was directly correlated with BMI, total fats, total monounsaturated fats, arachidonic acid, oleic acid, palmitoleic acid, palmitic acid, and stearic acid; it was inversely correlated with dietary magnesium,riboflavin, fiber, vitamin B6, vitamin C, calcium, phosphorus, pantothenic acid, folate, total sugars,total iron, non-heme iron, copper,vitamin A, and β-carotene. The DASH–Na trial showed that Na reduction caused additional BP lowering beyond effects of DASH diet alone.

Higher consumption of animal flesh was significantly associated with an increased risk of incident hypertension. It was  found that animal flesh intake was significantly associated with an increased risk of hypertension.

The association of hypertension in an individual may represent the effect of both genetic and non-genetic factors;the strongest risk factor being higher BMI in obese women leading to a higher rate for incidence of hypertension.   
A low-risk combinations of modifiable lifestyle factors, such as maintenance of a normal BMI, eating a diet high in fruits, vegetables, low-fat dairy products and low in sodium, engaging in physical exercise on a daily basis, drinking a modest amount of alcohol, avoiding analgesics, and taking supplemental folic acid, were associated with dramatic reductions in the incidence of hypertension

Both adiposity indicators (WC and BMI) decreased with a higher age at menarche, whereas the association between age at menarche and BP was weak. The main findings being early maturation related to obesity and higher BP in adulthood.

The relationship between depression, anxiety and stress with hypertension were categorized in to 3 levels like high, medium and low, and it was found that in all cases “high” was significantly related with hypertension indicating significant positive relationship of hypertension with depression, anxiety, stress and with demographic variables. Depression and hypertension are reciprocally correlated, depression leads to hypertensionand hypertension raises the level of depression.Interview-defined depression affects approximately 1/3rd of hypertensive patients.

Dietary habits of hypertensive patients revealed a prevalence of 24% among men and 15% among women. The majority of the daily sodium intake was from pulse-based dishes (29.7%) followed by rice-based (27.03%), vegetable-based (20%), and fruit-based (12.1%). Salt is added as part of the recipe of all dishes and it is important to keep in mind that salt intake can increase with additional dishes.The assessment of dietary salt intake is a crucial guide for determining the degree of salt restriction needed for hypertensive patients.

A focused evaluation of the renin-angiotensin system, and an understanding of the variables is the most sensitive to the sodium-to-potassium ratio (e.g., PRA vs. plasma renin concentration), and would lend greater insight into the biologic pathways underlying the regulation of blood pressure and fluid balance.

Modified DASH scores were significantly healthier in females when compared with their male counterparts. No effect of MDASH score on SBP nor DBP was observed.There was significant reductions in both SBP and DBP in each dietary intervention group compared to control group. In patients with hypertension, the DASH diet with low sodium, compared with the control diet with high sodium, lowered SBP by nearly 10 mm Hg among those with a baseline SBP of 140 to 149 mm Hg and >20 mm Hg among those with a baseline SBP of 150 mm Hg. The SBP reductions observed should lower the risk of CVD.Individual and combined effects of both sodium reduction and the DASH diet are great, particularly in hypertensive persons with higher BP. Compared to placebo, angiotensin-converting enzyme inhibitors reduce SBP by 12 mmHg, beta-blockers reduce SBP by 13 mm Hg, and calcium-channel blockers reduce SBP by 16mmHg. BP of subjects decreased from 145±16/85±11 mm Hg at the first visit to 130±12/70±11 mm Hg at the 10th visit and was due to increased use of antihypertensive drugs.

Patients (hypertensive &pre hypertensive) with salt intake ≥6 g/d had a family history of CVD and hypertension indicating high dietary salt intake as a risk factor .The salt intake of school children with high intake in high school children compared to elementary school children, correlated with that of their parents (7-8g/d) which led to obesity and high BP of the children. In the context of awareness a quarter (27%) was aware, 25% were on treatment and 9% achieved adequate control of hypertension despite the use of national program (NPCCDS) indicating for more spread of this program .

The excess sodium intake was found to be due to that of the personal barriers(difficulty of preparing low-salt diets separately, exclusion of certain food tastes, boringness of continuous dietary adherences, exclusion of participation in parties, and the high cost of regimen foods ,misperceptions of health information) rather than behavior patterns.

33.89% of men and 27.74% of women had hypertension. Among men, 59.57% of participants had stage 1 hypertension and 33.90% had stage 2 hypertension. Among women, 56.98% of participants had stage 1 hypertension and 32.83% had stage 2 hypertension and they had higher mean plasma glucose and higher total blood cholesterol level in addition to BP and that age was associated with the prevalence of BP (More than 65 yrs.) indicating lifetime risk of CHD is significantly affected by hypertension as evident of baseline measurements. BP variability was greater in those receiving beta-blockers which can also be due to Impaired arterial compliance, humoral factors, blood viscosity, behavioral changes (physical activity, sleep, postural changes and so on), emotional factors and even climatic changes.

There is a significant relation between Na/K to SBP in normal weight and obese strata which showed decrease in BP with the inclusion of DASH diet. The blood pressure of patients taking non-diuretic antihypertensive agents especially at nighttime had BP within normal range and their 24h urine samples showing significant correlation between overnight salt intake and 24-h salt and reduced risk cardiovascular death, myocardial infarction, stroke. The inclusion of an antihypertensive tablet at night was recommended by American Diabetes Association in the view of increased potential risks from overly restricting dietary sodium .

A 24-h urine collection, which uses a partition cup is mostly applied in clinical practice to facilitate self-measurement showed decrease in urinary salt excretion from 1st to 10th sample. INTERSALT and PURE survey revealed that lower salt reduction and potassium excretion had negative association with BP indicating modest salt reduction lowers bp without any adverse effect on blood lipids or catecholamine, and increases only slightly plasma renin activity and aldosterone. PREVND study showed low potassium diet associated with increased risk of developing Hypertension which is assessed by 24 h urinary Na:K excretion and also potassium chloride supplements showed reduction in BP.

As recommended by WHO the salt reduction to 3g/d which if applied to whole of population Lowers BP which is of public health significance and to categorize the population as salt sensitive or salt resistant according to changes in their BP.

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