Table Salt Intake: Its Relationship to Hypertension

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Abstract — This research tried to determine the relationship between salt intake and hypertension among individuals with high blood pressure in San Carlos City, Bayambang, Calasiao, Pangasinan, calendar year 1995-1996. It tried to determine the profile of patients with hypertension in terms of age, sex, blood pressure, degree of salt intake and salt-sensitiveness. It also tried to find out if there were significant differences between the degree of salt intake of patients grouped according to the aforementioned variables.

The research subjects were the outpatients of Virgen Milagrosa Medical Hospital in San Carlos City, Calasiao Community Clinic and Bayambang Community Clinic. The descriptive method research was used in the investigation and laboratory analysis done to gather the data needed in the study. Thus, the blood pressure of the research subjects were taken using sphygmomanometer and the table salt intake through urine analysis.

Research subjects consisted of the 135 out – patients of Virgen Milagrosa Medical Hospital in San Carlos City, Pangasinan, Bayambang Community Clinic in Calasiao, Pangasinan, calendar year 1995 – 1996, who were diagnosed by the physicians to have high blood pressure.

To solve the problem raised in the study, frequency counts, percentages, mean, one - way classification analysis of variance (ANOVA) and the chi – square test of independence were employed.

Based on the significant findings made, the following conclusions were drawn: Hypertension is common among females and those who are over 40 years old although younger adults are also affected by persistent high blood pressure, Hypertensive individuals having an average blood pressure of 140/100 have normal salt intake and have low salt sensitiveness, Individuals with blood pressure of more than 140/100 have high salt intake. Moreover, the degree of salt intake has something to do with the blood pressure of human beings and the degree of salt intake is significantly related hypertension. Therefore, teachers in the elementary and high school should include in their lessons the effect of common table salt found in many processed and junk foods in the blood pressure of man and people especially with high blood pressure should be made aware of the results of this research through the Department of Health.

Keywords — Table Salt, Hypertension, Health, Blood Pressure

I. Introduction

Hypertension or high blood pressure has been called a “silent killer” because it often remains symptomless for years. People with high blood pressure are three times more likely to have a heart attack and eight times more likely to suffer stroke, than are people with normal blood pressure. Hypertension is common among those over 40 years of age and it is on the increase throughout the Orient--especially in to large cities because processed and canned food is common them (Eight Secrets of Health , 1994). Hypertension refers to a consistently elevated blood

pressure. Generally concern about the young adults high blood pressure begins when he has a systolic reading of 140 or above diastolic reading of 90 or above (Payne, 1989).

Hypertension is an indication of some organic disorders already existing the heart, in the body, particularly in veins and kidneys (Tacio, 1993). Normally people have certain standards of reading blood pressure with 120/80 considered the median or average. The upper number called the systolic refers to the pumping capability of the heart while the lower number, termed the diastolic refers to the pressure exerted by the blood vessels all over the body.

About 10 percent of all cases of high blood pressure are due to kidney or adrenal disease, but the remaining 50 percent have no definitely known cause. There are, however six factors that may contribute to high blood pressure (Eight Secrets of Health, 1994):

1. Some people are more sensitive to salt than others. In fact, the sodium in salt may actually by the number one cause hypertension. Those populations consuming very little salt, less than 0.5 grams per day (Eskimos, New Guinea and Solomon Islands Tribes Australian aborigines) have no incidence of high blood pressure. The Lau tribes people in Solomon Islands, however, do have higher blood pressure. They traditionally boil their vegetables is sea water, thereby consuming up to 20 grams salt per day.

Northern Japanese farmers preserve their food with salt and eat an average of 30 grams of salt per day. Sixty percent of these farmers have hypertension and strokes are the most common cause of death among them.

Salt is vital to health, but the human bodies need only 0.2 grams of sodium per day. If salt intake is cut to one teaspoonful of salt per day (including that used in preparation of food the biggest health problems solved. Individuals with hypertension would have to cut the salt even more.

2. Arteriosclerosis (narrowing of blood vessels by cholesterol) is also thought to be factor hypertension. If this proves to be true, avoiding excessive fat and cholesterol in the diet would be of great help.

3. Obesity may also contribute to hypertension. Every pound of that fat requires thousands of extra blood vessels. These in turn require a higher blood pressure to circulate blood through them. Obese people are five times more likely to have hypertension. Anyone who is more than 20 percent overweight is considered obese.

4. Estrogen, a female hormone found in birth control pills or given for menopause, causes the body to retain salt, and has the same effect as consuming too much salt.

5. More recently, suspicion has been directed at the prolonged over - consumption of refined sugar as a possible contributing factor in persons with decreased kidney function.

6. Not to be forgotten as a cause of hypertension is stress whether it be social stress, noise stress or work stress. All of these may increase hypertension.

Three of the six major causative factors are linked to diet. Those who are guilty of dietary indiscretion are committing suicide by the fork and spoon. Many of the food habits are begun in youth, and become difficult to change.

Salt intake does not immediately produce high blood pressure a tendency toward it. It takes many months of continuous high salt intake even inthe faster -reaching laboratory rats to produce the high blood pressure.

Hoeber, et.al. (1972) tells that such a simple item in diet as table salt or sodium chloride is one of the suspected causes of heart failure, hypertension and other diseases.

More and more doctors are learning that the food eaten have a definite influence on whether or not one becomes susceptible to heart and artery trouble. Indeed, modern diet infants and growing children seem to be the prime reason behind the increased proneness of these age groups to cardiovascular disease.

Ironically, Filipinos love to eat salty food. Salt plays important role in regulating the balance of water and dissolved substances outside the body cells, and this balance is so delicate that normal metabolic functions stop whenever such balance is disturbed (Dr. Agana as mentioned by Tacio, 1993). Practically, all the vital functions of the body, including the heart action depend on what balance, whether or nor reducing salt, intake can prevent or effectively treat hypertension has become a sensitive subject among clinicians and researches. While observations have been made that societies that consume little salt tend to have low blood pressure, no firm proof has been established that consuming salt causes high blood pressure (Shore, 1991).

With this issue, the researcher ventured in an investigation that determined the relationships between sodium or salt intake of individuals and their blood pressure.

II. Methodology

Research Methods

This study which tried to determine the relationship between hypertension and the degree of salt intake among high blood patients is a descriptive research which made use of the laboratory analysis in the gathering of data needed in the investigation. Thus, urinalysis or urine analysis and the actual reading of the blood pressure of the research subjects were undertaken by the researcher herself, who is also a medical technologist.

Descriptive analysis is a method of determining and describing the nature of a thing by separating it into its parts. It has its purpose to discover the nature of a things. From the point of

view of continuing research, what new questions are brought to light by analytical work will serve as guides for future research

Research Subjects

The research subjects used in this study were the out patients of Virgen Milagrosa Medical Hospital in San Carlos, Calasiao Community Center in Calasiao, Pangasinan and Bayambang Community Center in Bayambang, Pangasinan, calendar year 1995-1996. These patients were diagnosed to have high blood pressure by the physicians.

Table 1
Distribution of Research Subjects
By Hospital/Center

Hospital / Center	Number	Percentage
Virgen Milagrosa Hospital	18	13.13
Bayambang Community Clinic	39	28.89
Calasiao Community Clinic	78	57.78
	135	**100**

Table 1 shows the distribution of research subjects according to hospital/medical center. It is indicated in the table that there is a total of 135 research subjects who were out patients of the Hospital and two medical centers in Pangasinan. Out of the 135, eighteen of 13:13 percent were out-patients of Virgen Milagrosa Hospital; 39 or 28.89 percent from the Bayambang Community Center and 78 or 57.78 percent from Calasiao Community Clinic.

Data Needed

The data needed in the investigation are the following:

1. number and percentage of patients with high blood pressure grouped according to:

    a. Age
    b. sex
    c. blood pressure
    d. degree of salt intake
    e. salt sensitiveness

2. mean degree of salt intake of patients grouped according to

    a. Age
    b. sex
    c. blood pressure

d. salt sensitiveness

3. F-value to determine the significant difference between the degree of salt intake and hypertension.

4. Chi-square value to determine significant relationship between hypertension and degree of salt intake.

Data Gathering Instrument

The medical form (Appendix B) which contains data such as age, sex, blood pressure and salt sensitiveness was utilized in the gathering needed in the investigation.

The sphygmomanometer was used to determine the blood pressure of the patients and urinalysis or laboratory of the sample was performed to determine the degree of salt intake. Thus, the following materials and reagents were used in the analysis of urine samples:

Equipment:

Centrifuge, Test tubes, Medicine dropper, Graduated cylinder and Analytical weighing balance

Reagents:

Potassium chromate, Strong nitric acid, Normal silver nitrate solution and Distilled water

The normal silver nitrate solution was prepared byadding 29.075 grams of silver nitrate to 1000 cc distilled water.

Data Gathering

A. Determination of the blood pressure

The blood pressure of the research subjects was taken every day for a period of 15 days using the syphgmomanometer the researcher who is medical technologist. The by readings were recorded in the medical form and then the average blood pressure was computed.

B. Determination of degree of salt intake

The centrifugal method which is a simpler procedure determining the degree of salt intake was followed in this investigation.

a. The graduated centrifuge tube was filled with urine up to 10 cubic centimeter mark.

b. Then 15 drops of strong nitric acid were dropped into the urine sample.

c. Silver nitrate with a concentration of 12% was then added up to the 15 cc mark.

d. These solutions were mixed thoroughly by inverting centrifuge tube several times. Then the tubes was allowed to stand for 5 minutes.

e. After 5 minutes, the tube was placed in the centrifuge and revolved at about 1200 revolutions per minute for approximately five minutes.

C. Determination of Salt-sensitiveness of Patients

Estimation of chlorides in the body through the urine determines the salt-sensitiveness of a person. The following procedures were then followed in determining salt-sensitiveness of the research subjects:

a. urine collection was gone from midstream voiding.

Here, urine sample was taken during the first urination in the morning. Urine samples were placed in sterilized vials.

b. Collected urine was placed in the graduated cylinder the 10 cubic centimeter mark and diluted up 30 cubic centimeter with distilled water.

c. Then 12 drops of potassium chromate solution was added which served as the indicator.

d. A normal solution of silver nitrate solution added drop by drop until the yellow color turned to red. This is the end point of the analysis.

To read, each cubic centimeter of the nitrate solution centimeter of one percent pure chloride solution. One cubic chloride solution. One cubic centimeter of the nitrate solution therefore is equivalent to 0.01 gram of chloride, mostly in the form of sodium chloride.

If 10 cubic centimeters of silver nitrate solution was required to turn the yellow color to red, the quantity of chloride would then be 0.10 for each cubic centimeter of urine or 10 grams for each liter.

The more the number of cubic centimeter of silver nitrate added to turn the color to red, the more salt- sensitive, the patient is.

Statistical Treatment

To solve sub-problem i which is about the profile of research subjects according to age, sex, blood pressure, degree of salt intake, and salt-sensitiveness, frequency counts and percentages were utilized.

Sub-problem 2 which is about the degree of salt intake of the patients, the mean was solved.

The responses were then categorized into:

	Mean range	Descriptive equivalent
1	0-1.0 vol precipitate of AgC1 in cc	Low
2	1.1-1.9 vol precipitate of AgC1 in cc	Normal
3	2.0-3.0 vol precipitate of AgC1 in cc	High

For sub-problem which deals on the difference between the degree of salt intake of the patients grouped according to age, sex, blood pressure and salt-sensitiveness, analysis of variance (ANOVA) was employed.

Then for sub-problem number 4 on the relationship between hypertension and the degree of salt intake, the chi- square test of independence was solved. The formula is:

$$x^2 = \frac{E\,(fo - fe)^2}{\text{fe}}$$

where:

E= Summation
Fo= observed frequency
fe = expected frequency

When the obtained chi-square value is greater than tabular chi-square value under the 0.5 level of significance, it was considered significant (existence of relationship). When the computed chi-square value is less than the tabular chi-square value, the results were considered insignificant. This means that there is no significant relationship between hypertension and the degree of salt intake.

III. Results and Discussion

Profile of Hypertensive Patients

The profile of hypertensive patients refers to the characteristics of the research subjects who were found to have hypertension by their physicians in terms of age, sex, blood pressure, degree of salt intake and salt- sensitiveness. Hypertension is an abnormality high blood pressure (the presence of the blood in the main arteries).

Profile of Hypertensive

Patients by Age

In this section, the research subject were grouped according to their age range 18-28; 29-39; 40-49; 50-59; and 60- above. Table 2 presents the number and percentage of hypertensive patients according to age.

It is reflected in this table that the highest number and percentage of hypertensive patients belong to age group 40-50 having a frequency of 63 or 46.67 percent. This is followed by those

with ages 29-39 having a frequency of 27 or 20 percent, and then by those with ages 50-59 having a frequency of 24 or 17.78 percent. Only 18 or 13.33 percent

Table 2
Number and Percentage of Hypertensive Patients According to Age

Age	F	Percentage	Rank
18 - 28	3	2.22	5
29 - 39	27	20	2
40 - 49	63	46.6	1
50 - 59	24	17.78	3
60 - above	18	13.33	4
Total	135	100	

of the hypertensive patients belong to age group 60 and above. Individuals with ages 18-28 are not free from hypertension as indicated in the frequency of three or 2.22 percent out of 135 hypertensive patients. Hoebel, let. al. (1972) mentioned that modern diet for infants and growing children seem to be the prime reason behind the increased proneness of the age group to cardiovascular diseases and hypertension. Thus, a majority of individuals who reach the age of 40 become hypertensive although those with ages 18 to 39 are not freed from such diseases. Canopio (1994) also stated that hypertension is common among those over years old.

Thus, a majority of hypertensive patients belong to age 40-50; followed by those with ages 29-39; then by those with ages 50-59; by 60 and above and lastly by the youngest group of patients having age range of 18-28.

Profile of Hypertensive Patients According to Sex

Table 2.a reflects the frequency and percentage of hypertensive patients according to sex.

It is portrayed in the table that out of the total of 135 hypertensive patients, there were 60 or 44.44 percent who were males and there were 75 or 55.56 percent who were females.

So, there were more female hypertensive patients than males.

Table 2.a
Number and Percentage of Hypertensive Patients by Sex

Sex	Number	Percentage	Rank
Male	60	44.44	2
Female	75	55.56	1
Total	135	100	

Profile of Hypertensive Patients By Blood Pressure

According to Wilson (1991), the average normal blood pressure of young adult is 120/80, and the normal range of blood pressure in E healthy young adult is 90 to 140 for the systolic and 60 to 90 for the diastolic. Persistent reading above 140 and 90 diastolic actually indicate hypertension.

Thus, in this section, the research subjects having average blood pressure of more than normal as cited by Wilson were considered to have hypertension. It has to be recalled that the average blood pressure was taken by reading the blood pressure of the research subjects for a period of 15 days.

Table 2.b portrays the number and percentage of the hypertensive patients according to blood pressure.

Table 2.b
Number and Percentage of Hypertensive Patients According to Blood Pressure

Average Blood Pressure	Number	Percentage	Rank
140/90	23	17.04	2
140/100	93	68.89	1
160/90	13	9.63	3
160/100	6	4.44	4
Total	135	100	

It could be deduced from the table that 68.89 percent or 93 of the 135 research subjects had a blood pressure of 140/90. According to Hoeber, et.al. (1972), the normal blood pressure should not be higher than 140/90. In this research, 140/90 was considered high blood pressure because these 23 subjects having this reading belong to early adolescence. According to Bustos (1985), early adulthood comprises individuals ages 10 to 40 years. A Great majority of the 23 respondents have ages 18 to 30. Wilson (1991) mentioned, too that the average normal blood pressure in young adult is 120/80.

There were only six or 4.44 percent of the 135 subjects shaving very high blood pressures with a reading of 160 systolic and 100 diastolic.

The highest number of hypertensive patients (93 or 68.89 percent) had average blood pressure of 140/100. The remaining 13 or 9.63 percent had blood pressure of 160/90.

Thus, rank number 1 were the 93 patients with 140/100 blood pressure. This was followed by those with 140/90; then by those with 160/90; and then by those with blood pressure of 160/100.

Profile of Hypertensive Patients by Degree of Salt Intake

Table 2c shows the number and percentage of hypertensive patients according to the degree of sodium chloride or table salt intake in by them as seen in their urine through urinalysis. Salt intake was categorized according to the following volume precipitate of silver chloride in cubic centimeter:

Category	Vol. Precipitate of AgC1 in cc	Descriptive Equivalent
1	1-1.0	Low Intake
2	1.1-1.9	Normal Intake
3	2.0-3.0	High Intake

Salt is vital to health but the human body needs only 0.2 grams of salt per day which is 1/10 of a teaspoon. Normally, urine contains more or less 15 grams of sodium chloride (Wilson, 1991).

Table 2.c
Number and Percentage of Hypertensive Patients by Degree of Salt Intake

Salt Intake	Number	Percentage	Rank
0-1.0 (Low)	29	21.48	3
1.1-1.9 (Normal)	71	52.59	1
2.0-3.0 (High)	35	25.93	2
Total	135	100	

It could be noted from the table that a greater percentage (52.59 percent) or 71 out of the 135 hypertensive patients had a normal intake of sodium chloride or salt as shown in the 1.1-1.9 results of the urinalysis performed by the researcher.

The 35 or 25.93 percent of the hypertensive patients had high intake of sodium chloride as indicated in the 2.0- 3.0 volume of precipitate of silver chloride in cubic centimeters of salt in the examination of their urine. Only 29 or 21.48 percent had low amounts of sodium chloride or salt intake since they had only from 0 to 1.0 found in their urine.

Thus, a majority of the hypertensive patients had normal salt intake. This was followed by those with high intake and then by those with low salt intake.

Profile of Hypertensive Patients by Salt Sensitiveness

Table 2. d indicates the number and percentage hypertensive patients by salt sensitiveness. Here, the chloride component of the sodium chloride was determined through urinalysis.

Salt sensitiveness among the hypertensive patients was categorized into:

Category	Amount of silver nitrate solution needed to turn the yellow color to red	Descriptive Equivalent
3	15-20 cc	Very high
2	10-14 cc	High
1	1-9 cc	Low

Table 2.d
Number and Percentage of Hypertensive Patients by Salt – sensitiveness

Salt sensitiveness	Number	Percentage	Rank
3 Very high (15-20 cc)	23	17.04	3
2 High (10-14 cc)	31	22.96	2
1 Low	81	60	1
Total	135	100	

It could be gleaned from the table that a greater percentage (60 percent) or 81 out of 135 hypertensive patients had low salt sensitiveness because it only required 1-9 cc of silver nitrate solution to produce a red color.

A total of 31 or 22.96 percent had high salt sensitiveness requiring 10-14 cc of silver nitrate solution.

Only 23 or 17.04 percent had very high salt sensitiveness requiring 15-20 cc silver nitrate solution.

Summarily, majority of the hypertensive patients had low salt-sensitiveness. This was followed by those with high salt-sensitiveness and lastly by those with very high salt-sensitiveness

Degree of Sodium Intake of Hypertensive Patients

Degree of Sodium Intake of Hypertensive Patients by Age

The degree of sodium intake of hypertensive patients was determined by solving for the mean by age.

Table 3 shows the mean degree of sodium intake of hypertensive patients according to age.

The mean values were categorized into the following, based on the volume of precipitate of silver chloride in cubic centimeters:

1	0-1.0	Low
2	1.1-1.9	Normal
3	2.0-3.0	High

It is shown in the table that hypertensive patients had high intake of sodium chloride or salt as seen in the average mean of 3, since all of them had large intake of salt. Those of ages 40 - 49 had high intake of salt, too having a mean of 2.22. Of the 63 subjects aged 40 - 49, only 2 had low intake, while 45 had normal intake and 16 high salt intake. Also, those with ages 60 and above had high intake of salt having a mean of 2.0. Of the 18 subjects, 6 had low sodium intake; another 6 with normal intake and the last 6 had high salt intake.

Table 3
Mean Degree of Sodium Intake of Hypertensive Patients by Age

Degree of Sodium Intake						
Age	1	2	3	Total	Mean	DE
18-28	0	0	3	3	3.0	High
29-39	12	11	4	27	1.7	Normal
40-49	2	45	16	63	2.22	High
50-59	9	9	6	24	1.88	Normal
60-above	6	6	6	18	2.0	High
Total	29	71	35	135	2.04	High

Legend:

1 = low sodium intake
2 = normal sodium intake
3 = high sodium intake
DE = descriptive equivalent

Age groups having normal intake of salt were 29-39 and 50 to 59 with means of 2.22 and 1.88, respectively.

Thus, generally, the hypertensive patients had a high intake of sodium chloride since the average mean is 2.04.

Degree of Salt Intake by Sex

Table 3.a reflects the mean degree of salt intake of hypertensive patients grouped according to sex.

Table 3.a
Mean Degree of Salt Intake of Hypertensive Patients by Sex

Degree of Salt Intake						
Sex	Low (1)	Normal (2)	High (3)	Total	Mean	DE
Male	12	33	15	60	2.05	High
Female	21	33	21	75	2.0	High
Total	33	66	36	135	2.02	High

It is indicated in the table that both sex of hypertensive patients have high intake of salt having means of 2.0 for the females and 2.05 for the males which are both within the range of the mean of 3.

So, the hypertensive patients had high intake of salt of sodium chloride as evidenced by the average mean of 2.02.

Degree of Salt Intake by Blood Pressure

Table 3.b pictures the mean degree of salt intake by hypertensive patients according to blood pressure.

Table 3.b
Mean Degree of Table Salt Intake by Blood Pressure

Degree of Salt Intake						
Blood Pressure	Low	Normal	High	Total	Mean	DE
140/90	3	10	10	23	2.30	High
140/100	17	57	19	93	2.02	High
160/90	6	4	3	13	1.77	Normal
160/100	3	0	3	6	2.00	High
Total	29	71	35	135	2.02	High

It is reflected in the table that only those hypertensive patients with blood pressure of 160/90 had normal intake of salt as shown in the mean value of 1.77 with 6 subjects having low salt intake, 4 normal and 3 with high salt intake.

All other patients with blood pressure ranging from 140/90 to 140/100 and 160/100 had high salt intake having mean values of 2.30; 2.02; and 2.0, respectively.

Thus, generally, hypertensive patients have high salt Intake as shown in the average mean value of 1.02. Sodium chloride is derived chiefly from the food eaten such as crackers, salted foods, cow's milk, junk foods and foods served during meals. According to Mence. et.al., (1980), salt intake does not immediately produce high blood pressure or 8 tendency toward it. It takes many months of continuous high salt intake to produce the high blood pressure.

Degree of Salt Intake of Hypertensive Patients by Salt-Sensitiveness

Table 3.c portrays the mean degree of salt intake of hypertensive patients according to salt-sensitiveness.

It could be gleaned from the table that those with high salt-sensitiveness had normal intake of salt as shown in the mean value of 1.87. Out of the three subjects who had high salt sensitiveness, 12 had low salt intake, 11 normal and 8 high salt intake.

Table 3.c
Mean Degree of Salt Intake of Hypertensive Patients by Salt – Sensitiveness

Salt-sensitiveness	Degree of Salt Intake					
	Low (1)	Normal (2)	High (3)	Total	Mean	DE
Very High (15-20 cc)	9	5	9	23	2.0	High
High (10-14 cc)	12	11	8	31	1.87	Normal
Low (1-9 cc)	8	55	18	81	2.12	High
Total	29	71	35	135	2.04	High

Those with very high salt sensitiveness and low salt sensitiveness had high salt intake as reflected in the mean values of 2.0 and 2.12, respectively. For the 23 subjects with very high salt sensitiveness, 9 had low salt intake, 5 had normal intake and 9 had high salt intake. And then out of the 81 research subjects with low salt sensitiveness, 8 had low-salt intake, 55 normal intake and 35 high salt intake.

Thus, in general, the hypertensive patients grouped according to salt sensitiveness had high salt intake as evidenced by the average mean value of 2.04.

Significant Difference Between the Degree of Salt Intake of Hypertensive Patients

To establish significance of difference in the degree of salt intake of hypertensive patients, the single- classification analysis of variance (ANOVA) was employed.

Table 4 depicts the cross tabulation of frequencies between the degree of salt intake and blood pressure of the hypertensive patients and the computed F-value.

Table 4
Cross Tabulation of Frequencies Between Degree of Salt Intake and Blood Pressure and the F-value

Blood Pressure	Low	Normal	High	Low^2	Normal^2	High^2
140/90	3	10	10	9	100	100
140/100	17	57	19	289	3249	361
160/90	6	4	3	36	16	9
160/100	3	0	3	9	0	9
Total	29	71	35	343	3365	479
EX		135			4187	
$\bar{x}$	7.25	17.75	8.75			
$\bar{x}$		11.25		F = 42.04 (Significant)		

F = 2, 9 = 4.26 at .05 alpha

To solve the problem, the following steps were followed:

A. The Total Sum of Squares

The total sum of squares was obtained by finding the mean of the 12 frequencies taking the deviation of each score from this mean, and squaring and summing these squared deviation. The sum of squares can be obtained by using the following equation (Downie and Health, 1994):

$$SS_t = EX^2 - \frac{(EX)^2}{N}$$

$$= 343 + 3365 + 479 - \frac{(29+71+35)^2}{12}$$

$$= 4187 - \frac{(135)^2}{12}$$

$$= 4187 - \frac{18225}{12}$$

$$= 4187 - 1518.75$$

$$= 2668.25$$

B. The Between Sum of Squares

The sum of the squares between the various groups was solved by taking the mean of each group, getting its deviation from the total mean, squaring this deviation and then multiplying each of these by the number of individuals in each group (n), as follows:

$$SS_b = \frac{(EX)^2}{N} - \frac{(EX)^2}{N}$$
$$= \frac{(29)^2}{4} + \frac{(71)^2}{4} + \frac{(35)^2}{4} - \frac{(135)^2}{12}$$
$$= \frac{841}{4} + \frac{5041}{4} + \frac{1225}{4} - \frac{18225}{12}$$
$$= 210.25 + 1260.25 + 306.25 - 1518.75$$
$$= 1776.75 - 1518.75$$
$$SS_b = 258$$

C. The Within Sum of Squares

To obtain the within sum of squares, the following formula was followed:

For the low group:

$$SS_w = EX^2 - \frac{(EX)^2}{N}$$
$$= 343 - \frac{(29)^2}{4}$$
$$= 343 - 210.25$$
$$= 132.75$$

For normal group:

$$SS = 3365 - \frac{712}{N}$$
$$= 3365 - 1260.25$$
$$= 2104.75$$

For High group:

$$SS = 479 - \frac{35^2}{4}$$
$$= 479 - 306.25$$
$$= 172.75$$

D. Summing for all three groups

$$SS_w = 132.75 + 2104.75 + 172.75$$
$$= 2410.75$$

The within sum of squares added to the between sum of squares should total sum of squares.

258 + 2410.25 = 2668.25

It follows then that the within sum of squares was obtained directly by subtracting the between sum of squares from the total sum of squares.

E. $SS_w = SS_t - SS_b$
$= 2668.25 - 2410.25$
$= 258$

Analysis of Variance of the Data

Source of variation	df	Sum of squares	Mean square
Between Group	2	2410.3	1205.125
Within Group	9	258	28.667
Total	11	2668.3	
F =	42.04		

Then the analysis of variance table is evaluated by the making the following F-test

$$F = \frac{mean - square\ for\ between\ group}{mean - square\ for\ within\ group}$$

$$F = \frac{1205.125}{28.667}$$

= 42.04 (significant)

F 2.9 = 4.26 at 0.5 level of significance
8.02 at 0.1 level of significance

The computed F-value of 42.04 is much greater than the critical F-ratio of 4.26 at the .05 level of significance. Thus, there were significant differences between the degree of salt intake in hypertensive patients with different blood pressure.

Since there were significant differences, in one of these tests, F-test (Schafe, 1957) as cited by Downie and Heath (1984) was followed in solving this problem.

In this problem, there were three means, thus three comparisons were made:

Low vs. Normal
Low vs. High
Normal vs. High
First, for each group an F-ratio like the following was computed.

$$F = \frac{(\bar{x}-\bar{x})^2}{2}$$

$$SS_W = (N1 + N2)/N1\ N2$$

For distribution low and normal:

$$F = \frac{(7.25 - 17.75)^2}{28.667\ (8)/16}$$

$$= \frac{10.5^2}{14.3335}$$

$$= \frac{110.25}{14.3335}$$

$$= 7.69$$

For distribution low and high:

$$F = \frac{(7.25 - 8.75)^2}{14.3335}$$

$$= 2.25/14.3335$$

$$= 0.157$$

For distribution normal and high:

$$F = \frac{(17.75 - 8.75)^2}{14.3335}$$

$$= 81/14.3335$$

$$= 5.65$$

Distribution	Computed F	Significant	Insignificant
Low and Normal	7.69	ü	
Low and High	0.157		ü
Normal and High	5.65	ü	

F 2.9 = 4.26 at 0.05 alpha

It is indicated in the table that two of the distributions have greater F-values than the .05 percent value and these are 7.6 and 5.65; the F-ratio computed between low salt intake and normal and normal and high salt intake. Then, it follows that the mean of normal differs significantly from that of low and high salt intake at the low and high salt intake.

Significant Relationship Between the Degree of Salt Intake and Hypertension

To determine if there is significant relationship between the degree of salt intake and hypertension, the chi-square test of independence was computed at the .05 level of significance.

Table 5 depicts the observed and expected frequencies of pairings of the degree of sodium intake and blood pressure of hypertensive patients.

Table 5
Cross Tabulation of Pairings of Sodium Intake and Blood Pressure and the Chi-Square Value

Degree of Salt Intake	Blood Pressure											
	:	140/90	:	140/100	:	160/90 - 160/100			:	Total		
Low	:	3 (4.94)	:	17 (19.98)	:	9 (4.08)			:	29		
Normal	:	10 (12.10)	:	57 (48.91)	:	4 (9.99)			:	71		
High	:	10 (5.96)	:	19 (24.11)	:	6 (4.84)			:	35		
Total	:	23	:	93	:	19			:	135		
Chi-square	=	16.48 (Significant)										

X^2 at .05 level of significance, df of 4 =9.4888

at .01 level of significance, df of 4 =13.277

The chi-square value as shown in the table is 16.48 which is greater than the tabulated chi-square at .05 level of significance, df of 4 which is only 9.4888. This shows that the null hypothesis of no significant relationship between the degree of salt intake and hypertension has to be rejected, thus the degree of salt intake has something to do with blood pressure or hypertension.

As cited by health and Home (Canopio.1994), sodium in salt may actually be the number cause of hypertension, according to this article, those population consuming very little salt, less than 0.5 grams per day (Eskimos, Quinea. and Solomon Tribes, Australian aborigines) have no incidence of high blood pressure.

On the other hand, Northern Japanese farmers preserved their food with salt and eat an average of 30 grams of salt per day. Hoeber, et.al. (1972), mentioned also that such thing in the diet as the table salt or sodium chloride is one of the suspected cause of hypertension and other diseases.

Significant Relationship Between Degree of Salt-Sensitiveness and Hypertension

Table 5.a presents the observed and expected frequencies of pairings of the degree of sodium intake and salt-sensitiveness of hypertensive patients.

It could be gleaned from the table that there is a need to reject the null hypothesis that there is no significant relationship between salt sensitiveness and hypertension as shown in the significant chi-square value of 20.14 which is greater than the tabular chi- square value of 12.592 at .05 areas level of significance, df of 6. Thus, hypertension is dependent on the salt-sensitiveness of an individual. The higher the salt-sensitiveness the greater is the possibility of high blood pressure among human beings.

Table 5.a
Cross Tabulation of Observed and Expected Frequencies of Blood Pressure and Salt-Sensitiveness and the Chi-Square

Salt Sensitiveness	Blood Pressure									
	:	140/90	:	140/100	:	160/90	:	160/100	:	Total
Very High	:	5 (3.92)	:	9 (15.84)	:	7 (2.21)	:	2 (1.02)	:	23
High	:	6 (5.28)	:	20 (21.36)	:	3 (2.99)	:	2 (1.38)	:	31
Low	:	12 (13.8)	:	64 (55.8)	:	3 (7.8)	:	2 (3.6)	:	81
Total	:	23	:	93	:	13	:	6	:	135
Chi-square value	=	20.14 (significant)								

X^2 at .05 level of significance, df of 6 = 12.592

.01 level of significance, df of 6 = 16.812

Nelson (1991) noted that in some hypertensive patients, the level of sodium intake does influence the blood pressure.

IV. Conclusion

Based on the significant findings made, the following conclusions were formulated:

1. Hypertension is common among those who are over 40 years of age, although younger adults are also affected by persistent high blood pressure.
2. More females have hypertension than males.
3. Hypertensive patients having an average blood pressure of 140/100 have normal intake of salt and have low salt sensitiveness.
4. Individuals with blood pressure of more than 140/100 have high salt intake.
5. Hypertensive patients have different levels of salt intake. The degree of salt intake has something to do with the blood pressure of human beings.
6. The degree of salt intake is significantly related to hypertension.

V. Recommendations

The following recommendations are hereby made based on the conclusions formulated:

1. Teachers in the elementary and high school should include in their lessons the effect of common table salt contained in many processed and junk foods on the blood pressure of man.

2. People especially with high blood pressure should be made aware of the results of this research through the Department of Health.

3. Health researchers should make a follow-up study of this research or conduct a parallel study in other places.

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