

ASSESSING SODIUM CONSUMPTION, DIETARY KNOWLEDGE OF HYPERTENSION MANAGEMENT AND THE IMPACT OF NUTRITIONAL EDUCATION TOOL AMONGST HYPERTENSIVE PATIENTS IN A TEACHING HOSPITAL

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ABSTRACT

Background: Hypertension is a major public health concern in India, with poor awareness and high dietary sodium intake contributing to poor control.

Objective: To assess sodium intake, dietary knowledge, and the impact of a nutrition education tool in hypertensive patients.

Methods: A six-month interventional cohort study was conducted at D.Y. Patil Hospital, Navi Mumbai, with 100 hypertensive patients using food frequency questionnaires and pre- and post-education assessments.

Results: Significant associations were found between BP categories and salt intake, dietary habits (e.g., instant noodles, pickles, bakery items), and demographic factors. Post-intervention, there was a marked improvement in knowledge of dietary management, especially regarding DASH diet, fruit/vegetable intake, and food label awareness. Normal BP was associated with lower salt intake (mean 5.24g vs. 8.56g in elevated BP).

Conclusion: Nutritional education effectively improved awareness and management of hypertension, particularly regarding sodium reduction and diet. However, limitations include single-centre design, short duration and self-reported data.

Keyword - Hypertension, Sodium Intake, Dietary Knowledge, Nutrition Education, DASH Diet, Blood Pressure, India, Salt Consumption, Food Frequency Questionnaire, Lifestyle Modification.

1. Introduction

Hypertension (high blood pressure) is when the pressure in your blood vessels is too high (140/90 mmHg or higher).

[1] Two types of hypertension exist: Primary: Elevated blood pressure unrelated to any other illness. Secondary: Another disease that affects the kidneys, arteries, heart, or endocrine system and raises blood pressure. Among the examples are Issues with sleep, such as sleep apnea, blocked renal arteries in the kidneys, and abnormal levels of hormones regulating blood pressure. [2] Essential, primary, or idiopathic hypertension is defined as high blood pressure without secondary reasons such as renovascular illness, renal failure, pheochromocytoma, aldosteronism, or other causes of secondary hypertension or mendelian variants (monogenic). Essential hypertension makes up 95% of all hypertension cases. Essential hypertension is a diverse illness, with distinct causes of high blood pressure for

each patient. It is necessary to distinguish essential hypertension from other syndromes since most individuals currently diagnosed with essential hypertension have identifiable causes of their elevated blood pressure. [3]

Globally, one in three adults suffers from high blood pressure. The alarming prevalence of hypertension in India's rural and urban populations is a serious threat to the healthcare system in the nation. [4] Over time, a significant upward trend ($P < 0.0001$) was observed in the prevalence of hypertension by gender and region. The ranges for hypertension awareness and control (11 studies) were 20–54% and 7.5–25%, respectively. [5]

Based on the estimations from the World Health Organization (WHO), suboptimal blood pressure (systolic > 115 mmHg) is responsible for roughly 49% of ischemic cardiovascular conditions and 62% of cerebrovascular diseases worldwide, with minimal difference by gender. Heart attack, stroke, kidney failure, and several other related comorbidities are all made more likely by hypertension. Reducing cardiovascular problems is linked to treating elevated blood pressure and keeping it below 140/90 mmHg. Non-communicable diseases (NCDs) like hypertension have notable out-of-pocket costs in nations like India, which significantly impact people with low incomes. A significant amount of spending goes on medications for these chronic illnesses. Because they focus on modifying lifestyles, population-based prevention strategies are highly effective as well as economical. [4]

Common risk factors consist of advancing age, body mass index, smoking, diabetes, and high sodium consumption. India has poor control rates and limited knowledge of hypertension. The risk of cardiovascular disease is high amongst Indians. A critical modifiable risk factor is hypertension. [5]

Risk factors for secondary hypertension.

- Use of oral contraceptives or corticosteroids
- Problems with your adrenal or thyroid glands
- Hormonal disorders or pregnancy
- A congenital defect of the aorta in your heart called coarctation
- Kidney disease, or insufficient blood flow to the kidneys due to arterial blockage
- Alcohol abuse
- Sleep apnea [6]

As per estimations from the Global Burden of Diseases Nutrition and Chronic Diseases Expert Group (NUTRICODE), the average amount of sodium consumed globally in 2010 was 3.95 g/day, with regional averages ranging between 2.18 and 5.51 g/day. As a result, the average sodium intake in this study falls within the global average. The Indian Council of Medical Research executed research in 13 states between 1986 and 1988 that provided the earliest data on salt intake in Asian Indians. The above study revealed that the average per capita salt consumption was 13.8 g/day (i.e., 5.5 g of sodium; 7–26 g/day in these various states). [3] Globally, there are significant variations in the average daily intake of sodium, which ranges from 3.5 to 5.5 g (or 9 to 12 g of salt). In the general population, the World Health Organization recommended limiting sodium intake to about 2.0 g per day (equivalent to about 5.0 g salt per day). In the hypertensive population, which includes over a billion patients around the world, particular focus should be paid to lowering salt intake. [7]

Table -1 Overall Knowledge score about hypertension management [8]

Score level	Male N (%)	Female N (%)	Total N (%)
Inadequate knowledge (< 50%)	155(89.1)	236 (94.4)	391(92.2)
Moderate knowledge (50-75%)	12 (6.9)	10 (4.0)	22 (5.2)
Good knowledge (>75%)	7 (4.0)	4 (1.6)	11 (2.6)

Overall knowledge score on the disease, its consequences, and management practices.

Patients' knowledge regarding hypertension, its consequences, and management techniques was insufficient. Particularly little was known about body weight maintenance, fruit and vegetable consumption, salt intake, and tobacco use. Patients with hypertension must receive the proper information from healthcare professionals about treatment techniques, means of control, and the adverse effects of hypertension. [8]

This study aims to assess sodium consumption patterns, dietary knowledge related to hypertension management, and the impact of a nutritional education tool among hypertensive patients at a teaching hospital. This study will provide insight on how to enhance dietary interventions to improve hypertension control and overall patient outcomes by assessing patients' knowledge, sodium intake, and the impact of nutritional education tool.

2. Objectives

Primary objectives

To assess sodium consumption and dietary knowledge about hypertension management and to measure the impact of educational tools in hypertension management.

Secondary objectives

Observe the frequency of intake of sodium-rich foods.

3. Methodology

3.1 Study Design

This study utilizes an Interventional Cohort Study.

3.2 Study Setting/Site

The study was conducted at D. Y. Hospital, Nerul, Navi Mumbai.

3.3 Study Duration

The study is scheduled to span three months. The Ethical clearance was obtained from the Institutional Ethical Committee before data collection.

3.4 Study Population

Participants in the study are individuals having essential hypertension.

3.5 Sampling Procedure

Convenience sampling will be employed, encompassing all eligible patients diagnosed with essential hypertension.

3.6 Sample Size

The sample size was 100 participants.

3.7 Selection Criteria

Inclusion criteria: Individuals who meet the specified inclusion criteria will be eligible for participation in the study. Essential hypertensive individuals.

Exclusion criteria: Unconscious, mentally retarded, disoriented, Unable to speak.

3.8 Development of tools

The study utilised the following equipment and materials to conduct the research.

a) QUESTIONNAIRE –

DEMOGRAPHIC AND HOUSEHOLD CONSUMPTION OF SALT QUESTIONNAIRE:

This questionnaire focuses on collecting information about anthropometric measurements like height, weight, BMI, etc. Also, household consumption of salt is collected. Through this questionnaire, salt consumption is analysed. Through this questionnaire will be able to understand whether patients are consuming more salt than recommended. Salt consumption is measured by the number of people living together in the house, duration of single salt packet

use, and weight of the salt packet in kgs. Through this information, individuals' daily consumption of salt is calculated.

PRE-EDUCATION QUESTIONNAIRE

This questionnaire focuses on gathering information related to knowledge regarding dietary approaches to hypertension management.

- Basic knowledge: Basic knowledge about hypertension management was asked, like the normal range of blood pressure and taking medications regularly.
- Personal insights: This questionnaire focuses on gathering patients' views on ways to manage hypertension. To analyse how much knowledge patients have regarding ways to manage hypertension.
- Dietary approaches: In this question, it will be analysed how many patients are aware of dietary approaches to hypertension management. Also, the question is asked how often individuals with hypertension should consume fruits and vegetables, which will also indicate dietary awareness to manage hypertension.
- Sodium-related views: These questions will analyse that do people with hypertension know the recommended sodium consumption, do people check labels for sodium content, and awareness about food substitutes for salt.
- Education opportunities: By asking the questionnaire, knowledge about the dietary approach to hypertension management will be analysed, and patients' responses will indicate if there is any knowledge gap in the patients regarding the dietary approach to hypertension management.

POST-EDUCATION QUESTIONNAIRE

This questionnaire focuses on questions asked as same as the pre-education test, but after educational intervention.

- Knowledge about dietary hypertension management: This will help analyse whether the has helped to bridge the gap of dietary knowledge.
- Giving variations: This will help patients to follow different aspects of hypertension management and will encourage people to do so.
- Food substitutes: This will help patients reduce salt intake as well as make food delicious by adding some food substitutes.
- Encouraging patients: It will also encourage patients to read food labels for sodium content.

b) DEVELOPMENT OF TOOL

- The title of the educational tool is “Diet in Hypertension.” This tool will provide information about dietary approaches to hypertension management and many other aspects.
- Basic information: This tool provides information about what hypertension is and the normal blood pressure range.
- Knowledge regarding Diet: This tool focuses on providing information about types of diets in hypertension management. Information regarding the Dietary Approach to Stop Hypertension (DASH) and, Mediterranean diet will be explained.
- Foods to avoid: Sodium-rich foods are to be avoided. A list of food products is mentioned in the tool, which are high in sodium and are to be avoided.
- The recommended daily sodium intake is mentioned in the tool, also to make it easy to understand household measure of salt is also provided.
- As there are many preservatives used in products, it is important to check the sodium content on the food label before consuming it.
- Food substitutes: A list of food substitutes for salt is mentioned in the tool. This will help patient reduce their daily salt intake.

• Effective ways to manage hypertension: ways to manage hypertension are mentioned in the tool apart from dietary management. This will help the patient to have better control of their blood pressure level.

3.9 Method of Data Collection

- The research was conducted at D.Y. Patil Hospital in Nerul, Navi Mumbai.
- Patients admitted to the hospital who met the inclusion criteria were enrolled in the study.
- Each patient received consent forms along with a patient information sheet in which the purpose, duration, location, benefits, and other relevant information were mentioned.
- The investigator used a demographic and household salt consumption questionnaire, a food frequency questionnaire, along with a pre-education questionnaire to collect information.
- With the help of an educational tool, an educational intervention was done.
- Immediately after the educational intervention, a post-education test was conducted by the investigator.
- SPSS was used to code and analyse all the gathered data.
- To conclude, the results and outcomes were discussed.
- The final report was prepared.

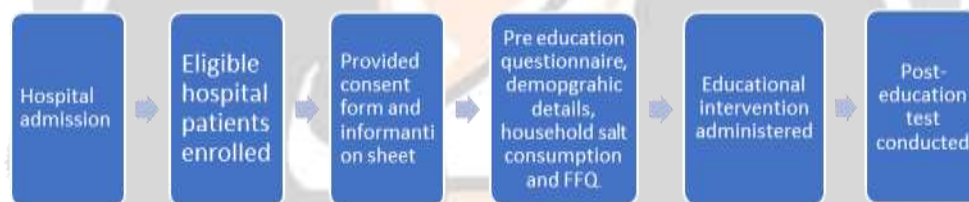


Fig -1 Methods of Data Collection

3.10 Method of Data collection relevant to the objective

The information was collected with the help of demographic details, household salt consumption, the Food Frequency Questionnaire, and a pre- and post-educational test. This comprised anthropometric details, consumption of salt, consumption of foods high in sodium, and knowledge of dietary approaches to hypertension management. An educational tool containing information about a dietary approach to manage hypertension, ways to reduce hypertension, and food substitutes for salt was utilised to educate the patient.

3.11 Data Analysis and Methods

The data analysis includes a total of 100 pre- and post-educational questionnaires. To provide a reasonable conclusion for the research, statistical analysis was conducted. Data analyses were done using a Windows-based statistical program, Stata version 13.1 (Stata Corp, USA).

The statistical analysis primarily utilized the Chi-Square (χ^2) test and ANOVA. The Chi-Square test was applied to assess associations between categorical variables, including blood pressure categories and factors such as dietary habits, hypertension management practices, and food consumption frequency. A significance of 0.05 for the P-value was utilised.

4. Results

4.1 Demographic data

Based on the findings presented in Table – 1 , there is a significant association between demographic characteristics and blood pressure awareness among hypertensive patients, which directly supports the study's primary objective— to assess sodium consumption, dietary knowledge, and the impact of educational tools on hypertension management. The data revealed that younger participants (<50 years) were more likely to be aware of their blood pressure status, with 58.8% of those in the <120/80 mmHg group falling in this age bracket ($p = 0.015$). Gender also played a notable role, with males predominantly represented in the higher BP categories and females making up the majority of those unaware of their BP readings ($p = 0.018$). Education level showed a highly significant correlation with BP awareness ($p < 0.0001$); nearly half (47.6%) of participants unaware of their BP had no formal education, whereas those with graduate-level education were more likely to have normal or controlled readings. Similarly, occupational status was linked to hypertension awareness ($p = 0.002$), with employed individuals demonstrating better BP knowledge and control. In contrast, those involved in household roles, retired, or engaged in labor work were more frequently unaware of their BP status. These findings highlight the need for targeted educational interventions, especially among older, less-educated, and unemployed populations, to improve dietary knowledge and sodium intake management in the context of hypertension.

Table -1: Demographic & Anthropometric characteristics of participants (n=100)

	<120/80 mmHg (n=17)		130/80 mmHg (n=15)		140/90 mmHg (n=05)		Don't know (n=63)		Total (n=100)		Chi-Square Test	
	No.	%	No.	%	No.	%	No.	%	No.	%	χ^2	'p'
Age Groups												
<50 yrs.	10	58.8%	8	53.3%	1	20.0%	15	23.8%	34	34.0%	10.519	0.015
>50 yrs	7	41.2%	7	46.7%	4	80.0%	48	76.2%	66	66.0%		
Gender												
Male	3	17.6%	10	66.7%	3	60.0%	36	57.1%	52	52.0%	10.126	0.018
Female	14	82.4%	5	33.3%	2	40.0%	27	42.9%	48	48.0%		
Education Level												
No formal education	1	5.9%	0	0.0%	0	0.0%	30	47.6%	31	31.0%	50.746	<0.0001
Primary school	0	0.0%	4	26.7%	1	20.0%	12	19.0%	17	17.0%		
High school	1	5.9%	5	33.3%	2	40.0%	10	15.9%	18	18.0%		
Undergraduate	1	5.9%	1	6.7%	1	20.0%	3	4.8%	6	6.0%		
Postgraduate	2	11.8%	0	0.0%	0	0.0%	2	3.2%	4	4.0%		
Graduate	12	70.6%	5	33.3%	1	20.0%	6	9.5%	24	24.0%		
Occupation												
Employed	12	70.6%	12	80.0%	4	80.0%	15	23.8%	43	43.0%	31.763	0.002
Household Roles	5	29.4%	1	6.7%	0	0.0%	23	36.5%	29	29.0%		
Labor/Skilled Work	0	0.0%	0	0.0%	0	0.0%	9	14.3%	9	9.0%		
Retired	0	0.0%	1	6.7%	1	20.0%	14	22.2%	16	16.0%		
Unemployed	0	0.0%	1	6.7%	0	0.0%	2	3.2%	3	3.0%		

n: Count, Yrs: Years; mmHg: millimetres of mercury. χ^2 (Chi-Square Test Statistic): A statistical measure used to determine if there is a significant association between categorical variables; 'p' (p-value): The probability that the observed results occurred by chance. A p-value ≤ 0.05 indicates a statistically significant association.

4.2 Food Frequency Questionnaire

Certain high-sodium processed foods (like noodles, sauces, and pickles) may be positively associated with higher blood pressure, indicating a possible dietary risk factor for hypertension.

Table 2: Food frequency questionnaire (n=100)

	<120/80 mmHg (n=17)		130/80 mmHg (n=15)		140/90 mmHg (n=05)		Don't know (n=63)		Total (n=100)		Chi-Square Test	
	No.	%	No.	%	No.	%	No.	%	No.	%	X ²	p'
FOOD FREQUENCY QUESTIONNAIRE												
Instant food Items												
<i>Instant Soup</i>												
Never	13	76.50%	14	93.30%	4	80.00%	54	85.70%	85	85.00%	2.479	0.871
Weekly	1	5.90%	0	-	0	-	2	3.20%	3	3.00%		
Monthly	3	17.60%	1	6.70%	1	20.00%	7	11.10%	12	12.00%		
Total	17	100.00%	15	100.00%	5	100.00%	63	100.00%	100	100.00%		
<i>Instant Noodles</i>												
Never	9	52.90%	7	46.70%	4	80.00%	56	88.90%	76	76.00%	24.098	0.004
Daily	0	-	1	6.70%	0	-	0	-	1	1.00%		
Weekly	0	-	1	6.70%	0	-	1	1.60%	2	2.00%		
Monthly	8	47.10%	6	40.00%	1	20.00%	6	9.50%	21	21.00%		
Total	17	100.00%	15	100.00%	5	100.00%	63	100.00%	100	100.00%		
Seasonings												
<i>Seasoning Cubes</i>												
Never	13	76.50%	13	86.70%	4	80.00%	53	84.10%	83	83.00%	4.413	0.621
Weekly	3	17.60%	0	-	1	20.00%	6	9.50%	10	10.00%		
Monthly	1	5.90%	2	13.30%	0	-	4	6.30%	7	7.00%		
<i>Seasoning Masala</i>												
Never	11	64.70%	13	86.70%	3	60.00%	52	82.50%	79	79.00%	6.971	0.324
Weekly	5	29.40%	1	6.70%	2	40.00%	7	11.10%	15	15.00%		
Monthly	1	5.90%	1	6.70%	0	-	4	6.30%	6	6.00%		
<i>Magic Masala</i>												
Never	5	29.40%	6	40.00%	2	40.00%	40	63.50%	53	53.00%	15.672	0.074
Daily	1	5.90%	1	6.70%	0	-	1	1.60%	3	3.00%		
Weekly	9	52.90%	4	26.70%	3	60.00%	19	30.20%	35	35.00%		
Monthly	2	11.80%	4	26.70%	0	-	3	4.80%	9	9.00%		
<i>Chaot Masala</i>												
Never	3	17.60%	2	13.30%	0	-	9	14.30%	14	14.00%	3.495	0.941
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	<120/80 mmHg (n=17)		130/80 mmHg (n=15)		140/90 mmHg (n=05)		Don't know (n=63)		Total (n=100)		Chi-Square Test	
	No.	%	No.	%	No.	%	No.	%	No.	%	X ²	p'
Daily	1	5.90%	0	-	0	-	5	7.90%	6	6.00%		
Weekly	9	52.90%	10	66.70%	4	80.00%	39	61.90%	62	62.00%		
Monthly	4	23.50%	3	20.00%	1	20.00%	10	15.90%	18	18.00%		
Sauces												
<i>Tomato Sauce</i>												
Never	4	23.50%	1	6.70%	0	-	24	38.10%	29	29.00%	20.495	0.015
Daily	1	5.90%	0	-	0	-	0	-	1	1.00%		
Weekly	7	41.20%	13	86.70%	5	100.00%	30	47.60%	55	55.00%		
Monthly	5	29.40%	1	6.70%	0	-	9	14.30%	15	15.00%		
<i>Barbecue Sauce</i>												
Never	12	70.60%	14	93.30%	3	60.00%	59	93.70%	88	88.00%	29.809	<0.0001
Daily	1	5.90%	0	-	0	-	0	0.00%	1	1.00%		
Weekly	0	-	0	-	1	20.00%	0	0.00%	1	1.00%		
Monthly	4	23.50%	1	6.70%	1	-	4	6.30%	10	10.00%		
<i>Soy Sauce</i>												
Never	7	41.20%	3	20.00%	3	60.00%	40	63.50%	53	53.00%	23.341	0.005
Daily	1	5.90%	0	-	0	-	0	-	1	1.00%		
Weekly	2	11.80%	8	53.30%	0	0.00%	9	14.30%	19	19.00%		
Monthly	7	41.20%	4	26.70%	2	40.00%	14	22.20%	27	27.00%		
<i>Chilli Sauce</i>												
Never	7	41.20%	3	20.00%	3	60.00%	39	61.90%	52	52.00%	22.647	0.007
Daily	1	5.90%	0	-	0	-	0	-	1	1.00%		
Weekly	2	11.80%	8	53.30%	0	-	9	14.30%	19	19.00%		
Monthly	7	41.20%	4	26.70%	2	40.00%	15	23.80%	28	28.00%		
Pickle												
Never	2	11.80%	1	6.70%	1	20.00%	0	-	4	4.00%	17.399	0.043
Daily	3	17.60%	3	20.00%	1	20.00%	20	31.70%	27	27.00%		
Weekly	9	52.90%	11	73.30%	3	60.00%	41	65.10%	64	64.00%		
Monthly	3	17.60%	0	-	0	-	2	3.20%	5	5.00%		
Papad												
Never	2	11.80%	0	-	0	-	2	3.20%	4	4.00%	11.877	0.220
Daily	2	11.80%	3	20.00%	1	20.00%	20	31.70%	26	26.00%		

	<120/80 mmHg (n=17)		130/80 mmHg (n=15)		140/90 mmHg (n=05)		Don't know (n=63)		Total (n=100)		Chi-Square Test	
	No.	%	No.	%	No.	%	No.	%	No.	%	X ²	p'
Weekly	11	64.70%	12	80.00%	4	80.00%	40	63.50%	67	67.00%		
Monthly	2	11.80%	0	-	0	-	1	1.60%	3	3.00%		
Bakery products												
<i>Bread</i>												
Never	4	23.50%	0	-	1	20.00%	15	23.80%	20	20.00%	10.08	0.344
Daily	2	11.80%	2	13.30%	1	20.00%	13	20.60%	18	18.00%		
Weekly	7	41.20%	12	80.00%	2	40.00%	26	41.30%	47	47.00%		
Monthly	4	23.50%	1	6.70%	1	20.00%	9	14.30%	15	15.00%		
<i>Biscuit</i>												
Never	3	17.60%	1	6.70%	0	-	3	4.80%	7	7.00%	20.45	0.015
Daily	7	41.20%	14	93.30%	5	100.00%	53	84.10%	79	79.00%		
Weekly	5	29.40%	0	-	0	-	6	9.50%	11	11.00%		
Monthly	2	11.80%	0	-	0	-	1	1.60%	3	3.00%		
<i>Khari</i>												
Never	7	41.20%	9	60.00%	3	60.00%	19	30.20%	38	38.00%	27.272	0.001
Daily	3	17.60%	6	40.00%	2	40.00%	36	57.10%	47	47.00%		
Weekly	4	23.50%	0	-	0	-	8	12.70%	12	12.00%		
Monthly	3	17.60%	0	-	0	-	0	-	3	3.00%		
<i>Butter Bakery Item</i>												
Never	10	58.80%	13	86.70%	5	100.00%	42	66.70%	70	70.00%	14.881	0.094
Daily	1	5.90%	1	6.70%	0	-	9	14.30%	11	11.00%		
Weekly	3	17.60%	1	6.70%	0	-	11	17.50%	15	15.00%		
Monthly	3	17.60%	0	-	0	-	1	1.60%	4	4.00%		
Indian Namkeen Snacks												
<i>Rusk</i>												
Never	10	58.80%	13	86.70%	5	100.00%	39	61.90%	67	67.00%	21.184	0.012
Daily	0	-	2	13.30%	0	-	12	19.00%	14	14.00%		
Weekly	5	29.40%	0	-	0	-	12	19.00%	17	17.00%		
Monthly	2	11.80%	0	-	0	-	0	-	2	2.00%		
<i>Salted Nuts</i>												
Never	10	58.80%	11	73.30%	3	60.00%	50	79.40%	74	74.00%	10.769	0.292
Daily	1	5.90%	0	-	0	-	0	-	1	1.00%		
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	<120/80 mmHg (n=17)		130/80 mmHg (n=15)		140/90 mmHg (n=05)		Don't know (n=63)		Total (n=100)		Chi-Square Test	
	No.	%	No.	%	No.	%	No.	%	No.	%	X ²	p'
Weekly	2	11.80%	1	6.70%	0	-	1	1.60%	4	4.00%		
Monthly	4	23.50%	3	20.00%	2	40.00%	12	19.00%	21	21.00%		
<i>Salted Peanuts</i>												
Never	9	52.90%	0	-	1	20.00%	17	27.00%	27	27.00%	20.752	0.014
Daily	1	5.90%	0	-	0	-	0	-	1	1.00%		
Weekly	2	11.80%	9	60.00%	3	60.00%	20	31.70%	34	34.00%		
Monthly	5	29.40%	6	40.00%	1	20.00%	26	41.30%	38	38.00%		
<i>Chivda</i>												
Never	1	5.90%	1	6.70%	1	20.00%	6	9.50%	9	9.00%	2.947	0.966
Daily	1	5.90%	0	-	0	-	1	1.60%	2	2.00%		
Weekly	10	58.80%	9	60.00%	3	60.00%	38	60.30%	60	60.00%		
Monthly	5	29.40%	5	33.30%	1	20.00%	18	28.60%	29	29.00%		
<i>Chakli</i>												
Never	5	29.40%	1	6.70%	3	60.00%	20	31.70%	29	29.00%	9.063	0.432
Daily	1	5.90%	0	-	0	-	1	1.60%	2	2.00%		
Weekly	6	35.30%	8	53.30%	2	40.00%	25	39.70%	41	41.00%		
Monthly	5	29.40%	6	40.00%	0	-	17	27.00%	28	28.00%		
<i>Potato Chips</i>												
Never	4	23.50%	2	13.30%	2	40.00%	29	46.00%	37	37.00%	13.603	0.137
Daily	1	5.90%	0	-	0	-	0	-	1	1.00%		
Weekly	5	29.40%	3	20.00%	1	20.00%	14	22.20%	23	23.00%		
Monthly	7	41.20%	10	66.70%	2	40.00%	20	31.70%	39	39.00%		
<i>Salted Biscuits</i>												
Never	6	35.30%	1	6.70%	1	20.00%	15	23.80%	23	23.00%	12.118	0.207
Daily	3	17.60%	1	6.70%	1	20.00%	6	9.50%	11	11.00%		
Weekly	2	11.80%	8	53.30%	1	20.00%	30	47.60%	41	41.00%		
Monthly	6	35.30%	5	33.30%	2	40.00%	12	19.00%	25	25.00%		
<i>Aaloo Bhujiya</i>												
Never	5	29.40%	1	6.70%	2	40.00%	22	34.90%	30	30.00%	11.023	0.274
Daily	1	5.90%	0	-	1	20.00%	3	4.80%	5	5.00%		
Weekly	3	17.60%	3	20.00%	0	-	14	22.20%	20	20.00%		
Monthly	8	47.10%	11	73.30%	2	40.00%	24	38.10%	45	45.00%		

	<120/80 mmHg (n=17)		130/80 mmHg (n=15)		140/90 mmHg (n=05)		Don't know (n=63)		Total (n=100)		Chi-Square Test	
	No.	%	No.	%	No.	%	No.	%	No.	%	X ²	p'
Kurkure												
Never	12	70.60%	11	73.30%	4	80.00%	54	85.70%	81	81.00%	11.138	0.266
Daily	2	11.80%	0	-	0	-	1	1.60%	3	3.00%		
Weekly	1	5.90%	1	6.70%	1	20.00%	5	7.90%	8	8.00%		
Monthly	2	11.80%	3	20.00%	0	-	3	4.80%	8	8.00%		
Processed foods												
<i>Salted Butter</i>												
Never	9	52.90%	4	26.70%	1	20.00%	41	65.10%	55	55.00%	30.113	<0.0001
Daily	2	11.80%	0	-	0	-	1	1.60%	3	3.00%		
Weekly	4	23.50%	0	-	0	-	4	6.30%	8	8.00%		
Monthly	2	11.80%	11	73.30%	4	80.00%	17	27.00%	34	34.00%		
<i>Processed Cheese</i>												
Never	8	47.10%	2	13.30%	2	40.00%	34	54.00%	46	46.00%	23.214	0.006
Daily	2	11.80%	0	-	0	-	1	1.60%	3	3.00%		
Weekly	3	17.60%	1	6.70%	1	20.00%	1	1.60%	6	6.00%		
Monthly	4	23.50%	12	80.00%	2	40.00%	27	42.90%	45	45.00%		
<i>Frozen Food Chicken Fish Fries Tikki</i>												
Never	9	52.90%	2	13.30%	3	60.00%	33	52.40%	47	47.00%	17.911	0.036
Daily	2	11.80%	0	-	0	-	1	1.60%	3	3.00%		
Weekly	2	11.80%	1	6.70%	0	-	2	3.20%	5	5.00%		
Monthly	4	23.50%	12	80.00%	2	40.00%	27	42.90%	45	45.00%		
Salted Dry Fish												
Never	9	52.90%	7	46.70%	3	60.00%	28	44.40%	47	47.00%	16	0.067
Daily	2	11.80%	0	-	0	-	1	1.60%	3	3.00%		
Weekly	1	5.90%	7	46.70%	2	40.00%	27	42.90%	37	37.00%		
Monthly	5	29.40%	1	6.70%	0	-	7	11.10%	13	13.00%		
Canned Foods												
Never	15	88.20%	15	100.00%	4	80.00%	62	98.40%	96	96.00%	24.676	<0.0001
Daily	2	11.80%	0	-	0	-	1	1.60%	3	3.00%		
Weekly	0	-	0	-	0	0.00%	0	-	0	-		
Monthly	0	-	0	-	1	20.00%	0	-	1	1.00%		
Pizza												
	<120/80 mmHg (n=17)		130/80 mmHg (n=15)		140/90 mmHg (n=05)		Don't know (n=63)		Total (n=100)		Chi-Square Test	
	No.	%	No.	%	No.	%	No.	%	No.	%	X ²	p'
Never	7	41.20%	12	80.00%	2	40.00%	53	84.10%	74	74.00%	22.312	0.008
Daily	2	11.80%	0	-	0	-	1	1.60%	3	3.00%		
Weekly	1	5.90%	0	-	0	-	0	-	1	1.00%		
Monthly	7	41.20%	3	20.00%	3	60.00%	9	14.30%	22	22.00%		
Indian Chinese Foods Msg												
Never	8	47.10%	3	20.00%	3	60.00%	41	65.10%	55	55.00%	27.245	0.001
Daily	2	11.80%	0	-	0	-	1	1.60%	3	3.00%		
Weekly	2	11.80%	9	60.00%	0	-	8	12.70%	19	19.00%		
Monthly	5	29.40%	3	20.00%	2	40.00%	13	20.60%	23	23.00%		
Mayonnaise Flavoured												
Never	9	52.90%	4	26.70%	3	60.00%	47	74.60%	63	63.00%	35.602	<0.0001
Daily	2	11.80%	0	-	0	-	1	1.60%	3	3.00%		
Weekly	3	17.60%	0	-	1	20.00%	0	-	4	4.00%		
Monthly	3	17.60%	11	73.30%	1	20.00%	15	23.80%	30	30.00%		
Flavoured Popcorn												
Never	8	47.10%	7	46.70%	3	60.00%	46	73.00%	64	64.00%	13.082	0.159
Daily	2	11.80%	0	-	0	-	1	1.60%	3	3.00%		
Weekly	1	5.90%	0	-	0	-	1	1.60%	2	2.00%		
Monthly	6	35.30%	8	53.30%	2	40.00%	15	23.80%	31	31.00%		

n: Count, mmHg: millimetres of mercury; X² (Chi-Square Test Statistic): A statistical measure used to determine if there is a significant association between categorical variables; 'p' (p-value): The probability that the observed results occurred by chance. A p-value ≤ 0.05 indicates a statistically significant association.

4.3 Improvement from pre- to post-intervention treatment (n=100)

The intervention, likely a nutritional education program, led to significant improvements in hypertensive patients' awareness and behaviors related to blood pressure management. Key areas with dramatic positive change included knowledge of salt reduction, regular exercise, medication adherence, the DASH and Mediterranean diets, increased consumption of fruits and vegetables, and checking food labels for sodium, most rising to 95-98% post-intervention. "Don't know" responses were eliminated, indicating a strong overall knowledge gain. Moderate improvements were seen in stress management and sodium intake awareness, while behaviors like regular medication use were already high and slightly improved. However, there was no improvement in awareness of low-fat and high-protein diets, suggesting these were not emphasized during the program.

Table 3: Improvement from pre- to post-intervention treatment (n=100)

		Improvement			
		Pre-Intervention		Post-Intervention	
		No.	%	No.	%
Blood Pressure	No	83	83.0%	2	2.0%
	Yes	17	17.0%	98	98.0%
Regular Medications	No	10	10.0%	3	3.0%
	Yes	90	90.0%	97	97.0%
Reduce Salt Intake	No	79	79.0%	2	2.0%
	Yes	21	21.0%	98	98.0%
Exercise Regularly	No	81	81.0%	25	25.0%
	Yes	19	19.0%	75	75.0%
Manage Stress	No	86	86.0%	43	43.0%
	Yes	14	14.0%	57	57.0%
Medication Adherence	No	45	45.0%	4	4.0%
	Yes	55	55.0%	96	96.0%
Don't Know (1st Response)	No	61	61.0%	100	100.0%
	Yes	39	39.0%	0	0.0%
Low Fat Diet	No	76	76.0%	100	100.0%
	Yes	24	24.0%	0	0.0%
DASH Diet	No	96	96.0%	5	5.0%
	Yes	4	4.0%	95	95.0%
High Protein Diet	No	92	92.0%	100	100.0%
	Yes	8	8.0%	0	0.0%
Mediterranean Diet	No	97	97.0%	34	34.0%
	Yes	3	3.0%	66	66.0%
Don't Know (2nd Response)	No	35	35.0%	100	100.0%
	Yes	65	65.0%	0	0.0%
Consume Vegetables	No	89	89.0%	2	2.0%
	Yes	11	11.0%	98	98.0%
Consume Fruits	No	89	89.0%	2	2.0%
	Yes	11	11.0%	98	98.0%
Awareness of Sodium Intake	No	93	93.0%	96	96.0%
	Yes	7	7.0%	4	4.0%
Check Food Labels for Sodium	No	83	83.0%	2	2.0%
	Yes	17	17.0%	98	98.0%
Enhance Taste of Food	Yes	5	5.0%	4	4.0%
	No	95	95.0%	96	96.0%

5. Discussion

This study assessed sodium consumption, dietary knowledge, and the impact of a nutritional education intervention on hypertension management among 100 hypertensive patients in a teaching hospital using a pre-post study design. Demographic, anthropometric, and socio-economic data were collected alongside dietary habits and hypertension awareness. Significant associations were found between blood pressure categories and factors such as age, gender, education, occupation, and daily salt intake ($p < 0.05$), with higher sodium intake linked to elevated BP. Consumption of specific high-sodium foods (instant noodles, sauces, pickles, biscuits, khari, and rusk) showed significant associations with BP levels, while other snacks did not. Pre-intervention data revealed limited awareness of hypertension management practices, specific diets (DASH, Mediterranean), and sodium monitoring, with

significant variations across BP groups. Post-intervention, there was a marked improvement in knowledge and practices, including near-universal awareness of salt reduction, dietary changes, and label reading ($\geq 98\%$), and significantly increased intake of fruits and vegetables (98%). While medication adherence remained consistently high, awareness of DASH diet improved significantly, whereas knowledge of low-fat and high-protein diets remained low. These findings highlight the effectiveness of targeted educational interventions in improving dietary behaviors and hypertension management.

A 2010 Nkosi, N. G., & Wright, S. C. D. study in Ga-Rankuwa day clinics revealed that higher nutrition knowledge was strongly associated with better diet quality and a significantly lower risk of hypertension, though multivariate analysis showed that diet quality (DASH score) did not mediate this relationship; the study also revealed that participants lacked practical knowledge of a balanced diet for hypertension and failed to translate information into behavior change, maintaining their risk levels. [9] A 2009 Grimes, C. A., Riddell, L. J., & Nowson, C. A. study on consumer knowledge and attitudes toward salt intake and labelled salt information revealed that about 50% of participants were unable to correctly identify low-sodium options using food labels; while increasing awareness of the health risks of excessive salt intake may encourage use of salt labels and low-salt purchases, the study also highlighted the need for more user-friendly labelling to effectively guide consumer. [10] A 2014 Doménech, M., Romanet al. one-year randomized clinical trial from the PREDIMED study revealed that Mediterranean diets supplemented with nuts or extra virgin olive oil significantly reduced 24-hour ambulatory blood pressure, total cholesterol, and fasting glucose in high-risk individuals, most of whom had treated hypertension, and also led to fewer cardiovascular events, including stroke, compared to a lower-fat control diet. [11] The study's findings are limited by its convenience sampling and single-center design, which restricts generalizability. The reliance on self-reported data from food frequency and knowledge questionnaires introduces potential recall and social desirability biases. The three-month duration might be insufficient to assess long-term impacts, and the assessment of sodium intake through questionnaires lacks the precision of more objective methods like urinary sodium excretion.

6. CONCLUSION

In conclusion, this study shows that nutritional education appears to have been highly effective in improving hypertensive patients' knowledge, and awareness related to various aspects of hypertension management, particularly regarding dietary changes (salt reduction, vegetable/fruit consumption, understanding the DASH and Mediterranean diets, checking food labels for sodium) and medication adherence. The concerning shift in the perception of blood pressure control likely indicates increased awareness of uncontrolled hypertension rather than a negative health outcome and warrants further investigation. Those with normal blood pressure consumed a mean of 5.24 g, compared to 8.56 g in the elevated blood pressure group and 7.94 g in the unknown blood pressure group. These findings strongly support the link between excessive sodium consumption and poor blood pressure control, highlighting the importance of interventions aimed at dietary sodium reduction.

Overall, the study concludes that the nutritional education tool was highly effective in enhancing patients' capacity to manage their hypertension, with significant implications for improving adherence to lifestyle modifications and dietary recommendations. Also, sodium consumption was significantly higher in hypertensive patients.

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