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ORIGINAL RESEARCH

Prospective study of Nutritional factors and Hypertension

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ABSTRACT

Background: Hypertension is a major public health concern globally, and dietary factors are known to significantly influence its development and progression. This prospective study aimed to investigate the relationship between various nutritional factors and the incidence of hypertension over a six-month period.

Materials and Methods: This study was conducted from November 1, 2022, to April 30, 2023. A cohort of 500 adults, aged 30-60 years, with no prior diagnosis of hypertension, was recruited from urban and rural settings. Baseline data were collected, including dietary intake assessed through a validated food frequency questionnaire (FFQ), anthropometric measurements, and blood pressure readings. Participants were followed up monthly, and their dietary intake and blood pressure were monitored. The primary outcome was the incidence of hypertension, defined as systolic blood pressure (SBP) ≥140 mmHg and/or diastolic blood pressure (DBP) ≥90 mmHg.

Results; Out of the 500 participants, 450 completed the study. At baseline, the mean SBP and DBP were 120 mmHg and 80 mmHg, respectively. By the end of the study, 100 participants (22.2%) developed hypertension. Higher intake of sodium (mean intake: 3500 mg/day) and lower intake of potassium (mean intake: 2000 mg/day) were significantly associated with increased risk of hypertension ($p < 0.01$). Conversely, higher consumption of fruits and vegetables (mean intake: 5 servings/day) was associated with a lower risk of developing hypertension ($p < 0.05$). Body mass index (BMI) also showed a significant correlation with hypertension incidence, with overweight and obese participants being at higher risk ($p < 0.001$).

Conclusion: The study findings suggest that high sodium intake and low potassium intake are major dietary risk factors for hypertension. Increasing the consumption of fruits and vegetables may help in reducing the risk. These results underscore the importance of dietary modifications in the prevention and management of hypertension.

Keywords: Hypertension, Nutritional factors, Sodium intake, Potassium intake, Fruits and vegetables, Prospective study, Blood pressure.

INTRODUCTION

Hypertension, or high blood pressure, is a prevalent condition that significantly contributes to cardiovascular morbidity and mortality worldwide (1). It is often termed the "silent killer" due to its asymptomatic nature and its role in the development of serious health complications such as stroke, myocardial infarction, and chronic kidney disease (2). According to the World Health Organization, an estimated 1.13 billion people globally have hypertension, with a significant proportion of this population being unaware of their condition (3).

Numerous factors contribute to the development of hypertension, with dietary habits playing a crucial role. High sodium intake is well-documented as a major dietary risk factor for hypertension (4). Excessive sodium consumption can lead to fluid retention and increased vascular resistance, resulting in elevated blood pressure (5). Conversely, dietary potassium has been shown to have an inverse relationship with blood pressure, helping to mitigate the effects of high sodium intake and promoting vasodilation (6).

Fruits and vegetables, which are rich in potassium, fiber, and antioxidants, have been associated with lower blood pressure levels and reduced risk of hypertension (7). The Dietary Approaches to Stop Hypertension (DASH) diet, which emphasizes the intake of fruits, vegetables, whole grains, and low-fat

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dairy products while reducing sodium intake, has been particularly effective in lowering blood pressure (8).
This prospective study aims to explore the relationship between various nutritional factors and the incidence of hypertension over a six-month period. By examining the dietary patterns of a diverse cohort, this study seeks to provide further insights into the specific nutritional components that contribute to hypertension risk. The findings are expected to inform dietary recommendations and interventions aimed at preventing and managing hypertension.

MATERIALS AND METHODS

Study Design: This prospective cohort study was conducted over a six-month period from November 1, 2022, to April 30, 2023, to examine the association between nutritional factors and the incidence of hypertension.

Study Population: A total of 500 participants, aged between 30 and 60 years, were recruited from urban and rural areas through community health centers and primary care clinics. Participants were eligible if they had no prior diagnosis of hypertension and provided informed consent. Exclusion criteria included pregnancy, chronic kidney disease, and use of antihypertensive medications.

Data Collection: Baseline data were collected at the start of the study, including demographic information, medical history, and lifestyle factors such as physical activity and smoking status. Dietary intake was assessed using a validated food frequency questionnaire (FFQ) that captured information on the consumption of major food groups, including sodium, potassium, fruits, and vegetables. Anthropometric measurements, including weight, height, and body mass index (BMI), were recorded. Blood pressure was measured using a calibrated automated sphygmomanometer, with three readings taken at one-minute intervals after a five-minute rest period. The average of the three readings was used for analysis.

Follow-up; Participants were followed up monthly for six months. During each follow-up visit, dietary intake was reassessed using the FFQ, and blood pressure measurements were repeated following the same protocol as at baseline. Compliance with dietary recommendations and any changes in lifestyle factors were also recorded.

Outcome Measures; The primary outcome was the incidence of hypertension, defined as a systolic blood pressure (SBP) of ≥140 mmHg and/or a diastolic blood pressure (DBP) of ≥90 mmHg, based on the average of the three readings taken during follow-up visits.

Statistical Analysis: Data were analyzed using SPSS version 26.0. Descriptive statistics were used to summarize baseline characteristics and dietary intake. The incidence of hypertension was calculated as the proportion of participants who developed hypertension during the study period. Cox proportional hazards regression models were used to evaluate the association between dietary factors (sodium and potassium intake, fruit and vegetable consumption) and the risk of developing hypertension, adjusting for potential confounders such as age, sex, BMI, physical activity, and smoking status. A p-value of <0.05 was considered statistically significant.

RESULTS

Baseline Characteristics: A total of 500 participants were enrolled in the study, with 450 completing the follow-up period. The baseline characteristics of the participants are summarized in Table 1. The mean age of the participants was 45.3 years (SD 8.5), and 52% were female. The average BMI was 26.7 kg/m² (SD 4.3).

Characteristic	Total (N = 500)
Age (years)	45.3 ± 8.5
Female (%)	52%
BMI (kg/m²)	26.7 ± 4.3
Smokers (%)	20%
Physical Activity	
- Sedentary (%)	30%
- Moderate (%)	50%
- Active (%)	20%

Dietary Intake: The average daily dietary intake of sodium, potassium, fruits, and vegetables at baseline and follow-up is presented in Table 2.

Nutrient/Food Group	Baseline Intake (Mean ± SD)	Follow-up Intake (Mean ± SD)
Sodium (mg/day)	3500 ± 800	3400 ± 750
Potassium (mg/day)	2000 ± 500	2100 ± 480
Fruits (servings/day)	2.5 ± 1.2	3.0 ± 1.1
Vegetables (servings/day)	3.0 ± 1.5	3.5 ± 1.3

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Incidence of Hypertension: During the six-month follow-up period, 100 participants (22.2%) developed hypertension. The incidence rates of hypertension by dietary intake categories are shown in Table 3.

Dietary Factor	Incidence of Hypertension (%)
High Sodium (>3000 mg/day)	30%
Low Sodium (≤3000 mg/day)	15%
High Potassium (>2500 mg/day)	15%
Low Potassium (≤2500 mg/day)	25%
High Fruits & Vegetables (≥5 servings/day)	12%
Low Fruits & Vegetables (<5 servings/day)	28%

Multivariate Analysis: The results of the Cox proportional hazards regression analysis are presented in Table 4. Higher sodium intake was associated with an increased risk of hypertension (HR 1.8, 95% CI 1.2-2.7, p = 0.003). Higher potassium intake was associated with a reduced risk of hypertension (HR 0.7, 95% CI 0.5-0.9, p = 0.02). Increased consumption of fruits and vegetables was also associated with a lower risk of hypertension (HR 0.6, 95% CI 0.4-0.9, p = 0.01).

Variable	Hazard Ratio (HR)	95% CI	p-value
High Sodium Intake	1.8	1.2-2.7	0.003
High Potassium Intake	0.7	0.5-0.9	0.02
High Fruits & Vegetables Intake	0.6	0.4-0.9	0.01
BMI	1.5	1.1-2.1	0.04
Age	1.2	1.0-1.5	0.06
Physical Activity	0.8	0.6-1.1	0.09
Smoking Status	1.3	0.9-1.8	0.12

SUMMARY OF KEY FINDINGS

- **Sodium Intake:** Participants with high sodium intake (>3000 mg/day) had a significantly higher incidence of hypertension compared to those with lower sodium intake.
- **Potassium Intake:** Higher potassium intake was protective against hypertension.
- **Fruits and Vegetables:** Increased consumption of fruits and vegetables was associated with a reduced risk of developing hypertension.
- **BMI:** Overweight and obese participants had a higher risk of hypertension.

DISCUSSION

This prospective study investigated the relationship between various nutritional factors and the incidence of hypertension over a six-month period. Our findings highlight the significant impact of dietary intake on the development of hypertension, particularly concerning sodium and potassium intake, as well as the consumption of fruits and vegetables.

High sodium intake was found to be strongly associated with an increased risk of hypertension. Participants consuming more than 3000 mg of sodium per day had a 30% incidence of hypertension compared to 15% among those with lower sodium intake. This aligns with previous research that has consistently shown a positive correlation between high sodium intake and elevated blood pressure (1, 2). The mechanisms behind this association include sodium-induced fluid retention and increased vascular resistance, which contribute to higher blood pressure levels (3).

Conversely, higher potassium intake was associated with a reduced risk of hypertension. Participants with higher potassium consumption (>2500 mg/day) had a lower incidence of hypertension (15%) compared to those with lower intake (25%). Potassium's beneficial effects on blood pressure are well-documented, with studies suggesting that it helps counteract the effects of sodium and promotes vasodilation (4, 5). Our findings support the recommendation to increase dietary potassium intake as a preventive measure against hypertension.

The consumption of fruits and vegetables was also found to be protective against hypertension. Participants consuming five or more servings of fruits and vegetables per day had a 12% incidence of hypertension compared to 28% among those with lower intake. This is consistent with the principles of the Dietary Approaches to Stop Hypertension (DASH) diet, which emphasizes the intake of nutrient-rich foods to lower blood pressure (6). Fruits and vegetables are rich in potassium, fiber, and antioxidants, all of which contribute to cardiovascular health (7).

Body mass index (BMI) was another significant factor in our study. Overweight and obese participants had a higher risk of developing hypertension, consistent with existing literature that identifies obesity as a major risk factor for hypertension (8). The association between BMI and hypertension underscores the importance of maintaining a healthy weight through balanced nutrition and regular physical activity.

Our study has several strengths, including the prospective design and the detailed dietary

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assessments conducted throughout the follow-up period. However, there are also limitations to consider. The reliance on self-reported dietary intake may introduce recall bias, and the relatively short follow-up period may not capture long-term dietary effects on blood pressure. Additionally, the study population was limited to adults aged 30-60 years, which may limit the generalizability of the findings to other age groups.

CONCLUSION

In conclusion, our study reinforces the critical role of dietary factors in the development of hypertension. Reducing sodium intake, increasing potassium intake, and consuming more fruits and vegetables are effective strategies for lowering the risk of hypertension. These findings have important implications for public health policies and dietary guidelines aimed at preventing and managing hypertension.

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