Original Article

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Excessive Salt Intake Among Hypertensive Patients in Nepal: A Multicenter Observational Study

Suman Acharya[1,2], Suraj Shrestha[3], Sanjeev Kharel[1], Ashru Neupane[4], Naresh Bahadur Khadka[5], Anjan Bhattarai[6], Mahesh Raj Sigdel[1,7], Dibya Singh Shah[1,7]

[1] Department of Internal Medicine, Tribhuvan University Teaching Hospital, Institute of Medicine (IoM), Maharajgunj, Kathmandu, Nepal
[2] Department of Internal Medicine, Lumbini Provincial Hospital, Butwal, Lumbini Province, Nepal
[3] Suryabinayak Hospital, Bhaktapur
[4] Department of Anaesthesia and Critical Care Medicine, Bir Hospital, National Academy of Medical Sciences, Mahaboudha, Kathmandu
[5] Department of Biochemistry, Tribhuvan University Teaching Hospital, Institute of Medicine (IoM), Maharajgunj, Kathmandu, Nepal
[6] Department of Neurology, Mercy Saint Vincent Medical Centre, Toledo, United States
[7] Department of Nephrology and Transplant Medicine, Tribhuvan University Teaching Hospital, Institute of Medicine (IoM), Maharajgunj, Kathmandu, Nepal

Corresponding Author:
Suman Acharya
MBBS, MD,
Department of Internal Medicine,
Tribhuvan University Teaching Hospital,
Institute of Medicine (IoM),
Maharajgunj, Kathmandu, Nepal
Email: Sumann.acharya@gmail.com
ORCID ID NO: 0000-0002-2141-2210

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Abstract

Background and Aims: Dietary salt is a modifiable risk factor for hypertension and cardiovascular diseases. The World Health Organisation recommends salt restriction to <5 grams/day, while Nepalese are consuming almost twice the recommended amount of salt. 24-hour urine sodium excretion is the gold standard measure of daily salt intake. However, various equations (eg. INTERSALT, Kawasaki) are used to derive salt intake from spot urine samples. This study aimed to assess dietary salt intake among patients with hypertension and its relationship with blood pressure.

Methodology: This is a cross-sectional, observational, multi-centre study among hypertensive patients who came to the medical OPD of Tribhuvan University Teaching Hospital and Manmohan Cardiothoracic Vascular and Transplant Centre. Random spot urine sodium, and creatinine were tested to estimate daily salt intake using the INTERSALT and the Kawasaki equation.

Results: A total of 222 participants (M = 95, F = 127) were enrolled in the study, with a mean systolic and diastolic blood pressure of 132.46 mmHg and 78.36 mmHg, respectively. Notably, 40.99% of participants had uncontrolled blood pressure. Average daily salt intake was 10.27 ± 2.60 grams and 10.31 ± 5.01 grams using the INTERSALT equation and the Kawasaki equation. About 97.1% were consuming higher than the recommended amount. Salt intake had a weak positive correlation with systolic blood pressure ($r = 0.266$; $p < 0.001$).

Conclusions: Participants were consuming twice the recommended amount of salt daily and had poor blood pressure control.

Keywords: hypertension, blood pressure, salt intake

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Introduction

Cardiovascular diseases (CVDs) accounted for approximately 18.6 million deaths in 2019, responsible for 32% of total global deaths. The prevalence of CVD nearly doubled from 271 million in 1990 to 523 million in 2019, reflecting a shift in global disease burden.[1,2] Developing countries in South Asia are undergoing an epidemiological transition, facing a double burden of communicable and non-communicable diseases.[1,2] Hypertension, a modifiable risk factor, lies at the core of this newfound burden.[3]

Key modifiable risk factors for hypertension include smoking, excess salt and low potassium intake, and physical inactivity.[4–6] In Nepal, hypertension prevalence is rising, yet awareness, treatment, and control remain suboptimal.[7] A meta-analysis found that the prevalence of hypertension in the Nepalese population between 2000 and 2025 is increasing, with current prevalence ranging from 25-30%. Only 30-50% of hypertensives were aware, 16-31% were receiving treatment, and 35-41% of the treated hypertensives had optimal blood pressure.[7]

Excess salt consumption is strongly linked to hypertension.[8] Sodium restriction constitutes COR I, LOE A in the ACC/AHA 2025 guideline for blood pressure management.[9] Several studies have reported about twice the recommended salt intake (<5 g/day) among the general Nepalese population.[10,11] There are limited studies among the Nepalese hypertensive patients. Methods to assess salt intake include food questionnaires, dietary surveys or urine sodium analysis.[12] Although cumbersome, a 24-hour urine sample is the gold standard for estimating daily salt intake. There are various equations (eg, INTERSALT, Kawasaki, etc) to calculate 24-hour salt intake using a spot urine sodium sample.[13] This study assessed salt compliance among the Nepalese hypertensive population.

Methods

This study was conducted at the outpatient departments of Tribhuvan University Teaching Hospital (TUTH) and Manmohan Cardiothoracic Vascular and Transplant Centre (MCVTC), Kathmandu, from July 2022 to October 2023. The sample size calculation was based upon 83% prevalence of dietary salt non-compliance among 13,033 US hypertensive patients in the National Health and Nutrition Examination Survey, 1999-2012.14 Although there are no prior studies among Nepalese hypertensive patients, a similar prevalence (81.6%) of excess dietary salt intake was found among the Nepalese adults in the community-based management of non-communicable diseases project in Nepal (COBIN).[11] Sample size (n) of 217 was calculated using the following equation.

$$n = \frac{Z^2 \times p \times (1-p)}{d^2}$$

Where Z= 1.96 for a 95% confidence interval

prevalence(p) = 0.83

error (d) = 5%

A total of 222 hypertensive patients on antihypertensive therapy (excluding diuretics) for over one month were enrolled using consecutive sampling of eligible patients.

Data collection involved a structured proforma covering demographic details, duration of hypertension, number of antihypertensive agents, and dietary patterns. Blood pressure was recorded at least twice,[15] minutes apart. Spot urine samples were analysed for urine sodium and creatinine. The estimated 24-hour sodium intake was calculated using the INTERSALT and Kawasaki equations, and urinary creatinine was estimated using the CKD-EPI formula, as shown in Table 1.12,15 The data obtained from the INTERSALT equation were used for final analysis.

Inclusion criteria were age >18 years, and a diagnosis of essential hypertension. Exclusion criteria included secondary hypertension, acute kidney injury, CKD stage IV/V, recent diagnosis (<1 month), and diuretic use.

The study received ethical clearance from the Institutional Review Committee, Institute of Medicine, and written informed consent was obtained from each participant. Data were entered in Google Sheets and analysed using SPSS version 22. Statistical significance was set at $p < 0.05$. The study was carried out according to the items in the STROBE checklist for the cross-sectional study.[16]

Results

A total of 222 participants from either MCVTC or TUTH medical OPD, diagnosed with essential hypertension on regular antihypertensives for at least one month, were enrolled in the study. The socio-demographic profile is shown in Table 2.

Clinical Profile of Participants

The mean duration of hypertension was 6.5 years. Participants were taking an average of 1.71 ± 0.81 antihypertensives, most commonly a combination of ACEi/ARB and CCB (31.5%). Monotherapy was used in 50.68% of cases. A history of cardiovascular events such as stroke, myocardial infarction, or peripheral artery disease was present in 15.31% of the participants. The average BMI was 25.40 kg/m².

Blood Pressure Maintenance Status

The mean systolic and diastolic pressures were 132.46 mmHg and 78.36 mmHg, respectively. The mean arterial pressure was 96.39 mmHg. Overall, 59.01% of participants had controlled blood pressure, while 40.99% had uncontrolled readings (SBP ≥ 140 mmHg or DBP ≥ 90 mmHg), with no statistically significant difference between sexes ($p = 0.466$).

Dietary Salt Intake

Out of 222 participants, 205 completed spot urine tests to estimate daily sodium intake. Seventeen participants either refused urine testing, did not follow up with the urine report or had an invalid urine report. Using the INTERSALT and Kawasaki equations, average sodium intake was 4109 mg/day and 4126 mg/day, equating to 10.27 ± 2.60 grams and 10.31 ± 5.01grams of salt daily, with no significant difference between equations ($p = 0.92$). The rest of the analysis was done using the INTERSALT equation. Only 2.9% (n = 6) consumed salt within recommended limits (<5 g/day), while 97.1% exceeded it, with over half (55%) consuming twice the recommended salt amount.

Variations in Salt Intake

Salt intake varied significantly across demographic groups. Elderly participants (>60 years) consumed more salt compared to younger groups ($p = 0.031$). Females had higher salt intake than males ($p < 0.001$). There were no differences in intake across various provinces, and between rural and urban residents. Salt intake differed among ethnic groups ($p = 0.003$), with Newar consuming the most (11.30 g/day) and Tharu/Madhesh the least (8.75 g/day). Higher education was associated with lower salt intake ($p < 0.001$). Homemakers had the highest salt consumption among occupations ($p = 0.003$).

Relationship of Blood Pressure with Salt Intake

In this section, various parameters of blood pressure measurement and their relationship with daily salt consumption will be discussed.

a. Daily Salt Intake and Pill Burden

The correlation between daily salt intake and the number of antihypertensive agents was analysed using simple linear correlation, which found a positive correlation but was statistically insignificant ($r = 0.003$, $p = 0.961$).

b. Cardiovascular Events and Daily Salt Intake

The participants with prior cardiovascular events were more compliant with salt restriction (9.39 ± 2.79 vs 10.4 ± 2.53 g/day) compared to those who had no prior CVDs, as shown in Table 3.

c. Blood Pressure among Salt Compliant Participants

Only six participants were consuming the recommended amount of salt (<5 g/day). Compared to those with higher salt intake, their mean systolic BP (107.11 mmHg vs 133.65 mmHg; $p = 0.044$), mean diastolic BP (62.56 mmHg vs 78.74 mmHg; $p = 0.031$) and mean arterial BP (77.30 vs 97.05; $p = 0.035$) were significantly lower.

d. Salt Intake among Controlled and Uncontrolled BP

The daily salt intake among participants with controlled blood pressure (SBP <140 mmHg and DBP <90 mmHg) and those with uncontrolled blood pressure was analysed, which was insignificant as shown in Table 3.

e. Blood Pressure and Salt Consumption

Blood pressure level was found to have a weak positive correlation with daily salt intake, i.e., higher salt intake correlated with higher blood pressure. SBP and MAP had a weak positive correlation with daily salt intake, with a Pearson correlation coefficient (r) of 0.266 ($p < 0.001$) and 0.187 ($p = 0.007$), respectively, as shown in Figure 8. However, the diastolic blood pressure was not statistically significant. ($r = 0.088$; $p = 0.208$)

Discussion

This study provides valuable insights into the status of blood pressure control and salt consumption patterns among hypertensive patients.

The mean age of participants was 59.6 years, consistent with the high prevalence of hypertension in the elderly.[17] There were more female participants (57.2%) in the study, reflecting female dominance in the national census of Nepal.[18] Almost half of the participants were from Kathmandu, and a majority (78.8%) from urban areas, reflecting the study setting and Nepal's urbanisation trends.[19] Higher proportion of Brahmin-Chhetri (54.5%) was represented in the study compared to national data (27.7%), likely due to their greater concentration in Kathmandu.[18] Low educational status was notable, with only 12.16% having higher education. Significant participants (40%) were illiterate, which might have impacted health literacy, leading to higher salt intake.

Participants had a higher blood pressure for a mean duration of 6.5 years and were treated with an average of 1.71 antihypertensive agents. Half were on monotherapy, primarily ACE inhibitors/ARBs or calcium channel blockers, while the rest used combination therapy. About 15% had prior cardiovascular events, 29.28% had Diabetes, and 21.62% had dyslipidemia. Blood pressure control was suboptimal, with 40.99% uncontrolled (SBP ≥ 140 or DBP ≥ 90 mmHg). This corroborates previous meta-analyses from Nepal reporting rates around 40–44%. [20,21]

Salt intake among participants was alarmingly high, averaging 10.27 g/day (INTERSALT equation) and 10.31 g/day (Kawasaki equation). There was no significant difference between the two equations. Over 97% exceeded the recommended limit of 5 g/day, and more than half of the participants consumed ≥ 10 g/day. This intake pattern is similar to other Nepalese studies reporting high salt consumption in the general Nepalese population.[10,11,22] Assessment of salt intake in 451 participants of the COBIN cohort in 2018 found a mean salt intake of 13.3 g/day, and 98% were consuming more than the recommended amount, similar to our study.[11] A 2021 systematic review reported almost twice the recommended amount of salt intake in South Asian countries (9.7 g/day).[23] MINISAL SIIA study in Italy, NHANES study in the US and a Japanese study reported similar trends among hypertensive participants, with 80-90% consuming excess salt.[14,24,25] The elderly population also had higher salt intake, possibly due to an age-related decline in taste buds. Interestingly, unlike many studies reporting higher salt intake among men, this study found higher intake among women, possibly due to cultural dietary preferences favouring spicier, saltier foods among Nepali women, a pattern also noted in Japan. [25]

Participants with prior cardiovascular events adhered more to salt restriction, though differences were not significant. Importantly, a weak positive correlation existed between daily salt intake and systolic blood pressure ($r = 0.266$, $p < 0.001$) and mean arterial pressure ($r = 0.187$, $p = 0.007$). These findings are consistent with prior evidence linking higher salt intake with increased blood pressure.[26]

Community-based salt reduction programs, consumer awareness programs, potassium-based salt substitution, product reformulation, establishing a sodium content target for foods, and front-of-pack labelling schemes are some intervention strategies practised around the world to reduce salt intake.[27] Nepal also needs a combination of these strategies to lower the salt intake. High salt intake should be utilised as an opportunity to intervene to reduce the burden of systemic hypertension and cardiovascular diseases in Nepal.

Limitations

Limitations of this study are hospital-based recruitment only from Kathmandu, cross sectional design, spot urine samples instead of 24-hour urine collections, use of equations not yet validated in the Nepali population are some of the limitations of this study. A few urine data were missing from the participants. Additionally, participants' dietary habits might have been altered at the time of participation due to hospital travel. Future studies should aim for multicenter, community-based designs with validated methods for better assessment of salt intake in hypertensive populations across Nepal.

Conclusion

This study revealed that hypertensive participants consumed more than twice the WHO-recommended salt intake. Salt intake also showed a positive correlation with blood pressure. Blood pressure control was suboptimal in a large proportion of participants. This further adds to the already worrisome burden of cardiovascular diseases in Nepal. This also put further financial burden in already frail Nepali health care system. Policy intervention, patient education and further scrutiny on dietary patterns and marketed foods are needed. These findings highlight an urgent need for public health interventions to limit salt intake in hypertensive individuals as well as in the general population.

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Conflict of Interest

None.

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Tables and Illustrations

Table 1: Equations to estimate salt intake from a spot urine sample

INTERSALT	Men = 23.51 + [0.45 × spot Na (mmol/L)] – [3.09 × spot Cr (mmol/L)] + [4.16 × BMI (kg/m2)] + [0.22 × age (y)]
	Women = 3.74 + [0.33 × spot Na (mmol/L)] – [2.44 × spot Cr (mmol/L)] + [2.42 × BMI (kg/m2)] + [2.34 × age (y)] – [0.03 × age2 (y)]
Kawasaki	16.3 × [spot urine Na (mmol/l) / (spot urine Cr (mg/dl) × 10) × estimated 24-hour urinary Cr (mg)]^0.5
CKD EPI	Estimated 24-hour creatinine excretion = 879.89 + 12.51 × weight (kg) – 6.19 × age + (34.51 if black) – (379.42 if female)

Table 2: Socio-demographic profile

Variable	Category	Number (n)	Percentage (%)
Age	<30 years	9	4.1%
	30–45 years	28	12.6%
	45–60 years	71	31.9%
	>60 years	114	51.4%
Sex	Male	95	42.8%
	Female	127	57.2%
Geography (address)	Koshi Province	19	8.6%
	Madhesh Province	11	4.9%
	Bagmati Province (excl. Kathmandu)	46	20.7%
	Kathmandu	106	47.7%
	Gandaki Province	14	6.3%
	Lumbini Province	18	8.1%
	Karnali Province	4	1.8%
	Sudurpaschim Province	4	1.8%
Geography (Residence Area)	Rural	47	21.2%
	Urban	175	78.8%
Ethnicity	Brahmin–Chhetri	121	54.5%
	Janajati (Rai, Magar, Gurung, Tamang, etc.)	44	19.8%
	Newar	33	14.9%
	Dalit	11	4.9%
	Tharu/Madheshi	13	5.9%
Religion	Hindu	196	88.3%
	Buddhist	18	8.1%
	Christian	7	3.2%
	Kirat	1	0.4%
Education	Illiterate	89	40.1%
	School-level	76	34.2%
	College-level	30	13.5%
	University-level	27	12.2%
Occupation	Homemaker	83	37.4%
	Unemployed/ Dependent	62	27.9%
	Service/Retired	37	16.7%
	Self-employed/Business	23	10.4%
	Farmer	14	6.3%
	Others	3	1.4%
Dietary Pattern	Mixed	190	85.6%
	Vegetarian	32	14.4%

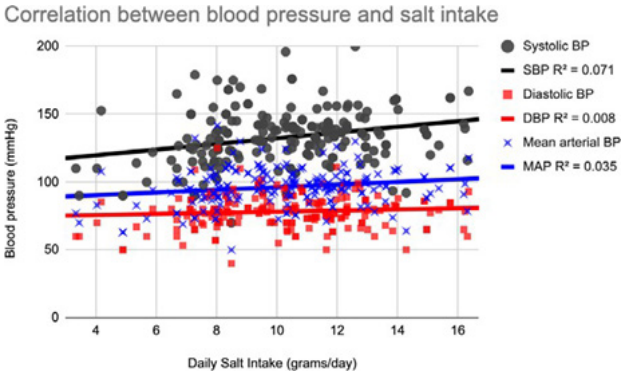
Table 3: Salt intake among those with or without cardiovascular events

	Cardiovascular events	Mean ± SD	p-value
24-hour salt intake (g/day)	None (n=172)	10.4 ± 2.5	0.051*
	Present (n=33)	9.39 ± 2.79	

Table 4: Salt Intake among Controlled and Uncontrolled Blood Pressure

	Controlled BP (n=119)	Uncontrolled BP (n=86)	p-value
24-hour salt intake (g/day)	10.30 ± 2.56	10.24 ± 2.66	0.87*

Figure 1: *Correlation between blood pressure and daily salt intake*



LEGENDS

Table 1: Equations to estimate salt intake from a spot urine sample

Table 2: Socio-demographic profile

Table 3: Salt intake among those with or without cardiovascular events

Table 4: Salt Intake among Controlled and Uncontrolled Blood Pressure

Figure 1: Correlation between blood pressure and daily salt intake