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Research Article

# Determinants of Blood Pressure Control among Hypertensive Patients in Nepal: A Cross-Sectional Study

**Kamala Timilsena Basnet[1] and Hom Nath Chalise[2]***

[1]NAMS- Birhospital, Kathmandu, Nepal

[2]Geriatric Society of Nepal, Kathmandu, Nepal

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***Corresponding authors:** Hom Nath Chalise, General Secretary, Geriatric Society of Nepal, Kathmandu, Nepal, E-mail: chalisehkpp@gmail.com

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## Abstract

**Background:** Hypertension is a leading modifiable risk factor for cardiovascular morbidity and mortality worldwide. In Nepal, prevalence is rising, yet determinants of blood pressure (BP) control remain insufficiently understood. This study examined socio-demographic, lifestyle, and clinical factors associated with BP control among hypertensive patients attending a tertiary hospital.

**Methods:** A descriptive cross-sectional study was conducted at the cardiology outpatient department of Bir Hospital, Kathmandu, between July and August 2018. A total of 360 hypertensive patients, aged ≥18 years with at least one year since diagnosis, were recruited using convenience sampling. Data on socio-demographics, hypertension knowledge, and lifestyle practices were collected using a validated bilingual questionnaire. BP was measured twice, and control was defined as <140/90 mmHg. Logistic regression was applied to identify independent predictors of BP control.

**Results:** The mean age of participants was 50.8 ± 15.3 years; 59.4% were female, 52.5% resided in rural areas, and 48.9% lived in joint families. Overall, 21.9% (79/360) of participants achieved BP control, while 78.1% (281/360) were uncontrolled. Logistic regression showed that rural residence (OR 0.47, 95% CI 0.27–0.84, $p$ = 0.012), alcohol use (OR 0.28, 95% CI 0.13–0.58, $p$ = 0.001), and family history of hypertension (OR 0.50, 95% CI 0.28–0.89, $p$ = 0.021) were associated with poorer control. Conversely, joint family structure (OR 1.51, 95% CI 1.10–2.08, $p$ = 0.011) and reported normal salt intake (~5 g/day) (OR 7.69, 95% CI 2.68–22.0, $p$ < 0.001) were positively associated with BP control.

**Conclusion:** Socio-demographic and lifestyle factors strongly influence BP control in Nepal. Strengthening rural outreach, promoting family-based interventions, and delivering culturally appropriate counseling on alcohol reduction and dietary salt are essential. Future community-based longitudinal studies are recommended to validate these findings and inform national strategies.

## Introduction

Hypertension is a major modifiable risk factor for cardiovascular disease and remains one of the leading causes of global morbidity and premature mortality [1,2]. It contributes substantially to the burden of ischemic heart disease, stroke, heart failure, and chronic kidney disease worldwide. Nearly one-third of the global adult population is affected by hypertension, with prevalence increasing steadily over the past decades [3]. Low- and middle-income countries (LMICs) bear a disproportionate share of this burden, driven by rapid urbanization, dietary transitions toward energy-dense and high-sodium foods, reduced physical activity, population ageing, and constrained health systems [3]. Although advances in detection and pharmacological treatment have improved outcomes in high-income settings, global awareness, treatment, and control rates remain suboptimal, particularly in LMICs [4].

In Nepal, hypertension has emerged as a major public health challenge. Population-based studies indicate that approximately 25% - 35% of Nepalese adults are hypertensive, with prevalence increasing across both urban and rural populations [5-7]. Despite the availability of antihypertensive medications and clinical guidelines, blood pressure (BP) control rates remain low, with fewer than one in five



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diagnosed patients achieving recommended targets [5-7]. Poor BP control in Nepal has been attributed to multiple factors, including delayed diagnosis, inadequate follow-up, inconsistent medication adherence, limited patient knowledge, and structural barriers to healthcare access, especially in rural and remote areas [8,9]. These challenges are compounded by socioeconomic disparities, out-of-pocket health expenditures, and variations in health literacy.

Lifestyle and behavioral factors play a central role in hypertension management and BP control. Excess dietary salt intake is well established as a key determinant of elevated BP, particularly in South Asian populations where traditional diets often contain high sodium levels [10-12]. Similarly, alcohol consumption has been consistently associated with poor BP control and increased cardiovascular risk [13,14]. Other behaviors such as smoking, physical inactivity, and suboptimal stress management further contribute to uncontrolled hypertension. Beyond individual behaviors, social and cultural contexts strongly influence chronic disease management. In Nepal and other South Asian societies, family structure, co-residence patterns, and social support can affect treatment adherence, dietary practices, and health-seeking behavior [15,16]. Joint family systems, in particular, may facilitate shared caregiving, medication supervision, and lifestyle modification, whereas fragmented family structures may pose challenges for sustained self-management.

Despite the growing burden of hypertension in Nepal, evidence on patient-level determinants of BP control remains limited, particularly from clinical settings where a large proportion of hypertensive patients seek care. Existing studies have largely focused on prevalence and awareness, with fewer investigations examining how socio-demographic characteristics, lifestyle behaviors, and clinical factors jointly influence BP control among treated hypertensive patients. Understanding these determinants is essential for designing context-specific, culturally appropriate interventions aimed at improving hypertension management and reducing cardiovascular risk.

This study, therefore, aimed to examine the socio-demographic, lifestyle, and clinical factors associated with BP control among hypertensive patients attending the cardiology outpatient department of Bir Hospital, Kathmandu. By identifying key predictors of controlled and uncontrolled BP, the findings are intended to inform targeted clinical counseling, family-based interventions, and public health strategies to improve hypertension outcomes in Nepal.

# Methods

## Study design and setting

This study employed a hospital-based, descriptive cross-sectional design conducted at the cardiology outpatient department (OPD) of Bir Hospital, Kathmandu, one of the largest tertiary referral hospitals in Nepal. The OPD runs six days per week, from 8:00 AM to 2:00 PM, and serves an average of 20–30 hypertensive patients daily. Data collection was carried out between July 12 and August 31, 2018, during regular OPD hours.

## Study population

The study population comprised adult men and women with a physician-confirmed diagnosis of hypertension who were attending the cardiology OPD during the study period. Eligible participants were those aged 18 years and above with at least one year since diagnosis. Patients with severe comorbid conditions such as stroke, renal failure, or heart failure, those with psychiatric illness, and those taking medications other than antihypertensives were excluded.

## Sample size and sampling technique

The required sample size was calculated using the item-to-sample ratio approach, with 30 questionnaire items multiplied by 10 respondents per item. An additional 20% was added to account for possible non-responses, resulting in a final target of 360 participants. A non-probability convenience sampling method was used to recruit hypertensive patients who attended the OPD during the study period, and the intended sample size was successfully achieved.

## Data collection tool

Data were collected using a structured, interviewer-administered questionnaire prepared in both Nepali and English. The tool was adapted from a validated instrument previously developed by Chalise and Acharya in Nepal, and comprised three sections: socio-demographic and medical characteristics, knowledge about hypertension, and lifestyle practices including diet, physical activity, alcohol and tobacco use, and stress reduction methods. Content validity indices (I-CVI/Ave) for the domains ranged from 0.89 to 0.94, confirming good validity. The questionnaire was pretested on 36 patients attending a comparable setting, and minor modifications were made to improve clarity and cultural appropriateness.

## Data collection procedure

Eligible patients were approached in the OPD waiting area, informed about the study objectives, and invited to participate. Written informed consent was obtained from all participants. Interviews were conducted in a private room by the principal investigator and two trained nurses to ensure confidentiality, with each interview lasting approximately 15–20 minutes. Questionnaires were checked daily for completeness, and responses were coded and entered into SPSS version 23.

Blood pressure measurement: Blood pressure was measured using a standard digital sphygmomanometer (Omron 10 series, Tokyo, Japan). Measurements were taken under standardized conditions: an appropriate cuff size was selected, participants sat with their backs supported and feet flat on the floor, the arm was supported at heart level, and they were asked to avoid caffeine, smoking, and vigorous physical activity for at least 30 minutes before measurement. Readings were taken on the same arm during routine OPD hours by trained nurses. Each



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participant was seated quietly for at least 10 minutes before measurement, and two readings were taken 30 minutes apart. The mean of the two readings was used for analysis. Blood pressure control was primarily defined as <140/90 mmHg, consistent with WHO/ESC guidelines [17], with secondary analyses applying <120/80 mmHg for stricter comparison.

### Quality control

To ensure reliability, interviewers received prior training on study procedures, and standard operating protocols were followed for all interviews and measurements. Daily reviews of completed questionnaires were carried out to ensure consistency and completeness. Data were double-entered independently by two researchers to minimize errors.

### Ethical considerations

Ethical approval was obtained from the Institutional Review Board of Nepal Health Research Council (NHRC, registration no. 397). Permission to conduct the study was also secured from Bir Hospital authorities. Participation was voluntary, and participants were informed of their right to withdraw at any stage without penalty. Confidentiality and privacy were maintained through the use of anonymized coding, and interviews were conducted in a separate room.

### Statistical analysis

Data analysis was conducted using SPSS version 23. Descriptive statistics, including means, standard deviations, frequencies, and percentages, were used to summarize socio-demographic, knowledge, and lifestyle characteristics. Associations between categorical variables and blood pressure control were examined using chi-square tests. Variables were entered into multivariable logistic regression based on bivariate screening ($p < 0.20$) and a priori clinical relevance. Collinearity was assessed using variance inflation factors (VIF), with no evidence of problematic multicollinearity (all VIF <2.5). Model fit was evaluated using the Hosmer–Lemeshow goodness-of-fit test and inspection of classification accuracy. Binary logistic regression analysis was then performed to identify independent predictors of blood pressure control, with results presented as odds ratios (ORs) and 95% confidence intervals (CIs). A $p$-value <0.05 was considered statistically significant.

## Results

### Participant characteristics

Table 1 presents the general characteristics of the 360 study participants. The mean age was 50.8 years (SD ± 15.3), and females made up the majority (59.4%). More than half resided in rural areas (52.5%), and nearly half lived in joint families (48.9%). About two-thirds were literate (68.3%), and just over one-fourth (26.9%) practiced self–blood pressure monitoring. Adequate hypertension knowledge was reported by 53.5% of participants. Most engaged in physical exercise (94.2%), while smaller proportions reported alcohol use (11.9%), smoking (2.8%), and consumption of extra salty foods (11.1%). The majority had low salt intake (<2 g/day, 92.5%), whereas only 7.5% reported normal intake (~5 g/day).

### Bivariate analysis of BP control

In total, 79 participants (21.9%) had controlled BP, and 281 (78.1%) had uncontrolled BP. Table 2 shows the bivariate associations of selected factors with blood pressure (BP) control among participants. Urban residents, those living in joint families, and non-alcohol users had significantly better BP control compared to their counterparts. Similarly, participants with normal (~5 g) salt intake had higher rates of BP control than those with lower salt consumption (<2 g). Extra salty food intake also showed a significant association, though the difference was modest. Overall, residence, family type, alcohol use, and salt intake patterns were significantly related to BP control.

### Factors associated with blood pressure control

Table 3 summarizes the logistic regression analysis of factors associated with blood pressure (BP) control. Participants living in rural areas (OR = 0.47, $p$ = 0.012), those consuming extra salty food (OR for no extra salty food = 0.42, $p$ = 0.046), alcohol users (OR = 0.28, $p$ = 0.001), and those with a family history of hypertension (OR = 0.50, $p$ = 0.021) had significantly

**Table 1:** General characteristics of study participants ($n$ = 360).

| Characteristic | n (%) or Mean ± SD |
|---|---|
| Age (years) | 50.8 ± 15.3 |
| Sex (female) | 214 (59.4) |
| Residence (rural) | 189 (52.5) |
| Family type (joint) | 176 (48.9) |
| Education (literate) | 246 (68.3) |
| Self BP monitoring (yes) | 97 (26.9) |
| Hypertension knowledge (adequate) | 193 (53.5) |
| Physical exercise (yes) | 339 (94.2) |
| Alcohol use (yes) | 43 (11.9) |
| Smoking (yes) | 10 (2.8) |
| Extra salty food (yes) | 40 (11.1) |
| Salt intake (low <2 g/day) | 333 (92.5) |
| Salt intake (normal ~5 g/day) | 27 (7.5) |

Note: Values are mean ± standard deviation (SD) or number (percentage).

**Table 2:** Bivariate associations of selected factors with BP control ($n$ = 360).

| Variable | Controlled (%) | Not controlled (%) | $p$-value |
|---|---|---|---|
| Residence (urban) | 45 (25.1) | 134 (74.9) | 0.010 |
| Residence (rural) | 34 (18.0) | 155 (82.0) | |
| Family type (nuclear) | 35 (17.9) | 160 (82.1) | 0.018 |
| Family type (joint) | 44 (25.0) | 132 (75.0) | |
| Alcohol use (yes) | 5 (11.6) | 38 (88.4) | 0.003 |
| Alcohol use (no) | 74 (23.2) | 246 (76.8) | |
| Extra salty food (yes) | 9 (22.5) | 31 (77.5) | 0.042 |
| Extra salty food (no) | 70 (21.5) | 253 (78.5) | |
| Salt intake (low <2 g) | 69 (20.7) | 264 (79.3) | <0.001 |
| Salt intake (normal ~5 g) | 10 (37.0) | 17 (63.0) | |

Note: BP = blood pressure. $p$-values from chi-square tests.



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lower odds of BP control. Conversely, living in joint families (OR = 1.51, $p$ = 0.011) and having normal salt intake (~5 g/day) (OR = 7.69, $p$ < 0.001) were strongly associated with better BP control. These findings highlight lifestyle and household factors as key determinants of BP management.

### Factors associated with daily blood pressure monitoring

Table 4 presents the logistic regression results for factors associated with daily blood pressure (BP) monitoring. Living in a joint family was significantly associated with higher odds of daily BP monitoring (OR = 1.59, $p$ = 0.030). Participants who did not consume alcohol had more than twice the odds of monitoring their BP daily (OR = 2.38, $p$ = 0.005). Similarly, those with a family history of hypertension were almost three times more likely to practice daily BP monitoring (OR = 2.93, $p$ < 0.001). These findings suggest that family context, lifestyle, and health history play important roles in influencing regular BP self-monitoring.

## Discussion

This study highlights the multifaceted determinants of blood pressure control among hypertensive patients in Nepal. Several important patterns emerged. Because this was a single-center, hospital-based study using convenience sampling from a tertiary cardiology OPD, the findings may not fully represent hypertensive patients managed in primary care settings or in remote rural communities across Nepal.

Rural residents' evidence was strongly linked to poorer BP control, echoing findings from both Nepal and other LMICs [5,6,18]. Barriers such as reduced access to healthcare facilities, medication supply issues, and limited health literacy likely contribute to these disparities. Strengthening rural outreach services, ensuring regular antihypertensive supply, and enhancing awareness campaigns tailored to rural populations are critical steps.

Family structure played a prominent role. Participants in joint families had better BP control and a higher likelihood of self-monitoring. This aligns with South Asian evidence where extended family systems provide financial, emotional, and caregiving support [15,16]. In Nepalese households, collective responsibility can encourage adherence to medication and lifestyle practices. Public health programs should consider family-centered counseling approaches.

Alcohol consumption emerged as a major barrier to control, consistent with global evidence showing alcohol's direct pressor effects and its association with poor adherence [13,14,19]. Reducing alcohol use through culturally sensitive strategies is vital, especially in contexts where alcohol is socially normalized.

The finding that normal salt intake (~5 g/day) was associated with better BP control compared with reported very low intake is counterintuitive. Notably, the very high proportion reporting very low salt intake (<2 g/day) likely reflects difficulty estimating salt use, recall bias, and potential misunderstanding of the questions; because intake was not objectively measured (e.g., 24-hour urinary sodium), misclassification of sodium intake is possible. Possible explanations include recall or reporting bias, difficulty estimating dietary sodium, or reverse causality (patients with uncontrolled BP attempting salt restriction after diagnosis). Nepalese diets often contain hidden sodium sources, such as pickles and processed foods [11,12]. This underscores the need for improved dietary counseling and standardized methods for salt intake assessment. Recent evidence supports population-wide salt substitution interventions [10].

Interestingly, patients with a family history of hypertension had poorer BP control despite being more likely to monitor BP. Awareness alone may not translate into effective behavior change, highlighting the need for interventions that build not only knowledge but also skills, motivation, and sustained support.

### Strengths

This study included a relatively large sample, used validated instruments, and applied multivariable regression to generate robust evidence for Nepalese clinical and policy contexts.

### Limitations

The cross-sectional design limits causal inference. Convenience sampling from a single tertiary hospital OPD and the facility-based nature of recruitment reduce generalizability to the broader hypertensive population in Nepal, particularly those managed in primary care or living in hard-to-reach rural settings. Self-reported lifestyle behaviors, including diet and alcohol, may be subject to recall or social desirability bias. Blood pressure control was classified using two readings obtained during a single clinic visit, which may lead to misclassification compared with guideline-recommended assessment across multiple visits; this limitation should be considered when interpreting control prevalence and associations. Finally, salt intake was based on self-report rather than biochemical assessment, which may have influenced findings.

**Table 3:** Logistic regression of factors associated with BP control ($n$ = 360).

| Factor | OR | 95% CI | $p$-value |
|---|---|---|---|
| Rural residence | 0.47 | 0.27–0.84 | 0.012 |
| Joint family | 1.51 | 1.10–2.08 | 0.011 |
| No extra salty food | 0.42 | 0.18–0.99 | 0.046 |
| Alcohol use | 0.28 | 0.13–0.58 | 0.001 |
| Normal salt (~5 g/day) | 7.69 | 2.68–22.0 | <0.001 |
| Family history of hypertension | 0.50 | 0.28–0.89 | 0.021 |

Note: OR = odds ratio; CI = confidence interval.

**Table 4:** Logistic regression of factors associated with daily BP monitoring.

| Factor | OR | 95% CI | $p$-value |
|---|---|---|---|
| Joint family | 1.59 | 1.05–2.41 | 0.030 |
| No alcohol use | 2.38 | 1.30–4.38 | 0.005 |
| Family history of hypertension | 2.93 | 1.74–4.93 | <0.001 |

Note: OR = odds ratio; CI = confidence interval.



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Policy and Practice Implications: Public health interventions should target rural outreach, integrate family-based counseling, promote accurate salt reduction strategies, and deliver culturally tailored alcohol reduction programs. Scaling up home BP monitoring and community-based support can further enhance hypertension management.

## Conclusion

Socio-demographic and lifestyle factors substantially influence BP control in Nepal. Rural outreach, family-based interventions, culturally sensitive alcohol and salt reduction counseling, and improved self-management strategies are needed. Future research should employ longitudinal and community-based designs to confirm these findings and inform national strategies.

### Authors' contributions

KTS designed the questionnaire, collected the data, and HNC worked on data analysis and drafting the initial manuscript. Both then read and agreed on the final version.

### Patient's Consent (if applicable)

All participants provided either oral or written informed consent before their inclusion in the study. The research adhered to the principles outlined in the Declaration of Helsinki.

### Ethical approval (if applicable)

NHRC registration no. 397 / 2018

### Availability of data and materials

Data will be available upon request with a genuine cause

### Disclosure

This research is a part of author Kamala Basnet's Thesis.

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