

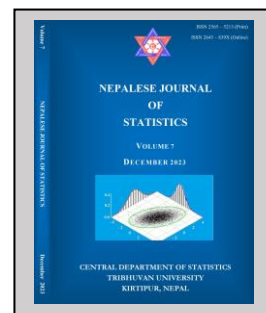
## Status of Hypertension and its Determinants among Teachers in Tribhuvan University Campus, Kirtipur, Kathmandu

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Submitted: 15 June 2023; Accepted: 17 November 2023

Published online: 26 December 2023

DOI: <https://doi.org/10.3126/njs.v7i1.61056>



### ABSTRACT

**Background:** Hypertension, often known as high blood pressure, is a crucial public health issue and an essential topic of study because of its high prevalence and being a vital exposure to cardiovascular diseases and other health consequences. Therefore, being both a standalone disease and a precursor to non-communicable illnesses, hypertension poses a global health menace.

**Objective:** The study was conducted to investigate the status of hypertension and its associated risk factors among the teachers from Tribhuvan University Campus.

**Materials and Methods:** The cross-sectional research study involved 247 teachers from TU central campus using stratified random sampling and both descriptive and inferential statistical analytical methods. Multinomial logistic regression model was employed to investigate the relationship between several variables and hypertension levels.

**Results:** The fitted model, which had a classification accuracy of 67.2%, met the diagnostic test requirements for goodness of fit, multi-collinearity and minimal criteria of the model's use. Influential variables for pre-hypertension included interpersonal relationship, age group, gender, duration of service, smoking and physical activeness. For hypertension, significant variables encompassed job itself, interpersonal relationship, age group (45-50 years), gender, duration of service, smoking, tobacco use and physical activeness.

**Conclusion:** It was observed that 37.7% of the respondents had hypertensive status, 30.3% were surpassing normotensive and 32.0% were pre-hypertensive. Teachers' hypertension status was discovered to be influenced by a variety of sociodemographic, behavioral, clinical, and stress variables. Concerned authorities must pay close attention to this issue.

**Keywords:** Hypertension, multinomial logistic regression, non-communicable diseases, occupational stress, physical activity, prevalence.

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## INTRODUCTION

Hypertension (HTN), often recognized as high blood pressure, is a disease where the force of blood on the artery walls is too strong. When left untreated, it can result in a heart attack, stroke, heart failure, and renal failure. The term "silent killer" relates to the fact that hypertension frequently causes no symptoms until our organs are harmed or fail. Severe hypertension symptoms include fatigue, nausea, vomiting, disorientation, anxiety, chest tightness, and muscle and joint pains. High blood pressure often develops gradually, influenced by poor lifestyle choices like an unhealthy diet and insufficient physical activity. Medical factors like high blood sugar and obesity can increase the risk. Pregnancy can also be a contributing factor to elevated blood pressure. Two numbers denote blood pressure (BP) namely systolic blood pressure (SBP) and Diastolic blood pressure (DBP). The SBP measures artery pressure when the heart contracts or beats. The DBP shows the pressure in the arteries while the heart is at rest in between beats. When the SBP reading is  $\geq 140$  mmHg and/or the DBP reading is  $\geq 90$  mmHg, hypertension is diagnosed. Pre-hypertension is characterized as a grey region amid 120–139 mmHg SBP and 80–89 mmHg DBP (Chobanian et al., 2003). Elevated blood pressure can gravely harm vital human organs such as the heart, brain, kidneys, and eyes. It can cause artery damage by making them less elastic, which reduces blood and oxygen supply to the heart and brain and leads to heart failure, heart attack, stroke, brain issues, and chronic kidney disease. (Centers for Disease Control and Prevention [CDC], 2005). Hypertension is a leading reason of mortality globally and an exposure for non-communicable illnesses. Hypertension affects an estimated 1.28 billion people aged 30-79 worldwide, with the predominance (two-thirds) residing in poor and medium-income nations (World Health Organization [WHO], 2023). According to a study of World Health Organization (WHO) on hypertension, one in every four males and one in every five females had hypertension. Taking a blood pressure reading is the sole way to determine whether a person has hypertension (Centers for Disease Control and Prevention [CDC], 2005).

Non-communicable diseases (NCDs) impact people of all ages, regions, and nations, with low- and middle-income countries being disproportionately afflicted (World Health Organization [WHO], 2023). Nation with low and moderate incomes are anticipated to reckon for 85 % of NCDs related premature mortality. Higher Blood Pressure and overweight/obesity are the two important metabolic risk factors for NCDs. In terms of attributable mortality, high blood pressure is the popular metabolic exposure accounting for 19% of global fatalities, followed by overweight and obesity, and high blood glucose (World Health Organization [WHO], 2023). More than three-quarters of all deaths globally are caused by NCDs (World Health Organization [WHO], 2023), whereas two-thirds of all deaths are due to NCDs in Nepal and the main factor in mortality is heart disease among them (Ministry of Health, Nepal, New ERA and ICF, 2017). While sedentary lifestyles, unbalanced diets, and tobacco and alcohol consumption have all contributed to the rise of NCDs and those who lost their lives to transmittable and curable sickness due to improper sanitation and hunger on account of inadequate knowledge, awareness, and access to medical

facilities (Dhakal, 2019). With the alarming health implications associated with hypertension and its recognition as the “silent killer,” the urgency to investigate its prevalence and driving factors becomes evident. This study takes on the task of delving into the realm of hypertension among teachers in Tribhuvan University campus, Kirtipur, with the overarching objective of comprehending its status and the determinants contributing to its occurrence. By shedding light on this pressing issue, the research endeavors to contribute valuable insights that could potentially pave the way for informed interventions and healthcare strategies within the community.

## METHODOLOGY

### Data and study area

The study, conducted at Tribhuvan University Campus in Kirtipur, Kathmandu, Nepal, focused on all 603 teachers listed in the 2075 communication directory by the Tribhuvan University Teachers Association (TUTA). Stratification occurred based on faculties, including Education, Management, Humanities and Social Sciences, and Institute of Science and Technology. The sample size was allocated proportionally to each stratum using a population proportionate method. Simple random sampling was then employed to select participants, excluding pregnant women and teachers on vacation.

### Sampling

The Taro Yamane approach, created by statistician Yamane (1967), was used to determine a minimum sample size for a survey that aims to provide a certain level of accuracy while keeping the sample size manageable. The formula assumes of simple random sampling without replacement from a finite population and expressed as

$$n = \frac{N}{1 + (N * e^2)}$$

where, n = sample size, N = size of population and e = precision level. Taking Population size as 603 and margin of error as 0.05, the necessary sample size was obtained as 240. And with the inclusion of 5% non-response rate, the ultimate sample size became 252. A total 247 responses were collected throughout the survey. Table I outlines the sampling distribution across four strata.

**Table I.** Sampling distribution within strata.

Faculty	Population	Proportion	Estimated sample
Faculty of Education	139	0.23	58
Faculty of Humanities and Social Science	240	0.40	100
Faculty of Management	33	0.05	14
Institute of Science and Technology	191	0.32	80
Total	603	1.00	252

The WHO STEPS instrument for Non-Communicable Diseases Risk Factor Surveillance 2019, Nepal was adopted to collect the required information for the study (Dhimal et al., 2020). The WHO STEPS instrument includes Core Items, which ask questions necessary to compute fundamental variables, and Expanded Items, which request more specific information. The STEPS instrument was slightly adjusted to fulfill the research aims and to accommodate the study subjects as needed. Adjustment was done by removing unnecessary expanded items to avoid redundant information for the study. The occupational stress of the respondent was assessed by using a job stress scale without any modification developed by Wu et al., to assess the job stress level on construction worker in Beijing, 2018. This job stress scale is similar to the most used Occupational Stress Indicator (OSI) introduced by Williams & Cooper (1997). Which is divided into six dimensions as: Job itself, Role management, Interpersonal Relationship, Organization Style, Career Development and Family work conflict and with a total of 20 Likert scale questions (Wu et al., 2018). Each participant had their blood pressure measured three times at intervals of five minutes and the average reading was taken from second and third measurement, strictly in accordance with JNC-7 recommendations.

### *Dependent variable*

The outcome variable of the study is hypertension status. It was categorized into three categories, Normotensive, Pre-hypertensive, and Hypertensive according to the blood pressure readings of the respondents based on the JNC-7 classifications, which was not gender-specific, and the same cut-off points were used for both males and females (Chobanian et al., 2003). Respondents who use anti-hypertensive medication and/or had SBP reading  $\geq 140$  mmHg and/or the DBP reading  $\geq 90$  mmHg were categorized as hypertensive subjects and coded by 2. Respondents who had SBP reading amid 120–139 mmHg and/or the DBP reading amid 80–89 mmHg were categorized as pre-hypertensive subjects and coded by 1. And the respondents who had SBP reading  $< 120$  mmHg and the DBP reading  $< 80$  mmHg were categorized as normotensive subjects and coded by 0.

### *Independent variables*

Mainly independent variables associate with major four factors as Socio-Demographic Factor, Behavioral Factor, Clinical Factor and Occupational Stress. Where Socio-demographic factor include the variables such as respondent's age, gender, marital status, ethnicity, religion, family type and modes of transportation. Behavioral factors consist of smoking habit, alcohol intake, tobacco, salt intake, and fruits and vegetables consumption. Respondents who consume cigarettes on a regular basis and/or if within the previous one week were considered as smokers. Alcohol consumers were those who drink alcohol on a regular basis and/or if within the preceding 30 days. The ingestion of salt was classified into three categories (too little, appropriate amount, and too much) based on the respondents' taste preferences, past intake experience, and family recommendations. Clinical factors include variables as obesity status, physical activeness, and status of other diseases (such as diabetes, cardiovascular diseases etc.). Obesity status of the respondents

was categorized into four categories based on the classification of their Body Mass Index (BMI) measures. BMI was measured by using the following formula.

$$BMI = \frac{Weight(kg)}{(Height(m))^2}$$

The classification of BMI was considered according to guidelines of Asia-Pacific BMI classification (World Health Organization [WHO], 2000) and the physical activity level was assessed depending on the time invested on different levels of vigorous, moderate, and daily based exercise by three different sorts of physical activity reported on guidelines for the data processing and analysis of the International Physical Activity Questionnaire (IPAQ, 2004). Walking, moderate-intensity exercises, and vigorous-intensity exercises are the categories of exercise that were evaluated. For each distinct type of activity, respondents' frequency (measured in days per week) and duration (measured in hours or minutes per day) were separately gathered. According to the total METs (Metabolic Equivalent score) that respondents obtained, their level of physical activity was divided into three groups. There are different levels of METs defined for different intensity of exercise. That is, 3.3 for walking, 4 for moderate-intensity exercise, and 8 for vigorous-intensity exercise. MET-min per week for each level was obtained by the product of MET-level, minutes of activity, and events per week. Then the total MET-min/week was computed by summing MET-level min per week of each level. Based on this total MET-level min/week score respondents were categorized into inactive, minimally active, and HEPA (Health-Enhancing Physical Activity) active. The classification table is provided in Table 2.

**Table 2.** IPAQ classification for physical exercise.

Levels of Physical Activity	Total METs Score
Inactive	No activity or activity reported but not enough to meet category of minimally active or HEPA active.
Minimally Active	600 METs $\leq$ total METs $\leq$ 3000 METs
HEPA Active	3000 $\leq$ total METs

Respondents' anthropometric measurement and blood pressure were measured with the help of nutritionist. The weighing machine's validation involves iterative measurements of a standardized one-kilogram salt packet to ensure consistent and accurate readings. The sphygmomanometer's validation was achieved through a direct comparison of its readings with those obtained from a device in use at the Tribhuvan University (TU) health center, affirming its alignment with established blood pressure measurement standards. Similarly, the height measuring tape's validation was executed by comparing its measurements against those of a standard stadiometer located within the TU health center, verifying its precision in capturing accurate height values.

### Data analysis

The research study included both descriptive and inferential analysis. The descriptive analysis includes frequencies, percentages, means, medians, standard deviations, and so on, while the inferential part includes bivariate analysis using the chi-square test, ANOVA, Odds ratio, Pseudo R- Square, and log-likelihood ratio test. Based on the outcomes of the individual chi-square and fisher exact tests, variables as Age Group, Gender, Duration of service, Smoking, Tobacco use, Alcohol intake, Salt intake, Physical activeness, Job itself, Interpersonal relationship, Organization style, and Family work conflict were found to be significant at the 5% level of significance, suggesting the variables that influence the hypertension status of teachers. Even though the response variable in this study has an ordinal character, we are unable to employ ordinal logistic regression since the parallel line test shows significant results, which suggests that the location parameters (the slope coefficient) are constant for all response categories. Therefore, an alternative model called Multinomial Logistic Regression Model (MLRM) must be accounted while examining how various factors affect the hypertension status of the faculty at TU Central Campus. Firstly, validity of the fitted model's assessment was made by the application of different tests like model adequacy tests and summary measure of goodness of fit tests and later MLRM was used after the verification of the validity of the model. Here, normotensive was taken as the reference category hence would take the odds of hypertensive against being normotensive and being pre-hypertensive versus being normotensive. Let us suppose the categories for the outcome variable Y (i.e., hypertension status) are coded 0, 1, and 2 for normotensive, pre-hypertensive and hypertensive, respectively. We compare categories 0 and 1 and 2 and 0. For the other two, the lack of contrast between categories 1 and 2 is simply made up for since  $\ln \frac{\pi_{i2}}{\pi_{i1}} = \ln \frac{\pi_{i0}}{\pi_{i1}} - \ln \frac{\pi_{i0}}{\pi_{i2}}$ .

Let,  $Y_{ij} = \begin{cases} 1, & \text{if the individual fall into category} \\ 0, & \text{otherwise} \end{cases}$  where,  $j=0,1$  and  $2$

Let,  $\pi_j = \Pr(Y_{ij}/X)$ , represents the probability that  $Y_{ij} = j$

Considering that the outcome groups are exclusive, we may state,

$$\sum_{j=0}^2 \pi_{ij} = 1$$

Now, let's consider at a model for  $\pi_{ij}$ , specifically, considering the model where their probabilities depend on a vector  $X_k$  of the covariates linked with the  $i^{th}$  individuals.

$$\ln \frac{\pi_{i2}}{\pi_{i1}} = \ln \frac{P(Y_{ij}=j|X)}{P(Y_{i0}=1|X)} = \alpha_j + \sum_{k=1}^g \beta_{jk} X_k$$

where,  $j = 1, 2$ , and  $\alpha_j$  is a constant.  $\beta_{jk}$  is the regression coefficient for  $j = 1, 2$  and  $X_k$  ( $k = 1, 2, \dots, g$ ) are independent variables.

The MLNR model may also be written in terms of probability  $\pi_{ij}$ ,

$$\pi_{ij} = \frac{e^{\alpha_j + \sum_{k=1}^g \beta_{jk} X_k}}{1 + e^{\alpha_j + \sum_{k=1}^g \beta_{jk} X_k}}$$

Iteratively reweighted least squares, which is similar to the logarithm of fisher scoring or Newton-Rapson, is employed to estimate the parameters of this multinomial logistic regression model to get maximum likelihood estimates (McCullough & Nelder, 1989).

## RESULTS

Cronbach's alpha test of reliability has been used to evaluate internal consistency. Role management has a higher value of Cronbach's alpha than 0.8 after omitting two items which is good. Job itself, interpersonal relationship, Organization Style, and Family work conflict have a value greater than 0.7 which is good and acceptable. After omitting one item Career development has a value greater than 0.6 which is acceptable. The table containing specific details about the Cronbach's alpha value is included in the Supplementary Material (Table S4). Among the respondents, 37.7% have hypertensive status, exceeding both normotensive (30.3%) and pre-hypertensive (32.0%) proportions (Table 1). In Table 4, data on hypertension prevalence across four strata reveals that teachers affiliated with the Institute of Science and Technology have the highest rate at 41%, surpassing other faculties. The Faculty of Education follows with a prevalence of 37.5%.

**Table 3.** The overall distribution of hypertension status of the respondents.

Hypertension Status	Frequency (n)	Percentage (%)
Normotensive	75	30.3
Pre-hypertensive	79	32
Hypertensive	93	37.7
Total	247	100

**Table 4.** Distribution of hypertension among faculties (strata).

Faculties	Hypertension			Total
	Normotensive	Pre-hypertensive	Hypertensive	
Education	20 (35.7%)	15 (26.8%)	21 (37.5%)	56 (100%)
Humanities and Social Science	33 (33.3%)	30 (30.3%)	36 (36.4%)	99 (100%)
Management	2 (14.3%)	8 (57.1%)	4 (28.6%)	14 (100%)
Science and Technology	20 (25.6%)	26 (33.3%)	32 (41.0%)	78 (100%)
Total	75 (30.3%)	79 (32.0%)	93 (37.7%)	247 (100%)

The distribution of sample characteristics under study is shown in Supplementary Material (Table S1), which comprises the distribution of study variables like socio-demographic, behavioral, and clinical variables. The respondents ranged in age from 30 to 62, with a mean age of 48.23( $\pm$ 7.277) years. It was discovered that 25.9% of those polled were between the ages of 40 to 44, the highest frequency among all groups, and 9.7 percent were from the age of 30 to 40. Male

respondents (84.6 %) outnumbered the female respondents. Furthermore, 97.2 % of respondents were married, with only 2% being single and 0.8 being widowers. The data also shows that the majority of teachers (75.7%) use vehicles as a form of transportation to the workplace, followed by walking (24.3%). Among teachers on the TU campus, service time was categorized into six groups. Notably, those with 10 to 15 years of service constituted the highest frequency at 23% of the total sample. Additionally, the study found that a significant majority of respondents (57.5%) reported a family history of hypertension. In the study, approximately half of the respondents (50.2%) reported being alcohol consumers. Regarding tobacco intake, 78.9% did not use any tobacco products, while 21.1% had tried various tobacco products with varying regularity. Cigarette smoking was observed in 21.1% of respondents. The majority (85.8%) believed they used an appropriate amount of salt in their meals. However, only a small percentage (2%) were deemed sufficient consumers of fruits and/or vegetables, while the rest (98%) appeared to be insufficient consumers.

Distribution of study variables also reveals that 28.3 % of respondents use anti-hypertensive medications for lowering blood pressure, 14.6 % of total respondents use drugs to control high blood sugar and 6.1% of total respondents use drugs for other long-term diseases. It has also been observed that more than half of the teachers (56.3 %) seemed as obese, 23.1 % of people were overweight and only 20.6 % have normal BMI status. In terms of physical activity, 59.5% of respondents were found to be HEPA active or minimally active, while 40.5 % were found inactive by doing insufficient physical activity. In Table 5, the average overall mean score for the job itself is 2.55, indicating that most employees disagree that the job is the sole source of stress. Regarding personal safety concerns during work, respondents generally disagreed, as evidenced by a mean score of 2.25 and a median of 2. In terms of role management, the overall mean score is 3.08, suggesting that most respondents agreed that the organization had a poor management system for defining employee roles. Specifically, within this category, with a mean score of 3.10 and a median of 4, the majority concurred that they were assigned to different work positions simultaneously. In Table 5, the overall mean score for interpersonal relationships is 1.93, indicating that the majority of respondents disagreed with the notion of lacking healthy relationships with coworkers. The lowest mean score, 1.85, for feeling isolated suggests that respondents did not feel lonely at work. The overall mean score for organizational style is 2.64, less than 3, suggesting that most participants were satisfied with the organization's supportive attitude. In the career development category, the total mean score is 2.23, less than 3, contradicting the idea that employees were anxious about future career advancement. The family work conflict's overall mean score is 2.34, less than 3, indicating that most respondents do not perceive a conflict between their job and family.

### *Bivariate analysis*

The study employed the independent chi-square test and cross-tabulation to assess the association between hypertension status and various socio-demographic, behavioral, and clinical variables. A total of 23 variables were included in the bivariate analysis, encompassing factors such as age, gender, marital status, ethnicity, family type, religion, modes of transportation, duration of



service, family history of hypertension, alcohol intake, tobacco use, cigarette smoking, salt intake, fruits/vegetables intake, obesity, physical activeness, presence of other diseases, and six continuous variables derived from occupational stress factors.

**Table 5.** Descriptive information on occupational stress (n = 247).

Dimension	Items	Mean	Median	S.D.
9522555Job Itself	My job is very complicated	2.43	2	1.26
	Worry about personal safety at the job	2.25	2	1.17
	I often do overtime in my job	3.06	3	1.3
	Afraid of accountability	2.47	2	1.35
	Overall	2.55	2.5	0.97
Role Management	Sometimes I receive different job requirements from the job leaders	3.06	3	1.24
	Sometimes I am assigned to different positions at the same time	3.1	4	1.18
	Overall	3.08	3	1.12
Interpersonal Relationship	Conflict or unhappiness with colleagues	2.01	2	1.09
	Feeling isolated at the job	1.85	2	0.89
	Overall	1.93	2	0.88
Organizational Style	Lack of support from leadership	2.67	2	1.26
	Leaders were unable or unwilling to help me with my job problem	2.6	2	1.2
	The unit wage system is not reasonable	2.87	3	1.25
	The organization did not respond well to my performance	2.42	2	1.3
	Overall	2.64	2.5	0.98
Career Development	I am worried about my future career development	2.3	2	1.32
	My rights are sometimes not protected	2.17	2	1.17
	Overall	2.23	2	1.08
Family Work Conflict	I feel that I have a heavy financial burden on my family	2.36	2	1.2
	The nature of the job requires separation and not enough to take care of the family	2.45	2	1.29
	Family members do not have enough understanding and support for the job	2.21	2	1.35
	Overall	2.34	2	1.02

This thorough examination aims to uncover correlations between hypertension and a diverse range of factors, providing a comprehensive understanding of potential associations in the studied population. Out of which only 12 variables seemed to have significant association with the outcome variable. From the comparison of hypertension status among the respondents with different categorical variables separately, Age Group ( $p$ -value $<0.001$ ), Gender ( $p$ -value $<0.001$ ), Duration of service ( $p$ -value $<0.001$ ), Smoking ( $p$ -value $<0.001$ ), Tobacco use ( $p$ -value $<0.001$ ), Alcohol intake ( $p$ -value = 0.036), Salt intake ( $p$ -value $<0.001$ ), Physical activeness ( $p$ -value $<0.001$ ) were found significantly associated with status of hypertension at 5% level of significance. The precise tabular information of bivariate analysis was provided in the Supplementary Material.

Analysis of the status of hypertension with the continuous composite variable of occupational stress was assessed by using ANOVA method and from ANOVA we can observe that the  $p$ -value for most of the variables (job itself, interpersonal relationship, organization style, and family work conflict) were significant at a 5% level of significance. MLRM was fitted by employing the 'Enter Method', including all the twelve variables that showed a significant association with the dependent variable based on chi-square tests, to collectively assess their joint impact on the outcome. Table 6 comprises the estimates of MLRM coefficients,  $p$ -value, and odds ratios for each category. From the fitted MNLR model, variables like interpersonal relationship, age group, smoking, and physical activeness were significant to the model of pre-hypertensive versus normotensive status of hypertension, as per the fitted multinomial logistic regression. And the variables like job itself, interpersonal relationship, age group (45-50 years), gender, duration of service (below 5 years, 5-10 years, 10-15 years), smoking, tobacco (occasionally), physical activeness were significant to the model of hypertensive versus normotensive status of hypertension among TU central campus' teachers. The odds ratios for job itself and interpersonal relationships at the job were found to be 1.53 and 2.47 respectively for the model pre-hypertension versus normotension. It indicates that, when compared to teachers who had one less mean score, those who had one mean score greater in the job itself score and interpersonal relationship at the job score were around 1.5 and 2.5 times more likely to be at risk of developing pre-hypertension. In a similar vein, when compared to teachers who had one less mean score, those who had one mean score greater in the interpersonal relationship at the job score were 2.3 times more likely to be at risk of developing hypertension relative to normotension status of hypertension. Age groups 30 to 40, between 40 and 45, and between 45 and 50 years had odds ratios of 7.54, 6.95, and 9.70, respectively, for the pre-hypertensive versus normotensive models.

Compared to teachers over 55 years, those in the age groups 30 to 40, 40 to 45, and 45 to 50 are approximately 7.5, 7, and 9.7 times more likely to have pre-hypertension relative to normotensive conditions. This suggests that teachers in younger age groups have a higher likelihood of developing pre-hypertension compared to their older counterparts. Likewise, the odds ratio for the age group 45 to 50 years is found to be 6.94 for the model hypertensive vs normotensive,

meaning that teachers in this age group are about 7 times more likely to acquire HTN than those in the age group 55 and older. The odds ratio for female teachers over male teachers is the same for the both models (0.26).

**Table 6.** Fitted model explaining status of hypertension.

Variable	Prehypertension Versus Normotension				Hypertension Versus Normotension			
	Estimated coefficient	P-value	Odds ratio	95% CI of OR	Estimated coefficient	P-value	Odds ratio	95% CI of OR
Intercept	2.53	0.219			1.99	0.323		
Job itself	0.42	0.141	1.53	(0.869, 2.695)	0.59	0.037*	1.8	(1.035, 3.151)
Interpersonal Relationship	0.9	0.021*	2.47	(1.149, 5.334)	0.84	0.019*	2.32	(1.147, 4.728)
Organization Style	-0.06	0.853	0.94	(0.496, 1.787)	0.23	0.455	1.26	(0.679, 2.374)
Family work conflict	-0.25	0.37	0.77	(0.440, 1.358)	-0.22	0.404	0.79	(0.466, 1.361)
Age group = 30 to 40	3.72	0.005*	7.54	(3.167, 45.035)	-0.21	0.871	0.8	(0.063, 10.379)
Age group = 40 to 45	3.43	0.002*	6.95	(3.414, 80.706)	1.53	0.122	4.64	(0.662, 32.558)
Age group = 45 to 50	3.9	0.001*	9.7	(6.101, 34.978)	1.93	0.045*	6.94	(1.043, 46.200)
Age group = 50 to 55	1.52	0.091	4.58	(0.783, 26.871)	0.6	0.433	1.83	(0.402, 8.396)
Age group = above 55®								
Gender = Female	-1.34	0.034*	0.26	(0.076, 0.904)	-1.34	0.049*	0.26	(0.069, 0.992)
Gender = Male®								
Duration of service = below 5 years	-4.22	0.001*	0.015	(0.001, 0.186)	-3.15	0.013*	0.04	(0.004, 0.513)
Duration of service = 5 to 10 years	-4.6	0.001*	0.01	(0.001, 0.138)	-3.59	0.008*	0.02	(0.002, 0.383)
Duration of service = 10 to 15 years	-3.28	0.006*	0.03	(0.004, 0.381)	-1.97	0.066	0.13	(0.017, 1.137)

Duration of service = 15 to 20 years	-1.78	0.11	0.16	(0.019, 1.496)	-1.08	0.302	0.33	(0.043, 2.649)
Duration of service = 20 to 25 years	-1.34	0.179	0.26	(0.037, 1.853)	-0.15	0.864	0.85	(0.147, 4.995)
Duration of service = above 25 years®								
Smoking= Yes	2.27	0.002*	9.75	(1.691, 27.432)	2.45	0.001*	11.61	(1.809, 32.723)
Smoking= No®								
Tobacco= Never	-0.21	0.877	0.8	(0.052, 12.477)	-0.69	0.608	0.5	(0.036, 6.997)
Tobacco= Occasionally	-1.03	0.518	0.35	(0.015, 8.228)	-3.75	0.025*	0.02	(0.001, 0.629)
Tobacco= Regularly®								
Alcohol= No	-0.78	0.134	0.45	(0.163, 1.273)	-0.31	0.56	0.73	(0.258, 2.080)
Alcohol= Yes®								
Salt intake= Too low or right amount	-1	0.155	0.36	(0.093, 1.459)	-0.21	0.78	0.8	(0.173, 3.739)
Salt intake= Too much®								
Physical activeness= Inactive	1.17	0.028*	3.24	(1.135, 9.275)	1.96	0.001*	7.16	(2.607, 19.699)
Physical activeness= Minimally or HEPA active®								

® denotes reference category, \* = p - value < 0.05, n= 247

In comparison to males, women had around 74% reduced risk of experiencing both pre-hypertension and hypertension when compared to normotensive status. For the model comparing pre-hypertensive to normotensive conditions of hypertension, odds ratios for service durations below 5 years, 5 to 10 years, and 10 to 15 years are 0.015, 0.01, and 0.03, respectively. This indicates that teachers with less than five, five to ten, and ten to fifteen years of service at TU Central Campus

are less likely to have pre-hypertension compared to those with over 25 years of service. Similarly, for the model comparing hypertensive to normotensive status, odds ratios for service durations under five years and between 5 to 10 years, compared to over 25 years, are 0.043 and 0.027, respectively. This suggests a 95.7% and 97.3% lower likelihood of developing hypertension for teachers with less than five years and between five and ten years of service, respectively. The pre-hypertensive versus normotensive model has an odds ratio for smokers over non-smokers of 9.75 and 11.61 for the model hypertensive versus normotensive. Relative to normotensive status, teachers who smoke had around 9.7 times more likelihood of developing pre-hypertension and about 11.6 times higher risk of developing hypertension than teachers who don't smoke cigarettes.

The odds ratio between teachers who occasionally consume smokeless tobacco and those who regularly do so is found to be 0.023 for the model hypertensive versus normotensive status. This means that teachers who occasionally consume smokeless tobacco had a 97.7% lower risk of developing hypertension than teachers who regularly consume relative to normotensive status of hypertension. However, using smokeless tobacco had no discernible impact on the model pre-hypertensive vs normotensive. The odds ratio for physically inactive teachers over physically active (minimally active or HEPA active) teachers for the model pre-hypertensive versus normotensive is found to be 3.24, which indicates that the teachers with insufficient physical activity were 3.2 times more likely to have pre-hypertension as compared to those who do significant physical activity relative to normotensive status of hypertension. Likewise, the odds ratio for the same comparison between teachers who are physically inactive and those who are minimally active or HEPA active is found to be 7.16, indicating that the likelihood of developing hypertension among teachers was around 7.2 times higher than that of teachers who are physically active relative to those who have normotensive status of hypertension.

### Model adequacy test

In the logistic regression model, the likelihood ratio test is based on the -2LL value. The likelihood ratio test is the test of significance using the Chi-square test, where the difference between the baseline model and the final model is computed. The following table 7 displays the likelihood ratio test for the overall significance of each predictor's coefficient as well as the significance of a single predictor in the model.

**Table 7.** Model fitting information.

Model	Model fitting criteria	Likelihood ratio test		
	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept only	540.578			
Final	370.077	170.502	40	0

In this research, the likelihood value is 540.578 measures of the model with no independent variables and the final -2 log-likelihood value is 370.077 which is computed after the independent variables have been interred into the Multinomial logistic regression (MLNR) model. The difference between these two measures follows a chi-square distribution with 40 degrees of freedom and measures how well the independent variables affect the outcome variable. The study explores p-value as  $< 0.001$ , which demonstrates that at least single coefficient, and maybe the majority, are different from zero. Additionally, it may also mean that all the predictors significantly contribute to the outcome variable's prediction. Since the chi-square test for the model is significant, it concludes to have the appropriate MNLR model fitting. The classification accuracy, which gauges the alignment between actual and predicted group membership based on the MNLR model, is a crucial metric for assessing its utility. A 25 percent improvement beyond chance precision is considered indicative of the MNLR model's effectiveness. The proportional accuracy rate, representing chance accuracy, is determined by adding the squared percentage of cases in each category. In this study, the categorization accuracy rate (67.2%) surpasses the chance accuracy level (42.03%). Therefore, the MNLR model demonstrates effective classification accuracy, indicating its reliability in predicting group membership. Further, the Cox and Snell  $R^2$  value was 0.499. However, this statistical measure has a theoretical maximum of 1, which it never achieves in practice. As a result, we employed Nagelkerke  $R^2$ . The Nagelkerke  $R^2$ , in this case, was determined to be 0.562, indicating that the explanatory variable accounts for around 56% of the variation in the categories of hypertension status. The Variance Inflation Factor (VIF) of all covariates was less than 3. Calculated values of VIF indicate that the assumption of multicollinearity is satisfied.

### Summary measure of goodness of fit

Deviance and Pearson's chi-square measurements are used to evaluate the estimated model's overall goodness of fit. There were 314 cells (i.e., dependent variable levels by subpopulations) having null frequencies, this calls into question the validity of the goodness-of-fit tests, however, the MLE for other predictor variables remains still valid. Therefore, we cannot safely use the findings of goodness of fit tests here since there are a lot of empty cells (66.7 %). Supported by the study, Multinomial logistic regression in workers' health (Grilo et al., 2017).

## DISCUSSION

In the current study, the prevalence of hypertension was 37.7%, which is greater in comparison with the prevalence reported as 24.5% in the STEPS survey 2019, Nepal (Bista et al., 2021). Males had a higher prevalence of hypertension in the current research than females (Male = 40.2% and Female = 23.7%), as was male prevalence of prehypertension (Male = 34.4% and Female = 18.4%). Which is consistent with the several research that showed that men had a greater prevalence of hypertension than women (Singh et al., 2011; Gao et al., 2013; Singh et al., 2017). Smoking, drinking alcohol, or engaging in physical exercise are behavioral risk factors that may contribute to the gender gap in the prevalence of hypertension. We hypothesize that smoking and

abstaining from tobacco use may be some of the safeguards against hypertension in women. Other than that, Chromosome disparities, biological sex variations, and hormonal imbalances which protects women from hypertension are among the biological causes. These biological determinants emerge during youth and persist throughout adulthood until women approach menopause, when gender differences in hypertension become less or nonexistent (Sandberg and Ji, 2012; Vitale et al., 2010; Vitale et al., 2009). A key risk factor for hypertension was shown to be age. Hypertension became more prevalent as people's ages increased in both sexes. Several additional studies, including Singh et al. (2017), Reddy et al. (2005), Tabrizi et al. (2016), and Erem et al. (2009), have consistently found a positive correlation between aging and hypertension. Age-related stiffening of the aorta and artery walls is a factor in the increased prevalence of hypertension in older age groups (Abebe et al., 2015).

Age is commonly acknowledged as a non-modifiable risk factor, with a clear linear association observed for both hypertension and pre-hypertension. However, it's important to note that the prevalence of hypertension and pre-hypertension doesn't necessarily follow a proportional pattern. This disparity arises because pre-hypertension typically represents the initial stage that can potentially advance to full-blown hypertension unless preventive measures are taken, thus affecting the prevalence of both conditions. Furthermore, as individuals age, their pre-hypertensive status can regress to a normotensive state, resulting in a similar outcome. This complexity means that the risk of pre-hypertension can actually be higher in younger age groups compared to older ones due to the possibility of progression to hypertension and subsequent regression to normal blood pressure (Li et al., 2023). Li et al. conducted a study with the objective of examining the rate of progression from prehypertension to hypertension in a cohort of Chinese middle-aged and elderly individuals (n=2845) over a 2-year duration. The results revealed that approximately 38.8% of the participants remained prehypertensive, while 32.8% shifted to a normotensive state, and 28.5% progressed to hypertension during this period. Another study revealed that over a period of four years, hypertension developed in nearly two thirds of patients with untreated prehypertension (Julius et al., 2006). In our study, it's essential to consider that the duration of service exclusively pertains to the service provided by respondents at the central campus of Tribhuvan University. Respondents can commence their service at various points in their life journey. Some may start early after completing their education, while others may join later after pursuing advanced degrees, gaining experience in related fields at different campuses. So, it's entirely possible to observe a range of ages within a specific service duration category, and this variation may contribute to the complexity of the relationship between age and service duration in our study. Therefore, despite observing a general linear relationship between age and service duration, our findings reveal contrasting results concerning the risk of pre-hypertension among teachers in younger age groups and those with shorter service durations. Further research is crucial to elucidate the precise underlying reasons for the observed discrepancies.

In the current study, tobacco use, smoking, interpersonal relationship in occupation, and physical activity were significantly associated with hypertension. In the current investigation, a strong link between physical activity and hypertension was observed. Physically inactive individuals had increased levels of hypertension than active or HEPA active individuals. According to the findings, those who did not get adequate physical activity had a threefold increased risk of pre-hypertension and about sevenfold increased risk of hypertension compared to those who did get sufficient physical activity. It was consistent with prior research that study participants who reported low levels of physical activity had an elevated risk of hypertension (Shanthirani et al., 2003; Malhotra et al., 1999; Dhungana et al., 2016). Unplanned and quick growing urbanization, a densely populated area, increased use of motor vehicles, and contemporary technology may be risk factors for this population's lack of physical activity. (Vaidya & Krettek, 2014). Although it is generally known that smoking raises the risk of hypertension, the magnitude of this link may vary depending on the demographic and research environment. According to the current study, teachers who smoke had a 9.7- and 11.6-times greater likelihood of developing pre-hypertension and hypertension, respectively, than those who don't smoke, which is higher than the finding of a community-based cross-sectional study in Kathmandu municipalities conducted by Dhungana et al. in 2016, which found that smoking doubled the risk of having hypertension. This difference may be attributable to the fact that study participants varied in how frequently and how long they smoked overall. Likewise, the present study found that teachers who occasionally consume smokeless tobacco had a 97.7% lower risk of developing hypertension than the teachers who consume smokeless tobacco on regular basis.

Interestingly, the current study was unable to demonstrate any significant association between alcohol consumption and hypertension. which is also corroborated by the research done by Shanthirani et al. (2003) and Chataut et al. (2011). It contrasts with the findings of Dhungana et al. (2016), who found that drinking alcohol raised the risk of hypertension by 1.6 times. However, several researches have shown alcohol's preventive properties against hypertension. These discrepancies in the results might have been brought on by variations in the quantity and quality of alcohol took in. According to Sacco et al. and Kannel & Ellison, moderate drinkers (those who consume up to two standard drinks per day) tended to have a protective benefit against hypertension and other cardiovascular illnesses, whereas heavy drinkers (those who consume seven or more drinks per day) experienced the reverse effect (Sacco et al., 1999; Kannel & Ellison, 1996). The apparent bidirectional effects of alcohol consumption on hypertension need to be investigated further. Regardless of the well-known inverse link between the consumption of vegetables and fruits and developing hypertension (Nunez-Cordoba et al., 2009), the present research found no association between them. A similar finding was also observed by research carried out in rural Nepal (Dhungana et al., 2014). Future research may help to validate these results by using a more thorough food frequency questionnaire. It may be challenging to clearly define the link between



hypertension and Nepal's variable pattern of fruit and vegetable consumption due to these items' seasonal availability (Lwanga & Lemeshow, 1991).

## CONCLUSION

Our study reveals that socio-demographic, behavioral, clinical, and occupational stress factors significantly impact the hypertension status of teachers at TU central campus. Female teachers demonstrate a 74% lower risk of pre-hypertension and hypertension compared to males, while younger age reduces overall risk. Longer service duration at Tribhuvan University Campus increases hypertension likelihood. Poor interpersonal relationships and job obstacles double hypertension risk. Occasional smokeless tobacco use lowers hypertension risk compared to regular use, but cigarette smoking elevates both pre-hypertension and hypertension risks. Physical inactivity substantially increases both risks. Lifestyle modifications, especially among youth, are crucial to mitigate hypertension risk. Encouraging health-conscious actions, prioritizing physical activity, and initiating government-level health programs are vital for fostering a healthy workforce in the educational sector and promoting overall well-being among government employees.

## Ethical approval

The study protocol was reviewed and approved by Institutional Review Committee (IRC) (Regd. No. IRCIOST-22-0030), Institute of Science and Technology, Tribhuvan University, Kirtipur, Kathmandu.

## CONFLICT OF INTEREST

The authors declared that there is no conflict of interest.

## ACKNOWLEDGEMENTS

The authors would like to express their sincere appreciation to all the respondents who have participated in the survey providing valuable information. The authors would also like to thank Prof. Dr. Srijan Lal Shrestha, Prof. Dr. Shankar Prasad Khanal, Prof. Dr. Gauri Shrestha, Prof. Dr. Chandra Mani Paudel and Prof. Dr. Ram Prasad Khatiwada for providing reasonable comments in completing this work. Appreciation also goes to nutritionist Mrs. Sarita Rai for her assistance during the data collection period.

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**Reference** to this paper should be made as follows:

Khadka, K., & Uprety, P. (2023). Status of hypertension and its determinants among teachers in Tribhuvan University Campus, Kirtipur, Kathmandu. *Nep. J. Stat*, 7, 33-52.