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May Measurement Month 2021: an analysis of blood pressure screening results from Nepal

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Despite the well-recognized importance of prevention and early treatment of hypertension, the majority of adults in Nepal are not aware of their high blood pressure (BP) and are left untreated. In this paper, we report the result of the May Measure Month 2021 campaign in Nepal: a nationwide community-based hypertension screening campaign. An opportunistic cross-sectional survey was conducted in 15 districts between September 2021 and December 2021. An individual was included if aged 18 years or more and provided informed consent. Structured questionnaires were administered, and BP was measured three times in a sitting position by trained volunteers. A total of 5172 participants were included. The median age (interquartile range) was 37 (25–51), and 49.9% were female. The mean (SD) of the systolic and diastolic BP was 123.9 (14.9) and 80.2 (9.3) mmHg, respectively. A total of 1066 participants (20.6%) were identified as hypertensive (systolic BP ≥ 140 mmHg or diastolic BP ≥ 90 mmHg or on antihypertensive medication), of whom 399 (39.5%) and 298 (29.5%) were aware of their BP status and treated with at least one antihypertensive medicine, respectively. Blood pressure control (<140/90 mmHg) was achieved in 15.6% of all hypertensives and in 56.0% of treated individuals. Multivariate logistic regression showed an association between hypertension and the following variables: every 1-year increase of age [odds ratio (OR) = 1.13 (1.11-1.15) if age < 40 and OR = 1.05 (1.04-1.06) if age ≥ 40], male [OR = 1.57 (1.33-1.89)], regular alcohol use [OR = 1.59 (1.30-1.93)], and diabetes [OR = 2.63 (1.93-3.58)]. Hypertension awareness, treatment, and control were suboptimal in Nepal. This study supports a strong need to scale up community-based hypertension programmes in Nepal and raises the possibility of task sharing with community health workers.

Introduction

Cardiovascular disease (CVD) is the leading cause of death and disability in Nepal,[1] and hypertension is the most attributable risk factor for CVD death in Nepal.[2] Recent

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Table 1 Baseline characteristics

	Total	Male	Female	*P*-value*
Participants, *n*	5172	2589	2583	
Age (years), median (IQR)	37 (25.0-51.0)	38.0 (25.0-52.0)	36.0 (25.0-50.0)	0.016**
SBP (mmHg), mean (SD)	123.9 (14.9)	127.2 (14.2)	120.6 (14.9)	<0.001**
DBP (mmHg), mean (SD)	80.2 (9.3)	81.7 (9.1)	78.7 (9.2)	<0.001**
Current smoking, *n* (%)	1118 (21.7)	934 (36.1)	184 (7.1)	<0.001
Regular alcohol use, *n* (%)	1132 (21.9)	927 (35.8)	205 (8.0)	<0.001
Diabetes, *n* (%)	210 (4.1)	118 (4.6)	92 (3.6)	0.069
Previous diagnosis of hypertension, *n* (%)	508 (10.7)	289 (12.2)	219 (9.2)	<0.001
History of CVDs, *n* (%)	28 (0.5)	18 (0.7)	10 (0.4)	0.13
History of COVID-19 infection, *n* (%)	37 (0.7)	23 (0.9)	14 (0.5)	0.14
Vaccinated against COVID-19, *n* (%)	4476 (86.5)	2290 (88.5)	2186 (84.6)	<0.001

CVDs, cardiovascular diseases; DBP, diastolic blood pressure; IQR, interquartile range; SBP, systolic blood pressure.

*Difference of mean value between male and female.

**Two-sample *t*-test, otherwise χ^2 test.

data suggest that hypertension affects 4.7 million adults in Nepal, of which 20% are aware of their high blood pressure (BP) status, 10% are under pharmacological treatment, and only 5% have their BP under control.[3] Given the rising burden of CVDs,[1] interventions to prevent and control hypertension are urgently needed.

May Measure Month (MMM) is a global initiative started by the International Society of Hypertension (ISH). The campaign aims to provide BP measurement opportunities for adults in communities who have not measured their BP in the previous year, give lifestyle advice to those identified as hypertensive, and present community-based data to policymakers. Since its initiation in 2017, MMM has been executed annually in Nepal under the leadership of the Nepal Development Society by engaging different stakeholders including professional organizations, non-profit organizations, and the government. In this paper, we present the results of the MMM21 in Nepal and the lessons we learned.

Methods

This is an opportunistic cross-sectional study conducted in 15 districts from September 2021 through December 2021 in Nepal. The study was originally planned in May 2021 but was postponed to September 2021 to execute under the appropriate safety procedures amid the COVID-19 pandemic. An individual with age $\geq$ 18 years old providing written consent was eligible for the study. No exclusion criteria were set. Eligible individuals were recruited via convenience sampling. Specifically, the study was advertised via home visits, flyers, telephone, and social media. The place of screening was either health facilities, religious places, community centres, available spaces in public and private buildings, and participants' houses.

Trained volunteers administered a structured questionnaire and then measured BP three times in a sitting position at 1-minute intervals using digital BP monitors after having participants seated and rested for 5 minutes. The questionnaire was developed in English by ISH and then translated into Nepali by bilingual research staff. Data were collected by volunteers who were medical, public health, or nursing college students, community health workers (CHWs), clinicians, and nurses. They underwent the 1-day in-person training if new to the programme or the half-day

refresher training if trained during previous MMM campaigns. The 1-day training covered the following topics: procedures for questionnaire administration, BP measurement with digital BP monitors, and lifestyle counselling for hypertensive individuals. All volunteers were provided with periodic on-site monitoring and supervision by research staff. Data were collected onto paper-based questionnaires and then entered onto a Microsoft Excel spreadsheet by the research staff.

After data collection, the compiled data in the Excel spreadsheet were imported and computed with the STATA version 17.0 by the first author (Y.I.). Hypertension was defined as the following: (i) mean of second and third systolic BP (SBP) readings $\geq$ 140 mmHg and/or diastolic BP (DBP) $\geq$ 90 mmHg or (ii) taking at least one antihypertensive medicine for hypertension diagnosed by health professionals. Missing values were not imputed, in contrast to the global results. Age, SBP, and DBP were treated as numerical variables, while sex, current smoking, regular alcohol use, diabetes, previous diagnosis of hypertension, and history of CVDs (i.e. myocardial infarction or stroke) were treated as dichotomized variables. Multivariate logistic regression was performed to explore associations between hypertension and the following risk factors: age, male sex, current smoking, regular alcohol use, diabetes, and history of CVDs. The variable age had a spline term at age 40, because the fitness of the data was optimized by adding a spline term at that age. By aggregating to the district level (15 districts), associations between hypertension and the following four socio-economic variables were also assessed: the Human Development Index (HDI), literacy (%), years of schooling (year), and per-capita income (USD). We developed four univariate linear regression models, each of which had one of the aforementioned socio-economic factors as a covariate. We also developed two multivariate linear regression models, where one had HDI, per-capita income, and years of schooling as covariates and the other had HDI, per-capita income, and literacy as covariates. All socio-economic data were drawn from the Nepal Human Development Report 2014.[4] Ethical approval was obtained from the Nepal Health Research Council.

Results

A total of 5172 participants were included. The median age was 37 (IQR: 25–51) years, and 49.9% were female (*Table 1*). Current smoking and regular alcohol use were seen in about 35% of males and less than 10% of females. Only 0.5% had a

Table 2 Hypertension cascade

	Total	Male	Female	*P*-value*
Hypertension, *n* (%)	1066 (20.6)	649 (25.1)	417 (16.2)	<0.001
Hypertension ACC/AHA guideline, *n* (%)[a]	3015 (58.3)	1728 (66.7)	1287 (49.9)	<0.001
Awareness among HTN, *n* (%)	399 (37.0)	241 (39.3)	158 (40.0)	0.81
Treated among HTN, *n* (%)	298 (29.5)	180 (29.3)	118 (29.9)	0.35
Controlled among treated, *n* (%)	167 (56.0)	101 (56.1)	66 (55.9)	0.98
Control among HTN, *n* (%)	167 (15.6)	101 (15.6)	66 (15.8)	0.97

ACC, American College of Cardiology; AHA, American Heart Association; HTN, hypertension.

[a]BP ≥ 130/80 mmHg or taking at least one antihypertensive medicine for raise BP.

*χ^2 test.

history of CVDs. The mean (± SD) of SBP and DBP was 123.9 (±14.9) and 80.2 (±9.3) mmHg, respectively.

Of 5167 participants whose second and third BP readings and data on antihypertensive medication use were available, 1066 (20.6%) were identified as hypertensive (Table 2). Using the American College of Cardiology and American Heart Association threshold of BP ≥ 130/80 mmHg, an additional 1949 individuals were identified as hypertensive. After excluding 57 hypertensives whose awareness or treatment data were missing, 399 (37.0%) were aware of their BP status, and 298 (29.5%) were treated with at least one antihypertensive medicine. The BP control rate (<140/90 mmHg) was 56.0% among treated hypertensives and 15.6% among all hypertensives.

The multivariate logistic regression model showed statistically significant associations between being hypertensive and the following covariates: every 1-year increase of age [odds ratio (OR) = 1.13 (1.11-1.15) if age < 40 and OR = 1.05 (1.04-1.06) if age ≥ 40), male [OR = 1.57 (1.33-1.89)] compared with female, regular alcohol use [OR = 1.59 (1.30-1.93)] vs. never/rare use, and diabetes [OR = 2.63 (1.93-3.58)] vs. not having diabetes. The linear combination showed that the odds of being hypertensive were 6.2 times higher (95% confidence interval 4.3-9.2) for a diabetic male with regular alcohol use at a certain age, compared with a non-diabetic female without regular alcohol use at the same age. At the district level, none of the six aforementioned linear regression models showed statistically significant association between hypertension and socio-economic factors.

Discussion

This is the fourth report of MMM from Nepal. A total of 5172 adults were screened over 2 months. 20.6% were identified as hypertensive, of which approximately 60% were not aware of their BP status and about 70% were not on pharmacological treatments. Approximately 85% of all hypertensives had uncontrolled BP levels. Males with diabetes who regularly consume alcohol had significantly greater odds of being hypertensive than non-diabetic females at the same age who do not regularly consume alcohol.

This study is consistent with previous data[3] that hypertension awareness, treatment, and control are suboptimal in Nepal. Although the MMM studies are not longitudinal, the results have been similar across the last 4 years[5-7] and are lower than the average of the 92 countries that participated in the MMM in 2019.[8] The Nepal government has launched the first noncommunicbale disease policy 'Multi-Sectoral Action Plan on the 'Prevention and Control of NCDs 2014-2020' and adopted the World Health Organization's package of essential NCD in 2019.[9] However, findings from the 2021 MMM campaign suggest that not much change has occurred at the ground level. Here, our study highlights the need for the government to urgently scale up the community-based programme that directly benefits individuals in communities.

Our study also explored hypertension risk factors both at the individual level and the district level. Older age, male sex, regular alcohol use, and diabetes were identified as potential risk factors for hypertension at the individual level. At the district level, we did not see any association between hypertension and socio-economic factors. Recently, Kirschbaum et al.[10] suggested that socio-economic factors had a minimal effect on hypertension using data from 76 lower- and middle-income countries (LMICs). Although further studies are needed, our study supports the idea that essential health services for hypertension management must be accessible and affordable for all adults in LMICs irrespective to socio-economic status.

The findings of our study may not be generalizable given participants were recruited via convenience sampling. Antihypertensive medication use is potentially misclassified sometimes due to the design of the questionnaire. Participants were asked the number of antihypertensive medicine classes they are taking instead of the number of antihypertensive medicines itself, which may have led to confusion and resulting misclassification. However, given the data were similar to that in previous MMM studies,[5-7] we consider the effect of the misclassification was minimal.

The strength of our study is its large sample size with over 5000 participants. Some data were also collected from hard-to-reach areas, which is not usually reported in national reports. Responses to our study suggested high motivation in the communities and raised the potential feasibility of task sharing with CHWs, given this is a non-funded study led entirely by volunteers, and some of these volunteers were CHWs who have never been trained in screening for hypertension.

In summary, our cross-sectional study showed that hypertension awareness, treatment, and control are suboptimal in Nepal. Our study also showed the feasibility

of having CHWs in hypertension screening and lifestyle counselling. The government should expedite the implementation of a community-based hypertension programme at the national level.

Data availability

The data of this article will be shared on reasonable request to the corresponding author.

References

1. World Health Organization. Global health estimates: Leading causes of death in Nepal [Internet]. The Global Health Observatory. World Health Organization. https://www.who.int/data/gho/data/themes/mortality-and-global-health-estimates/ghe-leading-causes-of-death (4 January 2023).
2. Institute for Health Metrics and Evaluation. GBD results [Internet]. Institute for Health Metrics and Evaluation. 2019. https://vizhub.healthdata.org/gbd-results/ (4 January 2023).
3. Dhimal M, Bista B, Bhattarai S, Dixit LP, Hyder MKA, Agrawal N *et al*. *Report of Non-Communicable Disease Risk Factors: STEPS Survey Nepal 2019*. Kathmandu: Nepal Health Research Council; 2020.
4. Sharma P, Guha-Khasnobis B, Khanal DR. *Nepal Human Development Report 2014: Beyond Geography, Unlocking Human Potential [Internet]*. Kathmandu: Government of Nepal, UNDP; 2014.
5. Bhattarai H, McLachlan CS, Khanal P, Adhikari TB, Ranabhat K, Koirala S *et al*. May Measurement Month 2019: an analysis of blood pressure screening results from Nepal. *Eur Heart J Suppl* 2021;**23**:B110–B113.
6. Adhikari TB, Bhattarai H, Ranabhat K, Khanal P, Mishra SR, Koirala S *et al*. May Measurement Month 2018: an analysis of blood pressure screening results from Nepal. *Eur Heart J Suppl* 2020;**22**:H92–H95.
7. Mishra SR, Shrestha N, Poudyal IP, Malla M, Gyawali B, Shrestha AD *et al*. May Measurement Month 2017: an analysis of blood pressure screening results in Nepal—South Asia. *Eur Heart J Suppl* 2019;**21**:D83–D85.
8. Beaney T, Schutte AE, Stergiou GS, Borghi C, Burger D, Charchar F *et al*. May Measurement Month 2019: the global blood pressure screening campaign of the International Society of Hypertension. *Hypertension* 2020;**76**:333–341.
9. World Health Organization Country Office for Nepal. *Package of Essential non Communicable Disease (PEN) Intervention at Primary Health Service Setting: PEN Training Trainee's Manual*. Kathmandu: World Health Organization Country Office for Nepal; 2019.
10. Kirschbaum TK, Sudharsanan N, Manne-Goehler J, De Neve JW, Lemp JM, Theilmann M *et al*. The association of socioeconomic status with hypertension in 76 low- and middle-income countries. *J Am Coll Cardiol* 2022;**80**:804–817.