The prevalence and associated factors for prehypertension and hypertension in Cambodia

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ABSTRACT

Background Hypertension is strongly associated with adverse cardiovascular outcomes and was the leading modifiable associated factor for global disease burden in 2010. Analysis of modifiable associated factors will be important to those concerned with mitigating the adverse effects of hypertension. We studied factors associated with hypertension in adults aged 25–64 years of age in Cambodia in order to help develop strategies for planned new initiatives for prevention and control of hypertension.

Methods Using data from a nationwide survey in Cambodia assessing the prevalence of associated factors for non-communicable disease in 2010 (WHO STEPs survey), 5017 participants between the ages of 25 and 64 years were included in a secondary analysis of the prevalence and predictors of hypertension.

Results The prevalence of prehypertension in this sample was approximately double that of overall hypertension (27.9% vs 15.3%). Male sex, increasing age and known cardiovascular associated factors, including higher Body Mass Index (BMI), dyslipidaemia, impaired fasting glycaemia, and abdominal obesity were all associated with an increased prevalence of hypertension. In multivariate models, increasing age was the strongest associated factor for hypertension (OR 8.79, 95% CI (5.43 to 14.2)), whereas, higher BMI was the primary associated factor associated with prehypertension (OR 3.27, 95% CI 2.21 to 4.82).

Conclusions Modifiable cardiovascular-associated factors are strongly correlated with prehypertension and hypertension in Cambodia, and may be a focus of public health and primary care strategies to mitigate subsequent ischaemic heart disease and stroke.
A national strategy aimed at increased screening and adherence to medical therapy is a necessary first step to reduce burden of disease and related morbidities.

INTRODUCTION

With recent evidence highlighting the prevalence of hypertension and related metabolic disorders in Cambodia,[1 2] attention is now being given to initiating evidence-based prevention and control strategies. A national survey in 2010 revealed that hypertension had an urban prevalence of approximately 16.90%, a rural prevalence of 10.00%, and overall country prevalence of 11.20% among persons aged 25–64 years.[3]

Hypertension is strongly correlated with adverse cardiovascular outcomes, including a twofold higher risk of developing coronary heart disease, fourfold higher risk of developing congestive heart failure, and seven times higher risk of stroke compared with normotensive persons.[4]

Given the prevalence of hypertension, the Cambodian Ministry of Health has designated its control as a priority area in its national health strategic plan. In order to help inform implementation planning, we conducted a secondary analysis of a population-based study of Cambodian adults in 2010 that assessed the prevalence of non-communicable disease and associated factors. Our study has two primary objectives: first, to characterise the variability in prevalence of hypertension across several clinical characteristics including established cardiovascular-associated factors such as Body Mass Index (BMI), abdominal obesity, hypercholesterolaemia, diabetes and smoking; and second, and of primary importance for in-country health policy, to describe associated factors with prehypertension and hypertension in this sample.

MATERIAL AND METHODS

Study design and population

From February to April 2010, the Ministry of Health conducted a nationwide cross-sectional survey in Cambodia assessing the prevalence of non-communicable disease, associated factors, and anthropometric characteristics. The study was funded by WHO and was conducted using the stepwise approach to surveillance protocol (STEPS) of WHO.[5] A total of 5643 participants, aged 25–64 years, were randomly selected through multistage cluster sampling. Response rate was 96.30%, with 5433 adults comprising the final dataset with minimal missing data. After excluding pregnant women and records with incomplete survey data, 5017 participants remained for inclusion in this secondary analysis on the prevalence and predictors of hypertension in Cambodia.

Data collection

Informed consent was obtained from each participant after recruitment and prior to data collection. Demographic data, including age, gender, sex, ethnicity, employment, marriage status, annual income and education level were obtained using this survey. Information regarding modifiable behavioural characteristics, including current and past use of smoked or smokeless tobacco products, frequency of alcohol consumption, amount of fruit/vegetable intake, and degree of physical activity was also obtained. Health examinations were conducted to measure anthropometric data, including height (cm), abdominal waist circumference (cm), weight (kg), blood pressure (mm/Hg), and resting pulse rate (beats/min). Fasting blood glucose (FBG) and total cholesterol measurements were also obtained by point-of-care testing from each survey participant that was analysed at a central laboratory.

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Selected outcome definitions

Prehypertension (systolic blood pressure (SBP) 120–139 or diastolic blood pressure (DBP) 80–89) and hypertension (Stage I SBP 140–159 or DBP 90–99; Stage II SBP 160 or > or DBP 100 or >) were defined according to the most recent guidelines of the Joint National Committee (JNC) on Prevention, Detection, Evaluation and Treatment of High Blood Pressure.[6] Patients on antihypertensive medications were identified via self-report; these individuals were included in our analysis according to their blood pressure measurements at the time of study enrolment, irrespective of their medication regimen. Categorisation of BMI and abdominal circumference stratifications used in our study were based on prior studies among non-Cambodians, suggesting that these two metrics of obesity should have lower cut-off thresholds (BMI >23, abdominal obesity of 90 cm among men and 80 cm among women) to signify increased cardiovascular risk among Asian populations.[7 8] Physical activity was categorised by quartiles according to responses to questions quantifying the degree of moderate or vigorous activity undertaken at work or recreationally per week. The lowest quartile was defined as less than 420 min of vigorous or less than 700 min of moderate activity weekly; the second quartile was 420–1260 min of vigorous or 700–2500 min of moderate activity; the third quartile included 1260–2500 min of vigorous or 2500–5000 min of moderate activity; and the highest quartile was defined as greater than 2500 min of vigorous or greater than 5000 min of moderate work/recreational activity weekly. All individuals categorised at the second quartile or higher met the WHO threshold for adequate weekly physical activity. Impaired fasting glycaemia was defined as FBG greater than or equal to 100 mg/dL as per the American Diabetes Association.[9] For the purposes of our analysis, patients were categorised as having impaired fasting glycaemia if they were on a diabetic regimen regardless of their FBG. Dyslipidaemia was defined as a total cholesterol level greater than or equal to 200;[10] high-density lipoprotein and low-density lipoprotein levels were not obtained on initial collection.

Statistical analysis

Descriptive statistics were calculated as n (per cent) or mean (SD) for categorical and continuous variables, respectively, stratified by gender. Differences by gender were determined using Pearsons χ^2 test for categorical, and analysis of variance for continuous measures. Bivariate relationships were also reported for potential associated factors by hypertension status defined as normotensive, prehypertension, Stage I hypertension and Stage II hypertension. p Values across comparisons are shown. Binomial logistic regression was used to simultaneously investigate associations between prehypertension and hypertension (outcomes in the regression model) with selected covariates. Unadjusted models and those adjusted for age, sex, degree of exercise, monthly alcohol consumption, tobacco use, impaired fasting glycaemia and dyslipidaemia are presented. Notably, separate models were analysed using either BMI or abdominal obesity as the marker of obesity; both sets of results are presented. All analyses were performed using STATA V.11 (STATA, College Station, Texas, USA).

Ethics statement

This secondary analysis using deidentified data was reviewed and approved by the National Ethics Committee for Health Research in Cambodia. The study was provided a waiver from committee review by the University of Washington Human Subjects Division.

RESULTS

Characteristics of study participants

The mean age of the cohort was 43.4 years (SD 11.0) and the majority were women (64.0%, table 1).

Table 1 Prevalence of demographic variables as stratified by gender

Gender	Male	Female
	1788 (36.0)	3229 (64.0)
Mean age (SD)	43.0 (11.2)	43.6 (10.9)
Age by category		
25–34	453 (25.3)	727 (22.5)
35–44	532 (29.8)	953 (29.5)
45–54	461 (25.8)	917 (28.4)
55–64	342 (19.1)	632 (19.6)
Education level (%)		
None	298 (16.7)	1087 (33.7)
Less than primary	693 (38.8)	1445 (44.8)
Finished primary	429 (24.0)	437 (13.5)
Finished secondary	231 (12.9)	191 (5.9)
Finished high school	137 (7.6)	69 (2.1)
Ethnicity (%)		
Khmer	1763 (98.6)	3190 (98.8)
Other	25 (1.4)	39 (1.2)
Marital status (%)		
Currently married	1621 (90.7)	2116 (65.5)
Otherwise	167 (9.3)	1113 (34.5)
Employment status (%)		
Employed	1727 (96.6)	2694 (83.4)
Unemployed	61 (3.4)	535 (16.6)
Mean income (SD)	1122 (1542)	1233 (2356)
Hypertension status		
Normotensive	862 (48.2)	2133 (66.1)
Prehypertensive	655 (36.6)	745 (23.1)
Stage I hypertensive	194 (10.9)	250 (7.7)
Stage II hypertensive	77 (4.3)	101 (3.1)
BMI		
<18.5	180 (10.1)	504 (15.6)
18.5–23	1123 (62.8)	1582 (49.0)
23–27.5	410 (22.9)	870 (26.9)
>27.5	75 (4.2)	273 (8.5)
Current smoking (%)		
Yes	1000 (55.9)	207 (6.4)
No	788 (44.1)	3022 (93.6)
Of current smokers, those who smoke daily (%)		
Yes	911 (91.1)	167 (80.7)
No	89 (8.9)	40 (19.3)
Smokeless tobacco (%)		
Yes	46 (2.6)	622 (19.3)
No	1742 (97.4)	2607 (80.7)
Degree of exercise (%)		
Suboptimal	448 (25.6)	956 (30.0)
Sufficient	664 (38.0)	1394 (43.8)
High-normal	317 (18.2)	494 (15.5)
Top fitness	318 (18.2)	338 (10.6)
Monthly alcohol consumption		
Daily	234 (16.1)	148 (10.9)
20 days	90 (6.2)	11 (0.8)
10 days	335 (23.1)	132 (9.7)
1 day or <	793 (54.6)	1069 (78.4)

BMI, Body Mass Index.

Almost all (>98.0%) were Khmer by ethnicity. The rate of marriage, employment and attainment of at least a primary education were all observed to be higher among men (p<0.001). Additionally, among men, rates of daily inhaled tobacco smoking, smokeless tobacco use and daily alcohol consumption were higher compared to women (p<0.001). Conversely, women had higher rates of elevated BMI (>23.0) compared with men (35.4% vs 27.1%, p<0.001) and lower rates of at least high-normal exercise, which was defined as 1260–2500 min of vigorous or 2500–5000 min of moderate work/recreational activity weekly (26.1% vs 36.4% among men, p<0.001).

Prevalence of hypertension

The overall prevalence of prehypertension was 27.9% (95% CI 26.6 to 29.1), Stage I hypertension was 8.8% (95% CI 8.1 to 9.6), and Stage II hypertension was 3.5% (95% CI 3.0 to 4.1, table 2).

The levels of exercise, level of education, mean annual income, marriage status and nutritional metrics including fruit/vegetable intake and type of oil used when cooking were not significantly related to prevalence of hypertension (table 2). Only 4.6% (n=231) of persons in our cohort were on antihypertensive therapy, and the mean SBP of these individuals was 158.2 (SD 20.8). As individuals with Stage II hypertension might comprise a possible target group for the initial phases of an active medication treatment programme, we note that of 178 individuals with Stage II hypertension, 89% (n=155) were 40 years or older.

Associated factors for hypertension

Age and gender were significantly associated with the development of prehypertension and hypertension (table 3).

The oldest age cohort in our study, those aged 55–64 years, were more likely to be hypertensive (OR of 8.79, 95% CI 5.43 to 14.2, p<0.001) than were adults under age 35 years. Male gender was also a strong associated factor for prehypertension (OR: 2.57, 95% CI 2.04 to 3.24, p<0.001) and hypertension (OR: 2.67, 95% CI 1.91 to 3.74, p<0.001). Among modifiable behavioural traits, only an increased frequency of alcohol consumption was significantly associated with hypertension. Specifically, among daily drinkers, there was an observed OR of 1.85 (95% CI 1.43 to 2.41, p<0.001) for prehypertension and OR of 2.05 (95% CI 1.44 to 2.94, p<0.001) for hypertension. Known cardiovascular associated factors were also strongly associated with hypertension, including: elevated BMI, abdominal obesity and dyslipidaemia.

DISCUSSION

Our study demonstrates the prevalence of prehypertension to be approximately double that of overall hypertension among a countrywide population-based sample of Cambodian adults aged 25–64 years. A comparatively smaller proportion of patients exhibited poorly controlled Stage II hypertension. Male sex, increasing age, daily alcohol consumption and current or previous tobacco use were all associated with a higher prevalence of hypertension. In terms of known cardiovascular associated factors: higher BMI, abdominal obesity, impaired fasting glycaemia, and dyslipidaemia were also all associated with a higher prevalence of hypertension. Multivariate analysis demonstrated that increasing age represented the strongest associated factor for hypertension, whereas, higher BMI was the primary associated factor associated with prehypertension. Abdominal obesity, male sex and at least 10 alcoholic drinks/month or greater were also associated with prehypertension and overall hypertension. Dyslipidaemia was a moderate associated factor for hypertension; impaired fasting glycaemia was also a moderate associated factor for hypertension when abdominal obesity was used in place of BMI in our multivariate regression model. Notably, tobacco smoking, long considered an associated factor for cardiovascular pathology, was not associated with the development of hypertension in our cohort.

Prevalence of prehypertension in Cambodia is similar to rates seen in other lower-middle-income countries, including Thailand,[11] Iran[12] and Jamaica,[13] where rates have ranged from 24.8% to 33.7%. Notably, middle and high-income countries, such as China,[14] Taiwan,[15] Japan[16] and the USA[17] have correspondingly higher rates of prehypertension, with a range in prevalence of 33–44%. Consistent with the majority of these prior studies, male sex and BMI were all associated with prehypertension. Notable exceptions include recent data out of Iran,[12] Japan[18] and China[19] which show an inverse correlation between age and the prevalence of prehypertension.

In our study, the cohort of individuals with prehypertension was an average of 5 years younger than those with hypertension (49.7 vs 45 years, p<0.001) and 6 years younger than those with Stage II hypertension alone (51 vs 45 years, p<0.001). Prior work in Nigeria[20] has attributed the earlier onset of prehypertension to a genetic predisposition to this condition versus the later onset of hypertension which is attributed to the outcome of several modifiable factors that may worsen/progress with age, including diet, dyslipidaemia, and/or impaired fasting glycaemia. There is no evidence of such a phenomenon in Cambodia. In our survey, dyslipidaemia and impaired fasting glycaemia were associated with hypertension. However, the remainder of associated factors remained the same for prehypertension and overall hypertension (male sex, increasing age, BMI, alcohol intake), with the magnitude of OR for each being consistently greater in correlating with the development of hypertension (table 3). Given the comparatively higher prevalence of individuals with prehypertension in our cohort, this will be an important group to focus public health initiatives towards encouraging lifestyle and dietary changes moving forward, especially considering the high risk of progression to hypertension over time.[21]

In our analyses, we investigated the risk of hypertension by two measures of obesity: BMI and abdominal obesity as measured by waist circumference. Both were found to be significantly associated with prehypertension and hypertension with relative risks much higher for prevalence of hypertension (table 3). The point estimates for associations with hypertension were higher for BMI than for abdominal obesity, although this may have been due to the greater numbers of categories used for BMI (four levels) that distinguished more obese individuals.

Regarding treatment and the direction of future policy initiatives, our data showed that only 14.3% of people categorised as hypertensive were on therapy: 11.9% of Stage I and 20.2% of Stage II hypertensives. Among these 89 individuals, mean SBP was 158.2 mm/Hg (SD 20.8) revealing that, despite being on therapy, these patients were not optimally controlled. Identifying patients with Stage II hypertension, particularly those already receiving care but with suboptimal control, and modifying their pharmacotherapy could be an efficient first step in minimising poor outcomes among those at highest risk. Alternatively, given the strong correlation between age >40 and the development of Stage II hypertension in Cambodia, future screening initiatives could focus on individuals with this age cut-off in mind to optimise resources.

Table 2 Prevalence of associated factors for hypertension among different clinical stratifications

Associated factor	Taking antihypertensive medications n (%)	Normotension n (%)	Pre-HTN n (%)	Stage I HTN n (%)	Stage II HTN n (%)	p Value*
Gender						
Male	48 (2.7)	854 (47.8)	636 (35.6)	182 (10.2)	68 (3.8)	<0.001
Female	183 (5.7)	2088 (64.7)	675 (20.9)	209 (6.5)	74 (2.3)	
Mean age (SD)	51.8 (8.8)	41.2 (10.8)	44.5 (10.8)	48.1 (9.9)	50.5 (8.9)	<0.001
Exercise						
Suboptimal	87 (6.2)	803 (57.2)	367 (26.1)	110 (7.8)	37 (2.6)	0.01
Sufficient	83 (4.0)	1222 (59.4)	526 (25.6)	167 (8.1)	60 (2.9)	
High-normal	25 (3.1)	499 (61.5)	208 (25.7)	58 (7.2)	21 (2.6)	
Top fitness	14 (2.1)	388 (59.2)	186 (28.4)	49 (7.5)	19 (2.9)	
Education						
None	65 (4.7)	824 (59.5)	342 (24.7)	105 (7.6)	49 (3.5)	0.68
<Primary	101 (4.7)	1236 (57.8)	578 (27.0)	173 (8.1)	50 (2.3)	
Primary	34 (3.9)	521 (60.2)	221 (25.5)	67 (7.7)	23 (2.7)	
Secondary	31 (4.9)	361 (57.5)	170 (27.1)	46 (7.3)	20 (3.2)	
Mean annual income (SD)	1701 (3484)	1178 (2083)	1150 (1825)	1029 (1694)	1548 (2741)	<0.001
Married						
Yes	157 (4.2)	2202 (58.9)	974 (26.1)	298 (8.0)	106 (2.8)	0.90
No	74 (5.8)	740 (57.8)	337 (26.3)	93 (7.3)	36 (2.8)	
Monthly alcohol consumption						
Daily	40 (12.0)	14 (3.7)	160 (41.9)	144 (37.7)	18 (4.7)	<0.001
20 days	6 (6.9)	3 (3.0)	44 (43.6)	41 (40.6)	6 (5.9)	
10 days	50 (12.2)	10 (2.1)	232 (49.7)	150 (32.1)	18 (3.9)	
1 day or <	134 (7.2)	61 (3.3)	1139 (61.2)	480 (25.8)	47 (2.5)	
Current smoking						
Yes	30 (2.5)	628 (52.0)	392 (32.5)	117 (9.7)	40 (3.3)	<0.001
No	201 (5.3)	2314 (60.7)	919 (24.1)	274 (7.2)	102 (2.7)	
Past smoking						
Yes	26 (6.2)	183 (43.3)	141 (33.3)	48 (11.4)	25 (5.9)	<0.001
No	178 (5.1)	2199 (62.5)	816 (23.2)	238 (6.8)	85 (2.4)	
Fruit servings daily						
2 or <	116 (5.0)	1382 (59.1)	587 (25.1)	193 (8.3)	62 (2.7)	0.31
3 or >	115 (4.3)	1560 (58.3)	724 (27.1)	198 (7.4)	80 (3.0)	
Vegetable servings daily						
2 or <	134 (4.4)	1811 (59.1)	817 (26.7)	227 (7.4)	76 (2.5)	0.14
3 or >	97 (5.0)	1131 (57.9)	494 (25.3)	164 (8.4)	66 (3.4)	
Type of cooking oil used						
Vegetable	187 (5.3)	2081 (58.7)	897 (25.3)	274 (7.7)	106 (3.0)	0.01
Lard or suet	27 (3.7)	414 (56.1)	224 (30.4)	61 (8.3)	12 (1.6)	
None	17 (2.3)	447 (60.9)	190 (25.9)	56 (7.6)	24 (3.3)	
BMI						
<18.5	15 (2.2)	469 (68.6)	145 (21.2)	42 (6.1)	13 (1.9)	<0.001
18.5–23	73 (2.7)	1728 (63.9)	672 (24.8)	168 (6.2)	64 (2.4)	
23–27.5	96 (7.5)	628 (49.1)	378 (29.5)	135 (10.6)	43 (3.4)	
>27.5	47 (13.5)	117 (33.6)	116 (33.3)	46 (13.2)	22 (6.3)	
Abdominal obesity						
Obese	137 (11.3)	556 (45.8)	331 (27.3)	136 (11.2)	54 (4.5)	<0.001
Not Obese	94 (2.5)	2386 (62.7)	980 (25.8)	255 (6.7)	88 (2.3)	
Impaired fasting glycaemia						
Yes	47 (17.2)	103 (37.7)	72 (26.4)	38 (13.9)	13 (4.8)	<0.001
No	184 (3.9)	2839 (59.8)	1239 (26.1)	353 (7.4)	129 (2.7)	
Dyslipidaemia						
Yes	77 (9.9)	359 (46.1)	208 (26.7)	91 (11.7)	43 (5.5)	<0.001
No	154 (3.6)	2583 (60.9)	1103 (26.0)	300 (7.1)	99 (2.3)	

*level of significance of comparisons between normotensives, prehypertensives, and Stage I/II hypertensive across each associated factor as calculated by analysis of variance.
BMI, Body Mass Index; HTN: hypertension.

Table 3 Predictors of prehypertension and hypertension

	Prehypertension			Hypertension		
Associated factor	Unadjusted OR (95% CI)	Adjusted OR* (95% CI)	Adjusted OR† (95% CI)	Unadjusted OR (95% CI)	Adjusted OR* (95% CI)	Adjusted OR† (95% CI)
Gender						
Female	–	–	–	–	–	–
Male	2.17 (1.91 to 2.48)	2.57 (2.04 to 3.24)	2.89 (2.28 to 3.66)	1.91 (1.60 to 2.28)	2.67 (1.91 to 3.74)	3.43 (2.42 to 4.87)
Age category						
25–34	–	–	–	–	–	–
35–44	1.24 (1.03 to 1.49)	1.07 (0.85 to 1.35)	1.05 (0.84 to 1.33)	2.97 (2.10 to 4.20)	2.90 (1.89 to 4.44)	2.89 (1.89 to 4.43)
45–54	1.86 (1.55 to 2.23)	1.68 (1.32 to 2.14)	1.65 (1.29 to 2.10)	5.78 (4.13 to 8.08)	4.78 (3.10 to 7.37)	4.57 (2.96 to 7.04)
55–64	2.39 (1.96 to 2.91)	2.21 (1.61 to 3.02)	2.06 (1.51 to 2.82)	9.12 (6.48 to 12.8)	8.79 (5.43 to 14.2)	8.20 (5.09 to 13.2)
Exercise						
Suboptimal	–	–	–	–	–	–
Sufficient	0.92 (0.79 to 1.08)	0.91 (0.73 to 1.14)	0.91 (0.73 to 1.14)	0.95 (0.77 to 1.17)	0.83 (0.61 to 1.14)	0.84 (0.62 to 1.15)
High-normal	0.90 (0.74 to 1.10)	0.79 (0.60 to 1.02)	0.77 (0.59 to 1.01)	0.79 (0.59 to 1.04)	0.73 (0.50 to 1.08)	0.74 (0.51 to 1.08)
Top fitness	1.02 (0.83 to 1.26)	0.82 (0.62 to 1.09)	0.83 (0.62 to 1.10)	0.84 (0.62 to 1.13)	0.71 (0.47 to 1.06)	0.72 (0.48 to 1.09)
Monthly alcohol consumption						
1 day or <	–	–	–	–	–	–
10 days	1.50 (1.19 to 1.88)	1.28 (1.00 to 1.64)	1.26 (0.99 to 1.61)	1.88 (1.40 to 2.53)	1.66 (1.19 to 2.33)	1.65 (1.18 to 2.30)
20 days	2.25 (1.46 to 3.46)	1.63 (1.03 to 2.58)	1.56 (0.98 to 2.46)	1.78 (0.96 to 3.31)	1.49 (0.75 to 2.96)	1.39 (0.71 to 2.74)
Daily	2.05 (1.60 to 2.62)	1.85 (1.43 to 2.41)	1.80 (1.39 to 2.33)	2.38 (1.73 to 3.26)	2.05 (1.44 to 2.94)	1.92 (1.34 to 2.73)
Tobacco use						
No history	–	–	–	–	–	–
Moderate‡	1.88 (1.52 to 2.32)	0.86 (0.63 to 1.18)	0.87 (0.64 to 1.19)	2.55 (1.97 to 3.30)	1.02 (0.67 to 1.55)	0.99 (0.66 to 1.50)
Daily	1.64 (1.41 to 1.92)	0.88 (0.69 to 1.12)	0.83 (0.65 to 1.06)	1.54 (1.25 to 1.91)	0.83 (0.58 to 1.189	0.77 (0.54 to 1.09)
BMI						
18.5–23	–	–	–	–	–	–
<18.5	0.82 (0.67 to 0.99)	0.84 (0.62 to 1.14)	–	0.84 (0.62 to 1.13)	0.79 (0.49 to 1.27)	–
23–27.5	1.56 (1.34 to 1.82)	1.68 (1.35 to 2.08)	–	2.27 (1.86 to 2.78)	2.28 (1.70 to 3.07)	–
>27.5	2.58 (1.99 to 3.34)	3.27 (2.21 to 4.82)	–	4.76 (3.52 to 6.43)	4.56 (2.80 to 7.43)	–
Abdominal obesity						
Not present	–	–	–	–	–	–
Obese	1.53 (1.31 to 1.77)		1.97 (1.54 to 2.51)	2.68 (2.23 to 3.22)		2.89 (2.09 to 4.00)
Impaired fasting glycaemia						
No	–	–	–	–	–	–
Yes	1.86 (1.40 to 2.48)	1.17 (0.74 to 1.85)	1.23 (0.78 to 1.94)	3.47 (2.54 to 4.73)	1.48 (0.86 to 2.55)	1.78 (1.05 to 3.02)
Dyslipidaemia						
No	–	–	–	–	–	–
Yes	1.37 (1.14 to 1.63)	1.02 (0.77 to 1.36)	1.08 (0.82 to 1.43)	2.71 (2.21 to 3.33)	1.60 (1.14 to 2.24)	1.72 (1.23 to 2.40)

BMI, Body Mass Index.
*OR adjusted for gender, age, exercise activity, monthly alcohol consumption, tobacco use, BMI, impaired fasting glycaemia and dyslipidaemia.
†OR adjusted for gender, age, exercise activity, monthly alcohol consumption, tobacco use, abdominal obesity, impaired fasting glycaemia and dyslipidaemia.
‡Moderate tobacco use defined as ongoing use of inhaled tobacco that occurs at less than daily frequency, or prior history of inhaled or smokeless tobacco.

Launching a programme to actively manage hypertensive patients at the primary care level which, in Cambodia is staffed only by nurses at the community health centre level, is complex, and challenged by limited staffing. Therefore, in light of the recent Cochrane review on hypertension therapies,[22] a programme that focuses initially on Stage II hypertensive patients might greatly reduce the burden on staff, while at the same time provide critically needed therapeutics to those most likely to benefit.

A primary limitation of our study was the lack of information available on individuals older than 65 years, a group that typically experiences high rates of hypertension. Additionally, as geographic data on each patient was not available to us at the time of analysis, our study was unable to assess the prevalence of hypertension and associated factors across the rural/urban divide. Rural-urban differences in the epidemiology of hypertension have been well documented globally,[23 24] and highlight the different lifestyle and environmental determinants that can influence disease onset. As the Cambodian population continues its rapid trend towards urbanisation,[25] further characterisation of the rural-urban dichotomy in terms of associated factor prevalence will be needed to optimise prevention strategies by province.

The results presented here confirm the high rate of unscreened and uncontrolled hypertension in Cambodia, particularly among those who report being on treatment, as well as the growing prevalence of prehypertension countrywide. Along with other countries experiencing a transition from infectious to non-communicable disease burden, it is important that trends in hypertension continue to be monitored to ascertain impact of initiatives developed to reduce morbidity and mortality due to this highly prevalent associated factor.

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