Supa Pengpid\textsuperscript{1,2} and Karl Peltzer\textsuperscript{3,4}

\textsuperscript{1}ASEAN Institute for Health Development, Mahidol University, Salaya, Phutthamonthon, Nakhonpathom, Thailand. \textsuperscript{2}Department of Research and Innovation, University of Limpopo, Turfloop, South Africa. \textsuperscript{3}Department for Management of Science and Technology Development, Ton Duc Thang University, Ho Chi Minh City, Vietnam. \textsuperscript{4}Faculty of Pharmacy, Ton Duc Thang University, Ho Chi Minh City, Vietnam (Correspondence to: K. Peltzer: karl.peltzer@tdt.edu.vn).

\textbf{Abstract}

\textbf{Background}: Hypertension is a major and fast-growing public health problem in Africa.

\textbf{Aims}: To determine the prevalence of hypertension and assess the levels of awareness, treatment and control in Kenya.

\textbf{Methods}: A national cross-sectional study based on stratified cluster random sampling was conducted in 2015. The total sample included 4500 individuals aged 18–69 years, (60.0\% female; median age 38.0 years, interquartile range 29–52 years) from Kenya. We used the World Health Organization STEPS method: Step 1, questionnaire interview; Step 2, anthropometric and blood pressure (BP) measurements; and Step 3, biochemical tests. Logistic regression was used to investigate the determinants of hypertension (systolic/diastolic BP \(\geq 140/90\) mm\(\text{Hg}\) or use of antihypertensive medication), and awareness, treatment and control.

\textbf{Results}: Overall, 28.6\% of the population had hypertension, 29.2\% among men and 27.9\% among women, 17.7\% among individuals 18–29 years and 58.3\% among those aged 60–69 years. Among hypertensives, 29.4\% were aware, 6.5\% were currently using antihypertensive medication, and 12.5\% had controlled their BP.

\textbf{Conclusions}: There was a high prevalence of hypertension among adults in Kenya, with low
Introduction

Globally, hypertension is a major cause of morbidity and mortality, with a prevalence of hypertension of 31.1% in 2010 (1). There has been an increase in the prevalence of hypertension in Africa, from 19.7% in 1990 to 30.8% in 2010 (2). In sub-Saharan Africa, between 2000 and 2013, the predicted prevalence of hypertension at mean ages of 30, 40, 50 and 60 years was 16%, 26%, 35% and 44% (3).

Previous studies have shown that awareness and control of hypertension are low. From 2000 to 2010, awareness (58.2% vs 67.0%), treatment (44.5% vs 55.6%) and control (17.9% vs 28.4%) increased substantially in high-income countries, whereas awareness (32.3% vs 37.9%) and treatment (24.9% vs 29.0%) increased less, and control (8.4% vs 7.7%) even decreased in low- and middle-income countries (1). In 2010, the pooled awareness rate (expressed as percentage of hypertensive cases) was 33.7% in Africa (2), while another review in sub-Saharan Africa found a pooled awareness rate of 27% (3). In the same review, 18% of individuals with hypertension were receiving treatment, and only 7% had controlled blood pressure (BP) (3).
In Kibera, a slum area in Nairobi, Kenya, the age-standardized prevalence of hypertension was 22.8%, and 20% were aware of their hypertensive status (4). In adults aged ³ 35 years (mean age 46.7 years), the age-standardized prevalence of hypertension was 29.4 %, and 39.0% were unaware they had hypertension (5). Kenya is experiencing an epidemiological transition that has contributed to an increase in prevalence of risk factors for hypertension, such as change in dietary pattern and sedentary lifestyle (4,5). There is a lack of national data on the prevalence and risk factors for hypertension in Kenya, and such data is needed for control strategies.

Hypertension is a preventable condition and is associated with unhealthy lifestyle, including tobacco smoking, lack of physical activity, and alcohol consumption (6). Various risk factors have been found to be linked with hypertension, including sociodemographics (older age, female or male gender, lower education level, and lower household income) (7–14), urban residence (9,13) and other risk factors, including body weight status, health risk behaviour, and psychosocial stress and support. Higher body mass index (BMI) is positively (7,9–11,15) and underweight negatively (15) associated with hypertension. Other metabolic risk factors for hypertension include diabetes (10,16). Various dietary behaviours, including insufficient fruit and vegetable intake (17), consumption of fatty foods (18), and salt intake (19), increase the odds of developing hypertension. Several studies have found an association between physical inactivity (15), smoking (20), problem or habitual drinking (7), and hypertension. The aim of this study was to assess the prevalence of hypertension and the levels of awareness, treatment and control in Kenya.

**Methods**

**Data, study design and participants**

A multistage cluster sampling method was used to select adults aged 18–69 years for the Kenya STEPS Survey (April–June 2015) (21). A 3-stage cluster sample design was adopted for the survey, involving selection of clusters, households and eligible individuals. In the first stage, 200 clusters (100 urban and 100 rural) were selected from 1 subsample of National Sample Surveys and Evaluation Programme master sample frame. A uniform sample of 30 households from the listed households in each cluster was selected in the second stage of sampling. The last stage of sampling was done using personal digital assistants (PDAs) at the time of survey, where one individual was randomly selected from all eligible listed household members using a programmed Kish method of sampling (26). The total sample included 4500 individuals aged 18–69 years, (60.0% female; median age 38.0 years, interquartile range 29–52 years) from Kenya. The response rate for Step 1 (questionnaire) was 95%, Step 2 (physical measurements) 99% and Step 3 (biochemical measurements) 93% (21). The Kenya Ministry of Health Ethics Committee approved the study protocol and participants provided written informed consent prior to the study.

**Measures**
The World Health Organization (WHO) STEPS method included 3 steps: Step 1, questionnaire interview; Step 2, anthropometric and BP measurements; and Step 3, biochemical tests (22). Physical activity level was calculated from the duration of moderate and vigorous physical activities (at work, transport and recreation) in a typical day and week. Physical activity levels were classified into low, moderate and high, as per WHO Global Physical Activity Questionnaire (GPAQ) (23). The GPAQ has been validated for crosscultural use (24). Current tobacco use was measured with 2 questions: “Do you currently smoke any tobacco products, such as cigarettes, hand-rolled, cigars, water pipes/shisha or pipes/kiko?” and “Do you currently use any smokeless tobacco products such as snuff, chewing tobacco, kuber pan?” (Yes, No) (25). Past month binge drinking was assessed by asking participants how many times they had ³ 6 standard alcoholic drinks in a single drinking session during the past 30 days (21). Dietary behaviour was assessed with the following questions. (1) “Consumption of soft drinks (like Fanta, coca cola, 7-up, Aya, Softa, Vimto or other sugary drinks?)” Responses: number of days in a week and number of servings in 1 day; classified into consumption of soft drinks 6 or 7 days a week or

BMI was classified as underweight ( Data analysis

Post-stratification adjustments were done to align with the population projections according to age–sex categories (21). Descriptive statistics on frequency, weighted prevalence and 95% confidence intervals (CIs) was performed for sociodemographic, health and hypertension variables. \( c^2 \) statistics were used for comparison of proportions across groups. Analysis of variance was used for comparison of means across groups and Wilcoxon rank-sum (Mann–Whitney) tests for comparing medians between groups. Logistic regression was conducted to assess associations between sociodemographic factors, health variables and hypertension. Variables from bivariate analysis with a significance level of \( P \)

### Results

#### Sample characteristics

Overall, 28.6% of the population had hypertension, 29.2% among men and 27.9% among women, 17.7% among individuals aged 18–29 years and 58.3% among those aged 60–69 years ( Table 1 ). Among hypertensives, 29.6% were aware that they had hypertension, which was higher in women (41.2%) than in men (18.2%) (P

#### Associations between risk factors and hypertension

Table 2 shows associations (odds ratios) between independent variables and the prevalence of hypertension. In the fully adjusted model, older age, higher education, overweight and obesity, past month binge drinking, and type 2 diabetes were positively associated with hypertension. In contrast, being underweight was negatively associated with hypertension.

Factors affecting awareness, treatment and control of hypertension
Only 44.1% of the population sample indicated that they had ever had their BP measured by a healthcare worker; this increased from 38.3% among those aged 18–29 years to 54.0% among those aged 60–69 years (P Table 3). Of individuals aware of their hypertension status, only 22.1% indicated that they were currently taking antihypertensive medication; this was 4.4% among those aged 18–29 years and 46.7% among those aged 60–69 years. A few of the participants (2.7%) who were aware of their hypertension status had ever consulted a traditional healer for their hypertension problem, and 1.1% were currently taking a herbal or traditional remedy for their hypertension. Among participants who were using antihypertensive medication, overall, 39.2% were controlled; this was the highest among those aged 30–44 years (45.6%).

**Associations between risk factors and awareness, treatment and control of hypertension**

In logistic regression analysis adjustment for age, sex, education, wealth quintile, residence status and BMI, being obese and having type 2 diabetes were associated with greater awareness and being male with poorer awareness of hypertension (Table 4). The odds for treatment of hypertension were higher among participants who were aged ≥ 45 years, women, or underweight or obese. The odds of controlled hypertension decreased with age and were lower among men, while individuals with type 2 diabetes were more likely to have controlled hypertension.

**Discussion**

In this first nationally representative population-based survey on hypertension in Kenya, we found a high prevalence of hypertension (28.6%), with low awareness, treatment and control of hypertension in adults aged 18–69 years. The prevalence of hypertension is similar to the pooled prevalence of hypertension in Africa (2) and the global prevalence (1), but higher than the prevalence in individuals in sub-Saharan Africa aged 50–60 years (3), and in previous surveys in slum areas in Nairobi, Kenya (4,5).

We found that older age was associated with hypertension, which agrees with previous studies (7–15). Higher education level and, in bivariate analysis, greater wealth increased the risk of hypertension, whereas, in a previous meta-analysis, lower socioeconomic status (income, education and occupation) was associated with hypertension (28). There are, however, studies in Africa showing a positive association between education and hypertension, for example, in Ghana (29). It is possible that in some low-income countries, such as Kenya, the epidemiological transition is affecting the better-educated segments of society first before reaching the lower-educated population. Previous studies have found an association between urban residence and hypertension (9,13,15), while we did not find such an association. The absence of an urban–rural difference in the prevalence of hypertension in the current study may
indicate equalization of the urban–rural divide in noncommunicable diseases and their risk factors, compared to older studies (30).

Overweight and obesity increased the odds of having hypertension, which agrees with previous studies (7–11,15). Obesity may be correlated independently with hypertension but it is also possible that obesity is mediated through an unhealthy diet and insufficient physical activity (12). Other metabolic risk factors for hypertension include diabetes (9,16), which was confirmed in the present study.

Consistent with previous studies (6,7,31), we found that binge drinking was associated with hypertension. Heavy drinking, especially binge drinking, is linked to higher mortality from cerebral thrombosis, cerebral haemorrhage and coronary artery disease, although the role of alcohol-related hypertension is not well established (32). While a number of previous studies (13,15) have found an association between low physical activity and hypertension, we did not find such an association. Unlike previous studies (17–19), we did not find an association between hypertension and intake of fruit and vegetables, saturated fat, fast food and salt. It is possible that participants with diagnosed hypertension adopted better lifestyle practices (diet and physical activity) to control BP (33). Current tobacco use is a significant risk factor for hypertension (20). However, we found no association. It is possible that the impact of current tobacco use on hypertension is delayed, and thus, current tobacco use may not be closely correlated with hypertension (34). Gao et al. (34) found that number of cigarettes smoked per day was negatively associated with risk of hypertension; however, the increase in life-course-adjusted number of cigarettes smoked per day was associated with higher risk of hypertension.

Of those who had hypertension, only 29.6% were aware, 6.5% were using antihypertensive medication and 12.5% had controlled their BP. Similar low hypertension awareness rates have been found across Africa (2,3), in slum areas in Kenya (4,5), and in low- and middle-income countries (1). The rate of using antihypertensive medication was lower in this study than in some of the previous studies (1,3) and the proportion of individuals who had controlled their BP was higher in the present study. The low levels of awareness, treatment and control of hypertension may be have been due to insufficient public health interventions, which have focused on infectious rather than noncommunicable diseases and their risk factors (7). The large number of hypertension cases left untreated and uncontrolled increases the risk for comorbidity, such as cardiovascular disorders, stroke and cardiac failure (35). Therefore, early identification, early and improved management, and regular follow-up of hypertension are urgently needed (35).
The awareness and treatment of hypertension in this study was greater among women than men, as found previously (13,26). This is probably related to better health-seeking behaviour among women than men (34). We also found that older age or being underweight or obese increased the odds for treatment of hypertension and decreased the odds of control of hypertension. Similar results were found in previous studies (13,14). These findings seem to suggest awareness and treatment of hypertension needs to be improved, especially among men and younger population groups. Contrary to a previous study (34), we found an association between type 2 diabetes and controlled hypertension, which may have been related to better management of comorbid hypertension and type 2 diabetes.

A strength of the present survey was that it used a sampling design that permitted nationally representative estimates by sex (male and female) and residence (urban and rural areas). Apart from blood chemistry, anthropometric and BP measurements, 1 study limitation was that all the other information assessed in this analysis was based on self-reporting. It is possible that certain behaviours were over- or under-reported. It is possible that the over-reporting of physical activity led to a nonsignificant association with hypertension. Furthermore, it was a cross-sectional study and causal relationships between risk factors and the development of hypertension could not be established.

Conclusion

We found a high prevalence of hypertension in a representative sample of the general adult population in Kenya. Less than one third of individuals with hypertension were aware of their condition and a minority were treated and controlled. Several risk factors, including sociodemographic variables (older age and completion of primary school), body weight status (obesity), health behaviour (binge drinking), and type 2 diabetes were identified, which can help in guiding intervention programmes. Interventions programmes operating at multiple levels are urgently needed that can increase awareness of hypertension, and access to BP treatment and community-wide health behaviour interventions that have been identified and are known to be effective in reducing high BP. Conducting targeted screening of high-risk groups, such as those with overweight or obesity and with type 2 diabetes, and treatment of all persons (where indicated) attending healthcare facilities is recommended. Interventions aimed at reducing binge drinking, especially among high-risk groups, should be integrated into health services.

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Prévalence, connaissance, traitement et maîtrise de l’hypertension chez les adultes au Kenya : enquête transversale nationale en population

Résumé

Contexte: L’hypertension constitue un problème de santé publique majeur qui connaît une forte expansion en Afrique.

Objectifs: Déterminer la prévalence de l’hypertension et évaluer le degré de sensibilisation à cette pathologie, ainsi que le niveau de traitement et de maîtrise de l’hypertension au Kenya.

Méthodes: Une étude transversale nationale fondée sur un échantillonnage aléatoire en grappes stratifiées a été réalisée en 2015. L’échantillon total comprenait 4500 individus kényans âgés de 18 à 69 ans (60,0 % de femmes ; âge médian de 38,0 ans, intervalle interquartile 29-52 ans). Nous avons utilisé l’approche STEPS de l’Organisation mondiale de la Santé : étape 1, entretien par questionnaire ; étape 2, mesures anthropométriques et mesure de la tension artérielle ; et étape 3, examens biochimiques. L’analyse de régression logistique a été utilisée pour étudier les déterminants de l’hypertension (tension artérielle systolique/diastolique à 140/90 mmHg ou recours aux médicaments antihypertenseurs), ainsi que la sensibilisation, le traitement et la maîtrise.

Résultats: Dans l’ensemble, 28,6 % de la population souffrait d’hypertension, dont 29,2 % des hommes et 27,9 % des femmes, 17,7 % des 18-29 ans et 58,3 % des 60-69 ans. Parmi les hypertendus, 29,4 % étaient conscients de leur état, 6,5 % prenaient des médicaments antihypertenseurs et 12,5 % avaient maîtrisé leur tension artérielle (