Cardiovascular disease prevention in the slums of Kenya

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CHAPTER 3

Prevalence, awareness, treatment and control of hypertension among slum dwellers in Nairobi, Kenya

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ABSTRACT

Aims
This study aims to assess the prevalence, awareness, treatment, and control of hypertension in two major slums in Nairobi, Kenya.

Methods
We use data from a cross-sectional population-based survey, conducted in 2008-2009, involving a random sample of 5190 (2794 men and 2396 women) adults aged 18 years and older resident in both slums.

Results
Overall, the prevalence (weighted by sampling and response rates) of hypertension (systolic blood pressure ≥140 mm Hg and/or diastolic blood pressure ≥ 90 mm Hg and/or antihypertensive medication) was 12.3% (12.7% in women and 12.0% in men). The overall level of awareness (having been previously informed of hypertensive status by a health professional) among hypertensives was 19.5% (30.7% in women and 10.8% in men). About 47% (44.9% in women and 50.9% in men) of those who were aware of being hypertensive reported being on anti-hypertensive treatment in the one year preceding the survey. Among those who reported being on treatment, only 21.5% (14.4% in women and 35.7% in men) had their hypertension controlled to levels below 140/90 mm Hg. Hypertension control among all hypertensives was below 3%.

Conclusion
Our findings suggest that hypertension is common in the slums, but the rates of awareness, treatment, and control are low. However, once people are aware of their hypertension, most seek treatment. This indicates that the best gains in treatment can be made when awareness is raised. Overall, there is urgent need to implement strategies that improve prevention, detection, and access to effective treatment in these neglected populations.
BACKGROUND

Cardiovascular disease (CVD) is the number one cause of mortality worldwide including Sub-Saharan Africa (SSA) [1]. The leading risk factor for CVD worldwide is hypertension [2]. In 2000, more than a quarter of the world’s adult population (nearly one billion) had hypertension, and this is projected to increase by almost 40% in 2025 [3]. This high prevalence, and its role as major risk factor for CVD makes hypertension the single most important contributor of total adult deaths, globally [4, 5].

In low- and middle- income countries, there appears to be an increase in the prevalence of hypertension [6]. The average blood pressure (BP) in more than half of the populations in low- and middle- income countries is higher than in a high-income country such as the United States [7], and increases in mean blood pressure have been observed. Specifically, in Kenya, the average systolic blood pressure increased from 127 mmHg to 132 mmHg in 1990 and 2008, respectively [8]. By contrast, in USA a decrease in average blood pressure by about 3 mmHg during the same period has been observed [8]. In SSA, although there is a relatively high prevalence of hypertension [9], the levels of awareness and treatment are still low [10-12]. Additionally, death from a major CVD such as stroke in urban African settings like Dar es Salaam, Tanzania, is more than five times higher than in England, and the most likely reason for this is the high prevalence and poor control of hypertension [13, 14].

One of the reasons for the increase in the prevalence of hypertension is urbanization [15]. The levels of hypertension are higher in urban than in rural settings [7, 10, 16]. This is mainly because of contextual and behavioural factors associated with urban environments such as dietary changes and sedentary lifestyle [15]. Large proportions of the urban populations in low- and middle- income countries live in slums. According to the United Nations, the proportion of urban dwellers living in slums decreased from 47% to 37% in low- and middle-income countries between 1990 and 2005 [17]. However, due to rapid population growth, the ab-
solute numbers of slum dwellers are increasing, especially in SSA. Current estimates from the UN HABITAT suggest that more than 62% of urban residents in SSA live in slum or slum-like conditions [18]. In Kenya, this percentage is approximately 58% [19].

Slum settlements are typically characterised by poor living conditions, which in turn has a major impact on health and access to health care for the population [20-26]. With the psychosocial burden of violence, insecurity, and stress, there may also be an increased risk of CVD [27-31]. However, information on CVD, their risk factors, and their management in slums is limited [32]. Therefore the aim of this study was to explore the magnitude of the problem of an important risk factor for CVD –hypertension. Specifically, we examined the levels of, and factors associated with, hypertension awareness, treatment, and control in the slums of Nairobi, Kenya.

METHODS

Study population
Data were collected in two slums of Viwandani and Korogocho in Nairobi, Kenya that are under surveillance as part of the Nairobi Urban Health and Demographic Surveillance System (NUHDSS). Details of the operation of the NUHDSS have been published elsewhere [33]. In brief, the demographic surveillance area is currently home to about 72,000 people of diverse ethnicities resident in about 30,000 households. Apart from the public health facilities usually located on the outskirts of the slums, private organisations provide the bulk of health care services for residents. Most providers are unlicensed, unregulated and many facilities are run by unqualified personnel [34]. About 90% of the slum population do not have any form of health insurance cover [35]. And among those who do have cover, nine out of ten were subscribed to the public health insurance scheme which currently only covers in-patient care [36].
Study design

The study was a population-based cross-sectional survey. Interviewers trained and employed by APHRC collected data between May 2008 and April 2009. The NUHDSS conducts four-monthly visits to all households under surveillance to monitor demographic trends including births, deaths, and migration.

The study utilized the sampling frame of the NUHDSS: a stratified sampling strategy based on the WHO STEPwise protocol [37] with a target of 250 respondents in each of the following strata: sex (male and female), age group (18-29, 30-39, 40-49, 50-59, 60 years and over), slum of residence (Korogocho and Viwandani). For each stratum, all eligible individuals registered as resident based on the most up-to-date NUHDSS database were used as the stratum-specific sampling frame and a random procedure in STATA used to select the study participants. The overall response rates were 94% in Korogocho and 95% in Viwandani.

Twenty-one interviewers collected information, using a structured questionnaire that was translated into the dominant local language (Kiswahili) on demographics, education level, wealth, ethnicity, history of hypertension, and current anti-hypertensive medication use. These interviewers were recruited from the local community to enhance ownership of the study and improve response rates. Interviewers must have completed and passed the national high school certificate examination at the minimum. They were trained for ten days on how to administer the questionnaires and collect the anthropometric and other measurements. They also received basic training on research ethics and interview techniques. Each interviewer was accompanied by one field assistant who provided logistic support to the interviewer including transportation of the study equipment (see below).

Blood pressure was measured with validated Oscillometric automated digital BP devices (OMRON ® Digital Automatic BP Monitor). Using appropriate cuff sizes, three readings were taken on the left arm in a seated position, at one minute intervals. The mean of the second and the third measurements was used for analysis. Hypertension was defined as mean systolic BP ≥ 140 mmHg,
or diastolic BP ≥ 90 mmHg, or self-reported previous diagnosis and current use of anti-hypertensive medication. Awareness of hypertension was defined as self-reporting of any prior diagnosis of hypertension by a healthcare professional. Treatment of hypertension was defined as receiving prescribed antihypertensive medication for management of high BP at some time in the one year preceding the survey. Control of hypertension was defined as the proportion of patients reporting antihypertensive therapy with systolic blood pressure of less than 140 mm Hg and diastolic blood pressure of less than 90 mm Hg.

Data on socio-demographic, behavioural and physiological risk factors for hypertension were collected based on the framework developed by Wong et al [38]. Socio-demographic factors included age, sex, ethnicity, education and wealth status. Age was categorized as previously described under our sampling strategy. Education was categorised into four groups (no formal schooling, did not complete primary school, completed primary school, and completed secondary school or higher). For ethnicity, we used the four biggest ethnic groups in Kenya and Nairobi (Luo, Luhya, Kamba, and Kikuyu) and the rest were categorised into a group of “others” due to small numbers. Data on wealth were obtained from the NUHDSS database and linked to the study participants. A composite wealth index in the whole NUHDSS was generated using principal component analysis with data on multiple measures of wealth (household expenditure, house type, amenities, and assets). Our study participants were categorised into tertiles based on the distribution in the whole NUHDSS population. Details about the computation of this index have been described elsewhere [39]. Behavioural and physiological variables were categorized according to WHO standards (see Text, Supplemental Digital Content 1, which details categorization of behavioural and physiological variables).

Data quality was verified by field supervisors who conducted frequent and random sit-ins (audits) and spot-checks of interviews. These supervisors also performed office editing of completed questionnaire to check for completeness and consistency of collected
data. Questionnaires that did not meet the required standards were returned to the field for correction. The completed questionnaires were then transported to a central location for double-data entry using MySQL data entry screens with Microsoft Access database backend. All analyses were performed with STATA 12.

The study protocol was approved by the Kenya Medical Research Institute (KEMRI)/National Ethical Review Committee (NON-SSC Protocol No. 339).

**Statistics**

All estimates were weighted for sampling probability (using the size of the stratum in the NUHDSS database as denominator) and for response probability (using the total number sampled per stratum as denominator). A composite weight taking both weights into account was applied to all estimates.

We conducted a description of the study participants’ socio-demographic, behavioural, and physiological risk factors by sex using Chi-square and ANOVA tests for significance at \( p \) less than 0.05. We then calculated the un-weighted and weighted overall prevalence of hypertension by sex. The WHO age-standardized prevalence of hypertension by sex was also calculated. Bivariate analyses stratified by sex were then conducted for socio-demographic variables with hypertension, awareness, treatment, and control using Chi-square tests of significance at \( p \) less than 0.05. Finally, in order to investigate factors associated with the prevalence of hypertension, we performed a univariate random effects logistic regression of hypertension over each factor, stratified by sex. All factors whose univariate association with the hypertension was significant at \( p \) less than 0.20 were then included in an adjusted analysis. The results are presented as odds ratios with corresponding 95% confidence intervals. All analyses were stratified by sex since it is expected that some associations might differ between women and men. This is with the exception of analyses for awareness, treatment, and control which could not be stratified due to small numbers. All outcome variables (hypertension, awareness, treatment, and control) presented in the above analyses were considered in their weighted form.
RESULTS

There were 2396 women (46%) and 2794 men (55%) in the study (Table 1). Men were significantly more educated than women, smoked and consumed alcohol more and reported more ‘adequate physical activity’. More women than men reported insufficient daily fruit and vegetables intake and were significantly more overweight, and had more general and abdominal obesity. Diabetes was also more common among women than among men. Finally, men had a higher mean systolic BP but had a lower mean diastolic BP than women.

The overall weighted prevalence of hypertension was 12.7% (95% CI, 11.4 to 14.2) in women and 12.0% (95% CI, 10.8-13.4) in men. The age-standardised prevalence using the WHO standard population (not shown in Table 1) was 18.4% (23.8% women and 17.2% men). Among both men and women, the prevalence of hypertension increased significantly with age but decreased with increasing education. Also, prevalence was highest among current daily alcohol users and the overweight/obese of either sex. Amongst women only, hypertension was significantly highest among current daily smokers and diabetics but there was no significant association with physical activity levels nor fruit and vegetable intake in either sex.

Table 2 shows the unadjusted and adjusted models of the association between hypertension and selected characteristics by sex. In the adjusted model, age, obesity and diabetes were associated with increased odds of hypertension among women whereas being of Kikuyu ethnic origin was associated with reduced odds. Among men, it was found that age, current daily drinking and waist circumference were associated with increased odds of being hypertensive whereas being of Luo ethnic origin or having a normal BMI were associated with reduced odds (full results are presented in Table, Supplemental Digital Content 2, which shows the odds ratios for the association between the prevalence of hypertension and selected characteristics among women and men).

Overall, less than a fifth of all hypertensives were aware of their condition, and only about half of them reported being on treat-
ment at any point in the year preceding. Finally, less than a third of those on treatment had their BP controlled (see Table, Supplemental Digital Content 3, which shows the distribution of the

| Table 1: Description of study participants by gender and prevalence of hypertension |
|-----------------|-------------------|-----------------|-------------------|
| **Women (N = 2316)** | **Men (N = 2374)** | **n (%)** | **Prevalence (95% CI)** |
| **n (%)** | **Prevalence (95% CI)** | **n (%)** | **Prevalence (95% CI)** |
| Overall (unweighted) | 2316 (86.2%) | 2374 (86.9%) | 17.9 (16.4–19.4) |
| Overall (weighted) | 2316 (86.4%) | 2374 (87.7%) | 12.0 (10.8–13.4) |
| Age (years) | | | |
| 15–24 | 516 (33.2%) | 554 (21.8%) | 17.8 (16.5–18.4) |
| 25–39 | 516 (33.2%) | 554 (21.8%) | 15.7 (14.5–17.0) |
| 40–49 | 706 (45.3%) | 706 (29.3%) | 18.3 (16.5–19.6) |
| 50–59 | 270 (17.6%) | 270 (12.6%) | 24.4 (23.1–26.1) |
| 60–69 | 204 (12.3%) | 204 (12.9%) | 14.9 (13.2–17.7) |
| Education | | | |
| No school | 406 (19.0%) | 406 (18.9%) | 14.9 (13.5–16.4) |
| Primary school | 593 (26.4%) | 593 (25.7%) | 16.8 (15.3–18.5) |
| Secondary school and higher | 801 (37.0%) | 801 (37.2%) | 15.4 (13.8–17.1) |
| Ethnicity | | | |
| P = 0.369 | | | |
| Wealth | | | |
| P = 0.60 | | | |
| Current drinking | | | |
| P = 0.091 | | | |
| Adequate physical activity | | | |
| P = 0.092 | | | |
| Insufficient fruit and vegetable intake | | | |
| P = 0.092 | | | |
| BMI (kg/m²) | | | |
| <18.5 | 132 (15.8%) | 132 (14.4%) | 12.8 (11.1–14.4) |
| 18.5–24.9 | 128 (15.0%) | 128 (13.8%) | 14.7 (13.0–16.5) |
| 25–29.9 | 128 (15.0%) | 128 (13.8%) | 14.7 (13.0–16.5) |
| ≥30 | 132 (15.8%) | 132 (14.4%) | 12.8 (11.1–14.4) |
| Waist-to-hip ratio | | | |
| ≤0.9 | 128 (15.0%) | 128 (13.8%) | 14.7 (13.0–16.5) |
| Normal | 128 (15.0%) | 128 (13.8%) | 14.7 (13.0–16.5) |
| >0.9 | 128 (15.0%) | 128 (13.8%) | 14.7 (13.0–16.5) |
| Waist circumference | | | |
| ≤94 cm (≤88 in) | 128 (15.0%) | 128 (13.8%) | 14.7 (13.0–16.5) |
| >94 cm (>88 in) | 128 (15.0%) | 128 (13.8%) | 14.7 (13.0–16.5) |
| Diabetes (IFG/IGT/DM) | | | |
| No | 128 (15.0%) | 128 (13.8%) | 14.7 (13.0–16.5) |
| Yes | 128 (15.0%) | 128 (13.8%) | 14.7 (13.0–16.5) |
| Blood pressure | | | |
| Mean systolic (mm Hg) | 128 (15.0%) | 128 (13.8%) | 14.7 (13.0–16.5) |
| Mean diastolic (mm Hg) | 128 (15.0%) | 128 (13.8%) | 14.7 (13.0–16.5) |

CI, confidence interval; RBS, random blood sugar. Missing data: Wealth (362), Smoking (1), Adequate physical activity (3), BMI (116), Waist–hip ratio (126), Waist circumference (1) All P-values derived using chi-squared test
Key findings
Our study finds that hypertension is common among slum dwellers in Nairobi both among women and men. The adjusted analysis shows that among women, increasing age, obesity, and being diabetic were significantly associated with increased odds of being hypertensive. Among men increasing age, being a current daily drinker of alcohol, and having abdominal obesity were all significantly associated with increased odds of being hypertensive. Overall, the levels of awareness, treatment, and control were quite low. Only 2.3% of hypertensives had their BP controlled but this largely reflects the low levels of awareness.
Prevalence

The weighted prevalence of hypertension in our study is slightly lower compared to other populations that have been studied in Africa [7, 10, 16, 40, 41]. This might be explained by the fact that this study was conducted in a slum setting, where poverty is rampant and the epidemiological transition is only starting [42]. In low-income countries, poorer people still have lower rates of hypertension [7, 41]. However, compared to earlier studies done on hypertension among populations in urban areas of Kenya [43, 44] the BP levels have risen substantially. The higher prevalence of hypertension in females is in line with other studies in low-income countries [7, 10, 16, 41]. Although in a study in urban Tanzania [45], males were more often hypertensives than females (51% versus 42%). A cross-sectional study in rural Uganda [46], and a review of the differences in prevalence of hypertension between developed and developing countries, both found no significant sex differences in the latter countries [40].

Differences in prevalence of hypertension were observed among different ethnic groups in the study population. There is limited literature published on ethnic differences in hypertension in this setting but there is substantial literature on the ethnic differences in the prevalence of hypertension elsewhere [47]. The different lifestyles, including occupation, diet, and sedentary behaviour may be the most plausible explanation for these significant differences, although genetic factors may have a role to play [48]. Additional research is required to better understand the source of the observed differences.

Awareness, treatment, and control

Awareness in the study area is very low compared to other countries including those in Africa [7, 40]. Hypertension awareness is already low in low-income countries, but in a slum setting the rate is even lower. This may most probably be due to the lack of accessible and affordable good quality health facilities in slums and low utilization of the few available services. The low rate of awareness in slums is a major public health concern as the population in
slums worldwide is growing. This means that there will be significantly large populations of hypertensive patients unaware of their increased risk of hypertensive related complications in the coming years.

In two published reviews [7, 40], almost all studied populations reported women to be more aware of their hypertension than men. Our finding of relatively high rate of awareness among women in our slum population is consistent with these previous reports. This difference among sexes may be explained by the fact that females are more in contact with health care services than men through maternal and child health programs.

Our study also found that less than 10% of all hypertensive people were receiving treatment (results not shown) which compared to literature from other studies [7, 10, 40, 41, 49, 50] is very low. In the above mentioned studies between one third and half of the hypertensives were on treatment respectively. An explanation for this difference is that the awareness in this study population is very low. Because the group of people that were aware is small, it is not surprising that small number of people were on treatment. Once people were aware of their hypertension, almost half in our study population were on treatment. As seen in other low-income countries [40], the rate of treatment among those aware is almost similar to that in high income countries. This shows that the best gains in treatment can be made when awareness is raised. In most populations women have higher rates of treatment than men [10, 11, 40, 49] sometimes double [7]. This is mostly explained by the fact that females are also more aware. However, in our study the difference in treatment between women and men was not significant.

Only 2.3% of all hypertensives were controlled (results not shown), which is much lower than other populations in Africa and the rest of the world [12, 40, 49, 51]. However, among people that had received medication at any time in the previous 12 months the percentage of being controlled (22.0%) is higher than some studies [40] and lower than others [12]. This percentage is still rather dismal in terms of the impact on future risk for CVD events in this population. About 58.7% of individuals who had reported
received treatment in the previous 12 months were on treatment in the two weeks preceding the survey (results not shown). Poor compliance and adherence to treatment may explain the poor control. Furthermore, we used a rather conservative definition of control. With a tighter definition say of BP 120/80 mmHg, less than 1% of hypertensives would have been classified as controlled.

In keeping with their higher rates of awareness, the overall level of control among hypertensives is often reported to be higher in women than in men [40, 49]. This was also the case in our study. However, contrary to the existing literature, our study found significantly better control among men who were on treatment compared with women.

**Strengths and limitations of the study**
The study has some limitations. First, the BP levels were based on the average of the last two measurements at a single visit, which might have overestimated the prevalence rates [52, 53]. Another limitation is that some of the data such as behavioural risk factors (smoking, alcohol misuse, diet and physical activity), use of medication, education, and wealth were self-reported. For instance, participants who reported wrongly receiving anti-hypertensive treatment and had BP below 140/90 mmHg were considered hypertensive. On the other hand, there might have been participants on antihypertensive treatment without knowing it. These types of incorrect reporting may affect our study conclusions. However, despite this limitation, such self-reported measures remain useful and validated components of standardized surveys across the world. The strength of this study is that it is one of the few studies assessing hypertension among slum dwellers in SSA. The sample size is large and is a good representation of the slum population. This is also a limitation in the sense that the study is only generalizable to the slum rather than the urban population in Nairobi. Further studies on the intra-urban differences are needed.
CONCLUSIONS

This is the first large study in SSA that shows that hypertension is common among slum dwellers, but the rates of awareness, treatment and control of hypertension are low. Of the people that are aware almost half had taken treatment, but only a small group had their BP controlled. These findings predict that even underprivileged populations such as those in SSA are not exempt from the so called ‘vascular time bomb’. Based on these results, it can be concluded that an intervention on lowering risk of hypertensive complications in slum setting should pay more attention to raising awareness and long term compliance of hypertension. As populations grow and levels of hypertension continue to rise in urban slums, it is important to start targeting health intervention programs in these settings.

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