ENGLISH SUMMARY

Introduction

Hypertension is increasingly common in sub-Saharan Africa. The epidemiology of this epidemic and the ways in which it relates to health systems in Africa, is poorly understood. A better understanding of the clinical epidemiology of hypertension and interaction between health systems and hypertension will be critical to improving health services and preventing cardiovascular disease in Africa. In 2012, there were four critical gaps in the published data about hypertension in Africa. First, the mortality attributable to hypertension in adults admitted to hospitals had not yet been described. Second, no published report had yet determined the preparedness of primary care facilities in East Africa to meet the rising tide of hypertension. Third, factors associated with better or worse control of hypertension in patients on treatment for hypertension had not yet been published. Fourth, although most HIV-infected adults live in Africa, the exact relationship between HIV and hypertension was not yet known for adults on this continent. The work described in this thesis aimed to address these gaps in the medical literature in order to inform public health efforts as well as the next steps in hypertension research in Africa.

Four primary papers conducted by the PhD candidate are presented here. Eighteen secondary papers authored by the PhD candidate are also discussed. The first paper was based on a three-year prospective study of >11,000 adults admitted to a hospital in Tanzania which aimed to determine the number of admissions, hospital days and deaths attributable to hypertension. The second paper was based on a cross-sectional
survey of a representative sample of 24 public and not-for-profit health facilities in urban and rural Tanzania. This study aimed to assess the burden of hypertension in health facilities and the strengths and weaknesses of the health system with regards to primary care management of hypertension. The third paper was based on a cross-sectional study of 300 consecutive adults seen in a hospital hypertension clinic, which aimed to determine the rates of hypertension control, and factors associated with blood pressure control. The fourth paper was a comparison of three groups: 1) 150 HIV-negative controls, 2) 150 HIV-infected, ART- naive adults and 3) 150 HIV-infected adults on ART for more than two years. In this study we aimed to determine whether the prevalence of hypertension differed significantly between the three groups after adjusting for possible confounding factors.

Results

In the first study we found that, out of 11,045 consecutive adults admitted to a hospital in Tanzania, 1611 (14.6%) of admissions and 13.6% of hospital days were due to hypertension. In addition, 314 / 2,049 (15.3%) of in-hospital deaths were due to hypertension. In-hospital mortality of adults admitted with hypertension was 19.5%. The median age of adults who died from hypertension-related diseases was 61 years [interquartile range: 48 – 72 years] and 56.7% were less than 65 years old.

In the second study, we reported that hypertension and diabetes combined accounted for 11.9% of all medical outpatient visits in hospitals but only 2.8% of clinic visits at primary care clinics (i.e. dispensaries). In many primary care facilities, guidelines,
diagnostic equipment, and first-line drug therapy for hypertension were lacking and management, training and reporting systems were weak. Services for HIV seemed stronger than services for hypertension. In addition, primary care health workers had low levels of knowledge and experience related to hypertension compared to HIV. For example, 119/150 (79%) of primary care nurses had at least fair knowledge about HIV vs. only 85/150 (57%) for hypertension; 111/150 (74%) had seen more than 5 patients with HIV in the past three months compared to only 50/150 (33%) for hypertension.

In the third study we determined that, of 300 enrolled clinic patients with hypertension, 28.3% met criteria for blood pressure control in their last three visits. Obesity and higher medication cost were associated with lower rates of blood pressure control. The effect of obesity and higher cost was mediated through adherence. Good knowledge (odds ratio [OR], 2.5; 95% confidence interval [CI], 1.0–6.1; P=0.047), attitudes towards (OR, 2.7; 95% CI, 1.0–7.1; P=0.04), and practices concerning (OR, 5.4; 95% CI, 2.3–13.0; P<0.001) hypertension were also independently associated with increased control. Good adherence had the strongest association with blood pressure control (OR, 14.6; 95% CI, 5.8–37.0; P<0.001).

In the fourth study we demonstrated the following results. Among HIV-negative adults, 25/153 (16.3%) had hypertension. HIV-infected adults on ART had a higher prevalence of hypertension (43/150 (28.7%), P = 0.01) and a higher odds of hypertension even after adjusting for age, sex, BMI, vigorous work and alcohol (adjusted odds ratio (aOR) = 2.19 (1.18 to 4.05), P = 0.01). HIV-infected, ART-naive adults had a lower prevalence
of hypertension (8/151 (5.3%), \( P = 0.003 \)) and a lower odds of hypertension after adjustment (aOR = 0.35 (0.15 to 0.84), \( P = 0.02 \) after adjusting for the same variables). Kidney disease was common in all three groups (25.6% to 41.3%) and a greater severity of kidney disease was strongly associated with hypertension in a linear fashion (\( P < 0.001 \) for trend). Among hypertensive participants, 50/76 (65.8%) had microalbuminuria and 20/76 (26.3%) had an estimated glomerular filtration rate (eGFR) <60 versus 33/184 (17.9%) and 16/184 (8.7%) in participants with normal blood pressure.

**Conclusions**

From these studies we made the following conclusions.

From Study I we concluded that approximately one-sixth of hospital admissions, hospital days and in-hospital deaths in Tanzania were related to hypertension. The majority of hypertension-related admissions and deaths were in young or middle-aged adults (<65 years old). Better programs for hypertension prevention and early detection and treatment are needed to reduce hypertension morbidity and mortality in Africa.

From Study II we concluded that the preparedness of primary care health systems in Tanzania is very low and consistently less than for HIV. Guidelines, basic diagnostic equipment, first-line drug therapy, management systems, training systems, reporting systems were all lacking and the levels of knowledge, comfort and experience of healthcare works for hypertension were low. For these reasons, very little hypertension
care is provided at the primary care level. Multi-faceted health systems interventions are needed to strengthen primary health services for hypertension in this region.

From Study III we concluded that obesity and higher medication cost are two major factors associated with uncontrolled blood pressure among patients with hypertension attending clinics in Tanzania. Self-reported medication adherence was the strongest factor associated with blood pressure control. Therefore, programs to improve hypertension control in African adults should seek to reduce medication costs for patients. Special attention should be paid to hypertensive adults who are also obese. Self-reported medication adherence (using the MMAS-4 scale) is a good marker of successful hypertension treatment in Tanzania.

From Study IV we concluded the following: compared to HIV-negative adults, HIV-infected adults had significantly less hypertension before starting ART but significantly more hypertension after just three to five years of ART. Nearly 30% of HIV-infected adults on ART had hypertension but less than one-quarter of these were aware of their hypertension. In addition, hypertension was associated with markers of renal disease in a linear fashion. Therefore, HIV clinics in Africa need to integrate hypertension screening and treatment into their services with a particular focus on adults who have recently started ART. In addition, more research is needed to determine the mechanism by which HIV-infected adults develop hypertension and whether this might be related to either immune reconstitution or renal disease.