Cardiovascular disease prevention in the slums of Kenya
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CARdioVASCULAR RISK FACTORS

Although cardiovascular disease (CVD) has often been regarded as a disease for the affluent, we showed that cardiovascular risk factors have reached significant levels all over the African continent (Chapter 2). The outcomes differ per country with hypertension prevalence rates ranging from 19.3% in Eritrea to 39.6% in Seychelles, which seems to be aligned with the epidemiological transition and the different levels of wealth in the various countries [1]. The overview also showed important rural and urban differences with blood pressure (BP) in urban settings, for example, being 5-10mmHg higher than in rural sites [2, 3]. Our findings also show striking sex differences in alcohol and tobacco use, with the prevalence rates being substantially higher in males than in females. These sex differences in alcohol and tobacco use are consistent over the whole continent, as the prevalence of these risk factors among the general population is increasing over the years [4]. The low rates of awareness, treatment, control of hypertension we found in several African countries are a major public health problem [5]. Most often the rate of control among hypertension patients varies between 5-10%, which is substantially below the global average [6]. There are several policy documents and guidelines on the rationale and content for CVD prevention in LMICs, and how this can be executed in the existing health care structure [7-9]. However, to our knowledge, the implementation and outcomes of successful interventions for prevention of CVD in Sub Sahara-Africa (SSA) are very limited, both on a national and local level particularly among the urban poor. Therefore we identified a strong need for introduction of CVD prevention programs, including structured guidelines and integration of primary and secondary prevention. Although we found sufficient data on the prevalence of cardiovascular risk factors on the African continent as a whole to detect the described increase, we concluded as well that there remain large areas where data are lacking, specifically among the growing group of the urban poor.
Subsequently we focused on the urban slums of Nairobi and found that prevalence of hypertension is also substantial among the urban poor (Chapter 3). Although, the prevalence of hypertension in the slums of Nairobi might be considered lower than in other settings in SSA [10] or the rest of the world [6], partly due to the early stage of the epidemiological transition as earlier mentioned in Chapter 2. The most important findings in this paper were the extremely low rates of awareness, treatment and control of hypertension in the slums. More than 80% of the people with hypertension were not aware of their increased risk. Once these patients were aware of their hypertension almost half of them were on treatment, yet only 2% of all people with hypertension had their BP adequately controlled. These outcomes are similar in other urban poor populations in the continent [11]. Our findings suggest that hypertension is indeed a public health problem among the urban poor and that there is an urgent need to develop and implement programs that improve awareness, treatment and control rates of this cardiovascular risk factor.

Within the same settings of the slums of Nairobi we looked into the prevalence, awareness, treatment and control of diabetes in Chapter 4. Aligned with the situation on hypertension we found that the prevalence of diabetes in this disadvantaged population is moderately high, almost reaching 5%, similar to other studies in the slums of Nairobi [12]. The levels of awareness, treatment and control were very low. Only 5% of all diabetes patients had their blood sugar under control, similarly to the rest of the continent [13]. We also demonstrated that within the slum settings obesity and overweight were significantly associated with increased blood sugar levels, particularly among women. Similar to hypertension, we identified a strong need for programs to prevent diabetes by targeting modifiable risk factors, and detect, treat and control diabetes patients in these impoverished settings.

In the last chapter of CVD risk factors we reported on the levels of overweight, obesity and the perception of body image among slum dwellers (Chapter 5). We found that levels of obesity and overweight are a prominent public health problem in the slums of
Nairobi as 43% of all women are obese or overweight. Of all those people who were overweight or obese more than half (53%) underestimated their weight. Another important finding was that in all BMI categories more than one third of all men and women preferred body sizes classified as obese or overweight. As overweight and obesity are on the rise in SSA, it is specifically the urban poor that have showed the strongest increase in the last decade [14]. The combination of underestimation of weight and strong preference for larger body sizes against a background of an increasing high prevalence of overweight and obesity, led us to conclude that there is an urgent need for interventions. Education of the urban poor on health risks associated to the increased weight should be part of strategies to reduce the prevalence of risk factors for CVD in the slums of Nairobi.

DESIGN OF INTERVENTION

In order to learn from best practices on CVD prevention in other settings for the development of our own study we reviewed community-based interventions for prevention of CVD in low- and middle-income countries (LMICs) (Chapter 6). The review included a total of 26 studies, which involved both population-based and high-risk interventions for cardiovascular prevention. The first group of interventions reviewed consisted of mainly health promotion through media and health education sometimes integrated in national or regional programs [15], whereas the second group concentrated more on education of patients, training of health care providers and implementation of treatment guidelines [16]. In both groups studies showed significant reduction of cardiovascular risk ranging from lifestyle changes on diet, smoking and alcohol to biomedical outcomes like BP, glucose levels or weight. We found also that some interventions demonstrated improved management of risk factors like increased control of hypertension or adherence to medication. In this review, we concluded that a combination of health education with a focus on
diet, training of health care providers and implementing treatment guidelines were key elements in successful interventions. We demonstrated that there have been effective community-based interventions aimed at reducing cardiovascular risk factors in LMICs, however these have generally excluded the urban poor.

In Chapter 7 we described the development of our intervention for prevention of CVD that is suitable for implementation in slum settings in Nairobi, by combining private sector and public health approaches. We showed how a collaboration of two non-profit organizations, Amsterdam Institute for Global Health and Development (AIGHD) and the African Population and Health Research Center (APHRC), and a private sector partner, Boston Consulting Group (BCG) designed a theoretic model for cardiovascular prevention with a focus on costs and feasibility. Initially we explored the possible interventions for reducing risk factors through behavioral change at the population level. However we realized that the evidence for effectiveness of these kind of interventions is not very convincing [17], specifically in a slum setting in SSA where awareness of risk factors for CVD is very low. In addition, specific risk factors like physical inactivity and smoking are still relatively low in prevalence in the slums of Nairobi due to the early phase of the epidemiological transition. Based on the current prevalence of risk factors in the slums and assumptions on the potential effect of different interventions derived from the literature, we estimated that the most cost-effective and feasible element should be detection and treatment of hypertension. Therefore we developed a conceptual framework around the cascade of care for hypertension. Within this cascade we identified the four pillars of our intervention, based on a theoretical (literature-based) cost-effectiveness analysis and input from stakeholders reaching from patients and the community to clinical officers and the Ministry of Health in order to increase ownership of the programme and its sustainability.

The four pillars we identified for our intervention were: 1) increasing community awareness through announcements at community gatherings and religious services, and a local communi-
ty radio jingle, 2) improving access to screening for hypertension and other cardiovascular risk factors through household visits, 3) increasing treatment-seeking through vouchers for free treatment and Community Health Worker (CHW) incentives to follow up patients and persuade them to visit the clinic, and 4) improving long-term compliance by setting up patient support groups, subsidizing medication through these groups, providing incentives for CHWs, and sending text messages (SMS) to remind patients of clinic appointments, medication use, and healthy lifestyles.

In the SCALE UP study protocol we explained how we aimed to evaluate the newly developed intervention in the slums in Nairobi (Chapter 8). We set up a prospective quasi-experimental community-based intervention study in two slum settlements (Korogocho and Viwandani) which are part of the NUHDSS (Nairobi Urban Health Demographic Surveillance System). The developed intervention was implemented in Korogocho, while the control community Viwandani accessed the usual standard of care for cardiovascular prevention. Korogocho had, unlike Viwandani, a centrally located health care facility with a reliable track record which was willing to integrate the treatment and control element of our programme, so this guided our choice for the location of intervention. We included the population of 35 years and above, which accounted for 71% of all known hypertensive cases according to an earlier study from Chapter 3. The main primary outcomes of the study were the difference in change in cardiovascular risk, the difference in change in mean systolic BP (SBP) both in the population and among people with hypertension, and the net cost of the intervention per disability-adjusted life year averted. The secondary outcomes to be explored included the differences in change in prevalence, awareness, treatment and control rates of hypertension, smoking, alcohol use, body mass index, physical inactivity and insufficient intake of vegetables and fruits.
IMPLEMENTATION AND EVALUATION

The urban population in Africa is estimated to triple in the next few decades, from 395 million in 2008 to 1.23 billion in 2050, and more than 60% of these urban population lives in slums - characterized by extreme poverty and poor health. However there is not much documented on how to implement health programs in these dynamic and deprived settings and the challenges that one might encounter in the process. In Chapter 9 we have described the challenges we were confronted with during the implementation of the SCALE UP project. Our views have been supported by the more than ten years of experience which the APHRC has in conducting research and implementing health programs in the slums of Nairobi. We identified that the key challenges for the SCALE UP study and other health programs in slum settings are insecurity, lack of infrastructure, high burden of disease, high population mobility, lack of social cohesion, political instability and interference, and attrition or dearth of human resources. These challenges are closely interlinked with poverty playing a central role. Aligned with earlier successful approaches, we have tried to mitigate these challenges through effective community sensitization throughout the project, recruiting staff from the target communities, use of local security structures, involvement of a diverse group of community leaders and stakeholders, community engagement based on values and principles that are consistently applied throughout the program, demonstrating the value of the institution to the community’s needs beyond a single project. Overall we concluded that slums are complex environments where residents have multiple competing priorities and therefore new programs and initiatives are not always perceived as being beneficial. On the other hand there was, and still is, a strong need for improvement in health and quality of life in the slum population, so with the right approach implementation of health programs could be highly rewarding.

In Chapter 10 we described the implementation processes and outcomes of each intervention component of the SCALE UP study. These outcomes were based on administrative re-
records such as activity reports, minutes of meetings, training attendance records among others, in combination with the various surveys we conducted at population and clinic level. We estimated the costs from a provider perspective in US$ 2013 through a top down costing approach, including all service and above service level costs of each itemized activity per component during the 18 months of the intervention, excluding evaluation and research-related activities. We reported that CHWs in the intervention reached 60% of the target population (4,049 people at US$ 17 per person screened), provided access to treatment for 68% of persons referred (660 people at US$123 per person with hypertension who attended the clinic), retained in care 27% of those recruited to the clinics (178 patients at US$194 per person who retained in care), and achieved BP control among 33% of those retained in care (n=58/178). The total intervention cost per patient with BP controlled was US$3205.

Even in the challenging environment of the slums, the programme reached a substantial number of people in the population for screening and referred participants with high BP to the clinic, at a cost that would be regarded as affordable. These percentages are well above the 50% of the so called rule of halves [18] and comparable with high income settings [17, 19]. However, the intervention underperformed in terms of addressing levels of retention in care and BP control with percentages well below the 50%, and much worse than other settings [20]. The main reasons given by the patients for these low outcomes were challenges with access and affordability of healthcare which were mentioned in earlier studies as well [21, 22]. Although we had lowered the cost of medication in our programme substantially through subsidies this was apparently not sufficient to keep the majority in the clinics. The total of US$3205 per controlled patient is comparable to other public health interventions such as a similar HIV intervention including screening, diagnosis, and chronic treatment [23], which costs are almost double. Based on these outcomes we were glad to share results and approaches to improve screening and referral and recommend that further research, especially operational research,
be conducted to address retention in care and BP control in similar impoverished settings.

Subsequently we report in Chapter 11 on the impact evaluation of the intervention of the SCALE UP study. We analyzed this through comparison of the cross-sectional surveys conducted at baseline and after 18 months in both the intervention and control group, using a difference–in-difference method. We screened 1,531 and 1,233 participants in the intervention and control sites. We observed a significant reduction in mean SBP when comparing before and after measurements at population level in both intervention (2.8 mmHg) and control (1.7 mmHg) groups. As BP levels are rising all over the continent (26) (27) (28) the reduction in SBP on population level in both the intervention as the control group was very substantial. Among people with hypertension at baseline the effect was even stronger, as systolic BP was reduced by 14.8 mmHg in the intervention and 14.1 mmHg at the control site, which is higher than most other studies in SSA describing successful BP reduction (29). One explanation for the decrease in BP in both groups could be the effect of the baseline measurements of BP and questionnaires in the control community, which might have influenced behavior and related BP levels. Another argument might be that the control group in Vwandani was still benefiting from the earlier WDF study (APHRC, unpublished data), in which participants screened with hypertension during the prevalence study in 2008 (Chapter 3) were assisted in treatment by creating patient support groups and accessing care in nearby public clinics.

We found no difference in changes in mean SBP nor prevalence of hypertension between our designed intervention (Chapter 7) compared to a control population, whose BP was measured at baseline. Our explanation for not finding an additional effect of the intervention, was that the above mentioned steps of the intervention after the household screening were not successful enough to yield an extra reduction in BP. Although we succeeded to double the rates of awareness in the intervention group from 10% to 21%, we have not been able to refer a sufficiently large group of
people with hypertension to health care clinics and maintain them there with monthly medication (Chapter 10) to see a significant effect compared to the control group.

During the intervention we decided to examine whether there was an effect of taking BP measurements at baseline in the control group, as the measurement in itself might have had an influence on lifestyle and health seeking behavior. If the one off measurement at baseline had a substantial effect on BP in the first control group, one would expect the additional control group at the time of the second measurement to have a higher BP compared to the intervention but also compared to the first control group, as they had not been exposed to the one off measurement yet. In order to measure this effect we added an extra control arm during the second survey, and included 1712 participants 35 years and older in Viwandani who had not been screened at baseline. The sample size was calculated based on a comparison of the second control group against the intervention arm, assuming an equivalent difference as for the initial comparison (control vs intervention). As shown in Table 1 we could detect a significant difference between the intervention and the second control group in both SDP (P-value: 0.045) and DBP (P-value: 0.001) which we could not find comparing the intervention with the first control group (P-value). However we cannot exclude a reduction in this second control group, as we don’t know their status at baseline.

Comparing the first and second control group we could find a difference of 1.2mmHg in SBP, to the advantage of the first control group, which was borderline significant (P-value=0.058). This might suggest that indeed there is an impact of baseline screening on levels of BP, although this difference is not clearly seen in the other outcomes like smoking, alcohol and diet, and levels of treatment and control of hypertension. In retrospective we could have reconsidered the inclusion and size of the extra control group, given the extra burden on the budget and participants, as it was not sufficient powered to detect an effect between the two control groups. therefore we cannot be sure what the effect of the one-off screening was.
Table 1: results endline study including extra control arm (Control 2) not included in baseline

<table>
<thead>
<tr>
<th></th>
<th>Intervention</th>
<th>Control 1</th>
<th>Control 2</th>
<th>P-value1</th>
<th>P-value2</th>
<th>P-value3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proportion with SBP&gt;=140mmHg and/or DBP&gt;=90mmHg</td>
<td>360 20.6</td>
<td>242 18.1</td>
<td>0.111</td>
<td>355 20.6</td>
<td>0.120</td>
<td>0.976</td>
</tr>
<tr>
<td>Mean systolic blood pressure</td>
<td>1519 121.0</td>
<td>1232 121.1</td>
<td>0.867</td>
<td>1720 122.3</td>
<td>0.058</td>
<td>0.045</td>
</tr>
<tr>
<td>Mean diastolic blood pressure</td>
<td>1519 80.8</td>
<td>1232 81.9</td>
<td>0.009</td>
<td>1720 82.3</td>
<td>0.421</td>
<td>0.001</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30 to 40</td>
<td>195 24.0</td>
<td>287 31.6</td>
<td>0.000</td>
<td>425 31.7</td>
<td>0.964</td>
<td>0.000</td>
</tr>
<tr>
<td>41 to 50</td>
<td>592 38.8</td>
<td>665 47.8</td>
<td>0.000</td>
<td>879 47.1</td>
<td>0.720</td>
<td>0.000</td>
</tr>
<tr>
<td>51 to 60</td>
<td>437 23.7</td>
<td>213 15.8</td>
<td>0.000</td>
<td>329 16.5</td>
<td>0.604</td>
<td>0.000</td>
</tr>
<tr>
<td>Above 60</td>
<td>307 13.5</td>
<td>68 4.8</td>
<td>0.000</td>
<td>94 4.7</td>
<td>0.898</td>
<td>0.000</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>671 48.8</td>
<td>772 72.8</td>
<td>0.000</td>
<td>1156 48.0</td>
<td>0.000</td>
<td>0.654</td>
</tr>
<tr>
<td>Male</td>
<td>860 51.2</td>
<td>461 27.2</td>
<td>0.000</td>
<td>571 52.0</td>
<td>0.000</td>
<td>0.654</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No education</td>
<td>244 12.9</td>
<td>42 2.9</td>
<td>0.000</td>
<td>80 5.3</td>
<td>0.002</td>
<td>0.000</td>
</tr>
<tr>
<td>Primary Incomplete</td>
<td>451 27.4</td>
<td>111 8.2</td>
<td>0.000</td>
<td>167 9.9</td>
<td>0.133</td>
<td>0.000</td>
</tr>
<tr>
<td>Primary Complete</td>
<td>621 43.7</td>
<td>631 49.9</td>
<td>0.002</td>
<td>865 51.1</td>
<td>0.543</td>
<td>0.000</td>
</tr>
<tr>
<td>Secondary+</td>
<td>215 16.1</td>
<td>449 39.0</td>
<td>0.000</td>
<td>615 33.7</td>
<td>0.006</td>
<td>0.000</td>
</tr>
<tr>
<td>Income (Kshs.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 5,000</td>
<td>685 55.8</td>
<td>162 12.3</td>
<td>0.000</td>
<td>245 18.8</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>5,000-9,999</td>
<td>359 33.3</td>
<td>405 34.8</td>
<td>0.483</td>
<td>623 41.8</td>
<td>0.001</td>
<td>0.000</td>
</tr>
<tr>
<td>&gt;=10,000</td>
<td>117 11.0</td>
<td>549 53.0</td>
<td>0.000</td>
<td>643 39.4</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Other risk factors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tobacco use</td>
<td>187 14.2</td>
<td>149 13.8</td>
<td>0.793</td>
<td>248 13.6</td>
<td>0.009</td>
<td>0.003</td>
</tr>
<tr>
<td>Alcohol use</td>
<td>282 21.3</td>
<td>250 23.1</td>
<td>0.296</td>
<td>486 22.5</td>
<td>0.715</td>
<td>0.424</td>
</tr>
<tr>
<td>Insufficient fruit and vegetable consumption</td>
<td>1,114 73.1</td>
<td>966 79.1</td>
<td>0.001</td>
<td>1238 71.9</td>
<td>0.000</td>
<td>0.466</td>
</tr>
<tr>
<td>Inadequate physical activity</td>
<td>75 4.3</td>
<td>97 7.3</td>
<td>0.001</td>
<td>76 5.4</td>
<td>0.050</td>
<td>0.189</td>
</tr>
<tr>
<td>Levels of awareness, treatment and control</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% of those with high BP aware of it</td>
<td>321 18.5</td>
<td>90 6.2</td>
<td>0.000</td>
<td>116 7.8</td>
<td>0.122</td>
<td>0.000</td>
</tr>
<tr>
<td>% of those needing treatment on treatment</td>
<td>195 58.2</td>
<td>57 62.2</td>
<td>0.527</td>
<td>78 65.1</td>
<td>0.687</td>
<td>0.245</td>
</tr>
<tr>
<td>% of those on treatment with a controlled BP</td>
<td>99 53.4</td>
<td>20 35.6</td>
<td>0.026</td>
<td>35 44.4</td>
<td>0.338</td>
<td>0.214</td>
</tr>
</tbody>
</table>

P-value1: comparing Intervention vs Control 1 at endline
P-value2: comparing Control 1 vs control 2 at endline
P-value3: comparing Intervention vs Control 2 at endline

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Regarding cardiovascular risk factors we found an increase of insufficient intake of fruits and vegetables in both the intervention and (first) control group and also an increase of inadequate physical activity in the control group. This is similar to other studies from the continent [24] and might be one of the causes for the rapid growth for overweight and obesity in these settings [14]. However, the reduction in alcohol and tobacco use we found in the control group during the study period is contrary compared to the rising trend in other slums [4]. We concluded that future interventions should concentrate more on getting more people that are in need into the health care system in order to create an additional and more sustainable reduction of cardiovascular risk.

Finally we discussed how the cardiovascular prevention model developed for the slums of Nairobi could be translated to the context with African migrants in Amsterdam (Chapter 12). Taking into account that all continents are confronted with the burden of CVD [25], prevention and treatment of CVD often requires active screening and lifelong follow up. Although treatment outcomes are generally better in high income settings [6], there is a challenge to the health services both of high-income and to deliver adequate care to those in need, with efficient use of resources. Although our initial aim was to develop a model that could be easily scaled up to other settings in the African region, we discovered that the model could also be used for specific populations in high income countries like migrant populations as they have similar low rates of awareness, treatment and control of hypertension [26, 27] probably related to common cultural beliefs and thoughts around hypertension and poor access to health and social services [28, 29].

The potential of this so called reverse innovation of implementing health programs from LMICs to high-income countries is supported by a growing body of evidence [30]. Following a developed manual the approach of the intervention could be adapted to the specific settings and characteristics of the local situation, for example, in Amsterdam. The reverse innovation might fit well within the health strategy for marginalized groups in high-income countries as there is a tendency to decentralize health care and in-
crease patient participation and ownership, for example by installing BP screening at churches or community centers and organize patient support groups, in order to increase compliance to medication and healthy lifestyle behavior [31, 32]. With the aimed implementation and evaluation of an adapted version of the SCALE UP study in Amsterdam, we argued that a model for cardiovascular prevention of CVD in the slums of Nairobi could be of use for improving CVD outcomes among African migrants and other vulnerable populations in high-income countries.

As this thesis is addressing the urban poor, it is essential to take the social determinants of health into account. Although CVD initially has been regarded as a disease of the affluent it is becoming a disease of the poor. In the high-income countries this difference has already been seen for many years [33], but recently this is also happening in lower middle-income countries like India [34]. In the urban slum of Nairobi we can see in this thesis that for example prevalence of hypertension increased with lower education (Chapter 3), and for obesity it has been demonstrated to increase fastest among the poorest of the urban population [14]. As described in Chapter 9 life for the poorest of the urban population is extremely challenging and different from other settings to conduct health programs. A report by APHRC on the social determinants of health in urban slums in Nairobi [35], found that lack of drinking water and poor drainage were cited as the major needs for the slum residents. In addition, they mention that stress about sanitation and security, and high levels of unemployment are emerging, specifically among the younger population. Although the health of slum dwellers is often in a poor state [36], it is not regarded as their main priority. Only when there are acute conditions do slum dwellers tend to use their limited resources on health issues [37]. Therefore there is a big paradox between the public health epidemic of an increasing burden of chronic diseases like CVD among the urban poor and the lack of priority at the individual level. In order to effectively diminish the increased risk of CVD among the urban poor it is essential to address the social and economic drivers of their poor health.
FUTURE RESEARCH

From the first part of this thesis we can conclude that there is a strong need for more data on prevalence of cardiovascular risk factors on the African continent. More specifically we need prospective data to identify the actual drivers of the increasing prevalence of CVD and to help develop risk prediction models in various communities in SSA. This research could be conducted on a local, regional or even national level like the STEPS surveys [38], which already have been taking place in some of the African countries [39]. The most specific group that should be included in this future research on prevalence studies are the urban poor. More than 300 million people are living in slums on the continent, but there are only a handful papers on cardiovascular risk factors in these impoverished settings.

Once there is more accurate data on the prevalence of the various cardiovascular risk factors on the continent including the slums, potential interventions can also be more specified. This is the next point that needs further research. We recommend that interventions for prevention of CVD adapted to the local environment should be implemented and evaluated. There are several documents that could guide local researchers and policymakers in the content of their intervention [40]. As there are limited resources to develop new studies we suggest that policymakers and implementers from the local and national government add an operational research component next to every intervention which evaluates their actions and outcomes in order to guide us to the development of more effective CVD interventions.

Based on our findings in this thesis we suggest two specific areas for interventions for prevention of CVD: 1) the effect of awareness campaigns and screening for CVD risk factors and 2) the retention in treatment programs and control of BP.

As awareness of CVD risk factors and more specifically hypertension is still very low in slum settings in SSA [3, 5, 41], we suggest to further explore the impact of a basic screening program on cardiovascular risk outcomes. In addition, treatment and retention
in clinics and consequently control of cardiovascular risk factors like hypertension are dismal, specifically among the urban poor. Therefore we suggest that future interventions should concentrate more on getting more people that are in need into the health care system in order to create an additional and more sustainable reduction of cardiovascular risk. As resources are limited on the continent, it is important that in future research on interventions for prevention of CVD costs and feasibility are included in the design and analysis.

There seems to be a sense of action in the global community regarding CVD as they have set targets including a 25% relative reduction in the prevalence of raised BP; and halt the rise in diabetes & obesity by 2025 [42]. Even in the upcoming Sustainable Development Goals (SDG) there will be a strong emphasis to reduce the public health catastrophe of CVD [43]. However we have to ensure that governments and all stakeholders involved commit themselves towards these ambitious but highly needed agreements, as international and national funding and policies are essential to reach the above mentioned recommendations.

CONCLUSION

We can no longer ignore the increasing presence of the cardiovascular risk factors in the African continent. This thesis shows that among the urban poor of Nairobi the rates of cardiovascular risk factors like hypertension, diabetes and obesity are substantial, whereas awareness and control of these risk factors remain very low. Therefore there is a strong urgency to develop and implement interventions to increase awareness, treatment and control of cardiovascular risk factors. The development of such interventions for prevention of CVD can be supported by approaches from both public health and private sector. It is important to realize that the implementation of these new interventions in slum settings can be confronted with serious challenges related with the high levels of poverty in these disadvantaged settings. However
we have demonstrated that a community based intervention with affordable costs can significantly increase awareness and access to treatment of hypertension, leading to a reduction of BP both in the population level as well as among people at high risk. This would hopefully encourage other researchers and policymakers to develop, implement and evaluate cost-effective interventions for prevention of CVD among the urban poor in Africa and beyond.
REFERENCES


