Hypertension Occurrence and Associated Risk Factors in HIV Patients on Antiretroviral Therapy in Nairobi County, Kenya

Mary Adonga [1], Rose Juma [1] &; Job Mapesa [1]*

[1]*Kenya Methodist University P.O. Box 1017 – 60200, Meru, Kenya*
*Correspondence email: maryadonga71@gmail.com

Abstract

Due to advances in antiretroviral treatment, the incidence of HIV infection has declined in recent years. However, cardiovascular illnesses continue to be the primary cause of death and morbidity among HIV-positive individuals, accounting for 10% of all deaths that are not related to AIDS. The paper aimed to determine occurrence and risk factors associated with hypertension among HIV patients on antiretroviral treatment in Nairobi County. The study adopted a cross-sectional design, and a sample size of 552 respondents. Purposive sampling technique was used to select the area, and systemic random sampling was used to select participants. Structured questionnaires were used to collect data, which was analyzed using excel and SPSS. Results indicated (64.86%) female and 35.69% male participants. About 55.43% participants were married, 61.41% had informal jobs, 43.48% had attained elementary school level, and 99.64% identified as Christians. Accordingly, 14.52% of people had elevated blood pressure, and 85.48% recorded normal blood pressure. About 44.21% of people were overweight/obese as indicated by their waist circumference and BMI findings, and 24.64% were at risk because of their elevated waist circumference. The risk of hypertension is substantially higher among respondents 46 years and older than in respondents under 25 years (p = 0.008) at 95%CL. A higher waist circumference is linked to a higher risk of hypertension (p = 0.012), family history (p=0.021) Cl, whereas a person's chance of developing hypertension is higher when their heart rate remains constant than when it changes slightly (p = 0.036). In conclusion, advancing age, female gender, increase in waist circumference, overweight/obesity and family history were predictors for hypertension in this study. The study recommended Nairobi health service to integrate hypertension and HIV services; to give health education to patients and care givers and promote lifestyle modification; and the Ministry of Health (MoH) to formulate integration policies.

Keywords: *HIV/AIDS, Antiretroviral therapy, Hypertension, Risk factors, Nairobi County, Sub-Saharan Africa.*

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1.0 Introduction

The general population in the African continent is experiencing a rising trend in non-communicable diseases (NCD), which presents a significant challenge to the weak health systems in regions with inadequate resources (Moucheraud, 2018). In Kenya, NCD cause more than half of all hospital admissions as well as more than half of hospital mortalities. There is double threat in Sub Sahara Africa, where, despite the infectious disease, there is a surge of NCD. This shift is mostly caused by rapid urbanization, changes in the economy, and concurrent changes in diet (Remais et al., 2012). Furthermore, compared to non-infected individuals, HIV-positive people are more likely to have cardiovascular disease (CVD) risk factors, cardiovascular morbidity, and cardiovascular death outcomes (Todowede et al., 2019a).

Consequently, Todowede et al. (2019a) indicates that around 10% of HIV-positive individuals have a very high chance of dying from CVD in the next ten years. According to levy et al. (2017), People living with HIV (PLHIV) taking antiretroviral therapy continue to confront obstacles like hypertension despite drug effectiveness.

The majority of researches on the relationship between HIV and cardiovascular risk factors comes from affluent nations (Cerrato et al., 2013), but 67% of HIV cases worldwide are found in Sub-Saharan Africa. Cerrato et al. (2013) observe that given the high prevalence of HIV and the known cardiovascular consequences of the virus, it is crucial to analyze the predictors of cardiovascular disease among PLHIV in South Africa. In Kenya, there is insufficient data about the prevalence of CVD risk factors among HIV patients (Achwoka et al., 2019). Previous studies on HIV comorbidity and cardiovascular risk, primarily from Western Kenya, has demonstrated that a high frequency of obesity and hypertension exists among HIV patients (Saito et al., 2020).

Despite being vital for HIV management, antiretroviral medication (ART) is likely to elevate blood pressure. Studies from a variety of cohorts, including those conducted in the US and other high-prevalence regions, clearly show the association between ART and cardiovascular comorbidities (Hatleberg et al., 2018). Because of the way ART and hypertension interact, it is important to optimize treatment approaches in order to reduce these risks. Additionally, in HIV patients, lifestyle and socio-demographic factors increase probability of development of hypertension. Studies reveal that elevated hypertension prevalence in this demographic can be attributed to male gender, advancing age, and particular lifestyle choices (Dai et al., 2022). McCombe et al. (2021) elucidated the purposes of properly managing chronic illnesses, and noted it is necessary to strengthen drug procurement, provide access to equipment and blood tests, offer thorough health education, and enhance continuity of care.

According to Peck et al. (2014), a large percentage of outpatient hospital visits are related to chronic conditions (38%; 20% at health centers and 13% at dispensaries). Many facilities lack the necessary protocols, medication therapy, and diagnostic tools for

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managing chronic illnesses, with HIV services typically being more robust than those for other NCDs. Compared to diabetes and hypertension, health professionals know more about HIV, and nurses in lower-level hospitals have less training and experience in managing NCDs.

Similarly, adults with HIV often have hypertension, which is most likely caused by a confluence of conventional risk factors, HIV-specific variables, and antiretroviral therapy (ART) (Fahme et al., 2018). They have discussed the available data about potential mechanisms of adult HIV infection-related hypertension that are connected to ART and HIV-specific variables.

Finally, in a meta-analysis of 141 of the 6,143 abstracts that were examined and approved for inclusion in the summary, showed non-communicable disorders, such as depression, hypertension, and hypercholesterolemia, had significant prevalence rates. Notably, there is a dearth of NCD-HIV integrated programs designed for locations with minimal resources (Patel et al., 2018) hence; the knowledge gap that this study seeks to fill.

2.0 Materials and Methods

This research adopted a cross sectional study design because it makes it possible to gather data at a certain moment in time, thus allowing effective examination of the frequency and connections between different characteristics in a population. The study area was Nairobi County, which was divided into three significant regions; namely, Nairobi West, Nairobi North, and Nairobi East. Specific facilities were selected for study as follows: Westlands (Kangemi health centre),

Ruaraka (Mathare North hospital) and Makadara (Makadara Hospital).

The target population was HIV patients who were on antiretroviral therapy (ART), and eighteen (18) years and above. Structured interviews guided by formulated questionnaire were used to gather information on lifestyle choices, medical histories, and clinical factors such as blood pressure readings. Inclusion criteria was HIV patients enrolled for treatment and care in the comprehensive care clinics (CCC) in selected facilities in Nairobi County. Only adults 18 years and above, and patients, both male and female, who were on ART for six months were considered. Exclusion criteria was female who were pregnant because their waist circumference, weight and BMI would affect the findings.

> "*The study revealed that age, gender and Sub-County of residence were statistically significant in the prevalence of hypertension and associated risk factors among HIV*

A sample size of 552 was obtained, using fisher formula. Purposive sampling technique was used for study area (Nairobi). Stratified sampling was used to select three regions, and the facilities in each area. Only one facility with highest number of HIV patients was considered. Systemic random

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sampling was used for selecting patients. Upon arrival at the clinic, patients were assigned numbers, and eligible participants who sought care and treatment were selected through systematic random sampling. They were taken through the consent form and the purpose of the study, patients who opted not to participate were excluded from the sampling period. The questionnaires and guidelines were translated into Kiswahili to ensure accuracy of responses and reduce errors.

All participants gave their informed consent, both verbally and in writing, before any data were collected. Nairobi County, NACOSTI, and the Kenya Methodist University Ethical Committee approved the data gathering. The study used descriptive frequencies and percentages, while inferential statistics such as Chi-square were used to analyze the data.

Results were presented in tables and explanation.

3.0 Results and Discussion

Out of the 552 questionnaires issued 549 were duly filled, giving a response rate of 99%.

Descriptive results for sociodemographic characteristics

The mean age of the participants was found to be 39 years, the youngest participant was 18 years and oldest was 71years. They were categorized into six groups, with the bigger proportion of the participants being 36 to 45 years. The study subjects were drawn from three facilities in three Sub Counties in Nairobi, Kenya. Their demographic and socioeconomic characteristics are summarized in Table 1.

Table 1

Demographic and Socioeconomic characteristics

Characteristics		Frequency	Percent
Age (Years)	Below 26	46	8.33
	26-35	149	26.99
	36-45	197	35.69
	46-55	117	21.2
	56-65	39	7.07
	Above 66	4	0.72
Gender	Male	194	35.14
	Female	358	64.86
Marital Status	Not married	100	18.12
	Married	306	55.43
	Separated	95	17.21
	Widowed	51	9.24
Employment	Not Employed	106	19.2
	Informal	339	61.41
	Formal	107	19.38
Education Level	No Formal Education	19	3.44
Primary	Primary	240	43.48

Secondary	Secondary	217	39.31
College	College	76	13.77
Religion	Christian	550	99.64
	Muslim	2	0.36

N=552

The results in table 1 indicates that majority of participants were female 64.86% (n=358) and male comprised of 35.14% (n=194). Regarding age, the majority (35.69%) n=195 were aged between 36-45 years. Majority were married 55.43% n=306, a notable proportion was working in informal sector 61.41% n=339 and majority had completed primary education 4348% n=240. The demographic profile of the participants indicates that most were within the working-age population, predominantly female, and largely engaged in informal employment. The study population was predominantly Christians with significant portion of the population being married and engaged in informal working environment. These findings resonate with findings by Parati et al. (2021) suggesting a notable rise in hypertension prevalence among older adults.

Occurrence of high blood pressure among HIV patients

Here the assessment was on occurrence of hypertension among the HIV patients on antiretroviral treatment in Nairobi County. The researcher essentially took blood pressure readings at least three measurements, and the average of the last two was recorded. Waist circumference, weight and height (body mass index) for all patients who met the inclusion criteria was taken, and findings summarized in Table 2.

Table 2

Occurrence of high blood pressure among HIV patients

Characteristics		Frequency	Percent	*Chi-Square(X)*	*P <0.05*
Blood Pressure	Normal	471	85.48		
	Hypertensive	80	14.52		
Waist Circumference	Normal	416	75.36		
	Increased Risk	136	24.64	4.14	0.042
Body Mass Index	Under weight	24	4.35		
	Normal weight	284	51.45		
	Over weight	178	32.25	8.61	0.035
	Obese	66	11.96		

N=552

The results show that participants with normal blood pressure were 75.36%, and 14.52% had raised. 75.36% had normal waist circumference, while 24.64% (136) recorded increased change in their waist. For BMI measurements indicated 51.45%, 32.25%,

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11.96% and 4.35% for normal, overweight, obese and underweight categories.

Study highlights that the population studied had increased risk of cardiovascular diseases as indicated by 14.52% who had elevated blood pressure. It was also clear that the other associated risk factors for blood pressure, namely overweight/obesity 44.21% and increased waist circumference change, 24.64%, reinforces this risk. The Statistical significance index for these risk factors were (p=0.042) Cl and (P=0.035) CI all at 95%. For waist circumference and body mass index respectively.

The prevalence statistics revealed by this study resonates with what other studies have reported. For instance, Mogaka et al. (2022) give a range of 6% to 50% hypertension prevalence among this population cohort. Study in Uganda by Lubega et al. (2021) recorded prevalence range of 8% to 70%. These statistics disagree with results from a study in Ghana which posted 17.4% as hypertension prevalence (Denu et al., 2024). On BMI the results are similar to finding by Wang et al. (2009) which revealed that 50% of participants had normal range, 15% obese and 30% overweight. In a similar cohort, Maffoni et al. (2020) found that 50% of participants fell within the normal weight range, whereas 15% were obese and 30% were overweight.

According to Bell et al. (2018), elevations in the total fat mass index and BMI at the age of ten were also linked to similar outcomes when it came to cardiometabolic traits at the age of eighteen. Similarly, reducing obesity prevalence and controlling its mediators is most effective in lowering the risk of cardiovascular disease because it affects metabolic risk factors including diabetes and hypertension (Gill et al., 2021).

Associated Risk Factors among PLHIV

The associated risk factors for hypertension were investigated on the sampled HIV patients who are on ART in Nairobi County. The aspects covered were the frequencies of alcohol consumption, cigarette smoking, physical activity unhealthy feeding practices especially adding salt to food and eating fruits and presence of hypertension in the family. The summary of the findings is tabulated in Table 3.

Table 3

Hypertension associated risk factors frequency

Characteristic		Frequency	Percent	Chi-Square(X)	P <0.05
Alcohol	Yes	120	21.74	1.6792	0.195
Consumption	No	432	78.26		
Smoking Status	Yes	49	8.89	0.8157	0.366
	No	502	91.11		
Physical Activity	None	242	44.32		
	Walking	252	46.15		
	Jogging or running	37	6.78		
	Riding Bicycle	14	2.56		
	Aerobics	1	0.18		

Salt Intake	Yes	256	46.46	0.1829	0.669
	No	295	53.54		
Fruit Intake	Every meal	36	6.55		
	Once a day	102	18.55	0.1439	0.931
	Sometimes	412	74.91		
Family History	Yes	116	21.01	7.737	0.021
	No	436	78.99		

Findings indicated 21.74% alcohol consumption among the participants, 8.89% cigarette smoking, and 25.16% unhealthy feeding practices. Those who were found to be adding salt on the food at the table were 46.46%. Positive family history for blood pressure was reported in 21.01%, while over 90% of the population under the study were either not doing any active physical activity or they were just walking normally.

The results indicated that only 21.74% of the participants were found to be consuming alcoholic drink exposing them to higher risks for non-communicable diseases including cardiovascular diseases, particularly hypertension, and diabetes.

For other risk factors like smoking cigarettes, 8.89% agreed that they smoke. This can be attributed to majority of study subjects being female (64.86%), this is supported by study done in Kenya which showed cigarette smoking practice as largely associated with males, with very low rates among females. National statistic approximates current smoking prevalence at 17.3 - 22.0% among Kenyan men and 0.18 - 2.0% among Kenyan women (Mogaka et al., 2022). Our results disagree with the findings that over 26% of Kenyan men are HIV positive, and over 1% of female Kenyan patients living with HIV were smoking cigarettes (Shuter et al., 2021).

However, high percentage of participants reported no physical activity (44.32%) where only small percentage choose cycling (2.56) or jogging/running (6.78%). This is a pointer that there is high possibility that a considerable proportion of the study sample get cardiovascular disease including high blood pressure, heart disease and stroke.

On assessment for risk factor of unhealthy diet habit nearly half of the participants (46.46%) add extra salt to their meals making them potential for increased blood pressure and related cardiovascular risks. Their low daily fruit intake, where only about 6.55% consumed a fruit in every meal, and 18.55% ate a fruit once a day indicates there is a risk exposure for higher proportion of study population for hypertension disease. This study does not align with World Health Organization recommendation of eating fruits at least five serving in a day (WHO, 2024). A study by Dhindsa et al. (2020) established a link between a higher fruit diet and a lower risk of cardiovascular disorders, such as hypertension. In a similar vein, Harimenshi et al. (2022) highlighted how fruits and vegetables can help prevent chronic diseases.

The results highlighted the importance of various lifestyle choices in this study cohort. According to Probst et al. (2020), there is

need for healthier lifestyle choices. Up to 27% of death rates associated with socioeconomic level can be attributed to alcohol intake, with high episodic drinking playing a major role. The intricate interplay between alcohol use and socioeconomic determinants in shaping health consequences is shown by the variable association between SES and alcohol usage. As per current clinical pronouncements for the general population, blood pressure is regarded as a significant modifiable risk factor in primary and secondary cardiovascular prevention (Expert Panel on Detection, 2001). With an emphasis on different dietary components and lifestyle adjustments, Passi (2017) noted that in order to battle NCDs in the poor third world countries preventative strategies, which center mostly on dietary determinants need to be emphasized.

Finally, nearly a quarter (21.01%) of participants reported having positive family history of hypertension, suggesting strong susceptibility of acquiring hypertension

disease among this population under study. The findings of this research agree with results which reported that blood pressure variance attributable to genetics is about 30% (Ranasinghe at al., 2015). Other research with similar findings on the relationship between family history of disease and its development were revealed by Ma et al., (2022).

Effect of hypertension and associated risk factors

The study sought to determine the effect of hypertension and associated risk factors outcomes among the HIV positive patients who were taking antiretroviral therapy in Nairobi County. The variables included presence of hypertension in the family, intake of alcoholic drinks among the participants within twelve months prior to assessment period. Cigarette smoking and unhealthy feeding practices particularly adding salt to food and fruits intake during meals. The findings are presented in Table 4.

Table 4

Effect of hypertension and associated risk factors outcomes as reported by study participants

Reason	Chi-Square(X)	P <0.05
Family history of hypertension	0.963	0.021
Over the past 12 months did you drink alcohol	1.679	0.195
Have your ever smoked cigarette	0.815	0.366
Do you usually add salt to food	0.182	0.669
How often do you eat fruits in your diet	0.143	0.931

Table 4 shows key findings from the association between hypertension and other variables. Genetic predisposition of hypertension among the study sample, p=0.021, alcoholic drinks, p=0.195, cigarette smoking, p=0.366 and unhealthy feeding practices, p=0.669 for adding salt to food and

eating fruits in meals, p=0.931. These results point out that among this population, a family history of hypertension is a key indicator for hypertension disease and by extension cardiovascular diseases.

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The low association of smoking cigarettes 8.89% (p=0.366) with blood pressure elevation can be attributed to majority of study subjects being female (64.86%). This is clarified in a study done in Kenya in which results showed cigarette smoking practice is largely a male practice, with very low rates among females. National statistic approximates current smoking prevalence of 17.3 - 22.0% among Kenyan men and 0.18 - 2.0% among Kenyan women (Mogaka et al., 2022). Our results differed with findings indicating that over 26% of Kenyan men who are HIV positive and over 1% of female Kenyan patients living with HIV were smoking cigarettes (Shuter et al., 2021).

The study noted low daily fruit intake, where about (p=0.931) showed a relationship of hypertension disease development and the practice of eating a fruit daily. The findings of this study shows deviation from recommendations by World Health Organization of eating fruits at least five serving in a day (WHO, 2024). Study by Dhindsa et al. (2020) discovered a link between a higher fruit diet and a lower risk of cardiovascular disorders, such as hypertension. Similarly, Harimenshi et al. (2022) highlighted how fruits and vegetables can help prevent chronic diseases.

Association of Hypertension and other variables

The study further sought to explore the bivariate logistic analyses of hypertension for the HIV patients on antiretroviral treatment. The variables whose effects were analyzed on hypertension were age, sub counties, waist circumference and the heart rate. The findings are outlined in Table 5;

Table 5

Association of Hypertension and other variables

Bivariate logistic analyses of hypertension and the below variables				
Variable	OR	CI		P-Value
Age				
26-35 Yrs	0.39167	0.04769	3.216913	0.383
36-45 Yrs	0.16019	0.02110	1.216119	0.077
46Plus Yrs	0.06450	0.00861	0.482896	0.008
Sub-County of Residence				
Ruaraka	2.34104	1.277002	4.291702	0.006
Makadara	2.29898	1.266695	4.172506	0.006
Waist Circumference				
Normal				
Hypertensive	0.51420	0.305921	0.86429	0.012
Heart Rate				
Moderate	2.30263	0.994831	5.329662	0.051
Large	1.22222	0.450912	3.312904	0.693
No Change	3.03571	1.076841	8.557958	0.036

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Results in table 5 show that the chance of having hypertension is considerably higher in those 46 years of age and older than in those under 25 years showing that advanced age is a precursor or predictor of hypertension disease. Statistical significance was at p=0.008 Cl. The area of residence was also found to have significant influence on increasing probability of acquiring hypertension disease. as indicated by findings from respondents in Ruaraka and Makadara sub counties in Nairobi County.

Those participants with increased changes in waist circumference measurement (p = 0.012) Cl and those who recorded minimal or no change in their heart rate (p= 0.036) Cl have more chance of recording elevated blood pressure compared to their counterpart. The age, location, waist circumference, and minimal change in heart rate indicated a significant relationship with hypertension disease in this study. Tian and Zhan (2022) reported similar results on positive association on location of residence, and age (p=<0.000) for each variable

4.0 Conclusion
The study revealed that sociodemographic characteristics of the study population; such as age, gender and sub county of residence

were are statistically significant in the prevalence of hypertension and associated risk factors among HIV patients on ART in Nairobi County. Other key hypertension disease predictors that indicated positive association with hypertension disease were family history of hypertension reported by HIV patient on antiretroviral therapy, elevated body mass index, and increased change in waist circumference.

5.0 Recommendations
The study recommends Nairobi County Director of Public Health to implement integration for non-communicable disease and HIV services through early detection and control of hypertension in order to enhance targeted lifestyle modifications. Secondly, the Ministry of Health policy makers should formulate policies to address the integration of Non-Communicable Disease and HIV services. For integration to happen effectively and efficiently, policies have to be formulated and rolled out in the health facilities for proper implementation. Thirdly, more research should be conducted in private and Faith Based Hospitals to explore the prevalence and associated risk factors among HIV patients on antiretroviral treatment in Nairobi County.

References

Bell, J. A., Carslake. D., O'Keeffe, L. M., Frysz, M., Howe, L. D., Hamer, M., Wadec, K. H., Timpson, N. J., Davey. S. G. (2018). Associations of Body Mass and Fat Indexes With Cardiometabolic Traits. *The Journal of the American College of Cardiology, 72*(24), 3142-3154. https://doi.10.1016/j.jacc.2018.09.066

Cerrato, E., D'Ascenzo, F., Biondi-Zoccai, G., Calcagno, A., Frea, S., Grosso Marra, W., Castagno, D., Omedè, P., Quadri, G., Sciuto, F., Presutti, D., Frati, G., Bonora, S., Moretti, C., &

Gaita, F. (2013). Cardiac dysfunction in pauci symptomatic human immunodeficiency virus patients: A meta-analysis in the highly active antiretroviral therapy era. *European Heart Journal*, *34*(19), 1432–1436. https://doi.org/10.1093/eurheartj/ehs471

Chiwandire, N., Zungu, N., Mabaso, M., & Chasela, C. (2021). Trends, prevalence and factors associated with hypertension and diabetes among South African adults living with HIV, 2005–2017. *BMC Public Health*, *21*(1), 462-3, https://doi.org/10.1186/s12889-021-10502-8

Dai, B., Addai-Dansoh, S., Nutakor, J. A., Osei-Kwakye, J., Larnyo, E., Oppong, S., Boahemaa, P. Y., & Arboh, F. (2022). The prevalence of hypertension and its associated risk factors among older adults in Ghana. *Frontiers in Cardiovascular Medicine*, *9* https://doi.org/10.3389/fcvm.2022.990616

Denu, M. K. I., Revoori, R., Buadu, M. A. E., Oladele, O., & Berko, K. P. (2024). Hypertension among persons living with HIV/AIDS and its association with HIV-related health factors. *AIDS Research and Therapy*, 21(5), 1-6. https://doi.org/10.1186/s12981-023-00576-2

Dhindsa, D. S., Khambhati, J., Schultz, W. M., Tahhan, A. S., & Quyumi, A. A. (2020). Marital status and outcomes in patients with cardiovascular disease. *Trends in cardiovascular medicine*, 30(4), 215–220. https://doi.org/10.1016/j.tcm.2019.05.012

Expert Panel on Detection, E., and Treatment of High Blood Cholesterol in Adults. (2001). Executive Summary of the Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). *JAMA*, *285*(19), 2486–2497. https://doi.org/10.1001/jama.285.19.2486

Fahme, S. A., Bloomfield, G. S., & Peck, R. (2018). Hypertension in HIV-Infected Adults. *Hypertension*, *72*(1), 44–55. https://doi.org/10.1161/HYPERTENSIONAHA.118.10893

Gill, D., Zuber, V., Dawson, J., Pearson-Stuttard, J., Carter, A. R., Sanderson, E., Karhunen, V., Levin, M. G., Wootton, R. E., Klarin, D., Tsao, P. S., Tsilidis, K. K., Damrauer, S. M., Burgess, S., & Elliott, P. (2021). Risk factors mediating the effect of body mass index and waist-to-hip ratio on cardiovascular outcomes: Mendelian randomization analysis. *International Journal of Obesity*, *45*(7), 1428–1438.https://doi.org/10.1038/s41366-021-00807-4

Hatleberg, C. I., Ryom, D. L., Monforte, A. d'Arminio, Fontas, E., Reiss, P., Kirk, O., Sadr, W. E., Phillips, A., de Wit, S., Dabis, F., Weber, R., Law, M., Lundgren, J. D., & Sabin, C. (2018). Association between exposure to antiretroviral drugs and the incidence of hypertension in

HIV-positive persons: The DAD Study. *HIV Medicine*, *19*(9), 605–618. https://doi.org/10.1111/hiv.12639

Harimenshi, D., Niyongabo, T., Preux, P. M., Aboyans, V., & Desormais, I. (2022). Hypertension and associated factors in HIV-infected patients receiving antiretroviral treatment in Burundi: Across-sectional study. *Scientific Reports*, 12(1), 1–8. https://doi.org/10.1038/s41598-022-24997-7

Lubega, G., Mayanja, B., Lutaakome, J., Abaasa, A., Thomson, R., & Lindan, C. (2021). Prevalence and factors associated with hypertension among people living with HIV/AIDS on antiretroviral therapy in Uganda. *Pan African Medical Journal* 38(216), 1-10. https://doi.org/10.11604/pamj.2021.38.216.28034

Ma, H., Wang, X., Li, X., Heianza, Y., & Qi, L. (2022). Adding Salt to Foods and Risk of Cardiovascular Disease. *College Journal of the American of Cardiology*, 80(23), 2157-2167. https://doi.org/10.1016/j.jacc.2022.09.039

Maffoni, M., Traversoni, S., Costa, E., Midão, L., Kardas, P., Kurczewska-Michalak, M., & Giardini, A. (2020). Medication adherence in the older adults with chronic multimorbidity: A systematic review of qualitative studies on patient's experience. *European Geriatric Medicine*, 11(3), 369–381. https://doi.org/10.1007/s41999-020-00313-2

McCombe, G., Murtagh, S., Lazarus, J. V., Van Hout, M. C., Bachmann, M., Jaffar, S., Garrib, A., Ramaiya, K., Sewankambo, N. K., Mfinanga, S., & Cullen, W. (2021). Integrating diabetes, hypertension and HIV care in sub-Saharan Africa: A Delphi consensus study on international best practice. *BMC Health Services Research*, *21*(1), 1235-6. https://doi.org/10.1186/s12913-021-07073-0

Mogaka, J. N., Sharma, M., Temu, T., Masyuko, S., Kinuthia, J., Osoti, A., Zifodya, J., Nakanjako, D., Njoroge, A., Otedo, A., Page, S., & Farquhar, C. (2022). Prevalence and factors associated with hypertension among adults with and without HIV in Western Kenya. *PLOS ONE*, 17(1), e0262400. https://doi.org/10.1371/journal.pone.0262400

Okyere, J., Ayebeng, C., Owusu, B. A., & Dickson, K. S. (2022). Prevalence and factors associated with hypertension among older people living with HIV in South Africa. *BMC Public Health*, *22*(1), 1684-5. https://doi.org/10.1186/s12889-022-14091-y

Parati, G., Lombardi, C., Pengo, M., Bilo, G., & Ochoa, J. E. (2021). Current challenges for hypertension management: From better hypertension diagnosis to improved patients' adherence and blood pressure control. *International Journal of Cardiology*, 331(3), 262-

Adonga, Juma and Mapesa

269. https://doi.org/10.1016/j.ijcard.2021.01.070

Passi, S. J. (2017). Prevention of Non-communicable Diseases by Balanced Nutrition: Population-specific Effective Public Health Approaches in Developing Countries. *Current Diabetes Reviews*, *13*(5), 461–476. https://doi.org/10.2174/1573399812666160905105951

Patel, P., Rose, C. E., Collins, P. Y., Nuche-Berenguer, B., Sahasrabuddhe, V. V., Peprah, E., Vorkoper, S., Pastakia, S. D., Rausch, D., Levitt, N. S., & Group, for the N. H. P. D. C. T. O. (2018). Noncommunicable diseases among HIV-infected persons in low-income and middle-income countries: A systematic review and meta-analysis. *AIDS*, 32(), S5-S20 https://doi.org/10.1097/QAD.0000000000001888

Peck, R., Mghamba, J., Vanobberghen, F., Kavishe, B., Rugarabamu, V., Smeeth, L., Hayes, R., Grosskurth, H., & Kapiga, S. (2014). Preparedness of Tanzanian health facilities for outpatient primary care of hypertension and diabetes: A cross-sectional survey. *The Lancet Global Health*, *2*(5), 285–292. https://doi.org/10.1016/S2214-109X(14)70033-6

Probst, C., Kilian, C., Sanchez, S., Lange, S., & Rehm, J. (2020). The role of alcohol use and drinking patterns in socioeconomic inequalities in mortality: A systematic review. *The Lancet Public Health*, 5(6), 324–332. https://doi.org/10.1016/S2468-2667(20)30052-9

Ranasinghe, P., Cooray, D. N., Jayawardena, R., & Katulanda, P. (2015). The influence of family history of hypertension on disease prevalence and associated metabolic risk factors among Sri Lankan adults. *BMC Public Health*, 15, 576. https://doi.org/10.1186/s12889-015-1927-7

Remais, J. V., Zeng, G., Li, G., Tian, L., & Engelgau, M. M. (2012). Convergence of non-communicable and infectious diseases in low- and middle-income countries, *International Journal of Epidemiology*, 42(1), 221–227, https://doi.org/10.1093/ije/dys135

Saito, A., Karama, M., & Kamiya, Y. (2020). HIV infection, and overweight and hypertension: A cross-sectional study of HIV-infected adults in Western Kenya. *Tropical Medicine and Health*, *48*, 31. https://doi.org/10.1186/s41182-020-00215-w

Tian, Y., & Zhang, Y. (2022). The relationship between hypertension and physical activity in middle-aged and older adults controlling for demographic, chronic disease, and mental health variables. *Medicine (Baltimore)*.101(47), e32092-4. https://doi: 10.1097/MD.0000000000032092.

Todowede, O. O., Sartorius, B., Magula, N., & Schutte, A. E. (2019a). Association of predicted 10 years cardiovascular mortality risk with duration of HIV infection and antiretroviral therapy among HIV-infected individuals in

Durban, South Africa. *Diabetology & Metabolic Syndrome*, *11*(1), 105 https://doi.org/10.1186/s13098-019-0502-2

Todowede, O. O., Sartorius, B., Magula, N., & Schutte, A. E. (2019b). Association of predicted 10 years cardiovascular mortality risk with duration of HIV infection and antiretroviral therapy among HIV-infected   individuals in Durban, South Africa. *Diabetology & Metabolic Syndrome*, *11*, 105 https://doi.org/10.1186/s13098-019-0502-2

Wang, Q., Song, X., Du, S., Du, W., Su, C., Zhang, J., Zhang, X., Zhang, B., & Wang, H. (2022). Waist Circumference Trajectories in Relation to Blood Pressure and the Risk of Hypertension in Chinese Adults. *Nutrients*, *14*(24), 5260, https://doi.org/10.3390/nu14245260

World Health Organization. (2024). HIV/AIDS: Overview. https://www.afro.who.int/health-topics/hivaids

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