

Risk Factors Associated with Hypertension among Adults 18-65 Years in Kirinyaga County, Kenya

Abstract

Hypertension is one of the non-communicable diseases linked with heart disease and accounts for about 64% of stroke cases globally. BP is becoming the leading global public health problem with over 10M death every year. Despite growing evidence that high blood pressure is on the rise, information about its risks factors on patients seeking medical care in Kenyan hospitals is limited. This research investigated the risk factors associated with high blood pressure among adults aged 18-65 in Kirinyaga County, Kenya.

Analytical cross-sectional study, using quantitative and qualitative methods of data collections, a multistage sampling procedure sampled 380 study participants chi square and logistic regression made deductions about the study population. In qualitative data, deductive approach used research questions as a guide for data analysis. Gender chi-square χ^2 (2, N=345=128.640, P=.000), respondent age χ^2 (5, N=345=158.021, P=.000), education level χ^2 (3, N=345=77.677, P=.000), marital status χ^2 (4, N=345=69.413, P=.000), state of being pregnancy χ^2 (1, N=345=224.599, P=.000), currently smoking cigarette χ^2 (1, N=50=28.890, P=.000), currently taking alcohol χ^2 (1, N=273=16.548, P=.000), engaging in physical activities χ^2 (3, N=345=58.183, P=.000), and weight status χ^2 (2, N=184=40.044, P=.000) were statistically significantly associated with the development of hypertension. Routine screening and advocacy by the health worker should be done for early detection, timely treatment, follow up and prevent complications related to hypertension.

Key words; blood pressure, Risk Factors

Introduction

As a major risk factor to heart diseases, hypertension is a worldwide contributor to illness and death (WHO 2015), it's defined as systolic blood pressure (SBP) 130-139 mmHg or diastolic blood pressure (DBP) 80-89 mmHg. BP is becoming the leading global public health problem with over 10M death every year (Mills, K. T., Stefanescu, A., & He, J, (2020). Around the globe, according to WHO 2015, the cases of hypertension among individuals 18years and older was at 24% for male and 20% for female; being high from 594 million in 1975 to 1.13 billion in 2015, respectively.). At least 45% of deaths globally are attributable to hypertension, which contributes to more than 7.1 million deaths annually from heart disease and 51% of deaths from stroke.

Age-related hypertension appears to be mostly systolic rather than diastolic, with systolic blood pressure rising into the eighth or ninth decade and diastolic blood pressure remaining constant or declining after age 40. There is a steady rise in BP with age (DesJardin, J. T., et al 2020). The identification and mitigation of cardiovascular disease risk factors have generally been neglected as a result of a disproportionate focus on infectious diseases, maternal and child health, and acute treatment, which is exacerbated by a lack of strong health systems. Prehypertension sufferers typically go unnoticed and are not monitored to stop progression (Bosu, W. K., Reilly, S. T., Aheto, J. M., & Zucchelli, E, (2019).

According to multinational population study by Mohamed, S. F., Mutua, M. K., Wamai, R., & et al., (2018), if current trends in high blood pressure do not change by 2025, people with the condition will increase in the region by 68% (from 74.7M to 125.7M. Health education, taking and adherence to treatment was found essential. Between 2003 and 2009, high blood pressure education rates were at 47%, treatment rates were 41% and control was at 32% of patients receiving treatment for hypertension., (Mohamed, S. F., Mutua, M. K., Wamai, R., & et al., (2018). A study published by the University of Vitvetrasund in South Africa in 2019 found that, high blood pressure was becoming health burden in Sub-Saharan Africa, with rates as high as 25% in East Africa, and low blood pressure in East Africa compared to the rest of the continent. Additionally, the report indicated that there might have early epidemic phases, especially

because people have more access to fast food and live a more sedentary lifestyle (Echouffo-Tcheugui, 2015).

In Kenya, according to WHO data released in May 2014, the age-adjusted death rate for hypertension in Kenya was 12.49 per 100,000 people, accounting for 1,995 fatalities, or 0.60% of all deaths, placing Kenya at position 120 globally. According to an AstraZeneca (2015) poll in Nairobi, just 20% of respondents were ignorant of their hypertensive condition, and only 20% had sought medical therapy to lower it. About half of Kenyan adults had elevated blood pressure (Temu, T. M., et al., 2021).

With a death toll of 2,845 (0.90%) and an age-adjusted death rate of 21.81/100,000 people, Kenya is ranked 121 in the world. Christensen and other (2008) Age, being overweight, and having had renal illness were shown to be the risk variables strongly related with hypertension among HIV-infected patients in a 2008 study conducted at Thika Comprehensive Care Clinic in Njeru (WHO, 2014)

In accordance with KDHS 2014, 9.4% of women and 3% men 15-49 yrs. of age were informed by health care provider that they had hypertension. In a Kenya Stepwise Survey by the Department of Health of 2015, 56 % of Kenyans haven't been screened for high blood pressure. Only 22.3% of those diagnosed with the condition were on prescribed medication, 8% 40-69 years had risk of heart disease greater than 30%, 6.2% on drug treatment and counselling to prevent heart attack and stroke and eight out of a hundred patient suffered severe hypertension, in which 23.8 percent were diagnosed with high blood pressure.

KSNHSSP 2017 reported that 6.1% of deaths in Kenya were linked with cardiovascular diseases, further studies showed that more than 13% of adult deaths was associated with hypertension. There was a dramatic increase in obesity in Kenya according to a statistical review of the Kenya Health Sector Strategic Plan 2014-2018, a condition often associated with high blood pressure, sedentary and poor diet (Mkuu, 2021). The report shows that the percentage of obese women increased from 7 percent to 13 percent between 2009 and 2015, the percentage of overweight or obese people in Kenya increased by 27% for women (38.5) and men (17.5%). In addition, 23% of adults have elevated blood pressure. Economic survey of 2017 conducted by the Kenya National Bureau Statistics, heart disease was one of the top ten reported causes of death, with 26,000 deaths from heart disease between 2012 and 2016 (Ngolo, (2018)). Heart diseases cases were reported to have been accelerated by high blood pressure. Three percent of Kenyan origin were found to have one of the danger factors i.e., sedentary lifestyle and poor dietary choices, while at age 45 and 69. Risk factors accounting for about 25.9 % for high risk of NCDs cerebrovascular Disease, chronic respiratory diseases and their complications, allowed interventions ranging from information, treatment and follow-up. Therefore, from this data, it can be concluded that Kenya faces a significant risk of high blood pressure if no interventions are taken, especially for people aged 45 and over. Additionally, little is deducted on the risk factors that could affect level of education on hypertension, drug taking or management. From the above there exist gaps on the risk factors of hypertension which this research seeks to determine among adults 18-65-year-olds living in Kirinyaga County, Kenya (Shen).

Methods

2.1 Research Design

Analytical cross-sectional study using qualitative and quantitative methods was employed to conduct this study. This approach allowed the researcher to determine the risk factors related with the occurrence of hypertension and also the integration that will allow for complete and synergistic data usage.

2.2 Study variables

Hypertension was the dependent variable of this study. Sex (dichotomous), age (yrs.), level of education (formal education levels), cigarettes smoking, alcohol consumption, diet, physical activity and other health conditions were the independent variables in the study.

2.3 Study area

The study was conducted in Kirinyaga county which is one of the 47 counties in Kenya. It is located east and south of Embu, west of Murang'a and northwest of Nyeri counties. It covers an area of 1,479.1km² situated in the south of Mount Kenya, and south (Mwea) plains which form part of Tana River and has a population of 610,411 according to 2019 population census.

The study was conducted on general population 18-65 years of age resident of Kirinyaga County. Those participants who will be selected will be those who have lived in Kirinyaga County for over 3 years, 18-65 years. Health provider practiced in Kirinyaga county for more than 3 years. Those who are mentally challenged and who have lived in Kirinyaga county for less than 3 years were not included in the study. Health care providers formed the Key informants in this research.

The study selected the site based on a study conducted by a Jomo Kenyatta University of Agriculture and technology student on the prevalence of hypertension in the same county a 2009 study, which found that high blood pressure was the leading non-communicable condition in the county at 29% prevalence in 2009. The study recommended for further study on the risk factors associated with the condition which this research pursue to investigate (Ondimu, 2021).

Multistage sampling procedure was employed whereby; of the four constituencies namely Gichugu, Mwea, Kirinyaga Central and Ndia, purposive sampling was used to select two constituencies namely Gichugu and Kirinyaga central as a representative; randomly three wards were sampled from each constituency namely Baragwi, Kabare and Karumandi from Gichugu constituency and Inoi, Kanyeki-ine and Kirinyaga central from Kirinyaga central. This is based on social economic activities practiced by the residents of the wards, which informed in describing human behavior examples in lifestyle, trade center, cash crop farming and subsistence respectively (economic survey, 2016).

The sample for quantitative data was obtained using Fisher's et.al 1998 where by 345 responded were selected to take part in the study. For qualitative data, Purposive sampling method was used to sample key informant whereby, clinical officers, public health nurses and doctors from Kianyaga, Kabare and Karumandi (located at Baragwi, Kabare and Karumandi wards respectively, Gichugu constituency, Kirinyaga County), Kerugoya county referral, Kagumo and Kutus (located at Inoi, Kanyeki-ine and Kerugoya central respectively) facilities respectively were reached for a one-on-one interview. Purposive sampling method was used to sample focus group discussion participates. Focus group discussion was conducted where subgroup was created based on their age category. Eight focus group discussion was conducted one per ward and two were conducted to women and health providers in the study area where the FGD guide was used to guide the interview.

2.4 Research Instruments

An android mobile phone installed with survey CTO collect, uploaded with a structured research questionnaire was used in the collection of quantitative data while audio recorder was used in KIIs and FGDs. Notebook was used to note key information during focus group discussion in qualitative data collection.

2.5 Validity and Reliability of research Instruments

To check for validity, the researcher used content validity in which the questionnaire was given to qualified professionals and research supervisors to check on content and provide guidance in reference to the study objectives and relevance of the questions to the study. Having assessed the validity of questionnaire and making sound correction date it qualified for data collection. This helped the researcher to have valid results that correctly represented the phenomenon under study.

To test the reliability of the instrument, the researcher carried out a pre-test study in Mwea constituency, Kutus ward which neighbor constituencies of study and with social economic activities similar with that of the selected study area. This helped the researcher to test the reliability of the questioner as a data collection instrument without interfering with the study population. Prior test of CTO application was done to test the ability of the tools to yield consistent result during the pre-test study this was done to ascertain the reliability of the study tools. The reliability tests were undertaken through test and retest method in

which the coefficient of reliability of 0.7 or above was used as the threshold of reliability after which conclusive judgement was made on data collection instruments.

2.6 Data Collection Techniques

Structured questionnaires uploaded in a survey CTO collect, was used in collection of quantitative data where numerical data was captured. Questionnaires was used to capture data regarding social demographic, awareness, reported comorbidities associated with hypertension and hypertension risks assessment. A study participant from each selected household 18 year and above of age were taken through the survey.

2.7 Data analysis

Collected data was cleaned to detect errors, missing values, inconsistency during data entry to ensuring data quality. This was done using Ms. Excel afterwards exported to SPSS software version 26 for descriptive and inferential statistics analysis. SPSS version 26 software was used to analyze quantitative data. Descriptive statistics was used to examine social demographic and study variables whereby bar charts, pie charts and frequency distribution tables was used to present the data. Chi square was conducted to assess the significance differences between categorical variables; gender, age, level of education, occupation, marital status and weight status. Logistic regression was employed to obtain odds ratio (OR). Factors which remained significant at $p \leq 0.05$ after adjusting all others were regarded as independently linked with development of hypertension. For qualitative data, content analysis was used to analyze the documented information from text, narrative. The source of data was from personal interviews, field observation, and surveys.

3. Result and Discussion

A total of 345 research participant, resident of Kirinyaga took part in the study. Of the participants, 92 (26.7%) were male while 253 (73.3%) were female. The study realized that women stayed at their homes as they manage family welfare while their male counterparts were in search of employment opportunities; for this reason, more women took part in this research as compared to male (Figure 1).

The result about the age brackets of the participants reveals that majority of the participant 90/345 (26.1%) aged between 36-45 years while 18-25 years accounted for 25/345 (7.2%).

On the level of education, Majority of the study participants reported they had gone through secondary level of education accounting for 198 (57.4%), while primary, university and other levels of education accounting for 76 (22.0%), 37 (10.7%) and 34 (9.9%) respectively. Self-employed study participants accounted for 144 (41.7%), not employed 124 (35.9%) while employed accounted for 77 (22.3%). Married study participants accounted for 242 (70.1%), 47 (13.6%) single, separated at 23 (6.7%), widow at 23 (6.7%) and divorced at 10 (2.9%).

Gender $X^2(2, N=345=128.640, P=.000$, respondent age $X^2(5, N=345=158.021, P=.000$, education level $X^2(3, N=345=77.677, P=.000$, occupation $X^2(2, N=345=13.963, P=.001$ and marital status $X^2(4, N=345=69.413, P=.000$ were statistically significantly associated with the development of hypertension.

3.1 Risk Factors Associated with Hypertension

The section describes the associated risk factors of hypertension by logistic regression.

Factors discussed in the section are gender, age, education, occupation marital status, marital status, state of being pregnancy, engaging in physical activities, currently smoking cigarette, currently taking alcohol and weight status

The research found that female gender had OR 2.329 (95% CI) of being hypertensive compared to male (OR .933 (CL .557-1.562)). Women are predisposed to health issues such as pregnancy and menopause in advance age which could have contributed to their likelihood of developing hypertension. Additionally, women health seeking behavior contribute to early detection of hypertension as compared to male

gender. The study findings were in line with the American Heart Association study of (2012) that found that male gender had higher chances of developing hypertension than women however years later, it was found that women are at higher risk of the condition due to menopause and birth control pills. Respondents age bracket of 36-55 years OR 280.0 (95% CI 31.14- 142.42) likely to be hypertensive compared to 26-35 years OR 44.8 (95% CL.000-2517.7). This is in line to a 2016 group study from Framingham by Craig and Richard, which found that blood pressure continues to rise after 30 years. Additionally, the findings were consistent with the Kenya Stepwise Survey for Non-Communicable (2015) which found that 8% of Kenyans aged between 40-69 have a higher risk of hypertension. A study by Wamala et al., (2009) found that participants with hypertension were significantly older with an average age of 46 being at higher risk of developing hypertension. Advancing age increases the risk of exposure to the lifestyle risk factors for hypertension and hence the observed increase in hypertensive risk with aging.

This study found a relationship between hypertension and education levels. The participants who had university level of education had OR 6.556 (95% CI 3.005-14.305) likely to be diagnosed with hypertensive compared to those whose level of education was secondary OR .519 (95% CL .227-1.190). The study realized that participant who attended university were more aware of hypertension and therefore sort for hypertension screening services as compared to those who attended primary level. Being informed and health seeking habit of those who attended university was associated with more being diagnosed with hypertension....” *majority of those who willingly visit the hospital for BP checkup are found to be informed of the condition or learnt it from different sources such as university or from other media*” (Doctor in charge, K11).

Divorced participants OR 17.06 (95% CI 4.910-59.27) likely to be hypertensive compared to widow OR 8.667 (95% CL 1.999-37.58). Divorced participant reported to have been subjected to stressful experiences in marriage life this was realized to have led to divorce. Members of the focus group agreed that stressful experiences exposed participant to hypertension....” *divorced individuals go through lots of stressful life experiences which predispose them to hypertension before deciding to have divorce*” (respondent N4, FGD 3). However, the study finding was not in line with the finding by WHO (2016) which stated that being a widow was more likely to expose one to hypertension and also by a report by Ramezankhani, Azizi & Hadaegh, 2019), which found that being never married was associated with higher risk of hypertension.

Respondents who reported to have heard of hypertension had OR 5.032 (95% CL1.835-13.58) likely to develop hypertension compared to those who hadn't heard of it OR .500 (95% CI. Women participants pregnant or had been pregnant OR 2.402 (95% CL.) likely to developed hypertension compared to those who aren't or haven't been in the state OR .608 (95% CL..288-1.283).

The study realized that participants who engaged in physical activities had OR 5.352 (95% CL3.177-9.016) likely to suffer from hypertension than those who didn't (OR .706 (95% CL). Regular physical activities result to strong heart which pump blood with less effort. As a result, there is a decrease in force in the arteries therefore reducing blood pressure. Physical exercise helps in losing excess body weight thereafter controlling blood pressure (WHO 2016). The study was consistence with a snapshot study conducted by Chataut, Adhikari & Sinha, (2011), that reported that physical Activity was associated with the development of hypertension (P-value 0.013) and also consistent with a population-based snap shot research by Varsakiya & Kathad, 2018), in Bhadrabas that found that physical activity was statistically significantly associated with the development of hypertension (P-value 0.00). The study was inconsistent with a study conducted by (Tsioufis, et al., 2011) that revealed that hypertension was likely to develop to individuals who were not engaging in physical activities.

The study found that Respondents currently smoking cigarette OR 2.476(95% CI) likely to suffer from hypertension compared to those who had quitted OR 1.010 (95% CL.453-2.248). The World Health Organization's 2015 international report on tobacco smoking trends found that smoking triggers high blood pressure, especially by stimulating the nervous system. Tobacco smoking was a serious risk to the heart and blood vessels; quitting smoking was listed as the most effective way to prevent most heart diseases. The study finding was similar to the finding of Dochi et al., (2009), that found cigarette smokers were twice OR 3.07 more likely of being hypertensive than nonsmokers OR 1.13.

The study found out that respondents currently taking alcohol OR 3.556 (95% C11.691-7.475) were likely to suffer from hypertension compared to those who quitted use alcohol (OR 1.875. (95%CL). Relationship between alcohol consumption and blood pressure was found to be a strong relationship and potential risk factors for high blood pressure. Blood pressure was found to lower within a few days of quitting alcohol

this is according to a journal of the American Heart Association (2017). The finding was in line with a study conducted by Manandhar, Kaju, Sinha & Humagain, (2012), which reported that alcohol consumption increased risk of developing hypertension and with snapshot research in Nepal conducted to 405 participants by Manandhar, Kaju, Sinha & Humagain, (2012), which revealed that hypertension was found to positively associated with alcohol consumption. The study found out that respondents with overweight status (OR 11.167 (95% CI 3.327-37.475) were likely to suffer from hypertension compared to those with obese status OR .469 (95% CL.152-1.449). This was unlike what was found by WHO 2016, that revealed that obese individual were 2-6 times likely to be hypertensive compared to individual with overweight weight status. Kenya Health Sector Strategic Plan (2014-2018) found that overweight persons in Kenya were at 27% whereby the percentage of women (38.5%) was much higher than men (17.5%). A cohort study of 300 Japanese-Americans which was done by (Kotsis et al., 2015) revealed that body mass index was a contributory factor for high blood pressure and that being overweight was a risk factor for hypertension. This result was consistent with another study conducted by (Mishra, Arnold, Semenov, Hong & Mukuria, 2012) that reported that, for men the risk of hypertension was strongly positively associated with overweight. This finding was consistency with present study finding with similar social cultural factors where, a cross-sectional study among 15-45 years at Amtalab Raichure was conducted by Zoorob, Buchowski, et al., (2013). These findings therefore show that a normal weight, or losing weight among those who are overweight, would reduce the chances of developing hypertension. Perhaps the risk imposed by these is all reflected in the BMI of the individual.

UNDER PEER REVIEW

Table 1: Risk factors associated of hypertension by logistic regression

Risk factor	Odd Ratio	95% Confidence Interval		P-Value	
		Lower	Upper		
Gender	Male	.933	.557	1.562	.791
	Female	2.329			.000
Age	18-25				.000
	26-35	9.0466	.000	2517.695	.998
	36-45	280.000	31.140	142.419	.000
	46-55	44.800	14.092	64.097	.000
	56-65	21.350	7.111	6.319	.000
	>65	2.128	.717	2517.695	.174
Education	Primary				.000
	Secondary	.519	.227	1.190	.121
	University	6.556	3.005	14.305	.000
	Others	5.812	1.928	17.523	.002
Marital status	Single				.000
	Married	10.7698	.000	.	.997
	Divorced	17.059	4.910	59.270	.000
	separated	2.857	.464	17.583	.257
	Widow	8.667	1.999	37.582	.004
Heard of hypertension	Yes	5.032	1.835	13.803	.002
	No	.500			.166
Due to pregnancy	Yes	2.402			.000
	No	.608	.288	1.283	.192
Physical exercise	Yes	5.352	3.177	9.016	.000
	No	.706			.110
Currently smoking cigarette	Yes	2.476			.000
	No	1.010	.453	2.248	.981
Currently taking alcohol	Yes	3.556	1.691	7.475	.001
	No	1.875			.000
Weight	Normal				.000
	Overweight	11.167	3.327	37.475	.000
	Obese	.469	.152	1.449	.189
Had your BMI checked	Yes	11.385			.000
	No	.088	.046	.166	.000
Weight status	Normal				.000
	Overweight	11.167	3.327	37.475	.000
	Obese	.469	.152	1.449	.189

4 Conclusion

1. Hypertension was on rise in Kirinyaga county.
2. Social demographic factors; gender, being between 56-65 years, not being employed and being married exposed individual to development of hypertension.
3. Behavioral factors; continued cigarette smoking and taking alcohol, engaging in physical activities individual body mass index exposed individual to development of hypertension.

4. Gender, respondent age, education level, marital status, state of being, currently smoking cigarette, currently taking alcohol, engaging in physical activities and weight status were statistically significantly associated with the development of hypertension.

Ethical considerations

The research was subjected to a number of ethical guidelines and approvals before collection of data was done. First, informed consent was obtained from the study participants, researcher assured for anonymity and confidentiality of the participants. This was done by ensuring that the information collected didn't contain identifiable information of study participant. The researcher protected the privacy of study participants and research information gathered from unauthorized access, use, disclosure, changes, loss or theft. The study provided the right to pull out at any point. Researcher obtained clearance from the Mount Kenya university ethics and research committee, permit to conduct the study from National Commission for Science, Technology & Innovation (NACOSTI) and obtained authority to interact with study participant from county commissioner and from the director of Ministry of education, Kirinyaga county.

REFERENCES

- Bosu, W. K., Reilly, S. T., Aheto, J. M., & Zucchelli, E. (2019). Hypertension in older adults in Africa: A systematic review and meta-analysis. *PLOS ONE*, 14(4), e0214934. <https://doi.org/10.1371/journal.pone.0214934>
- Carey, R. M., & Whelton, P. K. (2018). The 2017 American College of Cardiology/American Heart Association hypertension guideline: a resource for practicing clinicians. *Annals of Internal Medicine*, 168(5), 359-360.
- Chataut, J., Adhikari, R. K., & Sinha, N. P. (2011). The prevalence of and risk factors for hypertension in adults living in central development region of Nepal. *Kathmandu University medical journal (KUMJ)*, 9(33), 13–18. <https://doi.org/10.3126/kumj.v9i1.6255>
- DesJardin, J. T., Kolaitis, N. A., Kime, N., Kronmal, R. A., Benza, R. L., Elwing, J. M., ... & Zwicke, D. L. (2020). Age-related differences in hemodynamics and functional status in pulmonary arterial hypertension: baseline results from the Pulmonary Hypertension Association Registry. *The Journal of heart and lung transplantation*, 39(9), 945-953.
- Kotsis, V., Nilsson, P., Grassi, G., Mancia, G., Redon, J., Luft, F., ... & Jordan, J. (2015). New developments in the pathogenesis of obesity-induced hypertension. *Journal of hypertension*, 33(8), 1499-1508.
- Manandhar, K., Koju, R., Sinha, N. P., & Humagain, S. (2012). Prevalence and associated risk factors of hypertension among people aged 50 years and more in Banepa Municipality, Nepal. *Kathmandu university medical journal*, 10(3), 35-38.
- Mills, K. T., Stefanescu, A., & He, J. (2020). The global epidemiology of hypertension. *Nature reviews. Nephrology*, 16(4), 223–237. <https://doi.org/10.1038/s41581-019-0244-2>
- Mishra, V., Arnold, F., Semenov, G., Hong, R., & Mukuria, A. (2006). Epidemiology of obesity and hypertension and related risk factors in Uzbekistan. *European Journal of Clinical Nutrition*, 60(12), 1355-1366. <https://doi.org/10.1038/sj.ejcn.1602465>
- Mohamed, S. F., Mutua, M. K., Wamai, R., Wekesah, F., Haregu, T., Juma, P., Nyanjau, L., Kyobutungi, C., & Ogola, E. (2018). Prevalence, awareness, treatment and control of hypertension and their

determinants: Results from a national survey in Kenya. *BMC Public Health*, 18(S3). <https://doi.org/10.1186/s12889-018-6052-y>

- Mugenda and Mugenda, (2003). *Research methods, quantitative and qualitative approaches*. ACT, Nairobi.
- Ramezankhani, A., Azizi, F., & Hadaegh, F. (2019). Associations of marital status with diabetes, hypertension, cardiovascular disease and all-cause mortality: A long term follow-up study. *PLoS one*, 14(4), e0215593.
- Temu, T. M., Macharia, P., Mtui, J., Mwangi, M., Ngungi, P. W., Wanjalla, C., ... & Kibachio, J. (2021). Obesity and risk for hypertension and diabetes among Kenyan adults: Results from a national survey. *Medicine*, 100(40).
- Tsioufis, C., Kyvelou, S., Tsiachris, D., Tolis, P., Hararis, G., Koufakis, N., ... & Stefanadis, C. (2011). Relation between physical activity and blood pressure levels in young Greek adolescents: the Leontio Lyceum Study. *European Journal of Public Health*, 21(1), 63-68.
- Varsakiya, J., & Kathad, D. (2018). DIET AND LIFE STYLE INTERVENTION FOR METABOLIC DISORDERS IN AYURVEDA: A REVIEW.
- Wijnhoven, T. M., van Raaij, J. M., Spinelli, A., Starc, G., Hassapidou, M., Spiroski, I., ... & Breda, J. (2014). WHO European Childhood Obesity Surveillance Initiative: body mass index and level of overweight among 6–9-year-old children from school year 2007/2008 to school year 2009/2010. *BMC public health*, 14, 1-16.
- Zoorob, R., Buchowski, M. S., Beech, B. M., Canedo, J. R., Chandrasekhar, R., Akohoue, S., & Hull, P. C. (2013). Healthy families study: Design of a childhood obesity prevention trial for Hispanic families. *Contemporary Clinical Trials*, 35(2), 108-121.
- Echouffo-Tcheugui, J. B., Kengne, A. P., Erqou, S., & Cooper, R. S. (2015). High Blood Pressure in Sub-Saharan Africa: The Urgent Imperative for Prevention and Control. *Journal of clinical hypertension (Greenwich, Conn.)*, 17(10), 751–755. <https://doi.org/10.1111/jch.12620>
- Mkuu, R., Barry, A., Yonga, G., Nafukho, F., Wernz, C., Gilreath, T., Chowdhury, M. A. B., & Shevon Harvey, I. (2021). Prevalence and factors associated with overweight and obesity in Kenya. *Preventive medicine reports*, 22, 101340. <https://doi.org/10.1016/j.pmedr.2021.101340>
- Ngolo, J. (2018). *Assessing out of pocket costs and the incidence of catastrophic expenditures among chronic disease households in Kenya* (Doctoral dissertation, Strathmore University).
- Shen, Y., Chang, C., Zhang, J., Jiang, Y., Ni, B., & Wang, Y. (2017). Prevalence and risk factors associated with hypertension and prehypertension in a working population at high altitude in China: a cross-sectional study. *Environmental health and preventive medicine*, 22, 1-8.
- Ondimu, D. O. (2021). *Risk Factors for Hypertension among Patients Aged 18-35 Years Attending Tenwek Mission Hospital, Bomet County, Kenya* (Doctoral dissertation, JKUAT-COHES).