Review Article

PREVALENCE OF MALNUTRITION AMONG PEOPLE LIVING WITH OBESITY AND HYPERTENSION

ABSTRACT

Background: Obesity is a growing health problem and should keep in mind when treating patients with hypertension because it is a strong predictor of non-controlled blood pressure. As obesity and its metabolic and hemodynamic consequences are sustained during many years. Research has provided evidence justifying the management of metabolic components in obese individuals. The aim of this study is to provide evidence justifying the management of metabolic components in obese hypertensive individuals

Methods: This was a review study. Journal articles and publications from 2004 to 2022 were reviewed. Search engines included PubMed, Google Scholar, Science Direct and Cochrane. Search terms included prevalence, malnutrition, metabolic syndrome, obesity andhypertension. A total of 150 papers were retrieved during the search and only 53 were included in the review out of which 41 papers were on nutritional-related issues.

Results: The result from this review revealed that the incidence of obesity, has been the main stimulus for the research of the mechanisms underlying this pathology and the related disorders. Therefore, the consequences are an aggravation of the disease and an increase in obesity related pathology like diabetes, cardiovascular disease, and cancer.Individuals with significantly higher weight, body mass index, waist circumference, waist to height ratio, hip circumference, fat mass, and fat-free mass values had hypertension compared to normotension, supporting the direct association between obesity and hypertension.Hypertension and excess body weight are major risk factors of cardiovascular morbidity and mortality in developing countries. Some risk factors associated with the development of hypertension in adults are: age, regular alcohol consumption, level of physical activity, obesity, stress and fasting blood glucose concentration in blood.

Conclusion: Obesity is a multi factorial pathology and chronic diet related non-communicable disease. The most widely used parameter for it diagnosis is the body mass index (BMI) which is not suitable for assessing the body fat and other metabolic components. Obesity is an independent risk factor for hypertension.

Comment [RV1]: Kindly check for spelling and grammatical errors

Comment [RV2]: Does it mean only 12 papers were reviewed in total, if not so then kindly rephrase this to convey correct meaning

Recommendation: Other anthropometrics like the waist-hip ratio (WHR), waist to height ratio (WHtR) waist circumference and metabolic/biochemical components should be considered in the diagnosis of obesity.

Keywords: Prevalence, Malnutrition, Metabolic Syndrome, obesity, hypertension.

Introduction: Given the increase of sedentary lifestyle and bad diet in our life, the prevalence of obesity and hypertension has remarkably increased among most population in the last years (Hammami et al., 2021). Obesity is agrowinghealth and should keep in mind when treating patients with hypertension because it is a strong predictor of non-controlled blood pressure (Hammami et al., 2021). As obesity and its metabolic and hemodynamic consequences are sustained during many years, renal injury gradually makes the hypertension more severe and more resistance to therapy (John et al., 2015). Although weight loss is helpful in managing hypertension, many obese patients are unable to sustain adequate weight loss through lifestyle modifications and there are few available drugs that safely and effectively produce adequate long-term weight loss. Current therapeutic approaches are, therefore, aimed mainly at treating the hypertension and metabolic consequences of obesity, including diabetes mellitus, dyslipidemia, and inflammation.

Comment [RV3]: Incomplete..!!! Is a growing health concern or challenge?

The obesity epidemic started in the 1970s, initially in the United States and subsequently spreading worldwide. Approximately 60-80% of adults in most Western countries are now overweight or obese, which is unprecedented in human history (Ayton and Ali, 2019). A recent study by Jennifer et al. (2016) reveals that obesity was independently associated with hypertension in population-based controls. There is a high prevalence of unrecognized hypertension and obesity among Inter-Regional Metromass Bus Drivers which were associated

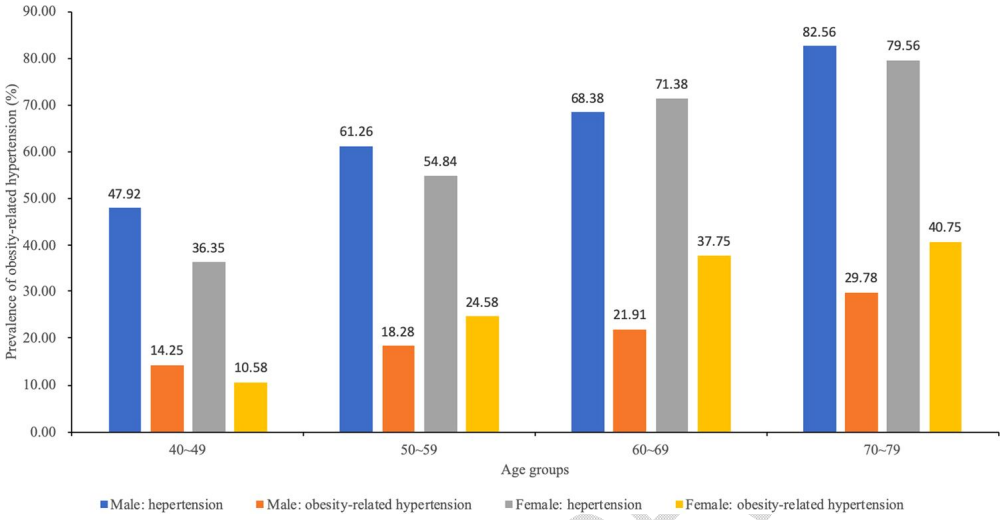
with individual lifestyle and behaviors (Enoch et al., 2020). Increased awareness through educational and screening programs will trigger lifestyle modifications that will reduce cardio-metabolic disease onset and offer clues for better disease predictive, preventive and personalized medicine (Enoch et al., 2020). Hypertension is the commonest risk factor for cardiovascular diseases and it is associated with many morbidities and mortalities worldwide (Enoch et al., 2020).

Physiological studies and epidemiological data suggest a potential inverse association between adult height and blood pressure (Cochran et al., 2021). Significant data exist linking increased height and leg length with lower blood pressure. These findings identify shorter individuals as having higher risk with regard to hypertension and cardiovascular disease (Cochran et al. 2021). Large scale epidemiological studies have shown that hypertension is two to three times more present in the obese than in lean individuals. Moreover, blood pressure values and body weight are directly related at any age of life (Guido, 2013). This increase in obesity and obesity- related chronic diseases threaten economies and individual lives (Onwah, 2019). Given the huge costs (both public and personal) of obesity and how difficult it is to lose weight once one is obese, prevention now is key.

Furthermore, disparities in obesity□attributable hypertension exist by sex□race/ethnicity. Public health and policy changes targeting obesity are needed to reduce the morbidity and mortality (Natalie et al., 2021). Hypertension and dyslipidemia frequently coexisted in obese female along with other diseases. In obese male, dyslipidemia and diabetes were the major diseases in the co-morbidity network. Results provide evidence justifying the management of metabolic

components in obese individuals. The results will help prioritize interventions for co-morbidity reduction as a public health goal (Hye and Hyesook, 2021).

Global: Malnutrition is a universal issue that no country in the world can afford to overlook. 39% of the world's adults are obese (2018 Global Nutrition Report). Beyond health, slow progress on malnutrition is also impacting the social and economic development of countries. It is estimated that malnutrition in all its forms could cost society up to US$3.5 trillion per year, with obesity alone costing US$500 billion per year (2018 Global Nutrition Report). According to the 2018 Global Nutrition Report, malnutrition is responsible for more ill-health than any other cause. According to WHO (2021), the fundamental cause of obesity is an energy imbalance between calories consumed and calories expended. Globally, there has been an increased intake of energy-dense foods that are high in fat and sugars; and an increase in physical inactivity due to the increasingly sedentary nature of many forms of work, changing modes of transportation, and increasing urbanization. Body mass index (BMI) is a simple index of weight-for-height that is commonly used to classify overweight and obesity in adults. It is defined as a person's weight in kilograms divided by the square of his height in meters (kg/m^2). For adults, WHO defines obesity as a BMI greater than or equal to 30 (WHO, 2021). The risk for these non-communicable diseases increases, with increases in BMI (WHO, 2021). The health consequences of obesity and hypertension contribute to an estimated four million deaths.



Sourced: Zhang, *et al.*(2019)

Figure 1: The prevalence of hypertension and obesity-related hypertension across different age groups.

Worldwide obesity has nearly tripled since 1975. In 2016, over 650 million were obese making a total of 13% adults. Most of the world's population lives in countries where obesity kills more people than underweight (WHO, 2021). Hypertension is the single largest global contributor to disability-adjusted life years lost. According to the American Heart Association (AHA), approximately 86 million adults (34%) in the United States are affected by hypertension, which is defined as a systolic blood pressure (SBP) of 140 mm Hg or more or a diastolic blood pressure (DBP) of 90 mm Hg or more, taking antihypertensive medication, or having been told by clinicians on at least 2 occasions as having hypertension (Whelton et al., 2017). The majority of the populations aged over 60 years have hypertension (Christopher et al., 2021). Obesity and hypertension are the next major epidemiologic challenge facing today's doctors, with the annual

allocation of healthcare resources for the disease and related co-morbidities projected to exceed $150 billion in the United States (Ryan et al., 2010). Another study by Omair and Travis (2020) showed that obesity is a significant public health challenge worldwide and is inextricably linked to adverse cardiovascular outcomes. The relationship between excess adiposity and increased blood pressure is well established, and it is estimated that obesity accounts for 65–78% of cases of primary hypertension (Omair and Travis, 2020). High blood pressure is the most common cardiovascular disorder affecting approximately one billion people globally and remains a major contributor to the global burden of non-communicable diseases and mortality.

A study on cardiovascular disease which assess intakes of refined grains, whole grains, and white rice at a median follow-up of 9.5 years, 9.2% experienced a primary outcome, which was a composite of death and major cardiovascular events (cardiovascular death, nonfatal myocardial infarction, heart failure, or stroke). Higher intake of refined grains was associated with higher risk (Swaminathan et al., 2021).

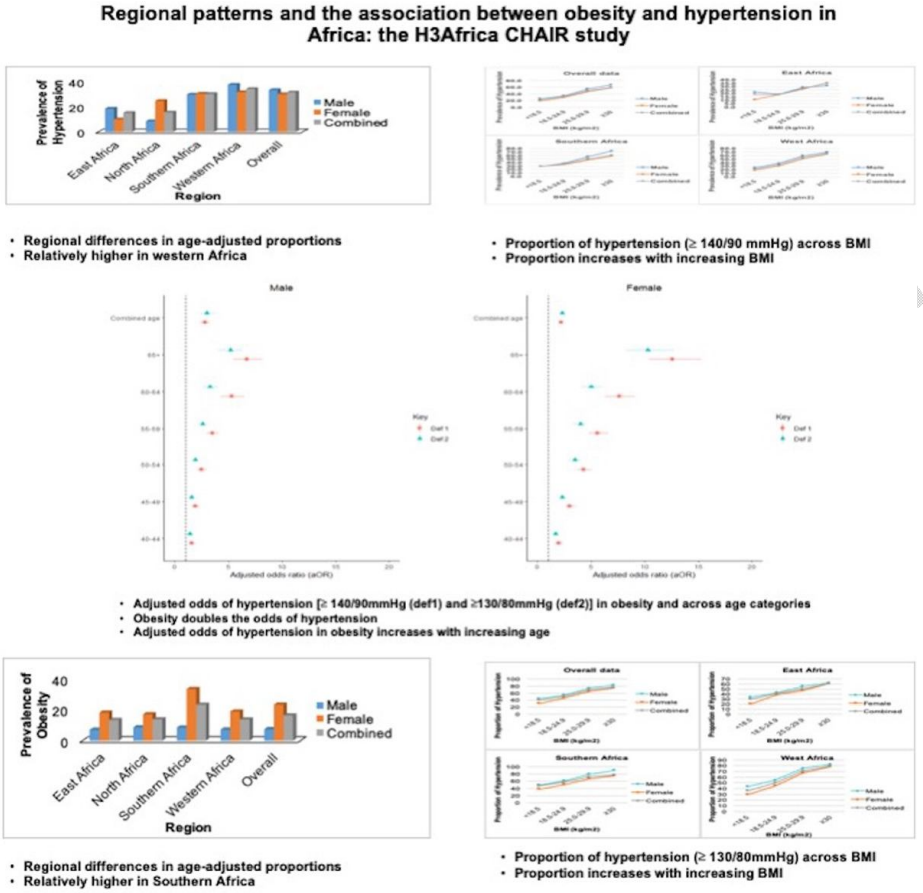
Excess weight gain, especially when associated with increased visceral adiposity, is a major cause of hypertension, accounting for 65% to 75% of the risk for human primary (essential) hypertension. Increased renal tubular sodium re-absorption impairs pressure natriuresis and plays an important role in initiating obesity hypertension (John et al., 2015).

Prevention at the individual level is achieved by limiting energy intake from total fats and sugars, increasing consumption of fruit and vegetables, as well as legumes, whole grains and nuts; and engaging in regular physical activity (60 minutes a day for children and 150 minutes spread through the week for adults). This is possible through sustained implementation of evidence based and population based policies that make regular physical activity and healthier dietary

choices available, affordable and easily accessible to everyone, particularly to the poorest individuals. An example of such a policy is a tax on sugar sweetened beverages (WHO, 2021).

Prevention of obesity and hypertension at the industry level can be achieved by reducing the fat, sugar and salt content of processed foods, ensuring that healthy and nutritious choices are available and affordable to all consumers; restricting marketing of foods high in sugars, salt and fats, especially those foods aimed at children and teenagers; and ensuring the availability of healthy food choices and supporting regular physical activity practice in the workplace (WHO, 2021).

Africa: Hypertension and obesity are major public health concerns that contribute substantially to the rising global trend in morbidity and premature mortality (Akpa et al., 2020). The global burden of disease attributable to hypertension has significantly increased from ≈4.5% in 2000 to 7% in 2010 and is predicted to rise to as high as 29.2% (28.8%–29.7%) by 2025. Compared with other WHO regions, Africa has the highest prevalence of hypertension with an overall prevalence of 46% in adults aged 25 years and above (Akpa et al., 2020). Obesity is an important risk factor for hypertension and other cardiovascular diseases. Its prevalence is on the rise globally and current estimates show that 20% to 50% of people living in urban populations in Africa are either overweight or obese. Thus, obesity and hypertension are 2 of the most important risk factors for morbidity and mortality in Africa (Akpa et al., 2020).



Sourced: Onoja, et al 2020

Figure 2: Regional Patterns and the Association between Obesity and Hypertension in Africa.

According to Akpa et al. (2020), the age-standardized prevalence of hypertension was 19.3% (95%CI: 17.3–21.3) in rural Nigeria, 21.4% (19.8–23.0) in rural Kenya, 23.7% (21.3–26.2) in urban Tanzania, and 38.0% (35.9–40.1) in urban Namibia. In individuals with hypertension, the

proportion of grade 2 (≥160/100 mmHg) or grade 3 hypertension (≥180/110 mmHg) ranged from 29.2% (Namibia) to 43.3% (Nigeria) (Hendriks et al., 2012). According to Hendriks et al., (2012) control of hypertension ranged from 2.6% in Kenya to 17.8% in Namibia. Obesity prevalence (BMI ≥30) ranged from 6.1% (Nigeria) to 17.4% (Tanzania) and together with age and gender, BMI independently predicted blood pressure level in all study populations

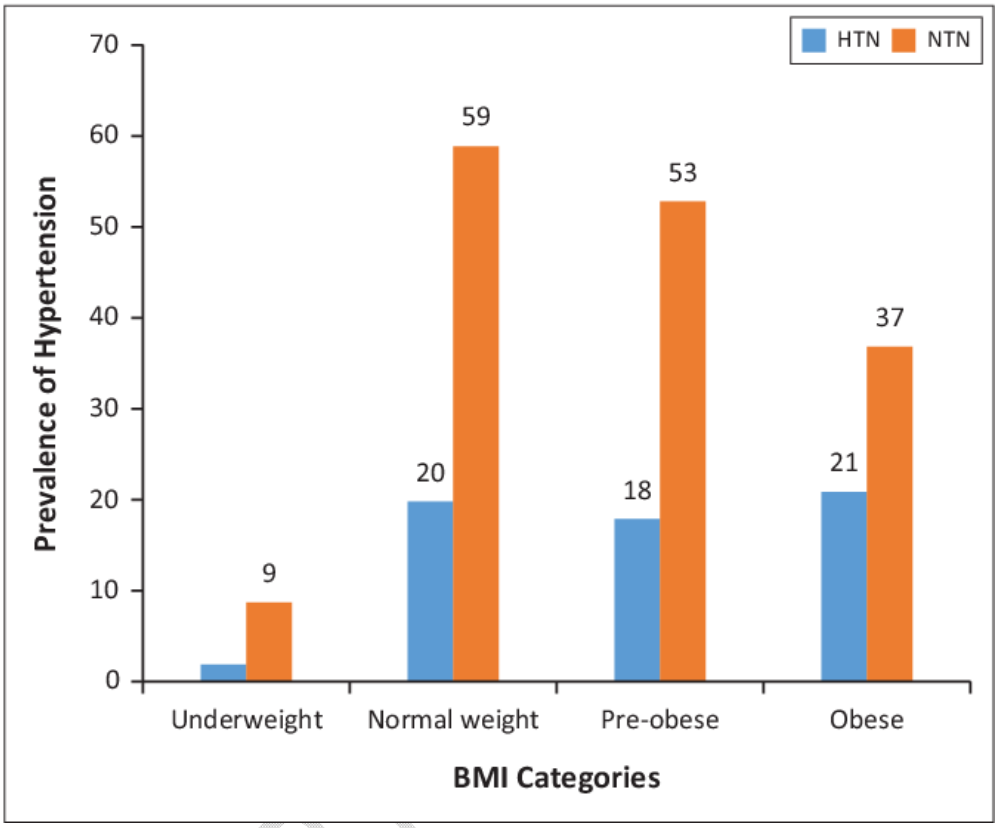
According to Jennifer et al. (2016) hypertension and obesity are the most important modifiable risk factors for cardiovascular diseases, but their association is not well characterized in Africa. Obesity and hypertension are major risk factors for cardiovascular diseases; hypertension is a major public health challenge worldwide; it is the most important risk factor for cardiovascular disease (mainly heart disease and stroke) amongst others (Ikeoluwapo et al., 2016), which were the leading cause of death in 2012., Hypertension once rare in traditional African societies, is now a major public health problem probably because of a rise in its risk factors (Fuh et al., 2019); it is a major health problem in Ghana, being a leading cause of admissions and deaths in the country (Bosu and Bosu, 2021). More than one in four adults in Ghana have hypertension. This high prevalence has persisted for decades and is similar in rural and urban populations. With the low awareness and poor control of hypertension, greater investments in cardiovascular health are required if Ghana is to meet the global target for hypertension (Bosu and Bosu, 2021). In low-and-middle income countries and sub-Saharan Africa (SSA), about 46% of the people currently have hypertension. More disturbing are those having subclinical disease, also known as suboptimal health. This state is defined as an intermediate between health and chronic disease, such as hypertension, and characterized by perceived body weakness and lack of vitality (Enoch et al., 2020). Obese Africans were more than twice as likely to be hypertensive and the odds increased with increasing age. Hypertension is becoming an increasingly common health issue

worldwide, especially in countries in Sub-Saharan Africa. Hypertension is the leading risk factor for premature death and disability worldwide, and it is the leading risk factor for mortality from cardiovascular diseases worldwide (Saeed et al., 2020). There is a high rate of hypertension in Eastern Sudan, especially among older and obese individuals. Preventive measures, such as dietary measures, should be implemented (Saeed et al., 2020).

The trend of global prevalence for hypertension has been dramatically increasing for the past two decades in Southeast Asian countries. A systematic review aiming to assess the prevalence of hypertension and its risk factors among the urban population in Southeast Asian countries was conducted. The common risk factors that we found were male, ethnicity, education and socioeconomic level, body mass index, waist circumference, smoking, and dyslipidaemia. The review indicates an urgent need for primary and secondary prevention activities. Therefore, a multisectoral and intersectoral approach and collaboration should be undertaken to improve the overall health outcomes of all populations in all Southeast Asian countries (Azmawati et al., 2021). Obesity must be considered a real pathology. In the world wide, obesity represents one of the major public health issue associated with increased morbidity and mortality. Despite numerous informative campaigns, unfortunately, the fight against obesity does not seem to work: in the last years, the prevalence continued to increase (Antonino et al., 2019).

Nigeria and Edo State: A study by Chukwuonye et al. (2013), demonstrates the current relatively high prevalence of obesity and overweight in urban adults in Nigeria, and provides robust data that can be applied to highlight the imperative need to reinforce and implement preventive strategies to change the paradigm. From 35 studies ($n = 52,816$), the pooled crude prevalence rates of overweight and obesity in Nigeria were 25.0% (95% confidence interval, CI:

20.4–29.6) and 14.3% (95% CI: 12.0–15.5), respectively. The prevalence in women was higher compared to men at 25.5% (95% CI: 17.1–34.0) versus 25.2% (95% CI: 18.0–32.4) for overweight, and 19.8% (95% CI: 3.9–25.6) versus 12.9% (95% CI: 9.1–16.7) for obesity, respectively. The pooled mean body mass index (BMI) and waist circumference were 25.6 kg/m^2 and 86.5 cm, respectively. We estimated that there were 21 million and 12 million overweight and obese persons in the Nigerian population aged 15 years or more in 2020, accounting for an age-adjusted prevalence of 20.3% and 11.6%, respectively. The prevalence rates of overweight and obesity were consistently higher among urban dwellers (27.2% and 14.4%) compared to rural dwellers (16.4% and 12.1%). (Adeloye et al., 2021).



Sourced: Egbi et al (2021)

Figure 3: Prevalence of Hypertension related to Body Mass Index in a Rural Population in Edo State

Adverse cardiovascular outcomes are linked to higher burden of obesity and hypertension (Adegoke. *et al.* 2021). A secondary analysis of data was conducted for 5135 participants aged ≥ 16 years from community-based hypertension prevalence study to determine the prevalence of obesity and association between multiple anthropometric indices and blood pressure (BP). The indices were waist circumference (WC), body mass index (BMI), waist-to-height ratio (WHtR),

waist-to-hip ratio (WHR), a body shape index(ABSI), abdominal volume index (AVI), body adiposity index (BAI), body roundness index (BRI), visceral adiposity index (VAI) and conicity index (CI). A statistical analysis was performed to determine the association, predictive ability, cutoff values and independent determinants of hypertension. Crude prevalence of obesity was 136 per 1000 (95% confidence interval 126–146). BMI had the strongest correlation with systolic and diastolic BP ($r = 0.260$ and 0.264, respectively). Indices of central adiposity (AVI, WC, WHtR, BRI) were the strongest predictors of hypertension ($\geq 140/90$ mmHg), and their cut-off values were generally higher in females than males. WHR, age, BMI and CI were independent determinants of hypertension ≥ 140 mmHg ($p < 0.05$). The study concluded that measures of central adiposity are the strongest predictors and independent determinants of hypertension in the studied population (Adegoke. *et al*. 2021).

The prevalence of overweight and obesity were 13.8% and 9.4%, respectively. The prevalence of hypertensive range systolic BP in obese versus normal BMI females was 16% versus 23% (p=0.00) and 12.1% versus 6.4% (p=0.27) in males. The prevalence of hypertensive range diastolic BP in obese versus normal BMI females was 12% versus 1.4% (p=0.00) and 15.2% versus 3.5% (p=0.01) in males. BMI in group B was significantly associated with pre-hypertensive and hypertensive range systolic BP in overweight ($P = 0.01$, $P = 0.002$) and obese subjects ($P = 0.00$, $P = 0.00$) and with hypertensive range diastolic BP ($P = 0.00$) only in obese subjects. The only significant association in group A was between obesity and pre-hypertensive range diastolic BP ($P = 0.00$) (Oduwole *et al.* 2012).

Cardiovascular risk factors of hypertension and obesity differ substantially between women and men in rural communities (Abraham et al., 2021). Targeted public health response to obesity in Nigeria is relatively low due to limited epidemiologic understanding (Davies et al., 2021). The

overall prevalence of hypertension was 33.1% (male 36.8% and female 31.1%). The proportion of self reported hypertension was 11.1%, while 5.1% were currently on anti-hypertensive medication. The mean age of the respondents was 38.8 ±15.6 years. The body mass index of the respondents was 5.2%, 52.0%, 29.5% and 13.3% for underweight, normal, overweight and obese, respectively. Alcohol and tobacco use were found in 11.5% and 3.2%, respectively. The result of binary logistic regression analysis revealed that hypertension was significantly associated with being in age groups 30-49 years (OR 2.258, 95% CI: 1.311 - 3.884), ≥50 years (OR 7.145, 95% CI: 3.644 - 14.011), being overweight or obese (OR 2.281, 95% CI: 1.022 – 5.088). Hypertension was inversely associated with being underweight (OR 0.537, 95% CI: 0.395 – 0.832) 2021). (Ajayi et al. 2021).

The study further demonstrates that both BMI and the anthropometric indices of central adiposity are important contributors to the development of hypertension. However, the anthropometric indices of central adiposity (WHR, CI, AVI, WC, WHtR) may be more predictive of hypertension, and their routine incorporation was proposed into clinical practice instead of the over reliance on BMI alone. The findings also highlighted the relative impreciseness of cutoffs and caution that population specific ranges or cutoff values may be a more practical guide for guiding or benchmarking implementation of lifestyle modifications in practice. It was therefore acknowledged that the findings require further corroboration in the context of population (Chukwuonye et al., 2013).

Discussion: The progressive and rapid increase in the incidence of obesity, which has characterized most of the economically advanced countries in the last decade, has been the main stimulus for the research of the mechanisms underlying this pathology and the related disorders

(Antonino et al., 2019). The fallout of a correct and early diagnosis of obesity will also produce lower health costs for primary and secondary prevention of the most common degenerative diseases related to it (Antonino et al., 2019). Hence, the absolute therapeutic benefit is directly proportional to the basic risk. So, internationally interest on early diagnosis of obesity is growing to avoid under- and over-diagnosis consequences. Therefore, the consequences are an aggravation of the disease and an increase in obesity related pathology like diabetes, cardiovascular disease, and cancer(Antonino et al., 2019).

The clustering of obesity and other features of the metabolic syndrome might have important implications for prevention, particularly with regard to whether interventions targeted at visceral obesity would have beneficial effects on cardiovascular and renal morbidity (Krzysztof, 2006). Idiopathic intracranial hypertension incidence and prevalence is increasing considerably, corresponding to population increases in body mass index. This has important implications for health care professionals and policy makers given the comorbidities, complications, and increased health care utilization associated with idiopathic intracranial hypertension (Latif et al., 2021).

Estimating the effects of population□level increases in obesity on incident hypertension has substantial implications for public health policy (Natalie et al., 2021). Individuals with significantly higher weight, body mass index, waist circumference, hip circumference, fat mass, and fat-free mass values had hypertension compared to participants with normotension, supporting the direct association between obesity and hypertension.

Hypertension and excess body weight are major risk factors of cardiovascular morbidity and mortality in developing countries. Findings from research suggest a high prevalence of obesity in

Nigeria. This is marked in urban Nigeria and among women, which may in part be due to widespread sedentary lifestyles and a surge in processed food outlets, largely reflective of a trend across many African settings (Davies et al., 2021). From all studies, the highest prevalence of obesity was reported in Umuahia, Abia State, South-east Nigeria in 2012 at 33.7% (Ogah et al., (2013), with the lowest rate recorded in Kano, North-west Nigeria in 2013 at 0.84% (Shehu et al., 2013). Some risk factors associated with the development of hypertension (HTN) in adults are: age, regular alcohol consumption, level of physical activity, obesity, stress and fasting blood glucose concentration in blood. More than 60% of the study participants had knowledge on hypertension, practice save eating habits and exercise (Fuh et al., 2019). The prevalence of obesity in Irrua is similar to reports from other suburban communities, though

slightly higher than expected in this region (Onwah, 2019). This may be due to gradual changes in the lifestyle of the residents. The indices of obesity studied showed positive correlation with co- morbidities like hypertension and stroke which is the leading cause of death and disability worldwide, with hypertension being the most prevalent risk factor for stroke (Okokhere et al., 2013; Onwah, 2019). This study reveals that obesity and its' correlates and co morbidities are an increasing problem in this region (Onwah, 2019).

Conclusion: Obesity is a multi factorial pathology and chronic diet related non-communicable disease. The most widely used parameter for it diagnosis is the body mass index (BMI) which is not suitable for assessing the body fat. Many studies demonstrate that BMI alone cannot be use to define obesity. Obesity, most especially abdominal obesity is an independent risk factor for the development and progression of hypertension.Hypertension is a common health condition among people and most studies focused on the impact of body mass index (BMI).

Recommendation: Health talks on diet, regular physical activity and screening, are recommended.

Sensitization of the population on hypertension and its complications is important.

Specific guidelines for treating obesity-associated hypertension, in addition to the recommendation of reducing weight, are necessary.

Increased physical activity, abstaining from alcohol and smoking, increased intake of fruits and vegetables, and reduced intake of carbohydrates, meat, and fat have a positive influence on blood pressure control.

Therefore, weight-reduction interventions are essential for reducing the prevalence of hypertension.

Other parameters like the waist-hip ratio (WHR), waist-height ratio (WHtR) and waist circumference should be considered in the diagnosis of obesity which has been found to have a strong association with systolic and diastolic blood pressures.

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Comment [RV4]: Review the referencing and need to follow one style

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