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RESEARCH ARTICLE

Dietary Patterns and Metabolic Syndrome Risk in Adults Living with HIV: A Cross-Sectional Study in Lusaka District, Zambia

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ABSTRACT

Background: **Metabolic syndrome, a cluster of cardiovascular risk factors, affects approximately 25% of the global population, with a significant impact on the 37,900,000 people living with HIV in 2017.**

Objective: **This cross-sectional study (April-July 2020) in Lusaka District aimed to assess dietary patterns and metabolic syndrome risk in 180 randomly sampled HIV-positive individuals (aged 18 and above) from three health facilities.**

Methods: **Participants underwent anthropometric measurements, blood pressure checks, and biochemical assessments. High prevalence rates were observed for factors like high waist-hip ratio (39%), high total cholesterol (52%), high triglycerides (46%), and high blood pressure (33%).**

Results: **Three dietary clusters (omnivorous, vegetarian, unclassified) showed no significant association with metabolic syndrome or its components (p > 0.05).**

Conclusion: **While metabolic syndrome prevalence among HIV-positive individuals is low, there are notable occurrences of high blood pressure and predictors of non-communicable diseases. Commonly consumed foods did not show a significant association with metabolic syndrome predictors (p > 0.05).**

Keywords: Cardiovascular risk factors, dietary patterns, metabolic syndrome, non-communicable diseases.

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1. Introduction

Metabolic syndrome (MS) encompasses the simultaneous presence of multiple well-known risk factors for cardiovascular and diabetic complications, including insulin resistance, abdominal obesity, atherogenic dyslipidemia, elevated serum triglyceride levels, hypertension, and low high-density lipoprotein cholesterol levels [1]. The global prevalence of metabolic syndrome accounts for approximately 25% of the world's population and has demonstrated an upward trend in recent years [2]. After 2018, the global count of individuals living with HIV reached around 37,900,000 and 1,700,000 new infections were reported during that year [3].

A tidal wave of chronic diseases threatens to engulf sub-Saharan Africa, where cardiovascular disease already holds the grim title of leading cause of adult death [1], [4]. Adding to the urgency, non-communicable diseases claim a staggering 80% of adult lives in this region [5]. These stark realities demand immediate action to address the looming crisis.

In Sub-Saharan Africa, the interplay between metabolic syndrome and HIV status remains underexplored. However, rapid urbanization, population shifts, and changing lifestyles, alongside an ageing population, are likely propelling the rise of cardiovascular diseases, which are core components of metabolic syndrome [6]. Understanding the unique role of HIV within this complex picture is crucial.

In Zambia, where 14.5% of women and 9.5% of men aged 15–59 carry HIV, a double threat looms: metabolic syndrome [7]. While antiretroviral drugs, a lifeline for HIV-positive individuals, can raise lipid levels and increase the risk of metabolic syndrome components like hypertension, diabetes, and insulin resistance, rapid urbanization and changing lifestyles further exacerbate this risk [6].

The picture of metabolic syndrome in HIV-positive individuals is far from clear. Studies paint starkly different landscapes, influenced by how we define the condition and which antiretroviral therapies are on the scene. Two potential culprits stand out: lipotoxicity (fat buildup in tissues) and adipokines (signaling molecules released by fat cells). Recent research has also pointed the finger at certain antiretroviral treatments themselves as potential instigators of metabolic syndrome [6], [8], [9].

Zambia is facing a double-edged sword: a staggering rise in non-communicable diseases (NCDs) like heart disease, diabetes, and cancer and shifting dietary patterns that may fuel this fire [10]. These NCDs often share a common culprit: unhealthy lifestyle choices such as unhealthy eating, excessive alcohol consumption, smoking, physical inactivity, and obesity [11].

But the concern extends beyond the general population. HIV-positive individuals are already at higher risk due to the virus itself and potential side effects of antiretroviral therapy. Now, changes in dietary habits, driven by various demographic and epidemiological transitions, add another layer of vulnerability [12].

Why the focus on diet? Because what we eat plays a crucial role in how our bodies manage blood sugar, cholesterol, and weight, all key players in metabolic syndrome, a cluster of NCD risk factors. Understanding how dietary patterns influence this risk in HIV-positive individuals is crucial for developing targeted interventions and promoting healthier lifestyles.

Addressing MS in people living with HIV requires looking beyond medications. Insights from mental health care in low-resource settings point to the critical role of strengthening primary care [13]. Overcoming barriers like inadequate funding, community stigma, and low awareness is crucial to encourage health-seeking behaviors and providing holistic care. This resonates with local studies on healthcare challenges, where socio-demographic factors and proximity to health facilities emerge as key contributors to relapses and poor treatment outcomes [14]. By integrating these diverse perspectives, we can tailor interventions that empower patients and deliver the comprehensive care needed to improve health outcomes for this vulnerable population.

In summary, this research delves into the intricate relationship between MS and HIV, highlighting the prevalence of MS globally and its escalating trend. In sub-Saharan Africa, particularly in Zambia, the coexistence of HIV and MS poses a dual threat, exacerbated by factors such as rapid urbanization, lifestyle shifts, and the complex interplay of antiretroviral treatments. The study emphasizes the need to comprehend the multifaceted landscape of MS in HIV-positive individuals, considering potential instigators like lipotoxicity and adipokines. Zambia faces a rising tide of NCDs and changing dietary patterns, amplifying the risk, especially among HIV-positive individuals with altered dietary habits due to demographic transitions. The research underscores the critical role of diet in managing MS, elucidating its impact on blood sugar, cholesterol, and weight, a nexus crucial for NCD risk factors. Beyond medications, strengthening primary care is pivotal for holistic MS management in HIV-positive individuals. Overcoming barriers, such as funding constraints and stigma, is crucial for promoting health-seeking behaviors. Local healthcare studies further emphasize the importance of addressing socio-demographic factors and proximity to healthcare facilities to mitigate relapses and improve treatment outcomes. By integrating these perspectives, the research advocates for tailored interventions to enhance the comprehensive care required for the vulnerable population of people living with HIV and facing the challenges of metabolic syndrome.

2. Method

2.1. Study Design

From April to July 2020, a cross-sectional study examined the prevalence of metabolic syndrome among HIV-positive individuals in Lusaka District, Zambia. The study focused on three of the district's 26 health facilities, all offering antiretroviral therapy (ART) services. A total of 180 participants, randomly selected from the pool of HIV-positive individuals aged 18 and above attending these facilities, were included in the investigation.

It is noteworthy to mention that diets rich in high energy, coupled with antiretroviral medications known to elevate lipid profiles in the body, are associated with an increased risk of developing metabolic syndrome [6], [15].

2.2. Inclusion and Exclusion Criteria

The study included adults who were living with HIV, and their participation was voluntary, with each participant providing informed consent before the commencement of data collection. The adoption of a random sampling approach was employed to guarantee an unbiased representation of the study population. This method ensured that every individual within the target population had an equal chance of being selected, contributing to the overall robustness and reliability of the study findings.

2.3. Data and Data Collection Techniques

2.3.1. Dietary Assessment

A structured interview conducted by a trained nutritionist (the researcher) employed a Food Frequency Questionnaire (FFQ) comprising 53 food items to assess the dietary habits and nutritional intake of the participants. This questionnaire served as a valuable tool during the interview, enabling the identification of routinely consumed food items over a specified time period, particularly relevant for elucidating dietary patterns. Participants were prompted to recall their frequency of consuming each food item over the preceding four weeks.

The frequency of food intake was gauged using a scale of six categories: (00) never, (1) once per month, (2) once or twice per week, (3) 3–6 times a week, (4) once per day, and (5) ≥ once per day. This comprehensive approach facilitated a nuanced understanding of participants' dietary practices. The questionnaire covered a spectrum of 53 food items categorized into seven predefined groups based on the similarity in nutrient profiles, aligning with a grouping scheme utilized in prior studies [16], [17].

2.3.2. Anthropometry

Precise weight and height measurements were crucial for the study. This was ensured by using calibrated equipment (a digital platform scale and stadiometer) from the Zambia Bureau of Standards. Both instruments were placed on a level, stable surface in the examination rooms. Participants stood barefoot during measurements. For height, we aimed for 0.1 cm accuracy, making adjustments for long hair with a 30 cm rule when necessary. To measure weight (accurate to 0.1 kg), participants stood centered on the scale, distributing their weight evenly. BMI was calculated using the weight and height data in two ways: first, with a scientific calculator, and then verified against a reference BMI table and wheel. This double-checking ensured accurate BMI values.

2.3.3. Blood Pressure

To ensure accurate measurements, participants relaxed for 10 minutes before their blood pressure was taken. Their upper arm, supporting the cuff, was positioned at heart level for optimal reading.

2.3.4. Biomedical Parameters

Trained health personnel carefully drew a 3–4 ml blood sample from each participant's vein using a green-coded needle and 5 ml syringe. These samples were collected in plain red-top vacutainers and stored in a chilled cooler box for safe transport to the designated laboratory (Chelstone Health Centre). Once there, laboratory personnel, closely supervised by the principal researcher, analyzed the samples for triglycerides, total cholesterol, and random blood glucose.

2.4. Data Analyses and Management

Statistical analyses were conducted using SPSS version 22 for Windows. The data were meticulously analyzed, and the results were presented as the mean ± standard deviation (± SD) and percentages. The Chi-square test, with a critical value set at <0.05, was employed. Body Mass Index (BMI) was computed using weight and height measurements, and waist-to-hip ratio was analyzed using waist and hip measurements. These derived indices, in conjunction with variables on serum triglycerides and total cholesterol, were utilized to categorize subjects into those with or without metabolic syndrome.

Metabolic syndrome was defined in subjects exhibiting more than three of the following conditions: obesity, diabetes mellitus, dyslipidemia, hypertension, insulin resistance, and atherosclerosis. The study adhered to the World Health Organization's (WHO) definition of metabolic syndrome. Obesity was characterized by a BMI of ≥30 or above and a waist-to-hip ratio of ≥0.90 in males and ≥0.85 in females. Waist-to-hip ratio (WHR) was computed as the waist measurement divided by the hip measurement. Dyslipidemia was indicated by serum triglycerides levels of 1.5 mmol/l and above or total cholesterol levels less than 4.5 mmol/l in males and less than 4.9 mmol/l in females. Hypertension was defined by a blood pressure reading of 140/90 mm/Hg and above.

Food frequency data were categorized into three groups based on consumption frequency: more frequent, medium frequent, and less frequent. More frequent consumption involved consuming a food item more than twice or once a day, medium frequent consumption was consuming a food item three to six times and once or twice per week, while less frequent consumption was defined as consuming a food item once per month or never.

Principal Component Analysis was applied to the dietary data to identify common consumption profiles within the seven food categories (staples, animal products, legumes and nuts, fruits, vegetables, fats and oils, other foods, and beverages) on the food frequency questionnaire. This analysis aimed to elucidate variations in dietary intake, representing actual dietary habits or patterns in the studied population.

A binary logistic regression model was employed to determine the independent relationships of each predictor variable (dietary patterns, antiretroviral drugs, alcohol consumption, cigarette smoking, and physical inactivity) with the outcome variable (metabolic syndrome components).

2.5. Ethical Considerations

Ethical approval was diligently obtained from both the Tropical Disease Research Centre and the National Health Research Authority. Subsequently, permission to conduct the study was sought and granted from the Lusaka District Health Office management. The confidentiality of the data collected from respondents was rigorously maintained by securely storing the information in box files accessible only to the researcher. No details concerning the study participants have been disclosed to any third party. Individuals aged 18 years and above were expressly requested to provide consent, serving as permission for the collection of primary data. The questionnaire utilized for data collection intentionally omitted the names of research participants to ensure anonymity, instead using ID numbers for reference purposes.

3. Results

Table I presents the prevalence of non-communicable diseases and predictors of metabolic syndrome, including elevated triglycerides, increased waist-hip ratio, heightened waist circumference, and high blood pressure. Physical and biochemical assessments revealed that 39% (n = 70) of the respondents exhibited a high waist-hip ratio, with a notable gender difference in high waist circumference, affecting 21% (n = 38) of females compared to 4% (n = 7) of males. Among the participants, 52% (n = 93) had elevated total cholesterol levels, 46% (n = 83) showed increased triglycerides, and 33% (n = 60) had high blood pressure.

The majority of food items within various groups were typically consumed either 3 to 6 times per week or once a week, with a select few being consumed once or twice

TABLE I: Prevalence of Non-Communicable Diseases and Metabolic Syndrome Predictors N = 180

Predictor variables	Non-communicable diseases	Metabolic syndrome
Variables	% (n)	% (n)
High WHR	39 (70)	
High waist circumference (cm)*		
Male	4 (7)	
Female	21 (38)	
Overweight and obesity† (BMI ≥ 25 kg/m^2)		
BMI > 25		
Male	17 (31)	
Female	19 (34)	
BMI ≥ 30		
Female	12 (21)	
High total cholesterol	52 (93)	
High triglycerides	46 (83)	
High blood pressure	33 (60)	33 (60)

daily. Notably, staple foods were consumed more than once a day by the majority of respondents, accounting for 66% (n = 120), while vegetables were consumed once a day by a similar percentage of respondents, i.e., 66 (n = 120).

There was no positive correlation found between any of the food items and predictors of metabolic syndrome, with p-values consistently below 0.05. Utilizing principal component analysis, three distinct dietary patterns were derived, reflecting omnivorous habits characterized by the consumption of "staples, animal products, and fruits," vegetarian habits focused on "legumes and nuts," and an unclassified pattern encompassing "fats and oils, other foods and beverages, and vegetables." The detailed results are presented in Table II.

The findings presented in Table III reveal positive correlations between high blood pressure and several factors, including sex, alcohol consumption, and body mass index ($r = 0.215**$, $p = 0.004$, $r = 0.149*$, $p = 0.000$, and $r = 0.149$, $p = 0.046$, respectively). These variables were also found to be significantly associated with high blood pressure ($p < 0.05$). Conversely, fruits exhibited a negative correlation with high blood pressure ($r = -0.084$) but did not demonstrate a significant association ($p = 0.245$).

Table III further illustrates the serum triglyceride levels, indicating significant correlations with age, staple foods, fats/oils, and non-alcoholic beverages. Conversely, sex, fruits, and alcoholic consumption did not exhibit correlations with high triglyceride levels. Both age and body mass index showed significant associations with high triglyceride levels ($r = 0.279**$, $p = 0.000$ and $r = 0.170*$, $p = 0.002$, respectively).

A positive correlation with all variables of interest was observed for high waist-to-hip ratio in Table III ($p < 0.05$). Notably, the consumption of fruits displayed a slight negative correlation ($r = -0.004$, $p = 0.960$) with high waist circumference. In contrast, high waist circumference exhibited positive correlations with all key variables of interest, with significant associations noted for alcohol consumption, body mass index, and other foods and non-alcoholic beverages ($r = 0.304*$, $p = 0.000$, $r = 0.209$, $p = 0.005$, and $r = 0.600$, $p = 0.000$, respectively).

High total serum cholesterol also demonstrated positive correlations with all the key variables of interest in Table III. Notably, only the consumption of fruits exhibited a slight negative correlation ($r = -0.194$, $p = 0.009$) with high total cholesterol. However, none of the variables were found to be significantly associated ($p > 0.05$) with high total cholesterol.

Predictors of metabolic syndrome, such as high waist circumference (with a significant statistic W of 16.754) and elevated blood pressure, surpass the critical value derived from $Z(1-\alpha)/2$ with an alpha of 0.05.

In Table IV below, the odds ratio and 95% confidence intervals (CIs) for metabolic syndrome exhibit values beyond the critical threshold of 0.05. Additionally, the p-values for sex, BMI, and waist circumference are noteworthy. The p-value for sex is 0.006, while both BMI and waist circumference have p-values of 0.000. This implies that the statistical significance of these predictors is well-established.

The test statistics for sex ($W = 7.552$), BMI ($W = 21.847$), and waist circumference ($W = 16.754$) are all greater than their respective critical values at a significance level of 0.05, indicating the robustness of these predictors in influencing the occurrence of metabolic syndrome.

4. Discussion

This study aimed to determine the dietary patterns and the risk of metabolic syndrome among HIV positive individuals from selected health facilities in Lusaka District. Considering the public health concern of the components of metabolic syndrome (hypertension, diabetes mellitus, obesity, dyslipidemia and cardio-vascular diseases) in Zambia, the research was worth undertaking for the purpose of informing policy on the welfare of HIV positive individuals. Several studies, including the examination of the perception of health services for HIV-positive individuals with disabilities in Zambia, the provision of antiretroviral therapy regardless of CD4 count in Zambia, and the Zambia Population-Based HIV Impact Assessment, have been conducted [7], [18], [19]. These studies, however, focused on dietary patterns and how this predictor variable among other variables can predispose HIV positive individuals to having metabolic syndrome.

The occurrence rates of elevated blood pressure and factors predicting metabolic syndrome in this investigation align with the outcomes of the WHO 1998 and 2005 meta-analysis, as illustrated in Table III. Existing literature suggests that individuals undergoing ART are anticipated to exhibit elevated levels of total cholesterol and triglycerides [7], [20].

Among the seven food group items commonly consumed by study participants, none exhibited a noteworthy

TABLE II: Dietary Clusters from Frequently Consumed Foods by Study Participants N = 180

Variables	% (n)					
Foods consumed	>Once/day % (n)	Once/day % (n)	3-6 times/week % (n)	Once or twice/week % (n)	Once a month/never % (n)	p-value
Omnivorous						
Staples	66 (120)	15 (22)	12 (21)	6 (10)	1 (2)	0.352
Animal products	1 (5)	1 (5)	15 (28)	64 (115)	19 (35)	0.343
Fruits	1 (4)	1 (4)	6 (10)	41 (75)	3 (90)	0.591
Vegetarian						
Legumes and nuts	1 (2)	1 (2)	37 (66)	48 (87)	13 (24)	0.067
Unclassified						
Vegetables	11 (20)	66 (120)	15 (27)	6 (11)	1 (2)	0.194
Fats/oils	1 (70)	47 (84)	5 (10)	1 (25)	2 (4)	0.314
Other foods and beverages	6 (11)	6 (11)	59 (107)	26 (47)	15 (8)	0.458

TABLE III: Independent Variables versus High Blood Pressure and Non-Communicable Disease Predictors N = 180

		Blood pressure and non-communicable disease predictors				
Independent variables		High blood pressure	High triglycerides	High waist-hip ratio	High waist circumference	High total cholesterol
Sex (1 = f, 0 = m)	Spearman's rho	0.215**	−0.033	0.235*	0.009	0.097
	sig	0.004	0.666	0.001	0.907	0.196
Age (years)	Spearman's rho	0.043	0.279**	0.224*	0.304*	0.047
	sig	0.569	0.000	0.002	0.000	0.535
Staple foods	Spearman's rho	0.064	0.096	0.168*	0.090	0.944
	sig	0.392	0.199	0.024	0.230	0.555
Fruits	Spearman's rho	−0.084	−0.015	0.084	−0.004	−0.194
	sig	0.245	0.845	0.261	0.960	0.009
Fats/oils	Spearman's rho	0.058	0.034	0.192*	0.058	0.058
	sig	0.442	0.652	0.010	0.442	0.440
Other foods and beverages	Spearman's rho	0.125	0.125	0.125	0.125	0.125
	sig	0.094	0.094	0.094	0.094	0.094
Alcohol consumption	Spearman's rho	0.028	−0.071	0.071	0.209*	0.047
	sig	0.708	0.345	0.346	0.005	0.535
Body mass index	Spearman's rho	0.477*	0.170*	0.229*	0.600*	0.103
	sig	0.000	0.022	0.002	0.000	0.169
Occupation status	Spearman's rho	0.022	0.079	0.016	0.092	0.084
	sig	0.766	0.294	0.832	0.220	0.261

Note: N = 180* = significant at $p < 0.05$ (* and ** mean the variable is significant at $p < 0.05$).

TABLE IV: Binary Logistic Regression Parameters N = 180

Source	B	SE *B*	Wald X^2	p	OR	95% CI OR
Sex (M = 1, F = 2)	0.864	0.314	7.552	0.006	2.372	1.281
Occupation status	0.018	0.174	0.011	0.915	1.019	0.725
Age (years)	0.053	0.161	0.110	0.740	1.055	0.769
High total cholesterol	0.309	0.194	0.2.533	0.111	1.362	0.931
High triglyceride	−0.267	0.162	2.695	0.886	1.082	0.368
High waist hip ratio	0.200	0.402	0.246	0.620	1.221	0.555
BMI (Kg/m^2)	0.192	0.041	21.847	0.000	1.211	1.118
Waist circumference	0.070	0.017	16.754	0.000	1.072	1.037
Alcohol consumption	0.131	0.144	0.823	0.364	1.140	0.859
Staple foods	0.128	0.207	0.384	0.536	1.137	0.757
Fruits	−0.234	0.241	2.264	0.132	0.695	0.433
Fats and oils	0.327	0.382	0.735	0.391	1.387	0.657
Other foods and beverages	0.859	0.619	1.922	0.166	2.360	0.701

Note: Statistically significant set at $p < 0.05$ (at 95% CI).

association with predictors of metabolic syndrome ($p < 0.05$), as indicated in Table II. The principal component analysis applied to the food frequency questionnaire facilitated the identification of similar consumption patterns of food items within the seven food categories on the FFQ as input variables. This analysis revealed three distinct dietary clusters (Table II): omnivorous, characterized by the consumption of "staples, animal products, and fruits"; vegetarian, focused on "legumes and nuts"; and an unclassified cluster consisting of "fats and oils, other foods and beverages, and vegetables". However, none of these dietary clusters demonstrated a significant association with metabolic syndrome or its components ($p < 0.05$).

Conversely, the deposition of fat around the lower abdomen, thighs, and buttocks is seldom indicative of cardio-metabolic risks. The present study thus proposes that the specific location or site of fat accumulation plays a crucial role in assessing cardio-metabolic risks.

While frequent staple food consumption is typically recommended for its abundant energy supply, our study reveals surprisingly low intake among HIV-positive individuals [21]. This contradicts established knowledge of increased energy demands in HIV infection, where metabolic processes vital for fighting the virus necessitate ample calories [22]. Although our study focused on frequency, not quantity, the observed high rates of vegetable consumption (29% and 37%) are encouraging, as vegetables provide protective benefits against chronic diseases [23]. However, the positive effects of fruits and vegetables can be counteracted by excessive dietary fat, urging further investigation into the complete dietary picture of these individuals [24].

Table III reveals intriguing associations between various factors and cardiometabolic health. High blood pressure, for instance, showed positive correlations with sex, alcohol intake, and body mass index. Triglyceride levels, on the other hand, exhibited positive correlations with factors like age, staple foods, fats/oils, and other foods and non-alcoholic beverages. The observed connection between apple consumption and triglycerides aligns with growing evidence on the impact of dietary choices on cardiometabolic health, particularly in individuals with specific health conditions [25]. These compelling findings suggest the potential of dietary modifications in managing specific cardiometabolic markers. Further research is warranted to delve deeper into these associations and establish clear cause-and-effect relationships. By incorporating such insights into dietary recommendations, we can empower individuals to actively participate in safeguarding their cardiovascular health.

A growing body of research, including some studies, has established a critical principle: the location of adipose tissue holds significant implications for morbidity and mortality, independent of the total amount of fat accumulated [26]. Notably, the presence of visceral fat, situated in close proximity to abdominal organs, poses particular health risks, increasing susceptibility to various diseases and even premature death. While international health organizations, such as the National Institute for Health and Clinical Excellence, advocate for a combined approach employing body mass index (BMI) alongside anthropometric measures like waist and hip circumference, it is crucial to acknowledge the limitations inherent in BMI [27]. Specifically, BMI may fail to accurately reflect the health risks associated with central obesity, characterized by the accumulation of fat around vital organs.

This issue is not limited solely to individuals with HIV. Even, the impact of mental disorders extends to influencing individuals' behavioral tendencies, including alterations in their dietary habits [28], [29]. It becomes imperative to administer appropriate treatments, not only to address the mental health condition but also to mitigate potential gastrointestinal side effects [30]. Moreover, a careful selection of treatments is essential to avoid any disruption in nutritional well-being [31]. This underscores the intricate relationship between mental and physical health, emphasizing the necessity for a comprehensive healthcare approach.

Carrying excess fat around the waist, also known as android or abdominal obesity, significantly increases the risk of developing cardiometabolic health problems like heart disease, stroke, and diabetes [32]. This distinct fat distribution, compared to fat accumulation elsewhere, poses a greater threat to long-term health.

Over the past two decades, estimates indicate that the prevalence of overweight and obesity has affected approximately 1,400,000,000 adults, with obesity alone affecting over 10% of the global population. Factors such as older age, female gender, urban residence, physical inactivity, smoking, hypertension, hypercholesterolemia, hyperglycemia, diabetes, and a family history of diabetes have been identified as significant risk factors contributing to increased waist circumference and obesity [33].

Diets rich in saturated fats and cholesterol contribute to elevated blood cholesterol levels, posing a risk for heart disease. Being overweight is also associated with an increased risk of heart disease and tends to elevate serum cholesterol levels. Nevertheless, weight loss has been shown to have beneficial effects, lowering levels of LDL (bad) cholesterol, total cholesterol, and triglycerides while simultaneously raising HDL (good) cholesterol levels [34]. Hence, this study recommends the consumption of low-energy foods, regular engagement in physical activity, and weight management as strategies to reduce LDL cholesterol and enhance HDL cholesterol levels.

The binary logistic model revealed that three independent variables—sex, BMI, and waist circumference—were statistically significant in influencing the risk of high blood pressure among HIV-positive individuals, as indicated in Table IV. Following adjustment for potential confounding factors, a noteworthy inverse association was established between sex, BMI, and waist circumference, with odds ratios of 2.372, 1.211, and 1.072, respectively, at a 5 per cent significance level.

Contrary to expectations, the current study did not identify a correlation between adherence to a healthy diet and the presence of metabolic syndrome and its components. This lack of association may be attributed to the fact that the food items assessed through the food frequency questionnaire were not evaluated for their nutritional content. Additionally, it is plausible that individuals in the study cohort may be following specialized diets, and avoiding fast foods and salty snacks. Another potential factor could be the underreporting of dietary habits by individuals with noncommunicable diseases, potentially contributing to the manifestation of metabolic syndrome.

5. Conclusion

Based on the findings and discussions in the current study, the prevalence of metabolic syndrome among HIV-positive individuals is comparatively low. However, noteworthy observations include elevated blood pressure and certain predictors of non-communicable diseases, such as high serum triglyceride levels, a high waist-hip ratio, and increased waist circumference. Notably, no significant association was identified between commonly consumed foods and predictors of metabolic syndrome ($p > 0.05$). Principal component analysis yielded three distinct dietary clusters.

The binary logistic regression model indicated that hypertension is influenced by factors such as sex, body mass index, and waist circumference, with statistical significance at the five per cent level. Consequently, the management of preventive measures for non-communicable disease predictors and/or metabolic syndrome predictors should be considered to uphold a low prevalence of metabolic syndrome or non-communicable diseases among individuals living with HIV.

5.1. Recommendation

Based on the findings presented in this study, the researcher suggests the implementation of interventions targeting metabolic syndrome and non-communicable diseases during individual consultations, group sessions, and community health messaging initiatives. This proactive approach aims to mitigate the risk of metabolic syndrome among individuals living with HIV. These interventions may encompass guidance on the consumption of low-energy foods, engaging in non-strenuous physical activities, and cessation of alcohol consumption and smoking.

5.2. Strength

This research represents the inaugural investigation conducted among individuals with HIV in Zambia to examine the correlation between dietary patterns and metabolic syndrome. The study utilized a widely acknowledged and validated dietary questionnaire.

5.3. Limitations

The adoption of a cross-sectional study design in place of a case-control design was necessitated by the absence of genuine controls for the subjects. It's important to acknowledge the potential for information bias from respondents during the collection of dietary data in this study.

Conflict of Interest

Authors declare that they do not have any conflict of interest.

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