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FOOD AS MEDICINE: MANAGING NON-COMMUNICABLE DISEASES IN HIV-POSITIVE INDIVIDUALS THROUGH DIET AT BUSIA COUNTY HOSPITAL

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ABSTRACT: Non-communicable diseases (NCDs) account for 41 million deaths annually, representing 74% of all global fatalities, with a disproportionate burden on low- and middle-income countries. Of these deaths, 17 million are premature, occurring before the age of 70, with 86% of these individuals living in low-resource settings. Among these, People Living with HIV (PLHIV) are at heightened risk of developing chronic NCDs, exacerbating the already significant health challenges they face. As the profiles of PLHIV and their use of antiretroviral therapy (ART) evolve, the implications for both clinical care and management in urban and rural settings become increasingly important. The role of nutrition in the lives of PLHIV cannot be overstated, as poor dietary habits accelerate disease progression, elevate morbidity, and decrease life expectancy. Proper nutrition is recognized as a critical element for improving the quality of life (QoL) for those living with HIV, supporting immune function, and enhancing treatment outcomes. This study seeks to explore the intersection between diet and NCD management among PLHIV, emphasizing the need for tailored nutritional interventions that can significantly improve health outcomes, particularly in resource-limited settings.

Keywords: Non-communicable diseases, People Living with HIV, nutrition, antiretroviral therapy, public health

INTRODUCTION

Non-communicable diseases (NCDs) kill 41 million people each year, equivalent to 74% of all deaths globally. Each year, 17 million people die from an NCD before age 70; 86% of these premature deaths occur in low- and middle-income countries [1, 2, 3, 4,]. The risk of developing chronic non-communicable diseases is increasingly recognized as a major public health problem in People Living with HIV (PLHIV). The profile of PLHIV and ART is changing and this has major implications for clinical care and management in urban and rural areas. A proper diet can help those living with HIV improve their quality of life (QoL). In PLHIV, poor nutrition hastens disease development, increases morbidity, and shortens survival time [5].

It is known that the energy requirements [6] of PLHIV increase, hence the need for a balanced and diversified diet. It has also been found that the rates of NCDs appear to be increasing in PLHIV as compared to people living

without HIV and this also poses major implications for management, support, and clinical care [7]. This concern is evident, especially in developing countries where dietary and lifestyle risk factors associated with NCDs are becoming more prominent [8]. Both HIV and NCD are conditions that need proper management with a continuum of care that should include Food, Nutrition, and Dietetics which this study has emphasized using locally available foods, laboratory and clinical monitoring, behavioral changes, and adherence support.
However, the current study sought to go further to adopt an intervention targeting NCDs among PLHIV, with a different approach, using a food-based nutrition intervention, and it is the first of its kind in Kenya used for this cohort.

MATERIALS AND METHODS

Study Area and Population

The study took place in Busia, County in the Western Region of Kenya. The county borders westwards with the Republic of Uganda; this makes the border a business hub hence high chances of having men and women at risk of HIV. Studies have shown that the prevalence of HIV in Busia is higher than the National rates. Study subjects were People Living with HIV (PLHIV) with NCDs, aged 18 years and above. The county has an approximate area of 1261 square kilometers; this includes 137 square kilometers squares, (which is also under permanent water surface).

Sample size Determination by - G* Power

G*Power is a software used to calculate statistical power. The program offers the ability to calculate power for a wide variety of statistical tests including t-tests, Ftests, and chi-square-tests, among others. Additionally, the user must determine which of the many contexts this test is being used, such as a one-way ANOVA versus a multi-way ANOVA. In order to calculate power, the user must know four of five variables: either number of groups, number of observations, effect size, significance level (α), or power ($1-\beta$). G*Power has a built-in tool for determining effect size if it cannot be estimated from prior literature or is not easily calculable.
F tests – MANOVA: Repeated measures, within-between interaction
Options: Pillai V, O'Brien-Shieh Algorithm
Analysis: A priori: Compute required sample size Input: Effect size f(V) = 0.5 α err prob = 0.05
Power ($1-\beta$ err prob) = 0.95
Number of groups = 2
Number of measurements = 2
Output: Non-centrality parameter λ = 13.5000000
Critical F = 4.0266314
Numerator df = 1.0000000
Denominator df = 52.0000000
Total sample size = 54
Actual power = 0.9500773
Pillai V = 0.2000000
Note: This sample (54) was used with 10% attrition rate.
Target sample (54) subjects with 10% attrition rates = 59 subjects.

Sampling

Approximately 60 subjects purposively selected and then randomly selected and assigned equally to the two arms of the study.

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Figure 1: Drying of Chipped Pumpkin ((cucurbita maxima)

Procedure for processing the flour for the feed

The pumpkins were first washed to remove the soil and any unwanted parts. They were then chipped. After the chipping, the pumpkin chips and seeds were then dried outside on a canvas for a maximum of eight (8) hours per day for two weeks. When the chips and seeds were dry and crispy, they were milled using the local milling machine. The flour was then weighed, packed, labeled, and stored in the kitchen store. Likewise, the millet and soya beans were selected dirt removed, washed dried, and roasted to minimize anti–nutrients in readiness for milling into flour.

Figure: 2 organoleptic tests for the Power Porridge (PROLCARMIV)

The porridge was prepared for the 30 clients. The cooks served the porridge in designated mugs of 500mls for the treatment group and plumpy'nut was distributed to the control group by nutritionists, care was taken so that the clients did not take feeds that were not meant for them. This was achieved by using a list to call them out then instructed to sit in a designated place.

Study Measurable Variables

The variables analyzed at baseline and post-intervention included anthropometric measurements, dietary practices, cholesterol levels, hemoglobin levels, blood sugar levels, proteins in urine, specific gravity (SG), leucocytes, low-density lipoproteins (LDL), high-density lipoproteins (HDL), triglyceride, alanine transaminase (ALT), aspartate (AST) transaminase, alkaline phosphatase (ALP), gamma glutamyl transferase (GGT), total protein (PT), bilirubin time (BT), and albumin levels.

Statistical analysis

The data entry was done using Microsoft Excel and the analysis was done using SPSS version 26 for Windows. Descriptive statistics for the biochemical variables: mean, standard deviation, standard error, range and median were used. Mean change from baseline to post-intervention was obtained for the control and treatment groups. The t-tests were carried out for differences between the control and treatment groups. The intervention effect and the 95% confidence intervals (CI) were estimated from the differences. Data was tested for equality of variances and the appropriate value for significance (P- value) was applied. The t–test for paired data was used to compare pre- and post-intervention values within each group. P- values <0.05 were considered to be statistically significant.

RESULTS AND DISCUSSION

Objective number one of the study was to establish the prevalence of NCDs among PLHIV at the CCC in Busia County referral hospital, Kenya. The study findings indicate that a high percentage of the respondents were females as compared to males. The highest percentage study population was women, and most of them were living with HIV and NCDs. These results are in agreement with the 7th edition AIDS in Kenya reports which found an HIV prevalence rate of eight percent in adult women and four percent in adult men [10, 17].

What we eat and our nutritional status can affect cardiovascular diseases, some types of cancer, diabetes, and hypertension. Foods, diet, and nutritional status, including overweight and obesity, are associated with elevated blood pressure, blood cholesterol, and resistance to the action of insulin. These conditions are not only risk factors for NCDs but major causes of illnesses themselves [11, 18, 25] Consuming predominantly plant-based diets reduces the risk of developing obesity, diabetes, cardiovascular diseases, and some forms of cancer. Plant-based diets are high in vegetables and fruits, whole grains, pulses, nuts, and seeds, and have only modest amounts of meat and dairy. These diets help to achieve and maintain a healthy weight, reduce blood pressure, and are also rich in sources of dietary fiber, which protects against colorectal cancer [12]. This study looked at the effect of a food-based nutrition intervention that was basically plant-based, it focused on soya, millet, pumpkin, and plumpy'nut, and the effect on the study variables such as Low-Density Lipid, Total Cholesterol, and Triglyceride was decreased right from baseline to post–interventional.

Objective two of the study was to determine anthropometric measurements of PLHIV with NCDs at the CCC in Busia County referral hospital, Kenya.

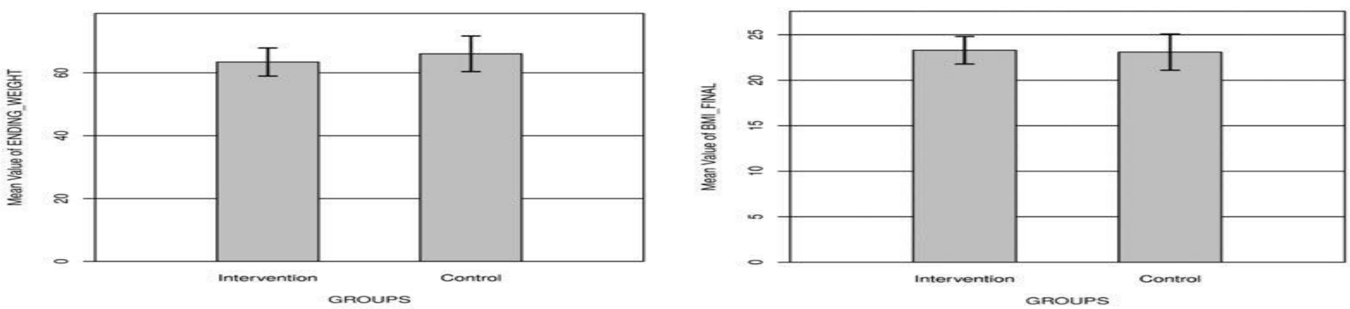

Figure 3: Ending Weight and final BMI for intervention and control groups

The increase in the BMI for the intervention group may be attributed to the compliance rate at which the subjects were feeding on the power porridge. This group's compliance rate was slightly higher, as observed in attendance, and it could be suggested that in this cohort there was an effect of the power porridge on the subject's weight. For post intervention weight, the t-test revealed a significant difference in post-intervention weights between the two groups (P = 0.044). Similarly, the mean post-intervention BMI of the intervention group (24.49) was statistically significantly different from that of the control group (23.98) (P = 0.041).

Objective three of this study was to assess dietary practices for PLHIV with NCDs at the CCC in Busia County Referral Hospital, Kenya.

Food Consumption Score (FCS) [9] is a proxy for household food security and is designed to reflect the quality of the population's diet. To measure the proportion of the target population with an acceptable FCS, household data on the frequency of eight food groups consumed over the previous seven days were collected.

In this study, the food consumption score was arrived at by using a modified Hellen Keller's food frequency questionnaire. The food consumption score classifies households into three categories namely: Poor (<21), Borderline (21.5-35), and Acceptable (>35) [13]. These study findings indicate that the majority of households of study subjects fell into the borderline category. The majority of the households (71.9%) fell into the 'Borderline' category with scores between 21.5 and 35. A notable 21.4% of the households had a 'Poor' food consumption score, indicating that these households might have inadequate access to a diverse and balanced diet, which may contribute to poor nutritional outcomes.

Objective number four of this study was to establish baseline lipid profile, random blood sugar levels, hemoglobin levels, and liver and kidney function of PLHIV with NCDs at the CCC in Busia County referral hospital, Kenya. The laboratory analysis of the following variables Hb, LDL, HDL, TG, DB, AST, ALT, ALB, ALP, TP, urea, creatinine, Na, K, CL and RBS was conducted at baseline and post-intervention to determine the effect of use of standard food product (Plumpy'Nut) and treatment food product (PROLCARMIV) among PLHIV with NCDs at the CCC in Busia County referral hospital in western region of Kenya.

There was an elevation of Hb levels following the intervention baseline (M = 13.27, SD = 1.99) vs. post-intervention (M = 13.91 SD 2.79), p =0.009. This finding indicates that the intervention led to a significant change in Hb levels within the intervention group from baseline to post-intervention (HB), the average level was slightly higher in the intervention group (M = 13.07 SD 2.10) than in the control group (M = 12.96, SD = 1.83). Additional laboratory chemistry test results for the control and experimental groups showed the following: Total Cholesterol (TC), for both the intervention and control groups, there was a significant decrease in TC levels from baseline to post-intervention (p < .001). The intervention group showed a mean decrease of 53.83 mmol/L (SD = 5.37) with a large effect size (d = 11.48), while the control group had a mean decrease of 59.76 mmol/L (SD = 5.38) with a similar effect size (d = 12.46). However, the TC mean was 4.39 (0.95) for the control group: 3.78 (0.94) was the mean for the intervention group with a p=0.017; HDL for the control group, the mean was 1.58 (0.57): 1.14(0.53), for the intervention group p=0.036: TG for the control group mean was 1.50 (0.50): for the intervention group p= 0.017: mean was 1.14: (0.46); LDL mean was 2.26(0.66) for the control group: the mean 1.43(0.42) for the intervention group p= 0.041: TC, LDL, HDL, TG exhibited significant decreases.

This study is indicative of the positive gains of the food-based nutrition intervention which was plant based in the reduction of TC, LDL, HDL and TG that were measured in the study subjects, it revealed that a high dietary intake of phytochemicals with vegetables, fruits, nuts, legumes, and whole grains is associated with a reduced risk for cardiovascular and other diseases [13]. Research has focused on the possible mechanisms of action of phytochemicals in preventing or treating NCDs, cancer, and heart diseases [14].

In recent years the role of some secondary metabolites such as phenols, polyphenols, phenolic, and tannins as protective dietary constituents has become an increasingly important area of human nutrition research. Unlike traditional vitamins, they are not essential for short-term well-being, but there is increasing evidence that modest long-term intakes can have favorable impacts on the incidence of cancers and many chronic diseases, including cardiovascular disease and type II diabetes, which are occurring in Western populations with increasing frequency [15].

CONCLUSION, AND RECOMMENDATIONS FOR DEVELOPMENT

The study aimed to investigate the effect of a food-based intervention on the management of NCDs among PLHIV in Busia. The results indicate that the most common NCD among the study subjects is hypertension. Further, findings showed that there was decreased total cholesterol, triglycerides, low density lipids and high-density lipids, indicating that PROLCARMIV can be used successfully in the management of NCDs among people living with HIV. High compliance in the intervention group, attracted adherence to CCC services, high attendance was observed as shown in the results, making the food-based intervention key in contributing to the quality of life (QoL) of the study subjects.

However, there was also elevated RBS in both control and experimental, prompting the need to do further research to isolate whether the effect was caused by ARVS or PROLCARMIV or the standard food product that was used in the study. Other effects were increased Hb and BMI; subsequently the dietary practices among the subjects were such that staple porridge, maize meal, and vegetables were consumed on a daily basis which is not in line with the national guidelines on healthy diets and lifestyles vthat recommends consumption of a diversified diet [16].

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Table 1: The ingredients and amounts for serving 30 adults -PLHIV with NCDs

PLUMPY 'NUT = 30 SACHETS	POWER PORRIDGE = 18LITERS
Standard Food	**Treatment Food**

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Peanut paste, vegetable oil, powdered milk, powdered sugar, vitamins, minerals 1 Sachet - Plumpy'Nut = 92 gms 1 sachet per person per day	Pumpkin flour = 300gms Soya bean Flour= 385 gms Millet flour = 300gms Sugar = 900gms Sun flower oil = 25 mls Water 19 liters I cup = 500mls per person per day of porridge

Organoleptic tests were done for taste, color, consistency, and texture, adjustments and improvements were made accordingly

Table 2: Socio-demographic characteristics

Relation to the household head	Household head Spouse/wife	26 (57.8) 19 (42.2)
Gender	Female Male	28 (62.2) 17 (37.8)
Age group, years	50 ≤ >50	24 (53.3) 21 (46.7)
Marital status	Married Single Widowed	30 (66.7) 3 (6.7) 12 (26.7)
Religion	Catholic Muslim Protestant	9 (20.0) 2 (4.4) 34 (75.6)
Level of education	College Lower primary Not attended school Secondary Upper primary	7 (15.6) 1 (2.2) 2 (4.4) 10 (22.2) 25 (55.6)
Occupational status	Not applicable Temporary employed Unemployed	2 (4.4) 10 (22.2) 33 (73.3)
Type of work	Artisan/Jua kali Business Casual laborer Farming Not applicable	3 (6.7) 20 (44.4) 12 (26.7) 4 (8.9) 6 (13.3)

Socio-demographic data are presented as n (%) number of participants (percentage)

Table 3: Baseline food consumption scores for control and intervention groups

Food consumption score (FCS)	**Control n =23**	**Intervention n =22**	**COR (95% CI)**	**AOR (95% CI)**	**P**
Poor <21	4 (8.0)	6 (13.3)	1.00 (ref)	1.00 (ref)	-
Borderline (21.5-35)	17 (37.7)	15 (33.3)	2.22 (1.01 - 4.88)	1.89 (0.86 - 4.14)	0.073
Acceptable >35	2 (4.4)	1 (2.2)	1.46 (0.61 - 3.47)	1.32 (0.55 - 3.17)	0.524

COR = crude odds ratio, AOR = adjusted odds ratio, CI = confidence interval. The P-value represents the statistical significance

Table 4: Two-tailed independent Samples t-test for anthropometric parameters by groups

Variable	**Control M (SD) n=23**	**Intervention M (SD) n=22**	**P**
Baseline Weight (kg)	65.96 (14.03)	62.84 (10.84)	0.411
Post-intervention Weight (kg)	66.07 (13.86)	64.89 (11.32)	0.044
Height (m)	1.68 (0.14)	1.68 (0.08)	0.823
Baseline BMI (kg/m²)	23.05 (4.96)	23.08 (3.77)	0.642
Post-intervention BMI (kg/m²)	23.9 8 (3.62)	24.4(6.34)	0.041

Note: Data are presented as mean (SD), the p-value is set at 0.05

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