International Journal of Food Science and Nutrition
www.foodsciencejournal.com
ISSN: 2455-4898
Received: 14-08-2024, Accepted: 13-09-2024, Published: 28-09-2024
Volume 9, Issue 3, 2024, Page No. 59-64

Socio-demographic factors and nutritional status assessment for nutritional interventions for women with HIV/AIDS in Bauchi state, Nigeria

Adebusoye Michael Sunday[1], Gbadegesin Imosi Oyesola[1*], Alabi Olubunmi Dupe[1], Adeyemo Ganiyat Adebola[1], Aderinkomi Abosede[2]

[1] Department of Nutrition and Dietetics, Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria
[2] Department of Guidance and Counselling, Federal Polytechnic Bauchi, Bauchi State, Nigeria

Abstract

Introduction: Human Immunodeficiency Virus (HIV) infection and Acquired Immune Deficiency Syndrome (AIDS) are becoming more critical global public health and development challenges. The study aimed to evaluate the socio-demographic factors, nutritional parameters, and anthropometric profiles in relation to nutritional interventions for Women Living with HIV/AIDS (WLWHA) in Bauchi State, Nigeria.

Methodology: A randomized block design was employed, with participants randomized into four groups: Nutrition Education (NE), Nutrition Education and Supplementary Feeding (NS), Supplementary Feeding (SF), and Control. The study population comprised HIV-positive women receiving Highly Active Antiretroviral Therapy (HAART). Sampling techniques involved a multistage approach, with interventions tailored to individual groups. Data were collected using structured questionnaires and measuring tools, covering identification, socio-demographics, and anthropometric measurements using the 2006 WHO standards. Statistical analyses were performed using SPSS version 25.0.

Results: The study included 426 participants, with 25.4% aged 18-25 years and 30.8% having secondary education. Only 27.5% earned above N50,000 monthly. Most participants (98.6%) had a low-risk waist circumference (<80 cm), but 57.0% showed severe malnutrition (MUAC <22.0 cm). Mean weight was similar across groups, around 64.0±12.5 kg ($p = 0.905$), and height was consistent at 1.59±0.342 meters ($p = 0.849$). Hip circumference means ranged between 75.80 cm and 76.54 cm ($p = 0.961$). BMI showed 35.9% with normal weight, 34.5% underweight, and 14.1% overweight. Waist-hip ratio means ranged from 0.81 to 0.85 ($p = 0.142$). Significant differences were found in waist circumference ($p = 0.001$) and MUAC ($p = 0.011$), indicating changes in body composition and muscle or fat mass, while hip circumference ($p = 0.208$) and waist-hip ratio ($p = 0.373$) showed no significant changes.

Conclusion and Recommendation: Nutrition interventions, including education and supplementary feeding, improved socio-economic status and nutritional parameters among women with HIV/AIDS. The study recommends integrating these interventions to enhance the nutrition and health outcomes of people living with HIV/AIDS.

Keywords: Women, HIV/AIDS, socio-demographic characteristics, anthropometric measurements, nutritional interventions – total words 313

Introduction

Acquired Immunodeficiency Syndrome (AIDS) is a consequence of impaired cellular immunity caused by human immunodeficiency virus (HIV) infection. It is identified by a CD4 positive lymphocyte count below 200 cells/micrometer and an elevated risk of opportunistic infections [1]. In May 1981, Dr. Michael Gottlieb of the Medical School of Los Angeles reported the first instances of AIDS in the United States. Following this, an official report from the Centre for Disease Control (CDC) on June 5, 1981, [2] further documented these cases, as outlined in the National Library of Medicine's information on acquired immunodeficiency syndrome. Nigeria, the most populous country in Africa and the seventh globally, is estimated to have a population of around 206,139,589 people [3]. The inaugural HIV/AIDS sentinel survey in 1991 reported a prevalence of 1.8%, which then increased to 3.8% in 1993, 4.5% in 1996, 5.4% in 1999, peaking at 5.8% in 2001c [4]. Subsequently, there was a declining trend post-2001, with rates of 5.0% in 2003, 4.4% in 2005, 4.6% in 2008, 4.1% in 2010, and 3.4% in 2013 [5].

With 3.4 million Nigerians living with HIV/AIDS, Nigeria is now ranked as the second-highest country globally in terms of the HIV/AIDS population, as reported by the National Agency for the Control of AIDS (NACA) in 2020. In Bauchi State, a 2010 report from the Bauchi State Agency for the Control of HIV/AIDS, Tuberculosis, Leprosy, and Malaria (BACATMA) revealed that over 40,000 people were infected with HIV/AIDS, with 14,000 already on anti-retroviral treatment [6]. Recent figures from BACATMA in 2020 show a substantial reduction in HIV/AIDS prevalence in the state, declining from 6.8% in 2001 to 0.4% in 2019. However, the state currently has 25,809 individuals living with the virus across its 20 local government areas, with 20,961 undergoing treatments at designated health facilities [7]. The HIV/AIDS epidemic, as highlighted by UNAIDS in 2016, presents a challenge to the health and overall socio-economic development in affected countries, impacting nutrition and food security [8].

The impact of socioeconomic status on HIV risk varies between men and women [9]. Findings suggest that income inequality is linked to an increased risk of HIV in males, while factors such as poverty, health, and housing circumstances are associated with elevated risk in females. Notably, both genders exhibit a lower likelihood of survival following an HIV diagnosis when exposed to heightened poverty and unemployment levels, coupled with a decrease

in median household income, as highlighted in the research by [10] Harrison, Ling, Song, and Hall (2008) [10].

Nevertheless, to our knowledge, scarce data is available on the evaluation of socio-demographic factors, nutritional parameters, and anthropometric profiles in relation to nutritional interventions for Women Living with HIV/AIDS (WLWHA) in Bauchi State, Nigeria. Hence, the main objective of this study is to evaluate socio-demographic factors, nutritional parameters, and anthropometric profiles in relation to nutritional interventions for Women Living with HIV/AIDS who are starting antiretroviral treatment.

Methodology

Brief description of study area

Bauchi State, one of Nigeria's 36 administrative states, stands among the 19 northern states and is recognized as one of the far-northern regions, predominantly inhabited by the Hausa/Fulani and Muslim communities, established in 1976.The present Bauchi State consists of 20 Local Government Areas and is situated in the northeastern part of Nigeria, representing 3.26 percent of the country's population. Notably, the population exhibits a balanced gender distribution, with 50.5 percent males and 49.5 percent females. Another significant aspect is the prevalence of young people, constituting 55.4 percent of the population aged 0 to 19 years. The economically active group, aged 20 to 64, accounts for 41.2 percent, while those aged 65 and above comprise only 3.4 percent of the population, as reported by the National Bureau of Statistics in 2016 [11].

Study design

The study employed a randomized block design, incorporating a pre-treatment phase preceding the randomization of participants into four groups: Nutrition Education (NE) group, Nutrition Education and Supplementary Feeding (NS) group, Supplementary Feeding (SF) group, and Control group. This randomization followed a factorial design, constituting a 6-month treatment protocol.

Study population

The population for this study was women living with HIV/AIDS in Bauchi State, receiving highly active antiretroviral therapy (HAART).

Inclusion criteria

All consenting HIV-positive women receiving HAART, irrespective of age.

Exclusion criteria

HIV-positive pregnant women not currently receiving HAART and those who were currently pregnant or had given birth within 2 months of the survey were excluded**.**

Sample size determination

Based on available data from 2015, the Bauchi State Agency for the Control of HIV/AIDS, Tuberculosis, Leprosy, and Malaria (BACATMA) reported 14,000 people living with HIV/AIDS receiving Highly Active Antiretroviral Therapy (HAART) in Bauchi State. The sample size required for this study was calculated using the formula from [12].

$$\text{Sample size (n)} = \frac{N}{1 + N(e)^2}$$

Where

n - Sample Size

N - Population Size (14,000 of HIV people receiving (HAART) in Bauchi State, 2019).

e - is the desired level of precision at 5%

$$n - \frac{14{,}000}{1 + 14{,}000(0.05)^2}$$

n - 388

Drop-out rate: To take care of non-response and to increase representativeness

$$N_s - \frac{n}{1-d}$$

Where,

D - Anticipated dropout rate 10% (0.1)

N_s - Adjusted sample size

n - Calculated sample size (388)

$$N_s - \frac{n}{1-d}$$

$$N_s - \frac{388}{1-0.1}$$

$$N_s - \frac{388}{0.9}$$

N_s - 431

However, a total of 450 participants were sampled, but 426 participants completed the study.

Sampling techniques

The study employed a multi-stage sampling technique at the Infectious Diseases Hospital in Baraya, Bauchi State. Eligible participants were identified from the medical record registry on different clinic days. Sampling intervals were determined (Nr/n = 1826/450 = 4), and participants were selected every 4th interval using a simple random technique. Randomization allocated participants into four groups, considering confounding variables like maternal factors (age, parity), and socio-economic characteristics (income, education, occupation). This approach aimed to eliminate allocation bias and ensure an even distribution of variables for the effectiveness of the intervention.

Intervention stage

In Group 1, consisting of 122 participants, the intervention focused solely on nutrition education using a specialized module for individuals living with HIV/AIDS.

Group 2, with 95 participants, received both nutrition education and supplementary feeding interventions, incorporating the same education module. Modalities for receiving and monitoring supplementary feeding were explained to this group.

Group 3, comprising 103 participants, exclusively underwent supplementary feeding intervention, with engagement in the modalities for receiving and monitoring supplementary feeding.

The Control Group (130 participants) shared identical baseline characteristics, specifically HIV-positive status, allowing for a comparison of changes in nutritional status between the intervention and control groups. This comparison aimed to determine whether improvements observed in nutritional status were a result of the intervention program or unrelated changes.

Monitoring of supplementary feeding

The participants received weekly rations of fruits and vegetables valued at N200 through nearby dedicated grocery shops. Phone calls were made to remind and monitor the participants, and records of the collected items (fruits and vegetables) were captured and stored.

Data collection tools and procedure

Data were gathered through structured interviewer-administered questionnaires and measuring kits. The questionnaires included two sections: the first covered participant identification and socio-demographic information, while the second involved anthropometric measurements such as height, weight, hip and waist circumferences, and mid-upper arm circumference (MUAC) using the 2006 WHO anthropometric standards.

Anthropometric measurement procedures

Anthropometric measurements, including height, waist, and hip, were taken using a Stadiometer and tape rule (butterfly model), following WHO standards, and Waist/Hip Ratio (WHR) was calculated. Mid-upper arm circumference (MUAC) was measured with a flexible non-stretchable tape, and readings were recorded to the nearest 0.1 cm. Three measures were taken for each parameter, and the mean was calculated. Weight was measured using a Bathroom scale (Hanson model), adjusted to zero, with participants standing without shoes and jewelry for an accurate reading, recorded to the nearest 0.1 kg. All measurements were used to determine the nutritional status of the respondents. Trained female research assistants conducted the anthropometric measurements, adhering to the 2006 WHO Anthropometric standards.

Statistical analysis

The collected questionnaire was checked manually for its completeness, coded and entered into Microsoft excel then exported to Statistical Package for the Social Sciences (SPSS) version 25.0 for further analysis. Descriptive statistics such as mean, standard deviation, frequency and percentage were used to analyse the socio-economic and demographic data inferential statistics were conducted to analyse normally distributed continuous data.

Parameters of interest

The parameters of interest followed for the present study were: age, sex, religion, monthly income, level of study, marital status, occupation, numbers of wife, height, weight, Mid Upper Arm Circumference, Waist/Hip - Ratio, body mass index (BMI), etc.

Ethical consideration

Ethical approval was obtained from the Research Ethics Committee of the Bauchi State Ministry of Health. Authorization to access the Facility Treatment centers was obtained from each competent authority of the various units included.

Results

Table 1: Socio-demographic characteristics of participants (n=426)

Variable	Frequency	Percentage
Age (years)		
18 – 25	108	25.4
26 – 35	88	20.7
36 – 45	78	18.3
46 – 55	62	14.6
> 55	90	21.1
Marital status		
Single	106	24.9
Married	230	54.0
Separated	26	6.1
Divorced	26	6.1
Widowed	38	8.9
Religion		
Islam	284	66.7
Christianity	142	33.3
Ethnicity		
Hausa	167	39.2
Fulani	61	14.3
Yoruba	16	3.8
Igbo	24	5.6
Others	158	37.1

Table 1: cont'd: Socio-demographic characteristics of participants (n=426)

Variable	Frequency	Percentage
Position of Wife		
1st	178	41.8
2nd	130	30.5
3rd	17	4.0
None	101	23.7
Number of Children		
None	98	23.0
1 – 2	97	22.8
3 – 5	115	27.0
6 – 8	95	22.3
9 – 11	16	3.8
> 11	5	1.2
Household Size		
1 – 2	39	9.2
3 – 5	157	36.9
6 – 8	152	35.7
9 – 11	78	18.3

Table 1 showed the socio-demographic characteristics of the participants, about a quarter (25.4%) of the participants were between the ages of 18 – 25 years, however, a little above one-seventh (14.6%) of them were between the age of 46 and 55 years. Slightly above half (54.0%) of the participants were married followed by 24.9% that were single, while few (6.1%) were separated and divorced respectively. Their predominant (66.7%) religion was Islam and (39.2%) were Hausas'. Below half (41.8%) were first wives followed by 30.5% that were 2nd wives while a few (4.0%) were 3rd wives. Above a quarter (27.0%) of the participants have a total number of children between 3 and 5, while 23.0% had no children. Above one- third (36.9% and 35.7%) reported that, their household sizes were between 3, 5, 6, and 8 respectively.

Table 2: Socio-economic characteristics of participants (n=426)

Variable	Frequency	Percentage
Level of Education		
No Education	51	12.0
Islamic Education	55	12.9
Primary	126	29.6
Secondary	131	30.8
Tertiary	63	14.8
Occupation		
Civil Servant	108	25.4
Trader	86	20.2
Farmer	84	19.7
Student	46	10.8
Artisan	23	5.4
Apprentices	19	5.4
Unemployed	60	14.1
Monthly Income		
<N10,000	9	2.1
N 10,000 – N 30,000	51	12.0
N 30,500 – N 50,000	53	12.4
>N 50,000	117	27.5
No Specific Income	196	46.0

Table 2 showed the socio-economic characteristics of the participants, where most (30.8%) of them had secondary school education followed by 29.6% who had primary school education and 14.8% for tertiary education respectively. One-quarter (25.4%) are civil servants, which occupy the largest, while 14.1% of them were unemployed. Finally, above a quarter (27.5%) reported that they received above N50, 000 monthly as income.

Table 3: Anthropometric Measurements of Participants (n=426)

Variable	Frequency	Percentage
Waist Circumference		
Low risk (< 80cm)	420	98.6
High risk (> 88cm)	6	1.4
Waist – Hip – Ratio		
Low risk (< 0.80)	157	36.9
Moderate risk (0.81 – 0.85)	87	20.4
High risk (> 0.85)	182	42.7
Mid Upper Arm Circumference		
Severe (< 22.0cm)	243	57.0
Moderate (22.1 – 24.9cm)	141	33.1
High (> 25.0cm)	42	9.9

With respect to participant's waist circumference, table 3 shows that majority (98.6%) of the participants had less than 80cm waist circumference that is, at low risk while minorities (1.4%) were at high risk. Also, higher percentage (42.7%) of the participants though below average were at high risk of cardiovascular disease with respect to their Waist Hip Ratio (WHR) measurement followed by 36.9% that were at low risk and 20.4% that were at moderate risk of cardiovascular diseases. Moreover, considering their Mid Upper Arm Circumference (MUAC) above average (57.0%) were severely malnourished (< 22.0cm) while just a few (9.9%) had high MUAC (> 25.0cm).

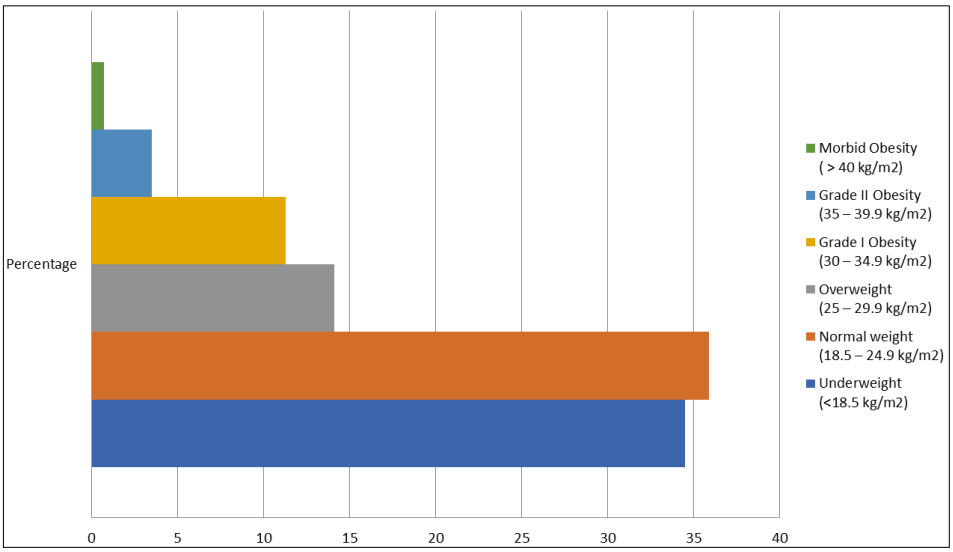

Fig 1: Body mass index of participants in percentage

Also, considering, their Body Mass Index (figure 1), a high percentage (35.9%) of participants had normal weight while 34.5% and 14.1% were underweight and overweight respectively.

Table 4: Descriptive analysis of selected baseline parameters (n=426)

Parameter	Nutrition Education Group (n=114) Mean ± S.D	Nutrition Education & Supplement Group (n=92) Mean± S.D	Supplement Group (n=96) Mean± S.D	Control Group (n=124) Mean± S.D	p-value
Weight (kg)	64.94±12.64	64.16±12.30	64.51±12.74	63.77±12.13	0.905
Height (m)	1.59± 0.07	1.59± 0.08	1.59± 0.08	1.60± 0.07	0.849
BMI (kg/m^2)	25.52± 5.40	25.30± 5.29	25.59± 5.72	24.93± 5.11	0.789
Waist Circumference (cm)	62.95± 9.92	62.23± 9.72	63.79±10.65	61.58± 9.97	0.413
Hip Circumference (cm)	75.80±9.97	76.03±10.83	76.06±11.06	76.54±10.97	0.961
Waist–Hip Circumference	0.83±0.09	0.82±0.12	0.85±0.13	0.81±0.11	0.142
MUAC (cm)	22.1±2.38	22.0± 2.32	21.8± 2.12	22.13±2.56	0.677

From Table 4 shown that, there was no statistically significant difference (p>0.05) in different groups considering their anthropometric variables.

Table 5: Descriptive analysis of selected endline parameters (n=426)

Parameter	Nutrition Education Group (n=114) Mean ± S.D	Nutrition & Supplement Group (n=92) Mean ± S.D	Supplement Group (n=96) Mean ± S.D	Control Group (n=124) Mean ± S.D	Anova p-value
Weight (kg)	66.50±11.85	71.36±11.98	71.52±12.82	62.48±11.70	0.040*
Height (m)	1.57±0.08	1.55±0.07	1.54±0.09	1.61±0.05	0.001*
BMI (kg/m^2)	24.96±0.78	27.03±0.73	26.99±0.78	25.44±0.89	0.000*
Waist Circum. (cm)	64.99±0.79	64.92±0.77	65.97±0.80	64.23±0.94	0.001*
Hip Circum. (cm)	74.66±0.98	84.72±0.88	79.74±0.90	78.49±0.92	0.208
Waist–Hip Circum.	0.88±0.65	0.89±0.07	0.91±0.09	0.42±0.64	0.373
MUAC (cm)	24.33±1.81	24.76±1.71	26.62±1.27	20.83±1.02	0.011*

* Significant at p<0.05

Discussion

This study aimed to provide baseline data on socio-economic status (SES) and anthropometric characteristics in relation to nutritional interventions for Women living with HIV/AIDS. HIV/AIDS infects women at the peak of their productive and income-generating years. Families feel its economic impact as soon as one of their members falls ill with an AIDS-related condition. Socio-economic status encompasses aspects of life quality, opportunities, and privileges within society. The impact of low socio-economic status, including lower educational attainment, poverty, and poor health, resonates throughout our society, leading to disparities in health distribution, resource allocation, and overall quality of life. Consequently, this study aims to offer evidence-based insights into the interplay between socioeconomic status, HIV prevalence, and anthropometric status specifically among women with HIV (women living positive). The findings of this research furnish valuable information for HIV programmers, policymakers, and all stakeholders involved in HIV, health, and the quality of life for women living positive in Nigeria.

The socio-economic characteristics of the participants in our study revealed some interesting patterns. Similar to our findings, a study conducted in a different region found that a significant proportion of participants had attained secondary school education, followed by primary and tertiary education levels [13]. Additionally, our study observed a comparable distribution of participants across various employment statuses, with a notable proportion being civil servants and some reporting unemployment. However, the reference to the 2015 Chinese General Social Survey (CGSS), a continuous large-scale nationwide survey conducted by the National Survey Research Center of China, appears to be out of context. Its relevance to the socio-economic status of women living with HIV in Nigeria remains unclear.

The results indicated that SES had a significant impact on people's physical health, but lifestyle had significant positive effects on both physical and psychological health. In addition, lifestyle mediated the relationship between SES and health [13, 14]. Furthermore, in line with our findings, another study reported that a substantial portion of participants had monthly incomes above a certain threshold, reflecting a diverse range of income levels within the cohort [15].

Our study revealed significant insights into the anthropometric characteristics of women living with HIV. Similar patterns were observed in a study conducted elsewhere, which found that the majority of participants had waist circumferences below 80cm, indicating a low risk for cardiovascular disease. This is also in line with findings from other studies in similar setups [16, 17]. However, contrasting findings were reported regarding the waist-hip ratio (WHR) measurements, where a higher percentage of participants in our study were categorized as being at high risk for cardiovascular disease [18]. Furthermore, concerning mid-upper arm circumference (MUAC), our study identified a substantial proportion of participants with measurements indicative of severe malnutrition, aligning with findings from another study that highlighted the prevalence of malnutrition among women living with HIV [19]. This can be justified by the advanced stage of the disease, high prevalence of malnutrition, and low socio-economic status.

The findings from Table 4 indicate that there were no statistically significant differences (p>0.05) in anthropometric variables among the different groups, despite variations in nutrition education and supplementation. These results align with those of a similar study that investigated the effects of nutrition education and supplementation on anthropometric measurements, reporting no significant differences across intervention groups [20]. Additionally, another study exploring the impact of nutrition interventions on anthropometric outcomes found comparable results, suggesting that while interventions may influence dietary behaviors, they may not necessarily lead to significant changes in anthropometric parameters.

Conclusion

Based on the findings of the study, it was clear that poor nutritional status, impaired immune function, increased vulnerability to infections, and increased nutritional needs significantly influence the overall nutritional status. For women living with HIV, these factors are impacted by income, education, occupation, and maternal responsibilities. Although the effect of nutrition education on knowledge, attitudes, and dietary practices was evident, the study concluded that the nutrition information provided by support group caregivers was not strongly associated with the nutritional status of individuals living with HIV. However, considering the effectiveness of intensive nutrition education programs on knowledge and practice, they were found to promote enhanced and long-lasting desirable changes.

Recommendations

In view of the above conclusion, we recommend that public health educational programs on general public health nutrition be conducted periodically at HIV centers in rural areas by public health professionals, such as dietitians or nutritionists. Larger-scale investigations should be conducted to explore the nutrition-related knowledge, attitudes, and practices (KAP) and nutritional status of women living with HIV/AIDS in Nigeria. These studies will help shape interventions, ensure they focus on the most critical aspects of nutrition, and assess the barriers to healthy nutrition within this population

References

1. National Library of Medicine. Acquired Immunodeficiency Syndrome. Available at: https://www.ncbi.nlm.nih.gov/mesh/68000163. Accessed 22 May 2022.
2. EROS. The Republic of Nigeria. Available at: https://eros.usgs.gov/west-africa/country/republic nigeria. Accessed 22 May 2022.
3. Worldometer. African countries by population, 2022. Available at: https://www.worldometer.info/population/countries in by population/. Accessed 22 May 2022.
4. Awofala AA, Ogundele OE. HIV epidemiology in Nigeria. Saudi J Biol Sci,2018:25(4):697–703.
5. Federal Ministry of Health. National HIV & AIDS and Reproductive Health Survey 2012. NARHS plus II.
6. Bauchi State Agency for the Control of HIV/AIDs, Tuberculosis, Leprosy and Malaria (BACATMA), 2010. Available at: http://www.findingdulcinea.com.
7. Bauchi State Agency for the Control of HIV/AIDs, Tuberculosis, Leprosy and Malaria (BACATMA), 2020.
8. United Nations AIDS (UNAIDS). Report on the Global AIDS Epidemic. Global report: Annexes, 2012. [Google Scholar]. UNAIDS, 2016.
9. Buot MLG, Docena JP, Ratemo BK, Bittner MJ, Burlew JT, Nuritdinov AR, Robbins JR. Beyond race and place: Distal sociological determinants of HIV disparities. PLoS ONE, 2014, 9(4). https://doi.org/10.1371/journal.pone.0091711.
10. Harrison KM, Ling Q, Song R, Hall HI. County-level socioeconomic status and survival after HIV diagnosis. Ann Epidemiol,2008:18:919-927. doi: 10.1016/j.annepidem.2008.09.003.
11. National Population Commission and ICF Macro. Nigeria Demographic and Health Survey 2008. Abuja, Nigeria, 2009. Accessed 6 February 2016.
12. Glenn DI. Determining Sample Size. Florida Cooperative Extension Service, University of Florida, 1992. PEOD-6.
13. Wang J, Geng L. Effects of socioeconomic status on physical and psychological health: Lifestyle as a mediator. Int J Environ Res Public Health,2019:16(2):281. https://doi.org/10.3390/ijerph16020281.
14. Hergenrather KC, Zeglin RJ, McGuire-Kuletz M, Rhodes SD. Employment as a social determinant of health: A systematic review of longitudinal studies exploring the relationship between employment status and physical health. Rehabil Res Policy Educ,2015:29(1):2. https://doi.org/10.1891/2168-6653.29.1.2.
15. West J Med. Income inequalities and health disparities. West J Med,2000:172(1):25. https://doi.org/10.1136/ewjm.172.1.25.
16. Yoo JE, Han K, Jung JH, Hur YI, Kim YH, Kim ES, *et al*. Body mass index, waist circumference and cardiovascular diseases in transitional ages (40 and 66 years). J Cachexia Sarcopenia Muscle,2023:14(1):369–381. https://doi.org/10.1002/jcsm.13138.
17. Czernichow S, Kengne AP, Stamatakis E, Hamer M, Batty GD. Body mass index, waist circumference, and waist-hip ratio: Which is the better discriminator of cardiovascular disease mortality risk? Evidence from an individual-participant meta-analysis of 82,864 participants from nine cohort studies. Obes Rev,2011:12(9):680–687. https://doi.org/10.1111/j.1467-789X.2011.00879.x.
18. Chan V, Cao L, Wong MMH, Lo K, Tam W. Diagnostic accuracy of waist-to-height ratio, waist circumference, and body mass index in identifying metabolic syndrome and its components in older adults: A systematic review and meta-analysis. Curr Dev Nutr,2023:8(1):102061. https://doi.org/10.1016/j.cdnut.2023.102061.
19. Mishra V, Bignami S, Greener R, Vaessen M, Hong R, Ghys P, *et al*. A study of the association of HIV infection with wealth in sub-Saharan Africa.
20. Rachmah Q, Martiana T, Mulyono P, Paskarini I, Dwiyanti E, Widajati N, *et al*. The effectiveness of nutrition and health intervention in workplace setting: A systematic review. J Public Health Res,2022:11(1):2312. https://doi.org/10.4081/jphr.2021.2312.
21. Nitschke E, Gottesman K, Hamlett P, Mattar L, Robinson J, Tovar A, *et al*. Impact of nutrition and physical activity interventions provided by nutrition and exercise practitioners for the adult general population: A systematic review and meta-analysis. Nutrients,2022:14(9):1729. https://doi.org/10.3390/nu14091729.