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Relationship Between Body Mass Index And Acquired Immunodeficiency Syndrome Cases At Baseline Among Treatment–Naive HIV-Infected Patients In Nigeria

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Abstract: ***Body mass index (BMI) is a screening but not a diagnostic tool and it measures the nutritional status of an individual. Higher BMI is associated with number of medical conditions, however HIV patients with higher BMI value may have more protection compared to those HIV patients with lower BMI value in experiencing Acquired Immunodeficiency Syndrome. (AIDS).***

A cross-sectional study was adopted in which an association between Body Mass Index (BMI) and proportion of Acquired Immunodeficiency Syndrome (AIDS) cases among 180 adults, males and females, treatment naïve HIV infected patients, attending HIV clinics at Usmanu Danfodiyo University Teaching Hospital, Sokoto (UDUTH) and Specialist Hospital Sokoto (SHS), was evaluated from March 2014 to October 2015.

Overall, 76(42.2), 81(45), 20(11.1), and 3(1.7), were underweight, normal, overweight, and obese respectively. There were significant differences by BMI category in mean $CD4^+$ T lymphocyte counts and age group (P< 0.0001; 0.002 respectively). Female study participants had higher mean BMI compared to males (P< 0.022). Mean $CD4^+$ T lymphocyte counts was significantly higher among underweight compared to other BMI categories (0.0001). The proportion AIDS cases based on immunologically defined AIDS ($CD4^+$ T lymphocyte counts < 200 cells/mm³) coupled with symptoms of AIDS defining illnesses (ADI) or immunologically defined AIDS or symptoms of ADI were significantly higher among underweight compared to other BMI categories (P< 0.005; 0.046; 0.0001 respectively).

HIV health care providers should therefore give closer attention to BMI at HIV diagnosis, as it may be a predictor and potentially be useful as a marker for initiation of ART especially in resource limited countries.

Keywords: HIV infection, Body Mass Index, Acquired Immunodeficiency Syndrome.

I. INTRODUCTION

Acquired Immunodeficiency Syndrome is a symptomatic (AIDS) stage of HIV infection in which a patient present with one or combination of the following**:** $CD4^+$ T lymphocyte counts <200 cells/mm³ (Immunologically defined AIDS/severe immunosuppression), ≥ 2 symptoms of AIDS defining illnesses (ADI) coupled with immunologically defined AIDS or based on only symptoms of ADI

(http;//www.aids.gov/hiv-aids-basics/just- diagnosed- with-hiv-aids/hiv-in-your-body/stages-of-hiv).

Body Mass Index (BMI) is used as a measure of nutritional status of an adult. It is obtained by the formula (Mass{kg}/Height{m²}) and it is categorized into underweight (< 18.5), normal weight (18.5-24.9), overweight (25-29.9), and obese (≥ 30) (https://www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/index.html). Higher BMI is associated with number of medical conditions (Fantuzzi, 2005).

Adipose tissue plays an important role in regulating immunity, and underweight indicates nutrients deficiencies and decreased immune system function (Fantuzzi, 2005; http**:**//nutritionstripped.com/underweight.nutrition-tips-gaining-weight/). In the current study, we examined relationship between BMI and with proportion of AIDS cases, among adults treatment naïve HIV patients at initial visit.

II. MATERIALS AND METHODS

This was a cross-sectional study in which HIV infected men and women attending HIV clinics at Usmanu Danfodiyo University (UDUTH) Sokoto and Specialist Hospital Sokoto (SHS) between March 2014 to September 2015 were enrolled.

A total of 180 adults study participants, who provided written informed consent and were treatment-naïve were included into this study. Our study was approved by the ethical committees of UDUTH Sokoto and SHS.

Questionnaire was used for the collection of some information about the study participants as well as other study variables at baseline which include**:** BMI, symptoms of ADI, history of Intravenous Drugs Usage (IDU), and CD4 T-lymphocyte counts at baseline. The BMI of the study participants was obtained by dividing study participant's weight in kg by height in m² (mass {kg}/height {m²}). The $CD4^+$ T lymphocyte counts was performed with Cyflowcounter machine (PARTEC Company, Germany).

Mean $CD4^+$ T lymphocyte counts, risk cohort of IDU and proportion of AIDS cases were compared across BMI categories. Body Mass Index categories were also compared across Sex, age group and tribes. The data was analysed using Statistical Package for Social Sciences (Version 20, SPSS). Statistical significance of associations between variables were ascertained using chi-square test, Student's T-test and ANOVA. Results were considered statistically significant for P values of < 0.05.

III. RESULTS

BASELINE PARTICIPANT'S CHARACTERISTICS BY BMI

Of 180 HIV study participants,76(42.2), 81(45), 20(11.1) and 3(1.7) were underweight, normal, overweight and obese respectively at baseline. All the study participants were blacks and majority were Hausa by tribe 144 (80). Mean age of the study participants was 32 ± 9 (Mean ± SD).

There were significant differences in relation to mean $CD4^+$ T lymphocyte counts and age group with BMI category (P< 0.0001; 0.002 respectively), with underweight having lower $CD4^+$ T lymphocyte counts compared to other BMI categories. The mean BMI differ with sex, higher in females compared to males (P< 0.022). There were no significant differences by BMI category in Sex, Intravenous Drugs Usage (IDU) and tribes (P< 0.161; 0.370; 0.709 respectively). These results are shown in Table 1.

Parameter	Overall	Underweight	Normal	Overweight	Obese	P-value
NO of participant(%)	180(100)	76(42.2)	81(45)	20(11.1)	3(1.7)	0.0001
Sex						
(i) Mean BMI						
Female	20.3					
Male	18.7					0.022
(ii) BMI category; (%) of participants						
Female		52.6	64.2	70.0	100	
Male		47.4	36.8	30.0	0.0	0.161
Age (Mean± SD) Years	32 ± 9					
Age group; % of participants						
< 20		13.2	6.2	0.0	0.0	
21-30		55.3	43.2	25.0	66.7	
31-40		14.5	32.1	50.0	0.0	
41-50		15.8	11.1	25.0	0.0	
51-60		1.3	7.4	0.0	33.3	0.002
Ethnicity; % of participants						
Hausa	80.0	84.4	77.5	75.0	66.7	
Fulani	5.0	6.5	5.0	0.0	0.0	
Igbo	1.7	1.3	2.5	0.0	0.0	
Yoruba	1.7	1.3	1.2	0.0	0.0	
Others	11.6	6.5	13.8	25.0	33.3	0.709
Mean BMI	19.7	15.8	21.0	26.8	34.4	0.0001
$CD4^+$ T lymphocyte counts, cells/m³ (Mean± SD)	374 ± 294	264 ± 247	425 ± 289	425 ± 282	727 ± 529	0.0001
IDU % of participant	1.1	0.0	2.5	0.0	0.0	0.480

Table 1: Association of baseline participant's characteristics, with BMI

ASSOCIATION BETWEEN BMI AND PROPORTION OF AIDS CASES AT BASELINE

Proportion of AIDS cases based on immunologically defined AIDS coupled with symptoms of ADI, or immunologically defined AIDS or symptoms of ADI were significantly higher among underweight compared to other BMI categories (P< 0.005 ; 0.046 ; 0.0001). These results are represented in Table 2.

AIDS	Underweight n(%)	Normal n(%)	Overweight n(%)	Obese n(%)	P-Value
Immunologically defined AIDS ($CD4^+$ T lymphocyte counts < 200 cells/mm³) + ≥ 2 symptoms of ADI	40(58.8)	23(33.8)	4(5.9)	1(1.5)	0.005

Immunologically defined AIDS ($CD4^+$ T lymphocyte counts < 200 cells/mm³)	43 (51.2)	32 (38.1)	8 (9.5)	1 (1.2)	0.046
≥2 symptoms of ADI	52 (61.2)	28 (32.9)	4(4.7)	1(1.2)	0.0001

Table 2: Relationship between BMI and proportion of AIDS cases at baseline

IV. DISCUSSION

The study recorded 76(42.2), 81(45), 20(11.1) and 3(1.7) as the prevalence of underweight, normal, overweight and obese respectively, with more underweight and less obese compared with previous studies (Jones *et al*, 2003; Sharma *et* al, 2015). Reasons for these variations may be due to difference in ethnicity and sex background of the study participants. The current study incorporate both men and women and all have the same racial background (blacks), while previous studies recruited women as the only study participants with different racial background. The study found significantly lower mean $CD4^+$ T lymphocyte counts in underweight than in other BMI categories, and this is consistent with some studies (Jones *et al*, 2003; Sharma *et* al, 2015). Contrary, Crum-Cianflone *et al*, (2011*)* in their study did not observed significant difference, though recorded higher mean $CD4^+$ T lymphocyte counts among underweight compared to other BMI categories. Similarly an increased in BMI from baseline was found to be associated with a positive change in $CD4^+$ T lymphocyte counts (Jones *et al*, 2003).

This study observed significant difference in BMI category in relation with age group and greater proportion of underweight and obese (55.3 % and 66.7 % respectively) patients were found in age group 21-30. Similarly Crum-Cianflone *et al*, (2011) in their study reported that younger participants were more likely to be underweight. Body mass index category did not differ by ethnicity group. However previous studies reported contrary results with regard to BMI category in racial groups, comprising Blacks, Whites, Hispanic and others, though one of the studies enrolled women as the only study participants (Jones *et al*, 2003), while the other study recruited both men and women as the study participants, however did not incorporate underweight BMI category (Johnson, 2013). Therefore subsequent researches may provide more explanation about these variations.

No significant difference was observed by BMI categories in Intravenous Drug Usage (IDU) and Sex. Contrary Jones *et al*, (2003) in their study among HIV women observed that overweight and obese participants were less likely to have a history of IDU compared to other BMI categories. Sex was observed not to differ with BMI category, and this is contrary to a study done by Johnson, (2013) who observed significant difference between sex in relation to BMI category and men study participants were more likely to have normal BMI category. The mean BMI was significantly higher among females than in males (20.3 Vs 18.7 respectively) and this is comparable to what was obtained by Johnson, (2013) who observed (30.1 Vs 25.8) as mean BMI among females and males respectively.

Proportion of AIDS cases based on immunologically defined AIDS and or due to symptoms of ADI were significantly higher among underweight compared to other BMI categories. These results are consistent with finding of Sharma *et al.,* (2015), who documented significantly higher prevalence of AIDS defining illnesses in underweight compared to other BMI categories, in HIV infected women prior to HAART initiation and also recorded higher prevalence of immunologically defined AIDS in underweight compared to other BMI categories. These results are also closely related to the finding made by Jones *et al.,* (2003) in their study who observed that patients with higher baseline BMI were less likely to experience opportunistic infections during the course of HIV infection and higher prevalence of immunologically defined AIDS occurred in underweight compared to other BMI categories, with borderline significant difference..

Adipose tissue produces leptin, a proinflammatory factor that regulates immunity by influencing T lymphocytes and macrophages, there by enhancing their activities (Fantuzzi, 2005). Macrophages and T lymphocytes play a central role in the immunology of HIV infection and are paramount in the fight against various infections including opportunistic infections. Decreased leptin levels is experienced in malnourished individuals, and this might predispose them to increased susceptibility to various infections.

These points may explain why proportion of AIDS cases were more prevalent in underweight HIV patients compared to HIV patients with other BMI categories. These results also agreed with under nutrition as one of the main causes of immunodeficiency and nutrition serves as a determinant of immunity (Roitt *et al*, 2001; David *et* al, 1997). A vicious circle between infection and under nutrition in HIV patients may occur in which one aggravates the other with subsequent immunodeficiency.

V. CONCLUSION

In conclusion, this study found small proportion of study participants with overweight and obese. The BMI categories differ by age group, but did not differ with ethnicity. Female study participants had higher mean BMI compared to males. Being underweight increases the likelihood of having lower mean $CD4^+$ T lymphocyte counts and markers of AIDS. We recommend that routine assessment of BMI in the management of HIV patients should be maintained, and also support the idea of some researchers of considering BMI as a tool for initiation of Anti Retroviral Therapy (ART), especially in low resources countries where laboratory assessment of $CD4^+$ T lymphocyte counts is not widely available. We also recommend that nutritional rehabilitation should be an integral part of management of HIV patients.

Limitations of our study include**:** lack of data on nutritional profile and immune function tests of $CD4^+$ T lymphocyte of the study participants.

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