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Low Body Mass Index Helps Detect HIV Infection in Uganda

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Authors' contributions

This work was carried out in collaboration between both authors. Author ET designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Authors ET and KI managed the analyses of the study. Both authors read and approved the final manuscript.

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ABSTRACT

Background: According to the most recent study of World Health Organization (WHO), 36.7 million people were living with HIV by the end of 2016 world-wide, and almost two-thirds of them are residing in Sub-Saharan Africa. Especially Sub-Saharan Africa is one of the most effected regions. UN statistics states that 65% of the population is infected with HIV. Although the Uganda Ministry of Health (MOH) has implemented the "Nutritional Education Program" at a hospital level, the actual nutritional condition of HIV positive people has not been documented yet. Therefore, we executed this investigation to examine the nutritional condition, and the eating habits, of HIV positive people compared to HIV negative people in Uganda.
Place and Duration of Study: Kampala, Busia, Mbende, Mbende General Hospital HIV Clinic, and Masafu General Hospital HIV Clinic in Uganda. 24th August 2013 and 2nd September 2013.
Methods: Eighty HIV positive patients visited two hospitals, and one hundred and eleven individuals who self-reported as HIV negative in Kampala, Mbende and Busia. Participant's weight, height and body size were measured using an electric weight scale, and a measuring tape were

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used to calculate BMI using standard equations. After calculating BMI scores for low BMI were filtered according to the WHO criteria (BMI<18.5). BMI scores were categorized by gender.
Results: There was a significant difference in BMI mean values between HIV positive and negative people. Although HIV positive and negative subjects consumed a similar amount of food every day, the mean BMI of HIV positive people is lower than that of HIV negative people. We saw similar results for all age groups.
Conclusion: HIV infection in the non-symptomatic carrier stage may influence the nutritional condition and eating habits for people in Uganda. Therefore, BMI measurement could be a very useful method for assessing chronic malnutrition.

Keywords: HIV; AIDS; BMI; nutritional condition.

1. INTRODUCTION

The purpose of this study is to prove to the Uganda government that HIV positive individuals show significantly lower BMI compared to HIV negative individuals. This means there is a cost-effective method to help hospital staff to identify HIV positive individuals faster. According to the most recent study of World Health Organization (WHO), 36.7 million people were living with HIV by the end of 2016 world-wide, and almost two-thirds of them are residing in Sub-Saharan Africa [1].

Uganda is the one of the countries in Sub-Saharan Africa that has been severely affected by HIV. Although the Ugandan government has been conducting several anti-HIV measures including a large-scaled HIV awareness campaign in early 2000's [2], the domestic HIV infection rate has increased in recent years [3]. The reasons for the increased infection rates in the area are due to a lack of public knowledge regarding preventative measures [4]. The other issue is that the HIV detection rate is very slow, because Uganda citizens do not have access to affordable HIV test. If affordable testing methods for HIV becomes available the HIV infection could be detected early, and infection prevention could be promoted in Uganda.

Low Body Mass Index (BMI) and body weight loss are known to be directly related to the CD4 (Antibody) reduction [5], and development of some diseases associate with HIV, such as tuberculosis (TB) [6,7].

BMI is easily measured and calculated with minimum tools and knowledge. Therefore, we conducted a research to find a relationship between BMI and HIV status in Uganda, based on an assumption that BMI of HIV carrier is lower than non-HIV carriers. If any relationship between those is confirmed, BMI could be an affordable and beneficial method to identify the possibility of an HIV infection.

Since a meal frequency links to weight gain and loss, we also studied a relationship between a meal frequency in HIV positive and negative [8].

2. STUDY POPULATION AND METHODS

2.1 Study Subjects

Eighty HIV positive patients visited two hospitals in Mbende and Busia. One hundred and eleven individuals who self-reported as HIV negative in Kampala, Mbende and Busia. All HIV positive participants were diagnosed based on the result of blood test conducted by those hospitals prior to this study. Only HIV positive individuals who presented no symptoms of AIDS or AIDS-related diseases that are defined by the World Health Organization (WHO) participated in this study. Subjects were enrolled if they were 18 years old or older, had an average income level (US $50-$100 per month) and no dietary restriction for religion. In 2014 approximately 13% of the Ugandan population practiced Muslim. Muslims do not eat pork so we felt it necessary to include this in the questionnaire for both males and females [9].

2.2 Informed Consent & Confidentiality

All subjects understood and gave consent before participating in this study. Participation was voluntary; anonymity, confidentiality and privacy of data were also explained and guaranteed. Written consent was required by all applicants.

2.3 BMI Assessment

Participant's weight, height and body size were measured using an electric weight scale, and a measuring tape, brought from Japan, to calculate BMI using standard equations. The quality of

electric weight scale was approved by measurement law, and confirmed measurement results become in tolerance (±200 g).

After calculating BMI scores for low BMI (BMI<18.5) were filtered according to the WHO criteria explains BMI18.5-24.9 is the healthiest. BMI scores were categorized by gender.

2.4 Lifestyle Factors

A standard and structured questionnaire was used to collect information on demographics and lifestyle factors. The data collection period was 24th August 2013 to 2nd September 2013.

The questionnaire was prepared both in English, and a local language spoken in the region. Content of the questionnaire includes the following: gender, age, occupation, HIV status, a chance of pregnancy, family structure, family history of HIV disease, smoking and drinking habits, medical history, and daily meal frequency. Daily meal frequency data was classified into 3 categories; 'twice or less,' '3 times' and '4 times or more,' and then compared with participant's HIV status. Please see the attached questionnaire at the end of the report.

2.5 Statistical Method

To validate the hypotheses on relationships between BIM and HIV status, the Student's t-test was used. Furthermore, multiple regression analysis adjusted confounders including age, medical history smoking and drinking habits, a chance of pregnancy and family history of HIV disease was applied. For examination of meal frequency and HIV status, the chi-square test and the Fisher's exact test were employed. All statistical analysis was conducted with the level of significance set at 0.05.

3. RESULTS

There were 80 HIV-positive individuals (39 males and 41 females), and 111 HIV-negative individuals (61 males and 50 females) enrolled in this study.

Table 1 shows the basic characteristics of the participants that were analyzed with a comparison between HIV-positive and HIV-negative group. BMI was significantly lower in the HIV-positive than HIV negative participants, both males (p=0.007) and females (p=0.02).

This difference remained significant in a multivariate analysis including age and other factors such as medical history smoking and drinking habits, a chance of pregnancy and family history of HIV disease.

The relative frequency distribution of HIV status and gender is shown in Table 2. Participants in low BMI (<18.5) were 7 males with HIV positive (17.9%), 3 males with HIV negative (5.0%), 8 females with HIV positive (19.5%), and 1 female with HIV negative (2.0%).

Table 1. Basic attributes

	Male: N=100 mean (SD)			Female: N=91 mean (SD)		
	HIV(+) n=39	HIV(-) n=61	P value	HIV(+) n=41	HIV(-) n=50	P value
BMI (kg/m^2)	20.6±2.4	22.1±3.0	0.007	21.6±3.1	23.3±3.7	0.02
BMI<18.5 (%)	7(17.9)	3(5.0)	0.04	8(19.5)	1(2.0)	0.01
Age (years)	35.3±5.3	27.2±5.8	<0.0001	32.9±5.8	27.7±6.1	0.0001
Height (cm)	168.7±6.5	170.8±6.3	0.12	159.2±7.8	161.4±6.1	0.13
Weight (kg)	58.6±7.8	64.5±9.3	0.001	55.0±10.5	60.9±11.5	0.013
Number of meals (/day)	3.0±0.7	2.6±0.7	0.04	2.9±0.6	2.8±0.4	0.06
Smoking (%)	6(15.4)	9(14.8)	1.0	1(2.0)	0	0.45
Drinking (%)	0	8(13.1)	0.02	0	2(4.0)	0.56
Chronic illness (%)	3(8.7)	9(14.8)	0.36	9(21.9)	3(6.0)	0.03
Family history of HIV	7(17.9)	9(14.8)	0.88	4(9.8)	4(8.0)	0.94

Table 2. Relative frequency distribution of HIV status and gender

BMI	Male: N=100		Female: N=91	
	HIV(+) n=39 (%)	HIV(-) n=61 (%)	HIV(+) n=41 (%)	HIV(-) n=50 (%)
16.5-18.5	7(17.9)	3(4.9)	8(19.5)	1(2.0)
18.5-20.5	17(43.6)	16(26.2)	10(24.4)	8(16.0)
20.5-22.5	5(12.8)	20(32.8)	7(17.1)	16(32.0)
22.5-24.5	7(17.9)	10(16.4)	7(17.1)	13(26.0)
24.5-26.5	2(5.1)	7(11.5)	6(14.6)	3(6.0)
26.5-28.5	1(2.6)	3(4.9)	3(7.3)	4(8.0)
28.5-30.5	0	0	0	1(2.0)
30.5-32.5	0	2(3.3)	0	3(6.0)
34.5-36.5	0	0	0	1(2.0)

The results of linear regression analysis using BMI and other explanatory valuables such as age, HIV status, medical history smoking and drinking habits, a chance of pregnancy and family history of HIV disease are shown in Table 3. The analysis revealed a negative relationship between BMI score and HIV status regardless of gender (p=0.02 in males and p=0.045 in females), even after adjusted for age (p=0.01 in males and p=0.03 in females).

Table 4 shows the correlation between HIV status and meal frequency. There was a certain tendency that HIV-positive participants eat more frequently a day than HIV-negative participants regardless of gender. However, the only relationship between HIV status in male and meal frequency was statistically significant (p=0.04). Besides, no significant association between participants in low nutritional condition (BMI<18.5) and daily meal frequency was confirmed regardless of gender.

4. DISCUSSION

In this study, a significant association between HIV infection and BMI was confirmed. Regardless of gender, individuals with HIV infection have lower BMI scores than individuals without HIV infection. The outcomes of this study shows that measuring and monitoring BMI score could be a key to catch symptoms of HIV infection early. According to DHS (Demographic and Health Survey) in Uganda, only 30% of HIV-positive individuals in Sub-Saharan Africa have access to anti-Retroviral (ARV) medication used

Table 3. Results of linear regression analysis composed of HIV status and other variable as an explanatory variable

Adjustment of age	**Male: N=100**			**Female: N=91**		
Variable	**Coefficient**	**SD**	**P value**	**Coefficient**	**SD**	**P value**
HIV status	**-1.76**	**0.69**	**0.01**	**-1.79**	**0.79**	**0.03**
Age	**0.03**	**0.05**	**0.6**	**0.02**	**0.06**	**0.76**
Linear regression analysis						
Variable	**Coefficient**	**SD**	**P value**	**Coefficient**	**SD**	**P value**
HIV status	-1.62	0.71	0.02	-1.79	0.79	0.045
Age	0.03	0.05	0.54	0.02	0.06	0.78
Chronic illness	1.71	0.88	0.05	-0.78	1.13	0.49
Drinking	0.36	1.06	0.74	0.07	2.54	0.98
Smoking	-0.8	0.79	0.31	-1.69	3.59	0.64
Family history of HIV	0.33	0.68	0.63	-0.68	0.65	0.32
Chance of pregnancy				-0.29	2.12	0.89

Table 4. Correlation between HIV status and meal intake situation

Male: N=100						
Number of meals (/day)	**ALL**			**BMI<18.5**		
	HIV(+) (%)	**HIV(-) (%)**	**P value Chi-squared test**	**HIV(+) (%)**	**HIV(-) (%)**	**P value Chi-squared test**
Twice or less	7(17.9)	25(41.0)	0.04	2(28.5)	0	0.3
3times	26(66.7)	32(52.4)		3(43.0)	3(100)	
4times or more	6(15.4)	4(6.6)		2(28.5)	0	
Total	39(100)	61(100)		7(100)	3(100)	
Female: N=91						
Number of meals (/day)	**ALL**			**BMI<18.5**		
	HIV(+) (%)	**HIV(-) (%)**	**P value Chi-squared test**	**HIV(+) (%)**	**HIV(-) (%)**	**P value Chi-squared test**
Twice or less	10(24.4)	10(20.0)	0.06	2(25.0)	0	0.3
3times	25(61.0)	39(78.0)		4(50.0)	1(100)	
4times or more	6(14.6)	1(2.0)		2(25.0)	0	
Total	41(100)	50(100)		8(100)	1(100)	

for HIV treatment [10]. While HIV infection and AIDS development have been promoted in those countries, effective countermeasures for them are needed. Of course, it is important to keep in mind that other symptoms such as fever, diarrhea or vomiting caused by HIV infection could breakout even in a widow period.

Limitations of this study are a lack of information about daily meal portion and exercise amount. Since these factors could greatly impact BMI, we cannot state that low BMI of HIV-positive individuals is caused by HIV infection or others such as daily meal portion and exercise amount [11]. Also nutrients needed to be pursued. Actually, we collected their meal items then, executed a nutrients classification. However, they are degenerating by cooking method and seasoning. Thus, more detailed field verification should have been implemented. In addition, we needed to get more details of medication history to consider about the effects by ART. Because representative side effects of ART, especially nausea, diarrhea may have great effect on their eating habits [12].

Nevertheless, we believe that measuring and monitoring BMI is an easy and economical method that promotes early detection and prevention of HIV.

5. CONCLUSION

HIV infection in the non-symptomatic carrier stage may influence the nutritional condition and eating habits for people in Uganda. Therefore, BMI measurement could be a very useful method for assessing chronic malnutrition. On the other hand, the previous study implemented in South Africa concluded Low BMI contributes to the risk for CVD (Cardio Vascular Disease). A lot of other factors including medical environment, regional characteristics and culture give influence to BMI fluctuation. Therefore, detailed examination needs to be conducted [13].

Lastly, we hope the findings in this study will contribute to future studies and improved care for HIV-positive individuals in Uganda, including early detection and access to testing opportunity and treatment.

CONSENT

As per international standard or university standard, patient's written consent has been collected and preserved by the authors.

ETHICAL APPROVAL

We got approval for this investigation by the Ethics committee of School of Public Health, Teikyo University. Authorization number: 13-157.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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QUESTIONNAIRE-1

RESEARCH ON EATING HABITS IN UGANDA

PLEASE CIRCLE THE NUMBER LEFT TO THE SITUATION THAT APPLIES TO YOU AND WRITE ABOUT YOUR PRESENT SITUATION.

DO YOU ACCEPT TO COOPERATE WITH THIS RESEARCH
(WOULD YOU WISH TO PARTICIPATE IN THIS SURVERY?)
(1.YES 2.NO)

OCCUPATION	AGE	SEX	HIV/AIDS STATUS	PREGNANCY
		1.M 2.F	1.PISITIVE 2.NEGATIE	(AT THE MOMENT) YES/NO

FAMILY STRUCTURE

LIVING WITH
1.SPOUSE (WIFE OR HUSBAND)
2.GRAND PARENTS (1.GRAND FATHER 2.GRAND MOTHER)
3.PARENTS (1.FATHER 2.MOTHER)
4.SIBLINGS H OW MANY ARE THEY?( ) HOW OLD ARE THEY?( )
5.RELATIVES HOW MANY ARE THEY?( ) HOW OLD ARE THEY?( )
6.CHILDREN HOW MANY ARE THEY?( ) HOW OLD ARE THEY?( )
ANYONE ELSE: *PLEASE WRITE IN DETAIL IF THERE IS A SPECIAL SITUATION ABOUT ANY OF YOUR FAMILY MEMBERS. EXAMPLE: LIVING WITH SOMEONE WHO IS NOT BLOOD RELATION.

IS THERE ANYONE WHO IS HIV POSITIVE IN YOUR FAMILY?
*INCLUDE YOURSELF

1.YOURSELF :WHEN DID YOU DISCLOSE YOUR HIV STATUS? ( )
2.GRAND PARENTS (1.GRAND FATHER 2.GRAND MOTHER)
3.PARENTS (1.FATHER 2.MOTHER)
4.SIBLINGS H OW MANY ARE THEY?( ) HOW OLD ARE THEY?( )
5.RELATIVES HOW MANY ARE THEY?( ) HOW OLD ARE THEY?( )
6.CHILDREN HOW MANY ARE THEY?( ) HOW OLD ARE THEY?( )
ANYONE ELSE: 付表 1-2

QUESTIONNAIRE-2

HOW MANY TIMES DO YOU HAVE MEALS IN A DAY?

1. ONCE
2. 2TIMES
3. 3TIMES
4. MORE ( )

WHAT SORT OF MEALS ARE YOU TAKING USUALLY?

BREAKFAST:

1.MATOOKE 2.POSHO 3.CHAPATI 4.RICE 5.BREAD 6.BEANS
6.BEEF 7.PORK 8.CHICKEN 9.GREENS 10.FISH 11.CHIPS
12.ALCOHOL 13.SODA 14.WATER
ANYTHING ELSE:

BREAK TEA:

1.MATOOKE 2.POSHO 3.CHAPATI 4.RICE 5.BREAD 6.BEANS
6.BEEF 7.PORK 8.CHICKEN 9.GREENS 10.FISH 11.CHIPS
12.ALCOHOL 13.SODA 14.WATER
ANYTHING ELSE:

LUNCH:

1.MATOOKE 2.POSHO 3.CHAPATI 4.RICE 5.BREAD 6.BEANS
6.BEEF 7.PORK 8.CHICKEN 9.GREENS 10.FISH 11.CHIPS
12.ALCOHOL 13.SODA 14.WATER
ANYTHING ELSE:

AFTERNOON TEA:

1.MATOOKE 2.POSHO 3.CHAPATI 4.RICE 5.BREAD 6.BEANS
6.BEEF 7.PORK 8.CHICKEN 9.GREENS 10.FISH 11.CHIPS
12.ALCOHOL 13.SODA 14.WATER
ANYTHING ELSE:

QUESTIONNAIRE-3

SUPPER:

1.MATOOKE 2.POSHO 3.CHAPATI 4.RICE 5.BREAD 6.BEANS
6.BEEF 7.PORK 8.CHICKEN 9.GREENS 10.FISH 11.CHIPS
12.ALCOHOL 13.SODA 14.WATER
ANYTHING ELSE:

DO YOU SMOKE?

1. YES
   : PAST SMOKER: HOW MANY YEARS ( )
   : CURRENT SMOKER: HOW MANY YEARS ( )
2. NO

DO YOU HAVE ANY CHRONIC ILLNESS?
HAVE YOU EVER HAD ANY ILLNESS BEFORE?
PLEASE WRITE THE NAME OF ILLNESS IN ( ).

1. YES
   : PRESENT MOMENT ( )
   : PAST ( )
2. NO

ASK A PERSON WHO IS HIV POSITIVE OR PLWHA IN YOUR FAMILY MEMBERS.
IF THEY ARE RECEIVING ANY GUIDANCE RELATED TO NUTRITION REGULARLY FROM ANY ORGANIZATION THEY ARE ATTACHED TO?
PLEASE WRITE THE NAME OF ORGANIZATION IF YOU HAVE BEEN RECEIVING NUTRITIONAL GUIDANCE.

1. YES (ORGANIZATION:)
2. NO

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