Njoh et al. Sleep Science and Practice (2017) 1:4
DOI 10.1186/s41606-016-0003-2

Sleep Science and Practice

RESEARCH Open Access

Likelihood of obstructive sleep apnea in people living with HIV in Cameroon – preliminary findings

Andreas Ateke Njoh[1†], Eta Ngole Mbong[1,3*†], Valeri Oben Mbi[2], Michel Karngong Mengnjo[1], Leonard Njamnshi Nfor[1], Leonard Ngarka[1], Samuel Eric Chokote[1], Julius Yundze Fonsah[1], Samuel Kingue[1], Felicien Enyime Ntone[1] and Alfred Kongnyu Njamnshi[1†]

Abstract

Background: Obstructive Sleep Apnea (OSA) has been observed to be common among people living with HIV/AIDS (PLWHA). Sleep scales can be used to screen patients at increased "risk" of OSA who can benefit from polysomnography. This study therefore sought to generate preliminary data on this often unattended complication of HIV Infection in Cameroon.

Methods: A case control study carried out at the Yaoundé Central Hospital in which 82 participants were enrolled: 39 PLWHA age- and sex-matched with 43 controls. The Berlin sleep questionnaire was used to assess the likelihood of OSA in both groups.

Results: Participants were aged 20 to 59 years with a mean age of 34.27 ± 9.29 (35.72 ± 10.09 and 32.92 ± 8.41 respectively for cases and controls, $p = 0.180$). Cases (PLWHA) compared to controls had higher likelihood of OSA (43.6% versus 14.0%, AOR 3.93 95% CI 1.12–13.80 on adjusting for socioeconomic status, depression and smoking) as well as 10 times higher rates of daytime somnolence (23.1% versus 2.3%, $p = 0.005$). Significant differences were found between PLWHA at "risk" of OSA and those without only with regards to rate of compliance to Highly Active anti-Retroviral Therapy (HAART), and mean abdominal and waist circumferences.

Conclusions: The likelihood of obstructive sleep apnea (OSA) in PLHWA is higher than in HIV negative controls. Integration of screening for OSA in HIV/AIDS care with the aid of sleep scales would permit timely diagnosis and management and reduce the incidence of chronic cardiorespiratory co-morbidities in PLWHA.

Keywords: Obstructive sleep apnea, Persons living with HIV/AIDS, Sleep scales, HAART, Cameroon

Background

Obstructive sleep apnea (OSA), results from repeated episodes of upper airway obstruction during sleep caused by collapse of the pharyngeal airway (Somers et al. 2008). Alterations in upper airway anatomy as well as disturbances in neuromuscular control play an important role in the pathogenesis of OSA (McGinley et al. 2008; Isono et al. 1999; Smith et al. 1988; Gupta et al. 2010). The disease is characterized by periodic cessation of breathing during sleep resulting in reduced blood oxygen levels, followed by brief arousal to reinitiate breathing (Taibi 2013). OSA is usually associated with obesity (Gupta et al. 2010; Resta et al. 2001) and the onset of sleep apnea frequently follows a marked increase in body weight (Smith et al. 1988). However, obesity alone is not essential for the development of OSA (Resta et al. 2001; Lo et al. 1998; Joy et al. 2008; Lo Re et al. 2006; Dorey-Stein et al. 2008; Epstein et al. 1995).

OSA has been observed by some authors to be common among persons living with HIV/AIDS (PLWHA) (Taibi 2013; Lo Re et al. 2006; Dorey-Stein et al. 2008; Epstein et al. 1995). In this group of persons, body composition abnormalities such as subcutaneous fat wasting, central fat accumulation (Brown et al. 2010), and adenotonsillar

* Correspondence: mbongeta@yahoo.fr
†Equal contributors
[1]Faculty of Medicine and Biomedical Sciences, University of Yaoundé 1, Yaoundé, Cameroon
[3]PC Great Soppo, P.O Box 547, Buea, Cameroon
Full list of author information is available at the end of the article

hypertrophy (Epstein et al. 1995) are common; partly due to the viral infection and Highly Active Anti-Retroviral Therapy (HAART) (Lo et al. 1998). Among non-obese PLWHA visceral fat has been found to be increased compared to HIV negative controls (Joy et al. 2008); fat accumulations are common along the cervical and dorsal regions of the bodies of PLWHA (Lo et al. 1998). Sleep scales can be used in clinical settings to screen patients likely to suffer from OSA who can be sent early to sleep laboratory for confirmatory polysomnography.

The impact of OSA on health cannot be over emphasized given the increased morbidity (Gupta et al. 2010) and mortality it is associated as a results of cardiovascular and metabolic complications in particular and impairment in quality of life in general (Somers et al. 2008; Brown et al. 2010; Kendzerska et al. 2014; Budhiraja and Quan 2005). Despite its known impact, data on this subtle but severe complication of HIV infection in Cameroon is inexistent.

It was therefore necessary to assess the "risk" of OSA among PLWHA in Cameroon in order to generate preliminary data from which initiatives to raise awareness and promote early diagnosis and management of OSA in this population can be started. This study sought therefore to study this often unattended-to complication of HIV Infection in Cameroon with the aid of the Berlin Questionnaire sleep scale, in a population of PLWHA compared with their HIV negative peers.

Methods

Study design

The study was a hospital-based case–control study conducted over a period of 8 months in 39 consenting PLWHA age- and sex-matched with 43 controls.

Study setting

The study was carried out in Yaoundé, the cosmopolitan capital city of Cameroon, specifically at the HIV/AIDS Treatment Centre and Neurology Service of the Yaoundé Central Hospital.

The Yaoundé Central Hospital is a government run tertiary health facility with a bustling HIV/AIDS outpatient department (the largest in the country), which serves PLWHA from Yaoundé and its environs. In addition, the Neurology Department of this hospital has a sleep laboratory that supports this kind of study.

Ethical approval was obtained from the review board of the Faculty of Medicine and Biomedical Sciences (FMBS) of the University of Yaoundé 1 and administrative clearance from the directorate of the Yaoundé Central Hospital. Information collected from study participants and patient files were coded and confidentially handled.

Study participants

Participants were adults aged 20 to 59 years (Khassawneh et al. 2009) with a confirmed HIV-positive serology (for cases) attending the HIV/AIDS Treatment Centre of the study site and clinically stable enough to participate in the study. Were excluded all PLWHA known to be obese (BMI ≥30 kg/m^2) prior to HIV diagnosis as well as pregnant women, demented patients, people with abnormal sleep-wake cycles due to night-shift work and all individuals who were on or had taken sleep inducing medications, or stimulants during the three months preceding the study.

Controls were selected from among other patients, care takers and others who visited the hospital and were confirmed HIV-negative at the time of the study.

Participants were contacted and recruited by the study investigators consecutively as they presented at the treatment center. The study objectives and procedures were explained to participants and informed consent obtained. A total of 82 participants were enrolled for the study.

Instruments

Socio-demographic and clinical data of study participants were collected through interviews with the aid of a pretested pre-structured questionnaire. Data collected included age (as at last birthday), sex, employment status, religion, monthly income bracket, highest level of formal education attained, cigarette smoking status, number of check-up and unwell visits to health care provider during the previous three months. PLWHA had their highly active antiretroviral treatment status, regimen and duration probed as well. All study participants benefitted from a complete physical examination with focus on neurological examination and anthropometric measurements.

The likelihood ("risk") of OSA was assessed with the aid of the Berlin Questionnaire and daytime sleepiness with the aid of the Epworth Sleepiness Scale (ESS). The *Berlin questionnaire* was designed to screen for sleep apnea in primary care population and stratifies patients into low or high "risk" (Netzer et al. 1999). It has high reliability (Cronbach α 0.86–0.92), and a high positive predictive value in identifying ambulatory OSA cases at high "risk" of sleep apnea (Netzer et al. 1999).

Study variables

HIV case: Confirmed by ELISA and dichotomized as positive or negative.

HIV serotype: Confirmed by laboratory analysis of blood samples of HIV positive cases; nominally grouped into HIV1, HIV 2, and HIV 1&2.

HIV clinical staging: Grouped into 4 clinical stages with respect to the WHO 2006 clinical staging algorithm (based on clinical signs and symptoms) (World Health

Organization 2007) and the CDC revised HIV classification algorithm (CDC 2014).

HAART use and regimen: Use of HAART was dichotomized as a yes or no as reported by the patient and confirmed by clinical records. Regimen type was nominally categorized.

Age at HIV diagnosis and disease duration: Age in years at which patient reported (confirmed by diagnosis report) he or she was diagnosed HIV positive from which *disease duration* was deducted after comparing with study date. The latter were expressed in years and months respectively then categorized ordinally as shown on Table 2.

Number of routine visits to physician and number of unwell visits to physician during previous three months: As reported by study participants and confirmed by patient records. Assessed as continuous data and then ordinally categorized as shown on Table 2.

Compliance to HAART treatment during the previous month was assessed dichotomously as yes or no. Cases were considered compliant to HAART if they reported

Table 1 Socio-demographic characteristics of participants

	HIV status				2 sided sig. of difference	Entire study sample	
	Negative (Controls)		Positive (Cases)				
	N	%	n	%		N	%
N	43	52.4	39	47.6		82	100.0
Sex							
Male	19	44.2	13	33.3	0.314	32	39.0
Female	24	55.8	26	66.7		50	61.0
Age (years)							
Mean ± SD	32.92 ± 8.41		35.72 ± 10.09		0.180	34.27 ± 9.29	
20–29	16	37.2	14	35.9	0.541	30	36.6
30–39	16	37.2	11	28.2		27	32.9
≥40	11	25.6	14	35.9		25	30.5
Employment status							
Unemployed	12	27.9	11	28.1	0.003	23	28.0
Employed	31	72.1	28	71.8		59	72.0
Level of education							
Primary	9	20.9	7	17.9	0.005	16	19.5
Secondary	19	44.2	29	74.4		48	58.5
Tertiary	15	34.9	3	7.7		18	22.0
Marital status		0.0		0.0		0	0.0
Single	28	65.1	24	61.5	0.244	52	63.4
Married	15	34.9	12	30.8		27	32.9
Widow(er)	0	0.0	3	7.7		3	3.7
Socioeconomic status (SES)							
Low SES	23	53.5	19	48.7	0.911	42	51.2
Middle SES	19	44.2	19	48.7		38	46.3
High SES	1	2.3	1	2.6		2	2.4
Smokes							
Yes	2	4.7	1	2.6	1.00	3	3.7
No	41	95.3	38	97.4		79	96.3
Alcohol consumption							
Yes	19	44.2	22	56.4	0.269	41	50.0
No	24	55.8	17	43.6		41	50.0

not having missed taking prescribed HAART not more than 7 times in a month.

Risk of OSA: Dichotomized as "risk" or "no risk" of OSA based on responses to items on the Berlin questionnaire.

Daytime sleepiness: Ordinally categorized with respect to scores got on assessment with the Epworth sleep scale (ESS): score of 1–14 (restful sleep and no daytime sleepiness), score ≥15 (excessive daytime somnolence).

Data analyses

Data collected was entered into an excel sheet and uploaded for analyses unto version 20 of the Statistical Package for Social Sciences (SPSS 20). Continuous data are presented as means ± SD as well as ordinate categories, and non-continuous data as proportions (%). Strengths of associations between categorical variables are presented as odds ratios and the differences between proportions determined with the aid of chi-squared tests (X^2). Differences between means of continuous variables between groups were done with the aid of t-tests. All test statistics are two-sided and considered statistically significant at $p < 0.05$.

Results

Socio-demographic characteristics of participants

A total of 82 participants were enrolled into the study (39 cases and 43 sex and age matched controls). Participants were as young as 20 and as old 59 years with a mean age of 34.27 years (SD 9.29). But for employment status and level of education, there was no significant difference between the socio-demographic characteristics of cases and controls (Table 1). More cases were unemployed than controls (5.1% versus 0.0%, $p = 0.003$) and fewer had attained tertiary levels of education (7.7% versus 34.9%, $p = 0.005$); Table1.

Table 2 Anthropometric and clinical characteristics of participants

	HIV status				2 sided sig. of difference	Entire study sample	
	Negative (Controls)		Positive (Cases)				
	N	%	n	%		N	%
BMI (kg/m^2)							
Mean ± SD	25.17 ± 4.34		25.23 ± 4.48		0.955	25.20 ± 4.38	
Underweight (<18.5)	1	2.3	1	2.6	0.928	2	2.5
Normal BMI (18.5–25.00)	25	58.1	21	55.3		46	56.8
Overweight (25.01–29.99)	10	23.3	11	28.9		21	25.9
Obese (≥30.00)	7	16.3	5	13.2		12	14.8
Weight gain (kg)	0.38 ± 5.20		−1.83 ± 6.10		0.104	−0.68 ± 5.72	
Neck circumference (cm)	36.53 ± 3.00		35.74 ± 4.70		0.360	36.16 ± 3.89	
Abdominal circumference (cm)	89.27 ± 12.80		86.30 ± 12.19		0.364	87.93 ± 12.52	
Waist circumference (cm)	86.28 ± 13.60		85.58 ± 11.98		0.808	85.95 ± 12.79	
Hip circumference (cm)	100.35 ± 13.80		100.05 ± 11.57		0.918	100.21 ± 12.73	
Waist Hip Ratio	0.86 ± 0.08		0.85 ± 0.06		0.712	0.86 ± 0.07	
Pulse (/min)							
Mean ± SD	74.29 ± 10.49		79.19 ± 16.57		0.086	76.46 ± 11.04	
Tachycardia	23	67.6	22	81.5	0.222	45	73.8
Normal	11	32.4	5	18.5		16	26.2
Blood pressure (mm/hg)							
Systolic (Mean ± SD)	119.51 ± 14.21		121.61 ± 17.77		0.561	120.47 ± 15.86	
Diastolic (Mean ± SD)	75.49 ± 10.27		75.42 ± 16.57		0.981	75.46 ± 13.42	
HBP							
Yes	6	14.0	8	22.2	0.338	14	17.7
No	37	86.0	28	77.8		65	82.3
Neurological examination							
Normal	43	100	36	92.3	0.103	79	96.3
Abnormal	0	0.0	3	7.7		3	3.7

Clinical and anthropometric assessments of participants

On clinical assessment (Table 2) anthropometric measurements, blood pressure and pulse were not significantly different between the two groups.

HIV disease characteristics and HAART

Almost a quarter (23.9%) of study cases were diagnosed positive with HIV at the age of under 25 years, three quarters (29; 76.2%) had lived with the disease for at least 6 months and two-thirds on HAART (24; 63.2%) of which half (54.1%) for at least 6 months (Table 3). 42.9% of cases on 1st line HAART were on a regimen with Efavirenz (Table 3).

HIV-AIDS disease history of cases and disease follow-up

Cases had a mean age of 32.26 ± 8.94 years and had been diagnosed HIV positive for more than three years (mean duration of 44.61 ± 50.12 months); Table 3. Two thirds (63.2%) were on HAART, mainly (92.1%) 1st line (Table 3).

Snoring habits and assessment of the "risk"/likelihood of OSA in cases and controls

Cases (PLWHA) compared to controls had higher rates of "risk" (moderate as well as high) of OSA (43.6% versus 14.0%, OR 4.77 95% CI 1.64–13.89 and AOR 3.93 95% CI 1.12–13.80 on adjusting for socioeconomic status, depression and smoking) and consequently had 10 times higher rates of daytime somnolence (Table 4).

HIV disease characteristics, and anthropometric and clinical parameters in PLWHA with and those without "risk" of OSA

With respect to OSA and HIV disease characteristics and management, cases with "risk" (moderate as well as high risk) of OSA differed significantly from those without, only with regards to compliance to HAART. The rate of compliance to HAART was higher in HIV cases with "risk" of OSA compared to HIV cases without (100.0% versus 60% respectively, $p = 0.034$); Table 5. With regards to anthropometry, significant differences were found with regards to abdominal and waist circumferences (Table 6).

Discussion

These preliminary findings are part of a study which sought to generate data on disordered sleep an often unattended complication of HIV Infection. Focus was on obstructive sleep apnea (OSA) whose likelihood was assessed with the aid of the Berlin Questionnaire sleep scale in people living with HIV/AIDS (PLWHA) compared to matched HIV negative controls.

Cases (PLWHA) compared to controls had higher "risk" (moderate as well as high) of OSA (43.6% versus 14.0%, $p = 0.003$ and AOR 3.98 95% CI 1.14–13.99 on adjusting for socioeconomic status, depression and

Table 3 HIV disease characteristics of the cases

	N	%
	39	47.6
Age at diagnosis (years)		
Mean ± SD	32.26 ± 8.94	
20–24	9	23.7
≥25	29	76.3
Disease duration since diagnosis		
Mean ± SD (months)	44.61 ± 50.12	
≤6 months	14	36.8
<6 months	24	63.2
CD4 count (count/mm^3), Mean ± SD	410.92 ± 144.90	
<350	3	23.1
≥350	10	76.9
WHO disease stage		
Stage 1	26	68.4
Stage 2	3	7.9
Stage 3	7	18.4
Stage 4	2	5.3
CDC disease stage		
A1	11	78.6
A2	1	7.1
C1	1	7.1
C3	1	7.1
Routine check-ups in last 3 months		
Mean ± SD	1.00 ± 1.33	
None	20	54.1
At least 1	17	45.9
Patient on HAART		
No	14	36.8
Yes	24	63.2
Compliant to HAART		
Yes	17	70.8
No	7	29.2
HAART duration since onset		
Mean ± SD (months)	47.76 ± 44.71	
<6 months	4	23.5
≥6 months	13	76.5
HAART protocol type		
1st line	13	92.9
2nd line	1	7.1
HIV complications during 3 months preceeding study		
At least one	2	5.4
None	35	94.6
Presence of other concurrent disease		
At least one	5	13.5
None	32	86.5

Table 4 Snoring habits, and rates of 'risk' of OSA and daytime somnolence

	HIV status				2 sided sig. of difference	Entire study sample	
	Negative (Controls)		Positive (Cases)				
	N	%	n	%		N	%
N	43		39			82	
Snoring							
Yes	11	25.6	10	25.6	1.00	21	25.6
No	32	74.4	29	74.4		61	74.4
Risk of OSA							
No risk	37	86.0	22	56.4	0.003	59	72.0
Moderate Risk	6	14.0	12	30.8		18	22.0
High risk	0	0.0	5	12.8		5	6.0
Daytime somnolence							
Yes	1	2.3	9	23.1	0.005	10	12.2
No	42	97.7	30	76.9		72	87.8

OSA Obstructive Sleep Apnea

smoking); Table 4. These findings corroborate findings of other authors in other settings who demonstrated that compared with HIV negative controls, obstructive sleep apnea (OSA) is more common in PLWHA (Taibi 2013; Lo Re et al. 2006; Dorey-Stein et al. 2008; Epstein et al. 1995). In this group of persons, body composition abnormalities (Brown et al. 2010), and adenotonsillar hypertrophy (Epstein et al. 1995) are common; partly due to the viral infection and Highly Active Anti-Retroviral Therapy (HAART) (Lo et al. 1998).

The higher likelihood of OSA this study observed in PLWHA compared to their HIV negative peers was despite the fact that the former did not differ significantly from the latter (Table 2) with respect to aspects related to externally observable fat accumulation: BMI, neck, waist and abdominal circumferences and lipodystrophy known predisposing factors of OSA in HIV negative persons. With the aid of dual-energy X-ray absorptiometry and computed tomography, PLWHA without clinical evidence of lipodystrophy have been shown to have significantly greater percentage of total body fat in the trunk and significantly lower percent of body fat in the extremities compared to HIV negative controls (CDC 2014). These, physical examination misses.

Vgontzas AN and collaborators in 2000 (Kosmiski et al. 2003), demonstrated that sleep apnea patients had a significantly greater amount of visceral fat compared to obese controls and that indices of sleep disordered breathing (SDB) were positively correlated with visceral fat, and not with BMI, total and subcutaneous fat. Another author (Brown et al. 2010) however showed that BMI, waist circumference, and neck circumference have better predictive value for moderate-severe SDB in HIV uninfected men compared to HIV-infected men, and had no value among HIV-infected men not receiving HAART. Among this latter group (HIV-infected men not on HAART), systemic inflammation is thought to contribute to the pathogenesis of SDB (Brown et al. 2010).

With respect to OSA and HIV disease characteristics and management, cases with "risk" of OSA in our study differed significantly from those without, only with regards to compliance to HAART (Table 5). Compliance to HAART favors fat redistribution in PLWHA: visceral as well as lipodystrophy (Lo Re et al. 2006; Kosmiski et al. 2003). Brigham and collaborators (McNicholas 2009) demonstrated that PLWHA not on HAART with moderate to severe OSA have high circulating levels of inflammatory markers especially TNF-alpha, compared to those with no-to-mild OSA after adjustment for age, race, smoking status, obstructive lung disease and BMI. Within this group, the association of high TNF-alpha concentrations with moderate-severe OSA was independent of CD4 cell count and viral load. Factors that reduce the inflammation associated with HIV infection such as HAART initially would reduce the occurrence of OSA in these patients. This improvement over time wanes due to fat redistribution secondary to HAART.

As was observed when compared with the HIV negative controls, HIV cases with "risk" of OSA did not show significant differences when compared HIV cases without risk of OSA with regards to mean BMI and neck circumferences (Table 6). Significant differences were however found between the two groups with respect to indices of abdominal obesity (waist and abdominal circumferences, Table 6). In the case of abdominal circumference, accumulation of fat in the abdominal wall may reduce respiratory effort and predispose to sleep apnea. Waist circumference on its

Table 5 "Risk" of OSA with respect to HIV disease characteristics

	OSA				2 sided sig. of difference	Entire HIV+ sample	
	No "risk" of OSA		"Risk" of OSA				
	N	%	N	%		N	%
HIV genotype							
HIV_1	8	42.1	5	31.3	0.679	13	37.1
HIV_2	1	5.3	2	12.5		3	8.6
HIV_{1+2}	0	0.0	1	6.3		1	2.9
Undetermined genotype	10	52.6	8	50.0		18	51.4
Age at diagnosis (years)							
Mean ± SD	34.55 ± 9.84		37.24 ± 10.51		0.416	34.27 ± 9.29	
20–24	6	28.6	3	17.6	0.425	9	23.7
≥25	15	71.4	14	82.4		29	76.3
Duration since diagnosis							
<= 6 months	8	38.1	6	35.3	0.717	14	36.8
>6 months	13	61.9	11	64.7		24	63.2
CD4 count (count/mm^3)							
Mean ± SD	387.10 ± 150.58		490.33 ± 107.96		0.299	410.92 ± 144.90	
<350	3	30.0	0	0.0	0.528	3	23.1
≥350	7	70.0	3	100.0		10	76.9
WHO disease stage							
Stage 1	15	71.4	11	64.7	0.930	26	68.4
Stage 2	2	9.5	1	5.9		3	7.9
Stages 3–4	4	19.1	5	29.4		9	23.7
Routine check-ups in last 3 months							
None	10	50.0	10	58.8	0.591	20	54.1
At least 1	10	50.0	7	41.2		17	45.9
Patient on HAART							
Yes	8	38.1	6	35.3	1.00	14	36.8
No	13	61.9	11	64.7		24	63.2
HAART duration							
Mean ± SD	61.11 ± 51.59		32.75 ± 32.27		0.201	47.76 ± 44.71	
<6 months	2	22.2	2	25.0	1.00	4	23.5
≥6 months	7	77.8	6	75.0		13	76.5
HAART protocols		0.0				0	
1st line	8	100.0	5	83.3	0.429	13	92.9
2nd line	0	0.0	1	16.7		1	7.1
Compliance last 30 days							
Compliant	4	40.0	6	100.0	*0.034*[a]	10	62.5
Not complaint	6	60.0	0	0.0		6	37.5
Complications in last 3 months							
None	0	0.0	2	11.8	0.204	2	5.4
At least one	20	100.0	15	88.2		35	94.
Presence of other concurrent diseases							
At least one	2	10.0	3	17.6	0.644	5	13.5
None	18	90.0	14	82.4		32	86.5

[a]significant difference. *OSA* Obstructive Sleep Apnea

Table 6 Occurrence of snoring and means of anthropometric and blood pressure parameters in PLWHA cases with OSA compared to those without

Characteristic	OSA		2 sided sig. of difference	Entire HIV+ sample
	No risk of OSA	Risk of OSA		
Snores				
No	21 (95.5)	8 (47.1)	0.001	29 (74.4)
Yes	1 (4.5)	9 (52.9)		10 (25.6)
Means ± SD				
Neck circumference (cm)	35.05 ± 4.92	36.69 ± 4.35	0.294	35.74 ± 4.70
BMI (kg/m^2)	24.54 ± 3.82	26.17 ± 5.24	0.273	25.23 ± 4.48
Abdominal circumference (cm)	81.80 ± 9.94	91.92 ± 12.80	*0.029*[a]	86.30 ± 12.19
Waist circumference (cm)	81.86 ± 12.38	90.69 ± 9.57	*0.023*[a]	85.58 ± 11.98
Waist hip ratio	0.84 ± 0.07	0.87 ± 0.04	0.114	0.85 ± 0.06
Systolic blood pressure (mm Hg)	123.30 ± 18.13	119.50 ± 17.66	0.532	121.61 ± 17.77
Diastolic blood pressure (mm Hg)	75.85 ± 15.63	74.88 ± 18.19	0.809	75.42 ± 16.57
Pulse (/min)	76.60 ± 12.09	82.42 ± 9.80	0.190	79.19 ± 16.57

[a]significant difference. *OSA* Obstructive Sleep Apnea, *PLWHA* Persons living with HIV/AIDS

part has not been shown to be a good surrogate marker of visceral obesity in PLWHA (Kapur et al. 1999). Further studies need to be done on the contribution of waist circumference in the occurrence of OSA in PLWHA.

Our study had some limitations. OSA was assessed with a questionnaire and was not confirmed with Polysomnography (PSG), the gold standard for the diagnosis of OSA. However, we used a standardized instrument (the Berlin Questionnaire) that has been validated and found to be reliable. Also, we did not clinically diagnose adenotonsillar hypertrophy known to play a role in the development of OSA in HIV positive persons (Epstein et al. 1995; McNicholas 2009). The study sample size as well as not all PLWHA having had a recent CD4 count at time of study as well as viral load limited comparisons with regards to disease progression and viral genotype.

Given the socio-economic burden of untreated OSA (Kapur et al. 1999), its association with HIV/AIDS (a pandemic most prevalent in sub-Saharan African settings like ours) and role of HAART (which more and more PLWHA in out setting now have access to) in HIV disease and OSA occurrence, it is relevant to integrate as part of care of PLWHA, routine screening to identify those at risk of OSA with the aid of sleep scales. Given the peculiarities of the pathophysiology OSA in PLWHA discussed above, unlike in HIV negative subjects, all PLWHA should be screened including those without obvious body fat changes and obesity and those not yet on HAART.

Early identification of the risk of OSA in PLWHA would go a long way to spur referrals for polysomnography, timely management and contribute to the reduction of the incidence of cardiorespiratory co-morbidities in HIV/AIDS, now a chronic condition in low resource settings like ours thanks to access to HAART. This however has to be supported by advocacy actions towards policy makers and duty bearers, for more sleep clinics to be set-up so as to ensure supply meets the increased demand which would be generated by raised awareness.

Conclusion

The "risk"/likelihood of obstructive sleep apnea (OSA) in people living with HIV/AIDS is higher than in HIV negative controls. Unlike HIV negative persons this risk appears not to be linked to externally obvious markers of obesity. Integration of screening for OSA with the aid of sleep scales (validated in our setting against gold standard polysomnography) in HIV/AIDS care will permit timely diagnosis and management which would go a long way to reduce the incidence of chronic cardiorespiratory co-morbidities in PLWHA.

Abbreviations

ESS: Epworth Sleepiness Scale; HAART: Highly Active Anti-Retroviral Therapy; PLWHA: People living with HIV/AIDS; PSQI: The Pittsburgh sleep quality index

Acknowledgments

Our gratitude to staff of the out-patients, neurology and Day Hospital (HIV/AIDS Treatment Center) of the Yaoundé Central Hospital for their contributions to data collection. Our thanks as well to the panel of professors of the Faculty of Medicine and Biomedical Sciences of the University of Yaoundé 1 who reviewed this work as part of the end-of-MD thesis exercise.

Funding

Not applicable.

Availability of data and materials
Data obtained from participants are available on Excel spread sheets and can be shared on request.

Authors' contributions
AAN, AKN and ENM designed the study and collected study data. AAN and ENM did the data analyses. All authors reviewed the article drafts and approved the submitted version.

Competing interests
The authors declare that they have no competing interests.

Consent for publication
Not applicable.

Ethics approval and consent to participate
Ethical approval was obtained from the review board of the Faculty of Medicine and Biomedical Sciences (FMBS) of the University of Yaoundé 1 and administrative clearance from the directorate of the study site (Yaoundé Central Hospital). Informed consent was obtained from study participants and information they provided as well as those got from patient files were coded and confidentially handled.

Author details
[1]Faculty of Medicine and Biomedical Sciences, University of Yaoundé 1, Yaoundé, Cameroon. [2]ISEC Schools of Health Sciences, Yaoundé, Cameroon. [3]PC Great Soppo, P.O Box 547, Buea, Cameroon.

Received: 26 July 2016 Accepted: 22 December 2016
Published online: 06 February 2017

References
Brown TT, Patil SP, Jacobson LP, Margolick JB, Laffan AM, Godfrey RJ, et al. Anthropometry in the prediction of sleep disordered breathing in HIV-positive and HIV-negative men. Antivir Ther. 2010;15(4):651–9.
Budhiraja R, Quan SF. Sleep-disordered breathing and cardiovascular health. Curr Opin Pulm Med. 2005;11(6):501–6.
CDC. Revised surveillance case definition for HIV infection — United States, 2014: recommendations and reports. MMWR. 2014;63(RR03):1–10.
Dorey-Stein Z, Amorosa VK, Kostman JR, Lo Re 3rd V, Shannon RP. Severe weight gain, lipodystrophy, dyslipidemia, and obstructive sleep apnea in a human immunodeficiency virus-infected patient following highly active antiretroviral therapy. J Cardiometab Syndr. 2008;3(2):111–4.
Epstein LJ, Strollo Jr PJ, Donegan RB, Delmar J, Hendrix C, Westbrook PR. Obstructive sleep apnea in patients with human immunodeficiency virus (HIV) disease. Sleep. 1995;18(5):368–76.
Gupta RK, Chandra A, Verm AK, Kumar S. Obstructive sleep apnoea: a clinical review. J Assoc Physicians India. 2010;58:438–41.
Isono S, Tanaka A, Nishino T. Effects of tongue electrical stimulation on pharyngeal mechanics in anaesthetized patients with obstructive sleep apnoea. Eur Respir J. 1999;14(6):1258–65.
Joy T, Keogh HM, Hadigan C, Dolan SE, Fitch K, Liebau J, et al. Relation of body composition to body mass index in HIV-infected patients with metabolic abnormalities. J Acquir Immune Defic Syndr. 2008;47(2):174–84.
Kapur V, Blough DK, Sandblom RE, Hert R, de Maine JB, Sullivan SD, et al. The medical cost of undiagnosed sleep apnea. Sleep. 1999;22(6):749–55.
Kendzerska T, Gershon AS, Hawker G, Leung RS, Tomlinson G. Obstructive sleep apnea and risk of cardiovascular events and all-cause mortality: a decade-long historical cohort study. PLoS Med. 2014;11(2):e1001599.
Khassawneh B, Ghazzawi M, Khader Y, Alomari M, Amarin Z, Shahrour B, et al. Symptoms and risk of obstructive sleep apnea in primary care patients in Jordan. Sleep Breath. 2009;13(3):227–32.
Kosmiski L, Kuritzkes D, Hamilton J, Sharp T, Lichtenstien K, Hill J, et al. Fat distribution is altered in HIV-infected men without clinical evidence of the HIV lipodystrophy syndrome. HIV Med. 2003;4(3):235–40.
Lo JC, Mulligan K, Tai VW, Algren H, Schambelan M. "Buffalo hump" in men with HIV-1 infection. Lancet. 1998;351(9106):867–70.
Lo Re 3rd V, Schutte-Rodin S, Kostman JR. Obstructive sleep apnoea among HIV patients. Int J STD AIDS. 2006;17(9):614–20.
McGinley BM, Schwartz AR, Schneider H, Kirkness JP, Smith PL, Patil SP. Upper airway neuromuscular compensation during sleep is defective in obstructive sleep apnea. J Appl Physiol (1985). 2008;105(1):197–205.
McNicholas WT. Obstructive sleep apnea and inflammation. Prog Cardiovasc Dis. 2009;51(5):392–9.
Netzer NC, Stoohs RA, Netzer CM, Clark K, Strohl KP. Using the Berlin Questionnaire to identify patients at risk for the sleep apnea syndrome. Ann Intern Med. 1999;131(7):485–91.
Resta O, Foschino-Barbaro MP, Legari G, Talamo S, Bonfitto P, Palumbo A, et al. Sleep-related breathing disorders, loud snoring and excessive daytime sleepiness in obese subjects. Int J Obes Relat Metab Disord. 2001;25(5):669–75.
Smith PL, Wise RA, Gold AR, Schwartz AR, Permutt S. Upper airway pressure-flow relationships in obstructive sleep apnea. J Appl Physiol (1985). 1988;64(2):789–95.
Somers VK, White DP, Amin R, Abraham WT, Costa F, Culebras A, et al. Sleep apnea and cardiovascular disease: an American heart association/American college of cardiology foundation scientific statement from the American heart association council for high blood pressure research professional education committee, council on clinical cardiology, stroke council, and council on cardiovascular nursing. In collaboration with the national heart, lung, and blood institute national center on sleep disorders research (National Institutes of Health). Circulation. 2008;118(10):1080–111.
Taibi DM. Sleep disturbances in persons living with HIV. J Assoc Nurses AIDS Care. 2013;24(1 Suppl):S72–85.
World Health Organization. Case definition of HIV for surveillane and revised clinical staging and immunological classification of HIV-related diseases in adult and children. 2007. http://www.who.int/hiv/pub/guidelines/HIVstaging150307.pdf. Accessed 18 Sep 2016.