

Excessive Daytime Sleepiness and Hypertension in Cameroonian Adult Population

Eric Walter Pefura-Yone^{1,2,*}, Olen Jean Pierre Kamga^{1,3}, Adamou Dodo Balkissou⁴, Jérôme François Kaze-Folefack^{1,5}, Amadou Djenabou⁶, Virginie Poka-Mayap², Alain Kuaban¹, Haman Djabbo Abdoul Whahab⁷, Sounou Asmaou⁸, Corine Kenne-Kenyo⁹, Christopher Kuaban¹⁰

¹Department of Internal Medicine and Specialties, Faculty of Medicine and Biomedical Sciences, University of Yaoundé 1, Yaoundé, Cameroon

²Pneumology A Service, Yaoundé Jamot Hospital, Yaoundé, Cameroon

³Psychiatry A Service, Yaoundé Jamot Hospital, Yaoundé, Cameroon

⁴Faculty of Medicine and Biomedical Sciences of Garoua, University of Ngaoundéré, Garoua, Cameroon

⁵Nephrology Center, Yaoundé Teaching Hospital, Yaoundé, Cameroon

⁶HIV Approved Treatment Center, Yaoundé Jamot Hospital, Yaoundé, Cameroon

⁷Sub-division Health Medical Center of Koza, Koza, Cameroon

⁸Meiganga District Hospital, Meiganga, Cameroon

⁹Institut Supérieur de Technologie Médicale, Yaoundé, Cameroon

¹⁰Faculty of Health Sciences, University of Bamenda, Bamenda, Cameroon

Email address:

Pefura2002@yahoo.fr (E. W. Pefura-Yone), olen_cm@yahoo.fr (O. J. P. Kamga), dodobalkissou@gmail.com (A. D. Balkissou), f_kaze@yahoo.fr (J. F. Kaze-Folefack), djenabuamadou@yahoo.fr (A. Djenabou), pokavirginie@yahoo.fr (V. Poka-Mayap), kuabanallen@yahoo.com (A. Kuaban), abdoulwahhab@gmail.com (H. D. A. Whahab), asmaousounou@gmail.com (S. Asmaou), corinekenyokenne@yahoo.fr (C. Kenne-Kenyo), ckuaban@yahoo.fr (C. Kuaban)

*Corresponding author

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Abstract: Data on association between excessive daytime sleepiness (EDS) and hypertension are very limited in sub-Saharan Africa. The aim of this study was to look for an independent association between EDS and hypertension and identify the factors associated to EDS in adult subjects with hypertension in Cameroon. Data from cross-sectional community surveys conducted from 2015 to 2018 in three regions of Cameroon (West, Littoral, and North) were analyzed. The participants aged ≥ 19 years were included using multilevel stratified random sampling method. EDS was defined as an Epworth score ≥ 10 . Subjects were considered to have hypertension if they were on treatment for hypertension or had a blood pressure $\geq 140/90$ mmHg measured by standard protocols. Logistic regression was used to investigate the factors associated to EDS. The p-value < 0.05 was set as significant statistical threshold. A total of 8288 subjects (55.2% females) of median age (25th -75th percentiles) of 39 (27-54) years were included. The prevalence of EDS was higher in subjects who had hypertension as than in those without hypertension (13.4% vs 11.5%, $p = 0.015$), with an unadjusted odds ratio (IC 95%) of 1.19 (1.04-1.38). After multivariate analysis including place of residence, age, sex, education level and body mass index (BMI), we did not find an independent association between EDS and hypertension [odds ratio 95% CI: 1.01 (0.8-1.18), $p = 0.937$]. The determinants of EDS in subjects with hypertension were residence in Bandjoun [2.23 (1.12-4.11), $p = 0.10$], Douala [2.78 (1.48-5.25), $p = 0.002$] and Garoua [1.95 (1.01-3.74), $p = 0.045$] compared to Figuil; and BMI [1.04 (1.02-1.06) per 1kg/m² increase, $p = 0.001$]. In conclusion, we did not find an independent association between EDS and hypertension in Cameroon. Obesity is associated with EDS in subjects with hypertension.

Keywords: Sleep Disorders, Daytime Sleepiness, Sleep Apnea Syndrome, High Blood Pressure, Hypertension

1. Introduction

Excessive daytime sleepiness (EDS) is a common clinical problem. It is one of the main consequences of sleep disorders and it is associated with a reduction of the quality of life, road accidents and workplace accidents [1, 2]. EDS is an inability to maintain vigilance and alertness during major period of the day when subject is expected to be awake, with sleep occurring unintentionally or at inappropriate times and this almost daily [3]. Its prevalence is estimated between 10 and 20% in the general population [4–12] and reaches 68% in some groups of patients [13]. The independent association between EDS and hypertension is found in several studies including patients with sleep apnea syndrome (SAS) [13–16]. Hypertension is a common condition in the general population and is one of the major risk factors for cardiovascular mortality and morbidity [17]. Studies of the relationship between EDS and hypertension in the general population regardless of association with SAS are scarce. In a prospective cohort study carried out in a relatively healthy adult population, Goldstein et al. found a high risk of developing hypertension in subjects with EDS [18]. Otherwise, in a recent prospective cohort study in Brazil, Drager et al. did not find any association between hypertension and EDS [19]. Moreover, in a group of subjects recruited from a sleep laboratory in China, normotensive subjects had a more severe SDE than hypertensive subjects with OSA [20]. The factors associated with EDS in hypertensive subjects are obesity, type 2 diabetes and uncontrolled hypertension [21]. In this light, we carried out this study having as objective to investigate the association between the EDS and hypertension, and to determine the factors associated with the EDS in the subjects having hypertension in the general adult population of Cameroon.

2. Methods

2.1. Setting and Participants

This cross-sectional community based study was carried out from November 2015 to April 2018. Subjects were recruited in the health district of Bandjoun (semi-urban and rural area) of the western region of Cameroon from November 2015 to April 2016, in the city of Douala (urban area, Littoral region) from November 2016 to April 2017 and in the city of Garoua (urban area, North region) and Figuil (semi-urban area, North region) from December 2017 to April 2018. Subjects aged 19 and above who gave their informed consent to participate in the study were included.

2.2. Sampling

The sampling method used in this study has been published elsewhere [22]. In summary, multi-level stratified

sampling method was applied in each recruitment area. At the first level, the enumeration areas corresponding to those used for the national immunization days were selected by random sampling. At the second level, households were selected by systematic sampling with variable sampling rate according to the size of each enumeration area. Subjects aged at least 19 years living in the households selected at the second level were then invited to participate in these surveys.

2.3. Data Collection

The data were collected by the final year medical students. Socio-demographic data including age, sex, level of formal education, marital status and ethnic group were recorded. Smoking habits were identified and subjects classified as: smoker (a subject who reported having smoked at least one cigarette a day for at least one year or who had smoked at least 20 packs of cigarettes in his life and who continues to smoke), ex-smoker (anyone who reported stopping smoking for at least 6 months) and non-smoker. Alcohol consumption was classified as regular consumption, occasional consumption, former consumption, non-consumption [23]. Weight (kg) and height (m) were used to calculate body mass index (BMI) as the ratio of weight (kg) to the square of height (m). The different categories of body mass index (BMI) are those used internationally and include: BMI <18.5kg / m² (underweight), BMI of 18.5 to 24.9 kg / m² (normal), BMI of 25 to 29.9 kg / m² (overweight) and BMI ≥30 kg / m² (obesity). The history of hypertension and antihypertensive therapy were recorded and the arterial blood pressure measured three times in sitting position (5th, 10th and 15th minute of rest) according to standard methods [17] using a OMRON electronic sphygmomanometer (OMRON HEALTHCARE, Kyoto, Japan). A subject was considered having hypertension if he was taking antihypertensive drugs for hypertension or if the average arterial blood pressure taken at the 10th and 15th minute of rest was greater than or equal to 140 mmHg for systolic and 90 mmHg for diastolic [17]. EDS was evaluated by the Epworth scale [17]. EDS was defined by an Epworth score ≥10 [24]. Ethical clearance was obtained from the Institutional Review Board of the Faculty of Medicine and Pharmaceutical Sciences of the University of Douala.

2.4. Data Analysis

Our data were analyzed using IBM-SPSS 20 for Windows (IBM, Chicago, USA). Qualitative data were summarized in terms of counts and frequencies. Quantitative variables were described by their mean (standard deviation) or median (25th - 75th percentiles) according to the type of distribution of variables. The Chi-2 test was used for the comparison of proportions while quantitative variables were compared using the non-parametric Mann-Whitney U test. Logistic regression analysis was used to identify the factors associated to EDS. The factors associated with EDS in univariate analysis with p <0.10 were introduced

into the same multinomial logistic regression model to search for independent factors associated to EDS. At this level a difference was considered significant if $p < 0.05$.

3. Results

3.1. General Characteristics of the Study Population

Of the 8415 subjects interviewed, 127 subjects had no information on EDS or hypertension and were excluded from the analysis. Of the 8288 subjects definitively included, 3031 (36.6%), 2669 (32.2%), 1638 (19.8%) and 950 (11.5%) were respectively recruited in Bandjoun, Douala, Garoua and Figuil. There were 4579 (55.2%) women and 3709 (44.8%) men with the median (25th-75th percentiles) age of 39 (27-54) years. Obesity and overweight were found in 29.5% and 22% of subjects, respectively. The prevalence of hypertension in this study was 28.5% (95% CI: 27.6-29.5%) and that of EDS was 12.1% (95% CI: 11.4% -12.8%). The general characteristics of the study population are presented in Table 1.

Table 1. General characteristics of study population.

Characteristics	N=8288 (%)
Residency	
Bandjoun	3031 (36.6)
Douala	2669 (32.2)
Garoua	1638 (19.8)
Figuil	950 (11.5)
Gender	
Men	3709 (44.8)
Women	4579 (55.2)
Age, years, median (25 th -75 th percentiles)	39 (27-54)
Education	
≤ Primary	3758/8287 (45.3%)
Secondary	3099/8287 (37.4)
University	1430/8287 (17.3)
Marital status	
Living in couple	4603/8274 (55.5)
Living alone	3671/8274 (44.3)
Ethnicity	
Semi-bantu	4504/8277 (54.4)
Sudanese	1674/8277 (20.2)
Bantu	1278/8277 (15.4)
Fulani	504/8277 (6.1)
Other	317/8277 (3.8)
Tobacco use	
Smokers	579/8280 (7)
Ex-smokers	521/8280 (6.3)
Non-smokers	7180 (86.6)
Alcohol use	
Occasional	3829/5696 (67.2)
Regular	809/5696 (14.2)
Former	322/5696 (5.7)
No Consumption	736/5696 (12.9)
BMI, kg/m ² , median (25 th -75 th percentiles)	25.2 (22.1-29.3)
BMI categories	
Normal	3632/8247 (44)
Underweight	366/8247 (4.4)
Overweight	2436/8247 (29.5)
Obesity	1813/8247 (22)
Hypertension	2365 (28.5)
Excessive daytime sleepiness	1000 (12.1)

BMI, body mass index.

3.2. Association Between Excessive Daytime Sleepiness and Hypertension

In univariate analysis, the prevalence of EDS was higher in subjects who had hypertension than in those who did not, with a significant difference (13.4% vs 11.5%, $p = 0.015$) with an odds ratio (95% CI) of 1.19 (1.04-1.37). The mean Epworth score (SD) was 4.4 (4.2) in the hypertension group and 4.0 (4.1) in the group without hypertension ($p < 0.001$).

The results of the multivariate analysis of the association between EDS and hypertension, and potential confounding factors (sex, age, place of residence, education level, ethnic group, BMI) are presented in Table 2. After adjusting for potential confounding factors, EDS was no longer associated with hypertension [adjusted odds ratio (95% CI): 1.01 (0.86-1.18), $p = 0.944$].

Table 2. Multivariate analysis of associated factors to excessive daytime sleepiness.

Factors	OR (IC à 95%)	p
Men	1.25 (1.08-1.44)	0.003
Age	1.00 (0.99-1.01)	0.934
Residency		
Figuil	1	
Bandjoun	3.42 (2.27-5.15)	< 0.001
Douala	4.23 (2.83-6.34)	< 0.001
Garoua	1.27 (0.90-1.79)	0.168
Education	1.36 (0.86-2.14)	0.192
University	1	
Secondary	1.57 (1.28-1.93)	< 0.001
≤ Primary	1.49 (1.17-1.91)	0.001
Ethnicity		
Fulani	1	
Semi-bantu	0.86 (0.54-1.38)	0.535
Bantu	0.95 (0.58-1.56)	0.844
Sudanese	1.71 (1.13-2.58)	0.011
Others	0.81 (0.45-1.45)	0.476
BMI, per 1 kg/m ² increase	1.04 (1.03-1.06)	< 0.001
Hypertension	1.01 (0.86-1.18)	0.944

OR, odds ratio; BMI, body mass index.

3.3. Determinants of Excessive Daytime Sleepiness in Subjects with Hypertension

The determinants of EDS in subjects with hypertension are presented in Table 3 (univariate analysis) and Table 4 (multivariate analysis). In the univariate analysis, sex, age, smoking and alcohol use were not associated with EDS in hypertensive subjects. On the other hand, place of recruitment, education level, marital status, ethnic group and BMI were associated with EDS in hypertensive subjects.

Table 3. Univariate analysis of factors associated to excessive daytime sleepiness (EDS) in patients with hypertension.

Factors	EDS N = 318 (%)	No EDS 2047 (%)	p
Gender			
Men	148 (46.5)	944 (46.1)	0.888
Women	170 (53.5)	1103 (53.9)	
Age, years, mean (SD)	50.9 (16.3)	51.2 (17.2)	0.821
Residency			
Bandjoun	137 (43.1)	873 (42.6)	<0.001
Douala	128 (40.3)	589 (28.8)	

Factors	EDS N = 318 (%)	No EDS 2047 (%)	p
Garoua	40 (12.6)	347 (17)	
Figuil	13 (4.1)	238 (11.6)	
Education			
≤ primary	155 (48.7)	1116 (54.5)	0.060
Secondary	124 (39)	661 (32.3)	
University	39 (12.3)	270 (13.2)	
Marital status			
Living in couple	198/318 (62.3)	1162/2045 (56.8)	0.068
No in couple	120/318 (37.7)	883/2045 (43.2)	
Ethnic group			
Semi-bantu	194/318 (61)	1161/2045 (56.8)	0.076
Sudanese	45/318 (14.2)	359/2045 (17.6)	
Bantu	59/318 (18.6)	330/2045 (16.1)	
Fulani	7/318 (2.2)	102/2045 (5)	
Others	13/318 (4.1)	92/2045 (4.5)	
Smoking habits			
Smokers	23/316 (7.3)	137/2047 (6.7)	0.668
Former smokers	27/316 (8.5)	206/2047 (10.1)	
Non-smokers	266/316 (84.2)	1704/2047 (83.2)	
Alcohol consumption			
Occasional	178/264 (67.4)	961/1462 (65.7)	0.104
Regular	45/264 (17)	205/1462 (14)	
Former	13/264 (4.9)	133/1462 (9.1)	
No	28 (10.6)	163/1462 (84.7)	
BMI, Kg/m ² , mean (SD)	29.9 (6.4)	27.9 (6.4)	< 0.001
BMI categories			
Normal	74/315 (23.5)	672/2037 (33)	< 0.001
Underweight	5/315 (1.6)	81/2037 (4)	
Overweight	90/315 (28.6)	624/2037 (30.6)	
Obese	146/315 (46.3)	660/2037 (32.4)	

SD, standard deviation; BMI, body mass index.

In the multivariate analysis, the determinants of EDS in subjects with hypertension were residence in Douala [adjusted odds ratio (95% CI): 5.57 (2.52-12.33)], residence in Bandjoun [3.98 (1.80-8.80), $p < 0.001$], being a Sudanese [2.51 (1.02-6.15), $p = 0.044$] and obesity [1.63 (1.18-2.23), $p = 0.003$].

Table 4. Multivariate analysis of factors associated to excessive daytime sleepiness (EDS) in patients with hypertension.

Factors	OR (IC à 95%)	p
Residency		
Figuil	1	
Bandjoun	3.98 (1.80-8.80)	0.001
Douala	5.57 (2.52-12.33)	< 0.001
Garoua	1.89 (0.97-3.68)	0.063
Education level		
University	1	
Secondary	1.16 (0.78-1.73)	0.472
≤ primary	1.12 (0.75-1.65)	0.294
Ethnicity		
Fulani	1	
Semi-bantu	1.21 (0.43-3.35)	0.720
Sudanese	2.51 (1.02-6.15)	0.044
Bantu	0.98 (0.34-2.81)	0.972
Others	1.38 (0.45-4.24)	0.578
BMI categories		
Normal	1	
Underweight	0.75 (0.29-1.93)	0.546
Overweight	1.17 (0.83-1.63)	0.373
Obese	1.63 (1.18-2.23)	0.003

4. Discussion

In this study, conducted in a sub-Saharan African country and including more than 8,000 community-recruited subjects, we found that: 1) the prevalence of EDS was higher in subjects with hypertension 2) there was no independent association between EDS and hypertension 3) the determinants of EDS in subjects with hypertension were residence in Douala or Bandjoun, belonging to the Sudanese ethnic group and obesity.

In this study, we found that in univariate analysis, the prevalence of EDS was higher in subjects with hypertension compared to those without hypertension but this association disappeared in multivariate analysis after taking into account the socio-demographic and anthropometric confounding factors. In the study by Goldstein et al. published in 2004 and covering a cohort of 133 adult subjects followed for 5 years, EDS was a risk factor for the occurrence of hypertension [18]. Studies in subjects with SAS indicate that there is an independent association between EDS and hypertension [13, 16, 18]. For example, in a large study of 1958 patients seen in a Western China Sleep Disorders Center, Epworth-based EDS was independently associated with hypertension with an adjusted odds ratio of 1.23 in apneic subjects [14]. Using objective measures of daytime sleepiness such as the iterative sleep latency test, Ren et al. found that a sleep latency < 5 minutes and between 5 and 8 minutes increased the odds of hypertension by 95% and 111% respectively [16]. However, in a comparative study involving 304 hypertensive subjects and 67 normotensive subjects, the mean Epworth score was significantly lower in hypertensive subjects [15].

In hypertensive patients with or without SAS, the prevalence of EDS appears to be high. Thus, in a study carried out in a tertiary hospital in Cameroon, the prevalence of subjective EDS evaluated by the Epworth scale was 62.8% in adult subjects with hypertension [21]. In our study, the prevalence of EDS was 13.4% in hypertensive patients, significantly lower than that reported by Mbatchou et al. [21]. This difference can be explained by the fact that the subjects included in the latter study were recruited in hospitals contrary to the subjects included in our study. Thus, it is possible that some co-morbid conditions associated with EDS are more frequent among hospital-recruited subjects.

In our study, place of residence, Sudanese ethnicity and obesity were associated with EDS in hypertensive subjects. In the series of Stater et al. including 173 apneic and non-apneic patients recruited from a London sleep study center, obesity was associated with EDS regardless of other sleep disorders and hypertension [25]. After adjusting for confounding factors, our obese subjects were 63% more likely to have EDS compared to subjects with normal BMI. This risk was 175% in the study including 411 hypertensive subjects recruited from a hospital center in Douala, Cameroon [21]. Other studies have also reported an association between obesity and EDS [9, 26].

The Sudanese ethnic group was independently associated with EDS in hypertensive subjects in our study. The subjects

belonging to this ethnic group were mainly recruited in the areas of northern Cameroon (62% in Garoua and 34% in Figuil), areas in which the prevalence of EDS was significantly lower. Thus, specific studies should be conducted in this ethnic group to determine the reasons for this association; for example, the more frequent occurrence of conditions associated with EDS such as sleep apnea syndrome, sleep insufficiency, chronic insomnia and other sleep disorders. The independent association between the EDS and the Bandjoun and Douala residences, located respectively in the West and Littoral regions of Cameroon could be explained by the socio-environmental factors (type of occupation, social interactions) and even the psychological profile of the subjects. Indeed, Goldstein *et al.* suggest that the Epworth scale outside the measure of the propensity to doze in particular situations, could also include the measurement of psychological factors [18].

We found no association between gender, age, marital status, level of education, smoking and alcohol consumption. These results corroborate those found in other studies [18, 21, 27]. In a study conducted in the Canadian rural general population and including 7597 subjects, EDS was associated with age, male sex, low socio-economic status and married subjects [26].

The main limitations of this study are the use of a subjective measurement method for the evaluation of the EDS (Epworth Scale) and its cross-sectional nature which does not allow us to have chronologic link between EDS and the potential risk factors. Nevertheless, the Epworth scale is widely used in epidemiological and clinical studies for the evaluation of EDS, allowing a comparison between the results of different studies [24]. In addition, the psychometric validity of the Epworth score has recently been reported in the African population [28].

5. Conclusion

In this large population-based study in a sub-Saharan African country, we found no independent association between excessive daytime sleepiness and hypertension. In hypertensive subjects, Sudanese ethnicity, residence in Bandjoun or Douala and obesity are factors independently associated with EDS. Thus, EDS should be systematically evaluated for in hypertensive and obese subjects in order to identify the cause as this will permit optimal management of these patients. In addition, other studies should examine the reasons for a higher prevalence of EDS in Sudanese hypertensive patients and also in those living in West and Littoral region of Cameroon. The reduction of body mass index should also allow a reduction of burden of EDS in hypertensive subjects.

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