THE NUTRITIONAL STATUS OF OLDER PEOPLE WITH AND WITHOUT DEMENTIA LIVING IN AN URBAN SETTING IN CENTRAL AFRICA: THE EDAC STUDY

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Abstract: *Objectives:* To determine the nutritional status of elderly African people and to investigate the association between undernutrition and dementia. *Design:* Door-to-door cross-sectional surveys in the general population. *Setting:* Representative districts of Bangui (Central African Republic) and Brazzaville (Republic of Congo). *Participants:* Population aged over 65 years. *Measurement:* Undernutrition was defined as a body mass index <18.5. Anthropometric parameters (arm circumference, waist circumference and triceps skinfold thickness) were measured, and information was gathered on nutritional habits. Participants underwent cognitive screening using the Community Screening Interview for Dementia (CSI-D) and the Five-Word Test. After further neuropsychological testing and neurological examination, the diagnosis of dementia was confirmed according to DSM-IV criteria. Multivariate logistic regression models were applied in order to identify factors associated with undernutrition in populations with or without dementia. *Results:* 1016 people were included. In the general population, the prevalence of undernutrition was 19.2%. Dementia was found in 7.4% of elderly people. Compared with healthy people, patients with dementia had an increased prevalence of undernutrition (32.0% vs. 17.7%; p=0.002), lower weight (49.3±10.5 kg vs. 58.4±13.5 kg ; p<0.001), and lower BMI (20.8±4.1 vs. 22.9±4.8 ; p<0.001); they were less likely to eat their fill (38.9% vs. 45.9% ; p=0.001), had more dietary restrictions (36.1% vs. 24.3% ; p=0.03) and ate less often with their family (66.7% vs. 90.6% ; p<0.0001). Eating only one meal per day was the sole factor associated with undernutrition in dementia (OR: 7.23 [CI: 1.65-31.7]; p=0.03). *Conclusion:* The prevalence of undernutrition is high in the older population. The nutritional status of patients with dementia is more impaired than that of healthy patients. However, they are less often malnourished than in French home care settings. This study is the first to look at the nutritional status of at-home patients with dementia in Africa. These comparative data will eventually be used in the development of new nutritional intervention strategies.

Key words: Nutritional status, dementia, Africa.

Introduction

Dementia is defined by cognitive impairment (memory, language, praxis, executive functions, etc.) that affects daily life and lasts for at least 6 months (1). It is increasingly common, due to aging populations and environmental factors. According to the PAQUID study, about 860,000 people in France have dementia (2). The World Health Organization (WHO) considers the diagnosis and management of dementia to be public health issues because it is the leading cause of dependence among the elderly and the principal reason for admission to an institution, leading to significant health costs. Malnutrition-related obesity may promote the development of dementia (3), given the important role of diet in the genesis of these disorders. In the context of Alzheimer's disease, primary dementia, research has identified protective dietary factors (fruits, polyunsaturated fatty acids and flavonoids) and factors that increase risk (alcohol consumption, saturated fatty acids) (4-9). Furthermore, weight loss must be prevented in patients with dementia because it is responsible for a decrease

in quality of life and a worsening of cognitive impairment (10). In Western countries, 30-50% of people with dementia lose weight through mechanisms that may be central, such as atrophy of the medial temporal cortex or decreased secretion of neuropeptide Y (orexigenic hypothalamic neuropeptide), or because of the appearance of apraxia or oppositional behavior when taking meals (11-16). In Africa, data on the nutritional status of people with dementia are very scarce: a study in Cairo among patients living in nursing homes found that 17.4% of malnourished subjects had mild cognitive impairment (17). A study in the general population of Nigeria demonstrated an association between BMI <18.5 and the presence of dementia in elderly subjects (18). This association was also found in a study in the Congo and the Central African Republic (CAR) (19).

The objective of the present study was to describe the nutritional status of elderly people living in urban areas in Central Africa and to explore possible links with the presence of dementia.

JNHA: CLINICAL NEUROSCIENCES

Method

A door-to-door study, the Epidemiology of Dementia in Central Africa (EDAC) survey, was carried out in the general populations of the capitals of the CAR and Congo, Brazzaville and Bangui, respectively (20, 21). National health authorities gave their approval, and mayors, heads of district and local associations were contacted before the survey to increase the awareness of the study, and the information was broadcasted on radio. The choice of neighborhoods (3rd district of Bangui and 4th district of Brazzaville) was guided by their multiethnic character and accessibility. The study was supervised by local investigators (PM, MA) and an epidemiologist (MG). Ten year-6 medical students proficient in local languages (Sango in the CAR, Kituba and Lingala in Congo) were recruited in each city as interviewers and given one week of training in the use of the questionnaire and how to conduct the physical examination.

To be included, participants were required to be aged at least 65 years and to be a stable resident of one of the targeted neighborhoods. Everyone living in the study areas was contacted by interviewers and invited to participate in the study. Informed consent of the participant and/or a family member was obtained after the conduct of research was explained. Those who refused or had comorbidity severe enough to interfere with cognitive testing were excluded.

General information

The age of respondents was determined using official documents (birth certificates, baptismal records, identity cards, passports). In the absence of such documents or when there was a discrepancy between them and the information provided by the subject and the family, age was estimated using landmarks of local life (independence dates, dates when local personalities had died, dates of local events) - a validated method in various sub-Saharan African countries (21, 22). Socio-demographic information such as gender, marital status (single, married or cohabiting, separated or divorced, widowed), educational level (formal education or not), and previous occupation (or current if still active) were collected. Medical histories were sought and current comorbidities noted: hypertension history or defined by systolic blood pressure ≥140 mmHg and/or diastolic blood pressure ≥90 mmHg, measured in a supine position at the brachial level; diabetes history or defined by a blood glucose adjusted by time of the last meal of ≥1.26 g/L fasting or ≥2.0 g/L postprandial (Accucheck Performa™ device, Roche Diagnostics, France); hypercholesterolemia determined by capillary finger measurement (considered high if>240 mg/dL) (Accutrend Plus™ , Roche Diagnostics, France); alcohol consumption (never/sometimes/regularly) or tobacco use (never/ex-smoker/current smoker); and the presence of peripheral arterial disease of the lower limbs (PAD) defined by an ankle brachial index (ABI) ≤0.9 (23).

Nutritional assessment and dietary surveys

Nutritional assessment included measurement of weight (kg), with a portable mechanical balance (SECA™ Hamburg, Germany), and height (m) with a carpenter's measure on a vertical surface, calculation of the body mass index (BMI = weight/height² in kg/m²), and determination of the abdominal circumference (AbC, cm) with a measuring tape midway between the last rib and the iliac wing. Abdominal obesity was defined as AbC ≥102 cm for men and ≥88 cm for women (24). Triceps skinfold thickness (TST mm), representing body fat was measured on the right, midway between the acromion and olecranon using Harpenden calipers. The mean of three consecutive measurements was retained (25). Brachial arm circumference (AC, cm) was measured at the same location using a tape measure, and arm muscle circumference (AMC, cm), representing lean mass, was calculated using the following formula: AMC = AC (cm) - (0.314 * TST (mm)) (25). Nutritional status was based on BMI, as recommended by the WHO: BMI <18.5 is considered undernutrition, a BMI between 18.5 and 24.9 is considered normal weight, a BMI between 25.0 and 29.9 overweight, and a BMI> 30.0 obesity (26).

A food frequency questionnaire asked if people ate their fill or not, if they are consuming all food types, and if they had dietary restrictions/interdictions/taboos. The number of meals per day was recorded, as were the reasons for people eating fewer than three. Other questions covered taking meals in the same room as the family, and the size of their portions in comparison to those given to others (more or less). The frequency of consumption over the previous 3 days was noted for fruits, vegetables, starches, oilseeds, meat or fish, eggs, and sugar. The autonomy of the elderly was assessed using questions relating to difficulties with housework, meal preparation, feeding (feed him/herself correctly, need simple cookware, need simple meals such as biscuits, and need to be fed), dressing and to use toilet.

Neuropsychiatric Evaluation

Dementia was screened using the Community Screening Interview for Dementia (CSI-D) and the Five-Word Test (27, 28). The presence of an informant (most often a family member) was required to answer questions from the CSI-D about the elderly. Subjects who had poor results in the CSI-D (<25.5) or the Five-Word Test (<10/10) received a neurological examination to confirm the presence or absence of dementia. Additional neuropsychological tests were performed to guide the diagnosis (Free and Cued Selective Reminding Test, Isaacs Set Test, Zazzo cancellation task, temporo-spatial orientation, mental calculation and similarities testing) (29-31). The diagnosis of dementia was made according the criteria of the Diagnostic and Statistical Manual of Mental Disorders - 4th edition (DSM-IV) (32). Screening for depression and/or anxiety symptoms involved the Goldberg scale (score> 5/9 revealing probable anxiety and >2/9 probable depression) (33). Recent loss of a loved one was also noted (34).

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Statistical analysis

The data were entered via EpiData™ 1.5 (Epidata Association, Odense, Denmark). Statistical analyzes were performed using SAS™ Version 9.2 software (SAS Institute, Cary, NC, USA).

Quantitative variables were compared using the Student t test. The Chi-2 was used for qualitative comparisons and the Fisher exact test was used when the theoretical numbers were too low. Multivariate analysis by logistic regression following a backward stepwise procedure was performed initially to identify factors associated with undernutrition in the population as a whole and in patients with or without dementia. The dependent variable was therefore the nutritional status (defined by BMI) and the independent variables were the various nutritional, medical, sociodemographic and psychosocial factors considered.

For each multivariate model, variables with p≤0.25 in univariate analysis were included in the initial logistic regression model. The presence of confounding variables and interactions between the independent variables in the final model were sought. The level of significance for all statistical analyses and the final logistic models was set at p≤0.05.

Ethical approval

The study received approval from the Ethics Committees of the CAR and Republic of Congo under the auspices of the Ministries of Public Health and Scientific Research.

Table 1
General information in people with dementia compared to people without dementia and in the total population

Criteria	People with dementia (n=75)				People without dementia (n=902)			Total population (n=1016)		
	Numbe /r	percentage	MD	P	Number /	percentage	MD	Number /	percentage	MD
Sex			0	<0.0001			0			0
- Men	15	20.0			389	43.1		416	40.9	
- Women	60	80.0			513	56.9		600	50.1	
Age (years ; mean±SD)		77.4±7.3	0	<0.0001		73.1±6.2	0		73.6±6.559.8	0
- 65-74	30	40.0			565	62.6		608	33.6	
- 75-84	31	41 .3			293	32.5		341	6.6	
- 85 or more	14	18.7			44	4.9		67		
Marital status			0	0.003			0			0
- Single	1	1.3			31	3.4		34	3.3	
- Married / couple	16	21.3			376	41.7		402	39.6	
- Separated	8	10.7			67	7.5		79	7.8	
- Widowed	50	66.7			428	47.4		501	49.3	
Formal education			0	<0.0001			0			2
- No education	57	76.0			453	50.2		510	50.3	
- Primary education	15	20.0			323	35.8		338	33.3	
- Secondary education	2	2.7			80	8.9		90	8.9	
- More than secondary education	1	1.3			20	2.2		21	2.1	
- Education but unknown level	0	0.0			26	2.9		55	5.4	
Occupation			0	<0.0001			0			0
- Employee	9	12.0			299	33.2		319	31.4	
- Storekeeper/commercial	8	10.7			219	24.3		238	23.4	
- Farmer/ breeder	47	62.7			287	31.8		347	34.2	
- No activity	2	2.6			14	1.5		18	1.8	
- Other	9	12.0			83	9.2		94	9.2	
Anxiety	57	76.0	_	0.0001	480	53.3	_	562	55.4	1
Depressive ymptomss	68	90.7	_	0.0001	631	70.0	_	729	71.8	1
Hypertension	51	68.0	_	0.53	579	64.4	_	654	64.6	3
Diabetes	10	13.9	_	0.44	126	16.7	_	141	16.5	160
Hypercholesterolemia	1	1.5	_	0.64	20	3.0	_	21	2.7	250
Alcohol consumption			1	0.37			1			2
- Never	36	48.6			366	40.6		420	41.4	
- Occasionally	32	43.2			435	48.3		483	47.6	
- Regularly	6	8.2			100	11.1		111	1 1 . 0	
Tobacco use			1	0.64			2			3
- Never	47	63.5			587	65.2		664	65.5	
- Ex-smoker	16	21.6			158	17.6		181	17.9	
- Current smoker	11	14.9			155	17.2		168	16.6	
Recent loss of a loved one	66	88.0	0	0.27	749	83.0	0	847	83.4	0

MD : Missing Data ; _ : Unknown

Results

During the survey, 1055 people over 65 were contacted (509 and 546 in Brazzaville and Bangui, respectively). Of those, 1016 were interviewed (520 and 496, respectively), the remainder declined to participate. The 1016 subjects (total population) included had a mean age of 73.6 ± 6.5 years, most were women (59.1%), mainly widows (49.3%), married or living in couple (39.6%) (Table 1). Almost half (47.3%) had completed school. In 26 participants (14 and 12, respectively), height (n=21) and/or weight (n=17) could not be measured because of their physical condition. Similarly, 39 of the 1016 participants could not be reviewed by the neurologist and therefore had an unknown cognitive status. In total, 977 participants were assessed on the cognitive status and the prevalence of dementia was estimated at 7.4% (8.1% (95%CI=[5.8-10.8]) in Bangui and 6.7% (95%CI=[4.7-9.2])

in Brazzaville) (20), 55.4% anxiety and 71.8% depression. Nutritionally, 19.2% of people were undernourished and 8.8% obese (Table 2). The prevalence of undernutrition was 29.5% (95% CI [24.8 to 32.7]) in Bangui and 9.5% (95% CI [7.0 to 11.9]) in Brazzaville, and that of obesity was 2.7% (95% CI [1.5 to 4.3]) and 14.6% (95% CI [11.4 to 17.4]).

Compared to those without, patients with dementia were different with respect to gender, age, marital status, level of education, occupation, and anxiety and depression (Table 1). From a nutritional point of view (Table 2), dementia patients had lower weight, BMI, TST and AMC (p<0.001 ; p<0.001 ; p=0.01 ; p<0.001) and were less likely to exhibit abdominal obesity (p=0.04). Similarly, they were more often undernourished (p<0.001), less often ate their fill (p=0.001), were more often forbidden certain foods (food taboos) (p=0.03) and less often ate with the family (p<0.0001). Their food intake differed from that of people without dementia, including a

Table 2
Nutritional parameters in people with dementia compared to people without dementia and in the total population

Criteria	People with dementia (n=75)				People without dementia (n=902)			Total population (n=1016)		
	Number / Number /	mean±SD percentage	MD	P	Number / Number /	mean±SD percentage	MD	Number / Number /	mean±SD percentage	MD
Height (cm)	72	154.2±7.3	3	<0.001	888	159.4±8.2	14	995	158.9±8.2	21
Weight (kg)	73	49.3±10.5	2	<0.001	890	58.4±13.5	12	999	57.4±13.4	17
Body mass index (kg/m²)	72	20.8±4.1	3	<0.001	883	22.9±4.8	19	990	22.7±4.8	26
- <18.5	25	34.7			156	17.7		190	19.2	
- 18.5-25	34	47.3			467	52.9		524	52.9	
- 25-30	12	16.7			175	19.8		189	19.1	
- >30	1	1.3			85	9.6		87	8.8	
Abdominal circumference (AbC, cm)	74	79.1±13.7	1	0.04	898	86.0±29.4	4	1011	85.3±28.2	5
Triceps skinfold thickness (TST, mm)	72	11.0±5.7	3	0.01	807	12.8±6.0	95	917	12.6±6.0	99
Arm Circumference (AC, cm)	74	24.8±4.9	1	<0.001	886	27.8±4.8	16	999	27.5±4.8	17
Arm muscle circumference (AMC, cm)	72	21.3±4.0	3	<0.001	796	23.9±4.1	106	906	23.6±4.1	110
Ankle brachial index (ABI)			5	0.001			29			40
- Low	29	41.4			201	23.0		236	24.2	
- Normal	37	52.9			552	63.3		613	62.8	
- High	4	5.7			120	13.7		127	13.0	
(102 cm for men/ 88 cm for women)	14	18.9	_	0.04	271	30.2	_	293	29.0	5
Difficulty to eat until full	49	67.1	0	0.01	488	54.1	0	562	55.3	0
Eating until full in previous 3 days	28	38.9	0	0.001	414	45.9	0	460	45.3	0
Eat all food	51	68.9	0	0.92	621	69.5	0	696	69.2	0
Has not allowed food	26	36.1	0	0.03	218	24.3	0	251	24.9	0
Number of meals			0	0.23			0			0
- 1	35	46.7			339	37.6		389	38.3	
- 2	33	44.0			436	48.3		487	47.9	
- 3	7	9.3			127	14.1		140	13.8	
Eating in the same room as the rest of the family	50	66.7	0	<0.0001	817	90.6	0	899	88.5	0
Size of portions compared to other family members			9	0.16			69			83
- Equal	43	65.1			628	75.4		698	74.8	
- Larger	19	28.8			166	19.9		192	20.6	
- Smaller	4	6.1			39	4.7		43	4.6	
Recent loss of a loved one	66	88.0	0	0.27	749	83.0	0	847	83.4	0

MD : Missing Data ; _ : Unknown

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Table 3
Nutritional information in people with dementia compared to people without dementia and in the total population

Consumption over the past 3 days	People with dementia (n=75)				People without dementia (n=902)			Total population (n=1016)		
	Number /	percentage	MD	P	Number /	percentage	MD	Number /	percentage	MD
Dairy product			1	0.16			0			1
- 0	52	70.3			547	60.6		619	61.0	
- 1-2	16	21.6			217	24.1		244	24.0	
- 3 or more times	6	8.1			138	15.3		152	15.0	
Fruits			*1*	*0.008*			*0*			*1*
- 0	40	54.0			331	36.7		387	38.1	
- 1-2	29	39.2			443	49.1		488	48.1	
- 3 or more times	5	6.8			128	14.2		140	13.8	
Vegetables			1	0.78			0			1
- 0	17	23.0			217	24.1		242	23.8	
- 1-2	46	62.2			526	58.3		597	58.8	
- 3 or more times	11	14.8			159	17.6		176	17.4	
Starchy food			1	0.59			0			1
- 0	6	8.1			105	11.6		117	11.5	
- 1-2	40	54.0			446	49.5		502	49.5	
- 3 or more times	28	37.9			351	38.9		396	39.0	
Legumes			1	0.60			0			1
- 0	37	50.0			499	55.3		554	54.6	
- 1-2	35	47.3			373	41.4		427	42.1	
- 3 or more times	2	2.7			30	3.3		34	3.3	
Oily food			3	0.12			0			3
- 0	31	41.9			289	32.0		331	32.6	
- 1-2	31	41.9			489	54.2		544	53.6	
- 3 or more times	12	16.2			124	13.8		140	13.8	
Meat or fish			1	0.02			0			1
- 0	29	39.2			222	24.6		262	25.8	
- 1-2	32	43.2			457	50.7		511	50.3	
- 3 or more times	13	17.6			223	24.7		242	23.9	
Eggs			1	0.84			0			1
- 0	66	89.2			787	87.2		885	87.2	
- 1-2	7	9.5			105	11.7		115	11.3	
- 3 or more times	1	1.3			10	1.1		15	1.5	
Sugar			1	0.33			0			1
- 0	29	39.2			341	37.8		380	37.4	
- 1-2	28	37.8			285	31.6		327	32.2	
- 3 or more times	17	23.0			276	30.6		308	30.4	

MD : Missing Data

lower consumption of fruit (p=0.01) and meat or fish (p=0.02). There were no significant differences in the consumption of dairy products, vegetables, starches, legumes, oilseeds, eggs or sugar (Table 3). People with dementia were also more dependent regarding housework (p<0.001) and meal intakes (p=0.0001) (Table 4).

After the multivariate analyses (Table 5), the factors positively associated with undernutrition in our population (n=977) were increasing age (p=0.0004) and smoking (p=0.002) while hypertension was negatively associated with undernutrition (p<0.0001). Taking only one meal a day was the only factor associated with undernutrition in people with dementia (n=75) (p=0.03). Among people without dementia (n=902), there were two risk factors, increasing age (p=0.002) and smoking (p=0.001), and one protective factor: hypertension (p<0.0001).

Discussion

The study is, to our knowledge, one of the few to address the relationships between undernutrition and dementia among elderly people living in urban areas in Africa. In the general population, undernutrition is more common (19.2%) than among elderly people in France living at home (4-10%) (35). This result is probably attributable to the poverty of the population studied. Gross domestic product per capita was US$ 800/year in CAR and US$ 4600/year in Congo (36,37).

The adjusted multivariate analysis shows that in urban central Africa, hypertension is a protective factor for undernutrition, probably related to the fact that hypertension is more often present in patients who are overweight or obese and therefore not classified as undernourished in this study. However, smoking and age are risk factors for undernutrition.

Table 4
Difficulties with housework, feeding, dressing and hygiene, in people with dementia compared to people without dementia and in the total population

Activity of daily living past 3 days	People with dementia (n=75)				People without dementia (n=902)			Total population (n=1016)		
	Number /	percentage	MD	P	Number /	percentage	MD	Number /	percentage	MD
Difficulties with house-work			3	<0.001			11			14
- None	17	23.6			504	56.6		532	53.1	
- Sometimes	20	27.8			298	33.4		330	32.9	
- Major difficulties	35	48.6			89	10.0		140	14.0	
Difficulties with feeding			2	<0.001			6			8
- Can feed him/herself correctly	55	75.3			850	94.8		942	93.4	
- Need simple cookware to eat	12	16.4			42	4.8		54	5.4	
- Need simple meals such as biscuits	4	5.6			3	0.3		7	0,7	
- Need to be feeded	2	2.7			1	0.1		5	0.5	
Difficulties with dressing			2	<0.001			6			8
- Dresse himself	48	65.7			855	95.4		935	92.7	
- Buttons placed occasionally in the wrong position	5	6.8			10	1.1		16	1.6	
- Mistakes, frequent forgetfulness	8	11.0			17	1.9		26	2.6	
- Unable to dress	12	16.5			14	1.6		31	3.1	
Difficulties to use the toilet			2	<0.001			7			9
- No problems	41	56,3			820	91.5		889	88.3	
- Occasionally wet the bed	11	15.0			52	5.8		68	6.7	
- Frequently wet bed	11	15.0			17	2.0		31	3.1	
- Double incontinence	10	13,7			6	0.7		19	1.9	

MD : Missing Data

Smoking is a known risk factor for undernutrition in terms of both its central effect of increased resting energy expenditure and its respiratory impact, decreased partial pressure of oxygen in the blood with central anorectic effects (35, 36). In Western countries, the elderly are typically more at risk of undernutrition than young adults because of psychiatric disorders, oral/dental problems, medication, and dependence on others for meals (35).

The anxiety and depressive symptoms seen in the elderly population studied are very common, as found by Saragat et al. (38), however only 0.5% of people were in need of assistance with food.

Obesity, which affects only 8.8% of subjects, is less common than in France (prevalence in 2012: 15.4%), again probably because of the poor economic conditions in the countries studied (39). However, these figures should be monitored because urbanization and the lifestyle changes that low-income countries currently face mean that the prevalence of obesity may increase over coming years (40).

People with dementia exhibit clear differences in nutritional status compared to those without. Weight and BMI values, representing fat mass, are lower and lean body mass is also lower. They eat less often than hunger dictates, are more often subject to dietary restrictions, and are often isolated during meals. Overall, they are more often malnourished (34.7% of cases versus 17.7% without dementia). The prevalences of undernutrition in patients with dementia in three European studies were much higher, at 45.3%, 50.0% and 52.0%, but the work was conducted in institutions (14-

16). Nevertheless, in Dutch elderly people at home with newly diagnosed Alzheimer's disease, no undernutrition (assessed by the mini nutritional assessment) was found (41). The only African study, conducted in a Cairo nursing home, shows, however, a lower prevalence (17.4%) (17). The fact that the prevalence of undernutrition in people with dementia is higher in France than in Central Africa seems paradoxical, but it can be partly explained by the higher average age of patients with Alzheimer's disease in France of 82 years (42) versus 77.4 years in our study and the survival of people with dementia in Africa might also be shorter. Therefore, the French patients may have more severe disease in the study population, and a greater nutritional impact. Moreover, in France, people with dementia are often cared for in specialized institutions, which may accentuate their isolation, whereas the great majority of people with dementia in central Africa remain at home with their families. Nutritional care might be beneficial to reduce the prevalence of undernutrition in this population (14, 43).

In multivariate analysis, the only risk factor for undernutrition in people with dementia was the realization of only one meal per day. This is not the case in studies from Western countries, but is easily explained: unlike in the West, people in Central Africa do not necessarily have access to three meals a day.

From a methodological point of view, in order to limit operator-dependent variations in anthropometric measurements, investigators received shared initial training from an experienced investigator, and many meetings leading to adjustment took place. In contrast, as in Western countries

Table 5
Factors associated with undernutrition in multivariate analysis for the global population and people with and without dementia

Factors associated with undernutrition for the whole population (n=977)			
Factors	**Odds ratio**	**95 % confidence interval**	**p**
Town (Brazzaville versus Bangui)	0.33	0.02-0.50	<0.0001
Age (for 10 more years)	1.68	1.26-2.24	0.0004
Arterial hypertension (yes/no)	0.40	0.27-0.59	<0.0001
Tobacco (smoker/non-smoker)	2.08	1.30-3.32	0.002
Factors associated with undernutrition in people with dementia adjusted by town (n=902)			
Factors	**Odds ratio**	**95 % confidence interval**	**p**
Town (Brazzaville versus Bangui)	0.34	0.09-1.39	0.13
Number of meals/day: 1 versus 2	7.23	1.65-31.7	0.03
Factors associated with undernutrition in people without dementia adjusted by town (n=75)			
Factors	**Odds ratio**	**95 % confidence interval**	**p**
Town (Brazzaville versus Bangui)	0.37	0.24-0.58	<0.0001
Age (for 10 more years)	1.67	1.21-2.32	0.002
Arterial hypertension (yes/no)	0.33	0.21-0.50	<0.0001
Tobacco (smoker/non-smoker)	2.24	1.37-3.66	0.001

MD : Missing Data

(44, 45), the subjectivity of dietary surveys could not be completely countered. Some participants had to be excluded from the analyses because of the lack of clarity concerning their cognitive status (dementia or not, n=38) or because of an inability to measure BMI (n=26). However, participants with no diagnosis of dementia did not differ significantly from the others with respect to gender, level of education, or cognitive screening performance, but were older in Bangui (data not shown). Those in whom we were not able to measure BMI did not differ from others in terms of age, sex, city of residence, or educational level, but were less likely to be married or cohabiting (19.2% vs. 40.1%) and were more often divorced or separated (26.9% vs. 7.3%). Excluded subjects were no more likely to have dementia than those included. The subjects in our analyses were therefore representative of the population participating in these surveys. However, it should be noted that the number of patients diagnosed with dementia was low (n=75). The limited sample size could lead to a reduction in the precision of estimates and the results should be considered with caution. They require confirmation by a larger study. This limited sample in each city has led to a joint statistical analysis of both countries. We are aware that those two countries, albeit neighbors might have different characteristics, however, no interaction between the city and the factors highlighted in our analyses was found.

Conclusions

This epidemiological study aimed to identify factors associated with undernutrition in people with and without dementia. In the general population, the higher prevalence of undernutrition than in France was probably linked to poor local economic conditions as well as age and smoking. As in many studies in Western countries, dementia patients were more malnourished than those without dementia, with low food consumption and isolation during meals. Surprisingly, the prevalence of undernutrition in people with dementia remained lower than in Western countries, where patients are older and likely to be more cognitively impaired and supported by an institution.

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