Cognitive Impairment and Dementia in Elderly People Living in Rural Benin, West Africa

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Key Words

Cognitive impairment • Elderly population • Benin, West Africa

Abstract

Background/Aims: Dementia is increasing as a priority public health problem because of the ageing of the world population. Our goal was to estimate dementia and cognitive impairment prevalence in an elderly population of rural Benin.

Methods: In a door-to-door survey, elderly people aged 65 years and above were screened using the Community Screening Interview for Dementia and the Five-Word Test.

Results: The prevalence of cognitive impairment was 10.4% and that of dementia was 2.6%. Age, current depressive disorder and absence of the APOE ϵ 2 allele were significantly associated with cognitive impairment. **Conclusion:** Prevalence of dementia and cognitive impairment appears to be lower in this study than in developed countries.

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The frequency of diseases associated with old age, such as dementia, increases, which will constitute a major public health problem in the future [1], even in developing countries.

Dementia has been documented in Nigeria thanks to the Indianapolis/Ibadan Dementia Project (IIDP), but data of the general population are scarce in the rest of the continent. Prevalence appears to be low, particularly for Alzheimer's disease (AD), in Nigeria with previous results being 2.3% for dementia and 1.4% for AD [2]. This level of prevalence was far lower than in developed countries such as the United States (about 8% for dementia and 6% for AD [2]) or Europe (about 6% for dementia and 4% for AD [3]). These findings were very surprising due to the high frequency of illiteracy and of subjects with the APOE4 allele in African countries [4], two strong risk factors for dementia, and need to be confirmed in different populations.

This study aimed at estimating the prevalence of dementia and cognitive impairment, and assessing factors associated with cognitive impairment in elderly living in rural Benin.

Methods

Study Design

The study was carried out in the rural commune of Djidja centre, about 150 km north of Cotonou (economic capital of Benin), between March and April 2007. Several epidemiological studies had already been conducted by the same research team in this area, with a good participation of inhabitants. The Benin total population is estimated at 8.7 million inhabitants, which represents about 0.1% of Africa's global population [5]. Ethical approval was obtained from the Ministry of Health of Benin.

A general population survey was carried out by means of a door-to-door screening in 7 randomly selected neighboured villages. Each village was fully investigated by a research team familiar with the area, visiting each small community composing the villages and asking for old people. The population of Djidja centre was estimated at 15,618 inhabitants (Census 2002) and the population of the 7 villages included in the study at about 12,792 inhabitants [6].

To be included in this study, individuals had to be ≥ 65 years old and to currently live in the area of Djidja centre. Subjects and families were informed about the study and signed a consent form before the interview.

In order to estimate the prevalence of dementia in elderly aged 65 years and above, the minimum number of subjects needed to detect a prevalence of 5% with a precision of 2% was 456 subjects.

Date of birth was estimated with historical landmarks well known to the population: the solar eclipse in 1946 and the independence of the Republic of Dahomey in 1960. This method had previously been used and validated in IIDP studies in Nigeria [2, 7] and had successfully been tested in elderly living in Benin (Cotonou) (intraclass correlation coefficient = 0.87, 95% CI = 0.81–0.91, sample size = 118 subjects, for both historical landmarks compared to official individual demographic data, personal data).

The questionnaire was administered by 5 field investigators trained to use the instruments and scales composing the questionnaire. This training was performed during 1 day by a physician who is currently working in this area and 2 operators supervising the study (M.G., M.N.P.). The first days of screening were performed in the presence of this physician and 1 supervisor (M.G.) to control the good execution of the different tasks by the investigators. Briefings were done after each day of field work and each questionnaire was checked at this occasion in order to avoid missing data and discrepancies. One supervisor (M.G.) was present during all the stages of this study.

Screening Instruments

Since the study involved a population with a low literacy level, the Community Screening Interview for Dementia (CSI-D) was used [8]. This screening instrument had already been used and validated in Nigeria (IIDP) [2, 9] by several steps: translation/back translation, preliminary trials for acceptability, and a pretest study for comparability, reliability, validity and to develop cut-off scores. This instrument has two parts: a cognitive and risk factor part and an informant part. The cognitive section contains items from the most used screening tests for dementia, selected conforming to dimensions designated in the DSM-III-R and ICD-10 criteria for dementia. They measure in a short interview: memory,

abstract thinking, judgement, other disturbance of higher cortical function, personality changes and behaviour at work and in social relationships.

Three tests from the Short Cognitive Evaluation Battery were also used: temporal orientation, oral version of the Five-Word Test (FWT) [10] and semantic verbal fluency task. The clock-drawing test was not included because of the high rate of illiterate people in this region (Benin literacy rate: 32.6%) [11].

Due to a total lack of temporal orientation of elderly subjects in rural Benin and the high rate of illiteracy, 30 was the highest possible score in the cognitive section of the CSI-D (instead of 33). Two questions, one assessing praxias and the other the current year, were not considered for the score. Moreover, it was not possible to take into account the informant section of the CSI-D because it was difficult to find true informants able to answer precisely to the questions. According to these revised criteria, cognitive impairment was defined as a poor performance in the CSI-D cognitive section (less than 25.5 out of 30) or a bad performance in the FWT (less than 10/10) [10].

Interview

Subjects screened for dementia were interviewed with a questionnaire assessing social data such as marital and educational status, ethnicity, and medical antecedents. The weight (± 1 kg) and height measurements (± 1 cm) of each subject were determined and their body mass index was calculated.

Blood pressure was measured and individuals were suspected of high blood pressure if the WHO criterion (systolic blood pressure ≥ 140 mm Hg and/or diastolic blood pressure ≥ 90 mm Hg) was met [12]. Capillary blood glucose levels were taken with a glucometer (OneTouch® Ultra®, LifeScan) to detect the existence of diabetes mellitus.

Goldberg's anxiety and depression scale was used to detect anxiety and depressive disorders in elderly [13]. Jacoby's stigma scale was adapted from epilepsy to measure stigmatization of elderly people screened for dementia [14]. Seventeen psychosocial factors were investigated for three different life periods according to Persson and Skoog [15].

Clinical Assessment

Subjects with a poor performance in CSI-D or FWT were suspected of dementia and underwent further tests consisting of a structured interview (second stage).

This interview was conducted by the same senior neurologist (J.-F.D.), who is very experienced in the clinical diagnosis of dementia in population-based studies (PAQUID and 3C studies), with the help of a specifically trained Fon translator. The interview had several parts: description of cognitive symptoms by the subject, assessment of cognitive disorders, careful description of activities of daily living (particularly leisure), instrumental activities of daily living with the same level of precision as the Lawton scale [16] but adapted to the context of rural Benin, occupational activities, social habits, past activities, current medical history and cognitive examination. Additional cognitive tests were conducted by the same experienced neuropsychologist: the oral version of the Free and Cued Selective Reminding Test (FCST) [17], Zazzo's cancellation task [18], and Isaacs' Set Test [19] of verbal fluency.

The diagnosis of dementia was made according to the DSM-IV criteria [20]. The diagnosis of probable and possible AD was based

Table 1. Prevalence of cognitive impairment and dementia in Djidja, Benin, by sex and age (2007)

Age	Men (n = 155)		Women (n = 347)		Total (n = 502)	
	n	prevalence (95% CI)	n	prevalence (95% CI)	n	prevalence (95% CI)
Cognitive impairment						
65–79 years old	5	4.4 (0.6–8.1)	18	7.6 (4.2–11.0)	23	6.5 (3.9–9.1)
80 years old and over	7	17.1 (5.6–28.6)	22	20.2 (12.6–27.7)	29	26.6 (19.5–33.7)
Total	12	7.7 (3.5–11.9)	40	11.5 (8.1–15.1)	52	10.4 (7.7–13.1)
Dementia						
65–79 years old	0	0.0 (0.0–3.2)	4	1.7 (0.4–4.2)	4	1.1 (0.3–2.9)
80 years old and over	1	2.4 (0.1–12.8)	8	7.3 (3.2–13.9)	9	6.0 (2.8–11.1)
Total	1	0.6 (0.0–3.5)	12	3.4 (1.8–5.0)	13	2.5 (1.1–3.8)

on the clinical criteria proposed by the National Institute of Neurological and Communicative Disorders and Stroke and the Alzheimer's Disease and Related Disorders Association (NINCDS-ADRDA) [21]. Diagnosis for other types of dementia was based on history of stroke and other clinical arguments.

A random sample of 50 subjects who scored above the cut-off of the screening tests, matched on sex and age to the suspected subjects of dementia, was also selected for the second stage to verify the validity of dementia case finding in our study. The same additional cognitive tests were conducted and diagnosis of dementia was made according to the same criteria.

ApoE Genotyping

Buccal epithelial cells were collected with cotton wool medical swabs by rubbing on the inner cheek after a mouth wash. Swabs were left to dry and stored refrigerated or frozen. Genomic DNA was isolated from the tips using a spin column-based procedure (Applichem, Gatersleben, Germany). PCR was performed on a LightCycler 480 (Roche Biochemicals, Basel, Switzerland) in 96-well plates. Genotyping was performed using hybridization probes in the 2nd round PCR as described before [22].

Statistical Analysis

Prevalence and 95% CIs were calculated for dementia and cognitive impairment by sex and by age (age groups: 65–79 years and ≥ 80).

The mean and standard deviation were used as summary statistics for quantitative variables (e.g. age, cognitive scores), and compared using Student's *t* test. Percentage counts were used for all qualitative variables of interest, and the Fisher exact tests were used for comparisons.

Multivariate analyses restricted to age, sex and APOE $\epsilon 4$ status and adjusted to education were performed.

Variables that had a *p* value ≤ 0.25 in the univariate analysis were included in a multivariate logistic regression model. This model was fitted using status (cognitive impairment or not) as the dependent variable and sociodemographic, medical and psychosocial data as independent variables [23]. We used a stepwise backward procedure. Interactions between independent variables

in the final model were examined. The level of significance for all the statistical analysis and the final multivariate model was fixed at 0.05.

Statistical analyses were carried out using SAS[®] software (version 9.1, SAS Institute, Cary, N.C., USA).

Results

Sociodemographic Data

A total of 514 individuals aged 65 years and above were eligible of whom 12 (2.3%) refused to participate (mean age 71.9 ± 5.0 years) and were therefore excluded from the analysis. Five hundred and two subjects aged 65 years and above (sex ratio M/F: 0.45; mean age 76.1 ± 9.4 years) were thus included in the study. Only 3.4% of them had gone to primary school (96.6% of illiteracy).

Screening for Dementia

Among the 502 subjects screened for dementia, 52 had cognitive impairment (40 women and 12 men) and were invited for further clinical assessment. The prevalence of cognitive impairment in this population was 10.4% (95% CI 7.7–13.1; table 1). The mean age of subjects with cognitive impairment (82.8 ± 11.8 years) was significantly higher than the mean age of the other subjects ($p < 0.0001$). The characteristics of the population studied are summarized in tables 2 and 3. Elderly people with cognitive impairment were significantly more anxious ($p = 0.02$) and more depressed ($p < 0.01$) at the time of the study. They also felt more stigmatized ($p = 0.03$). Marital status was different between subjects with cognitive impairment and others ($p < 0.01$) but not the status regard-

Table 2. Characteristics of subjects included in the study depending on the existence of a cognitive impairment, Djidja, Benin, 2007

	Cognitive impairment (n = 52)		No cognitive impairment (n = 450)		p value ¹
	n	%	n	%	
Sex					0.20
Female	40	76.9	307	68.2	
Age, years					<0.01
65–79	23	44.2	329	73.1	
80 and over	29	55.8	121	26.9	
Marital status					0.03
Married	18	34.6	227	50.5	
Divorced	0	0.0	15	3.3	
Widowed	34	65.4	206	45.8	
Single	0	0.0	2	0.4	
School					0.54
Yes	1	1.9	16	3.6	
BMI					0.10
Underweight	27	52.0	174	38.7	
Normal weight	24	46.1	236	52.4	
Overweight	1	1.9	35	7.8	
Obese	0	0.0	5	1.1	
Diabetes					0.91
Yes	12	23.1	107	23.8	
High blood pressure					0.15
Yes	15	28.8	91	20.2	
Head trauma					0.15
Yes	1	1.92	35	7.78	
Alcohol consumption					0.94
Past drinker	3	5.7	28	6.2	
Never	16	30.7	157	34.9	
Sometimes	20	38.5	162	36.0	
Regularly	13	25.1	103	22.9	
Tobacco consumption					0.15
Never smoked	22	42.3	253	56.2	
Former smoker	12	23.1	70	15.6	
Current smoker	18	34.6	127	28.2	
Anxiety	26	50.0	150	33.3	0.02
Depression	39	75.0	250	55.6	<0.01
Stigma					0.03
Not at all	26	50.0	301	66.9	
Slightly	14	26.9	99	22.0	
Moderately	7	13.5	36	8.0	
Highly	5	9.6	14	3.1	

¹ Fisher exact test.

ing body mass index, diabetes, high blood pressure, head trauma, alcohol or tobacco consumption. The mean score in the cognitive section of CSI-D for individuals with cognitive impairment was 24.1 ± 3.5 , whereas it was 28.8 ± 1.2 for the others.

Table 3. Psychosocial characteristics of subjects included in the study depending on the existence of a cognitive impairment, Djidja, Benin, 2007

	Cognitive impairment (n = 52)		No cognitive impairment (n = 450)		p value
	n	%	n	%	
<i>Before 16 years old</i>					
Death of one parent	18	34.6	135	30.0	0.49
Divorce of parents	0	100.0	8	1.8	1.00 ^a
Grown with one parent	14	26.9	108	24.0	0.64
Grown with other persons	10	19.2	89	19.8	0.92
Grown in extreme poverty	0	0.0	8	1.8	1.00 ^a
<i>Between 16 and 64 years old</i>					
Death of a spouse	31	59.6	172	38.2	<0.01
Death of a child	47	90.4	375	83.3	0.19
Illness of a child	20	38.5	168	37.3	0.87
Tiring job	18	34.6	158	35.1	0.94
Working at night	0	0.0	16	3.6	0.39 ^a
<i>65 years old and over</i>					
Death of a spouse	12	23.1	98	21.8	0.83
Serious physical illness of a spouse	9	17.3	47	10.4	<0.14
Mental illness of a spouse	2	3.8	5	1.1	0.13
Serious illness of a child	15	28.8	79	17.6	0.05
Death of relatives or friends	39	75.0	371	82.4	0.19
Moving	4	7.7	37	8.2	0.89
Change in financial status	27	51.92	249	55.5	0.62

^a p values are determined with the Fisher test because of the small number of subjects in these groups.

Clinical Assessment

Out of the 52 elderly suspected of dementia, 47 subjects (78.7% of women and 21.3% of men) were further examined. Thirteen elderly living in 5 different villages had dementia (7 probable AD, 4 possible AD, 1 possible vascular dementia, and 1 dementia with progressive aphasia). The prevalence of dementia was 2.6% (95% CI 1.1–3.8; table 1). This prevalence rate increased with age and more women suffered from dementia than men. The prevalence of AD was 2.2% (95% CI 0.9–3.5) in this population. The other 34 subjects were classified as having cognitive impairment/no dementia.

The 5 subjects lost to follow-up did not significantly differ in age from the examined subjects ($p = 0.8$) and had a mean score in the cognitive section of CSI-D of 26.2 (SD 1.9).

The prevalence of dementia was 2.7% in illiterate subjects and nil in subjects who went to school ($p = 0.68$).

Among the random sample of 50 subjects with good performance in screening tests, who underwent further neuropsychological tests, none were demented according to the DSM-IV criteria. The mean scores in the FCST for these subjects were: 35.1 ± 5.4 for free recall, 47.5 ± 0.9 for total recall, 11.2 ± 1.5 for delayed free recall and 15.9 ± 0.4 for total delayed recall, and for the subjects with cognitive impairment the mean scores were 17.4 ± 7.2 , 42.9 ± 6.7 , 7.4 ± 3.2 and 15.1 ± 2.2 , respectively. The mean scores were significantly higher in the elderly without cognitive impairment ($p < 0.0001$, $p < 0.0001$, $p < 0.0001$, and $p = 0.03$). The mean scores in Isaacs' Set Test were also significantly higher in the elderly without cognitive impairment ($p < 0.0001$).

APOE Analyses

A total of 416 individuals (83.2%) were genotyped for APOE, of whom 42 participated in the second stage.

The prevalence of dementia in people with APOE $\epsilon 4$ was 2.5% whereas it was 1.9% in non-APOE $\epsilon 4$ people ($p = 0.96$).

The frequencies of APOE alleles and APOE genotypes are reported in table 4. There was a significant difference in APOE allele frequency between the elderly with no cognitive impairment and the others ($p = 0.05$), and there were significantly less $\epsilon 2$ alleles in the group of people with cognitive impairment or dementia ($p = 0.03$).

The frequency of the APOE $\epsilon 4$ heterozygous genotype was 26.9% and that of the homozygous genotype was 11.3%. Genotypes were not significantly different in individuals with no cognitive impairment compared with those with cognitive impairment ($p = 0.28$).

Multivariate Statistical Analysis

Adjustment for education in a multivariate statistical analysis was not possible with the status of dementia because of the very low number of subjects with a high level of education and the absence of dementia in this subgroup. In a multivariate analysis restricted to age, sex and APOE $\epsilon 4$ status, only age was still significantly associated with dementia ($p = 0.03$).

Forty variables were tested for their association with cognitive impairment and 17 were included in the multivariate regression analysis (table 5).

Three variables were significantly and independently associated with cognitive impairment: age over 80 years compared to age between 65 and 79 years (OR = 3.0, 95% CI 1.5–5.8; $p = 0.0014$), the existence of a possible depressive disorder at the time of the study (OR = 3.3, 95% CI

Table 4. Allele and genotype frequencies for APOE in subjects, depending on the existence of a cognitive impairment, Djidja, Benin, 2007

	No cognitive impairment (n = 374)	Cognitive impairment	
		CIND (n = 42)	dementia (n = 9)
Allele			
$\epsilon 2$	71 (9.5)	2 (2.4)	0 (0.0)
$\epsilon 3$	490 (65.5)	63 (75.0)	14 (77.8)
$\epsilon 4$	187 (25.0)	19 (22.6)	4 (22.2)
Genotype			
$\epsilon 2/\epsilon 2$	16 (4.3)	1 (1.9)	0 (0.0)
$\epsilon 2/\epsilon 3$	29 (7.7)	0 (0.0)	0 (0.0)
$\epsilon 2/\epsilon 4$	10 (2.7)	0 (0.0)	0 (0.0)
$\epsilon 3/\epsilon 3$	184 (49.2)	27 (51.9)	5 (55.6)
$\epsilon 3/\epsilon 4$	93 (24.9)	9 (17.3)	0 (0.0)
$\epsilon 4/\epsilon 4$	42 (11.2)	5 (9.6)	4 (44.4)

CIND = Cognitive impairment/no dementia.

Figures in parentheses indicate percentages.

1.6–7.1; $p = 0.0016$) and the presence of at least one APOE $\epsilon 2$ allele (OR = 0.100, 95% CI 0.016–0.886; $p = 0.038$).

When age was included as a continuous variable, the significant variables in the model were unchanged.

Discussion

The prevalence of dementia in this region of Benin was very low (2.6%). Our results are similar to the reported rates in Nigeria where CSI-D was also used: 2.3% (95% CI 1.2–3.4) overall [2]. Considering other tropical countries, a low prevalence of dementia was also reported in Asia (about 2–3%) [24, 25], and of cognitive disorders in Latin Americans aged over 60 (about 4–10%) [26], while in developed countries, the prevalence of dementia reaches 12.6% in the USA among individuals aged 71 and older [27], 17.8% in elderly aged over 75 in the PAQUID study [28] and about 30% among 85-year-olds and above in Sweden [29, 30].

This low prevalence of dementia in Djidja in spite of the absence of schooling and of a high proportion of APOE $\epsilon 4$ subjects could be due to the cerebral activity sustained by the elderly. Indeed, we observed that most of the elderly were still implicated in the social activities in their village, very present in the education of their grandchildren and in supervising cultivations of their

Table 5. Factors associated with cognitive impairment in multivariate analyses, Djidja, Benin, 2007

		Multivariate analysis					
		initial model			final model		
		adjusted OR	95% CI	p value	adjusted OR	95% CI	p value
Sex	female/male	0.9	0.3–2.5	0.9			
Age, years	≥ 80/65–79	3.2	1.5–6.9	0.003	3.0	1.5–5.8	0.0014
Marital status	living alone/married	0.8	0.3–2.2	0.7			
BMI	thin/normal	1.3	0.7–2.9	0.4			
	overweight/normal	0.4	0.1–3.6	0.4			
High blood pressure	yes/no	1.2	0.5–2.7	0.6			
Head trauma	yes/no	0.2	0.03–2.12	0.2			
Tobacco consumption	former smoker/never smoked	1.9	0.7–5.1	0.2			
	current smoker/never smoked	2.1	0.9–4.8	0.1			
Anxiety	yes/no	1.0	0.4–2.3	1.0			
Depression	yes/no	2.1	0.9–5.0	0.1	3.3	1.6–7.1	0.0016
Stigmatization	slightly/not at all	1.7	0.7–4.3	0.2			
	moderately/not at all	3.9	1.1–14.7	0.04			
	highly/not at all	2.1	0.4–9.2	0.3			
APOE allele	at least one ε2/no ε2	0.1	0.01–0.7	0.02	0.1	0.02–0.9	0.0378
Between 16 and 64 years old	death of a spouse	1.7	0.8–3.8	0.2			
	death of a child	1.4	0.5–4.2	0.5			
65 years old and over	serious physical illness of a spouse	1.1	0.3–3.5	0.9			
	mental illness of a spouse	2.7	0.3–24.8	0.4			
	serious illness of a child	2.3	1.0–5.2	0.05			
	death of relatives or friends	0.7	0.3–1.7	0.5			

fields. Absence of schooling does not mean absence of education in rural Benin. Education was conducted by elderly people on an exclusively oral basis which could explain the good performance of the illiterates in the FCST since the scores obtained in this test were in the highest quintiles of the distribution of French population-based norms [31].

Another possible explanation for the apparently low prevalence of dementia in Djidja is that people with dementia have a shortened life expectancy. However, selective survival bias does not seem to be plausible: prevalence in elderly aged 80 years and over is nearly six times higher than prevalence in elderly aged between 65 and 79 years (table 1).

According to the INSAE (National Institute of Statistics and Economical Analyses), persons aged 60 and over in Benin represent 7.5% of the global population [32]. So, the population of people aged 60 and over in the 7 villages visited is estimated to be around 959 persons. Our sample was restricted to elderly aged over 65, and we can consider the sampling as relatively exhaustive.

A standardized instrument to screen dementia in the world might not be readily achieved because of the diver-

sity of languages, cultures and levels of literacy [33]. So, during the screening, we used two different instruments with the aim to detect any cognitive impairment of the subjects. The CSI-D is an instrument usually used in studies carried out in developing countries with low rates of literacy, especially in Nigeria [9], and by the 10/66 Dementia Research Group [34]. It is a relevant test which is adaptable and useful in populations with different socioeconomic and linguistic backgrounds [9]. The definition of cognitive impairment also included the FWT, which is a simple and sensible test for the diagnosis of AD (sensitivity = 91% and specificity = 87%) [10]. Based on oral language, this version of the verbal memory test could be applied accurately in illiterate subjects. The administration of neuropsychological tests in 50 elderly people found no additional case of dementia. These results validate our two-step screening method for dementia with the CSI-D and FWT as the first step, followed by an interview with a neurologist and further cognitive tests. This study confirms that assessments must be consistent with the culture and language of the population under study, and local normative data for test performance need to be compiled [33].

In our sample, the frequency of the APOE $\epsilon 4$ allele was high: about 20% in the different groups conforming to the $\epsilon 4$ allele average in Africa (about 20.9%). This proportion is higher than the averages observed in Europe, Asia and the USA [4]. The low prevalence of dementia in this genetic context is similar to the situation observed in Nigeria and might reflect environmental factors, genetic variation or genetic/environmental interactions [35].

The absence of a deleterious effect of the APOE $\epsilon 4$ allele on the risk of dementia and cognitive impairment is also interesting. A recent paper [36] has shown that children and adults with APOE $\epsilon 4$ had better performance in verbal fluency than subjects without the APOE $\epsilon 4$ allele. We can expect that in subjects with an exclusively oral culture, the reserve capacities in verbal tasks could compensate the deleterious effect of the APOE $\epsilon 4$ allele on the AD process.

The frequency of APOE $\epsilon 2$ in this population was 8.8%, in agreement with the higher frequencies of this allele observed in Africa and Oceania [4]. This frequency was significantly lower in persons with cognitive impairment and with dementia than in those with no cognitive impairment. Moreover, the absence of the APOE $\epsilon 2$ allele is significantly associated with cognitive impairment. The protective role of $\epsilon 2$ has already been suggested [37].

Age was significantly associated with cognitive impairment in elderly residing in Djidja. Age is a well-known risk factor for dementia and AD in the world [38, 39]. Indeed, the prevalence and incidence of dementia and AD increase with age [25, 40–42].

The determination of the correct age of individuals who do not possess formal documentation of birth is a factor that could hamper comparisons [33]; therefore, the chronological age was estimated with historical landmarks well-known to the population because of the absence of identity cards, birth certificates and reliable voter registration cards. The historical events were very often associated with flashes of the autobiographic memory

and allowed to estimate the age of the subject at the time of the event.

Possible depression was significantly associated with cognitive impairment. However, several hypotheses are still discussed by psychologists: (1) whether they are interrelated pathologies [43], (2) depression as an early prodrome of dementia, (3) depression brings forward the clinical manifestation of dementing disease, and (4) depression leads to damage to the hippocampus [44]. Unfortunately, the cross-sectional design of our study does not allow us to know the chronology between the depressive disorders and the cognitive impairment.

Low level of education is reported to be a risk factor for dementia and cognitive impairment in different parts of the world [28, 45] but was not associated with cognitive impairment in the present study. Considering the low proportion of subjects schooled in our sample, this factor was difficult to test.

No other variable was associated with dementia in the people with cognitive impairment. This result is probably due to the low number of subjects with cognitive impairment and dementia in this investigation.

This study highlighted that the prevalence of dementia is low in this population of Benin. It is important to develop actions allowing to survey the evolution of this situation. The need for further studies in Africa is evident. Other risk factors, at least cardiovascular and nutritional factors, require to be thoroughly investigated.

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