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Research Article

Cardiovascular Health and Near Visual Impairment Among Older Adults in the Republic of Congo: A Population-Based Study

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Abstract

Background: Visual impairment (VI) and determinants of poor cardiovascular health are very common in Sub-Saharan Africa. However, we do not know whether these determinants are associated with VI among older adults in this region. This study aimed at investigating the association between the determinants of poor cardiovascular health and near VI among older adults living in Congo.

Methods: Participants were Congolese adults aged 65 or older included in Epidemiology of Dementia in Central Africa—Follow-up population-based cohort. Near VI was defined as visual acuity less than 20/40 measured at 30 cm. Associations between determinants of poor cardiovascular health collected at baseline and near visual acuity measured at first follow-up were investigated using multivariable logistic regression models.

Results: Among the 549 participants included, 378 (68.8%; 95% confidence interval [CI]: 64.9%–72.7%]) had near VI. Of the determinants of poor cardiovascular health explored, we found that having high body mass index of at least 25 kg/m^2 (odds ratio [OR] = 2.15; 95% CI: 1.25–3.68), diabetes (OR = 2.12; 95% CI: 1.06–4.25) and hypertension (OR = 1.65; 95% CI: 1.02–2.64) were independently associated with near VI.

Conclusions: Several determinants of poor cardiovascular health were associated with near VI in this population. This study suggests that promoting good cardiovascular health could represent a target for VI prevention among older adults.

Keywords: Diabetes, Epidemiology, Hypertension, Sub-Saharan Africa, Visual impairment

Visual impairment (VI) is a sensory disorder, very common among older people, which has a heterogeneous worldwide distribution (1–3). Beyond normal aging, several studies showed that uncorrected refractive error and ocular diseases such as cataract, glaucoma, age-related macular degeneration (AMD), and diabetic retinopathy represent the most common causes for VI (2–4). However, geographical variations exist in the involvement of each cause of VI occurrences (5). Indeed, the proportion of VI due to uncorrected refractive error and cataract is more important in low- and middle-income countries (LMICs) than in high-income countries (HICs) (2,3,6,7). These conditions could be a consequence of low income and/or poor social health insurance or lack of private health insurance in the majority of the LMIC, leading to difficult access to ophthalmologic exams, vision correction tools (eg, spectacles, contact lens), and inadequate management (3,7–9).

Determinants of poor cardiovascular health due to unhealthy lifestyle behaviors are the main contributors to the most common eye diseases (eg, diabetic retinopathy, hypertensive retinopathy, glaucoma, AMD) and therefore are probably important causes of VI (3). Studies showed that unhealthy lifestyle behaviors such as smoking, drinking alcohol, poor diet, diabetes, and physical inactivity leading to poor cardiovascular health were strongly associated with VI among older people (10–13). However, the deleterious effect of some of those determinants on VI, including smoking and heavy drinking, remains inconsistent in the literature due to the heterogeneous assessment of drinking and smoking (pattern and type) and to varying characteristics of the populations included in previous studies (10,12,14,15).

VI is very common in Sub-Saharan Africa (SSA) (2,3,16). Among people aged 50 years and older, the age-standardized prevalence of moderate and severe distance VI was more than 13.0% (80% uncertainty interval: 6.6%–23.2%) while it was 58.5% (80% uncertainty interval: 42.6%–73.8%) for near VI/functional presbyopia in this region (2). However, evidence on near VI is limited in SSA where determinants of poor cardiovascular health are a major cause of non-communicable diseases (17,18). In addition, the prevalence of both morbidities is expected to remain high with the ongoing epidemiological transition (2,3,17,18). Cardiovascular risk factors such as diabetes or hypertension are still less diagnosed and undertreated in SSA populations. The consequences they generate are therefore greater, preventing the full extrapolation of observations from other populations (eg, high-income countries (HICs)) on the level of involvement of cardiovascular risk factors in VI (10,12,14,15) in these populations.

The association between poor cardiovascular health and VI among the African older population is unknown so far. Indeed, studies were performed mainly in hospitals and included only diabetic patients (19,20). Additionally, it is unknown whether the determinants of poor cardiovascular health contribute independently or not to VI among general older people. Cardiovascular factors are potentially modifiable factors that could represent easy targets for VI prevention and reduction of impact on the ability to perform activities of daily living (abilities most affected by near VI (21,22)). Using existing data from the general African population could allow us to identify cardiovascular factors associated with VI among older adults. The objective of the current study was to investigate the association between determinants of poor cardiovascular health and near VI among Congolese older adults included in the Epidemiology of Dementia in Central Africa—Follow-up (EPIDEMCA-FU) population-based cohort.

Method

Study Population

The EPIDEMCA study is a multicenter population-based survey carried out in the Central African Republic and the Republic of Congo (ROC) between November 2011 and December 2012 among adults aged 65 years or older (23). Its aim was to study the epidemiology of dementia among older adults in African populations. The study was performed in rural and urban areas of both countries. An annual follow-up of the EPIDEMCA participants was carried out only in ROC (due to the political instability in the Central African Republic) for a period of 2 years (in rural and urban areas). Participants recruited were adults aged at least 65 years of age, living in the identified settings. Exclusion criteria were refusal, presence of serious co-morbidities with a short-term high risk of death, or inability to conduct interviews in the absence of an informant. The sampling methodology was described elsewhere (23). Briefly, in the urban area (Brazzaville), a random sampling, proportional to the size of the population of each subdivision of the city, was carried out. For each subdivision, one district was randomly selected, and a door-to-door survey was conducted in a direction randomly chosen. The house of the district chief was the starting point for the survey. When the number of participants was not reached, the same process was replicated in another district randomly chosen, until the expected number of participants for the subdivision was reached. In the rural area (Gamboma), door-to-door sampling was carried out in all districts. Investigators marked all houses visited (study name, number of the house, participant, and investigator) with chalk, just above the door. This allowed to retrieve the house of all participants (n = 1029 for the ROC) during the follow-up survey, ensuring exhaustive identification, even in the absence of addresses. All participants and/or their families gave written consent (or oral in case of illiteracy) before inclusion in the study. Ethical approval was obtained from the CERSSA (Comité d'Ethique de la Recherche en Sciences de la Santé) in ROC and from an ethics review board (Comité de Protection des Personnes Sud-Ouest Outre-Mer) in France. Our analysis includes baseline (EPIDEMCA) and first follow-up (EPIDEMCA-FU) data.

Measures

Assessment of near vision impairment

Near VI, data were collected during the first follow-up. Binocular near vision acuity (with existing correction if the participant was wearing spectacles) was assessed at 30 cm using illiterate Parinaud chart (24). This chart combines signs looking like E and C ranging from P3 (small-size sign) to P20 (large-size sign). Participants were invited to read from the bottom up and to indicate the direction of each sign. The last line correctly reads corresponded to the visual acuity score. Near VI was defined as the inability to read P3 (ie, visual acuity less than 20/40 in U.S. notation at 30 cm). Then, we categorized near VI into 2 groups: mild/moderate VI (inability to read P3 to P10; ie, visual acuity <20/40 to ≥20/200 at 30 cm) and severe VI/blindness (inability to read P14 to P20; ie, visual acuity <20/200). An equivalence table (16,25) of the thresholds in French and U.S. notation is presented in Supplementary Table S1.

Assessment of the determinants of poor cardiovascular health

Nine determinants of poor cardiovascular health collected during the baseline survey were considered in the current study.

- *High Body Mass Index (BMI)*: BMI value was calculated by dividing weight by squared height and we defined a BMI of at least 25 kg/m^2 as high.
- *Hypertension*: Systolic and diastolic resting blood pressures were recorded. Two measures for each arm were performed with 5-minute intervals and the average of both measures was calculated. Hypertension was defined if the participant declared ongoing treatment and/or if his/her systolic blood pressure at rest was at least 140 mmHg or diastolic blood pressure at rest at least 90 mmHg (23).
- *Ankle–Brachial Index (ABI)*: Systolic blood pressures were measured in both arms and legs, with the participant in the supine position. Assessment details are presented elsewhere (23). ABI was calculated according to the American Heart Association guidelines (26). In this study, we have categorized the ABI into 2 groups: ABI between 0.90 and 1.40 was considered as normal and ABI 0.90 or less or ABI at least 1.40 was considered as pathological. To verify the reproducibility of ABI measurements, a double-blind test on voluntary participants was performed under the supervision of experienced cardiovascular specialists following the interviewer's training.
- *Diabetes*: Following the WHO recommendations, diabetes was defined as having a blood glucose level at least 126 mg/dL (if fasting: no caloric intake for at least 8 hours) or at least 200 mg/dL after more than 2 hours (if non-fasting) (27). Likewise, ongoing antidiabetic treatment or self-reported diabetes ("Have you ever been told that you had diabetes?") was considered as diabetes (23).
- *Physical inactivity*: Participants who reported less than 150 minutes of walking or cycling in the week prior to the survey were considered as physically inactive (23,28).
- *Hypercholesterolemia*: It was defined as having a total cholesterol level greater than 5.3 mmol/L after a blood test.
- *Smoking status and frequency of alcohol consumption*: Lifetime smoking and alcohol consumption were investigated through self-report and categorized into 3 groups: never smokers/former smokers/current smokers, and none/sometimes/regular for alcohol consumption.
- *Stroke history*: It was investigated using the following question: "Have you ever had a stroke that required medical attention?".

Other Covariates

All covariates used were collected at baseline. We collected sociodemographic variables such as age, sex, residence area (urban/rural), education level (no formal education vs formal education), and marital status (non-partnered vs partnered). Participants who were single, divorced, or widower were considered as non-partnered. Cognitive status (cognitive disorders vs no cognitive disorders) following the diagnosis of dementia and mild cognitive impairment after neuropsychological tests and neurological exam was also considered (29). The presence of the eye diseases (cataract—yes/no) was self-reported and/or based on the observations of the investigators (ie, medical students). Health care booklets when available were used to confirm the participants' statements.

Statistical Analyses

Prevalence of near VI was estimated in the study sample. Then, the age-standardized prevalence for each sex was calculated using the 2013 national demographic statistics of ROC from the United Nations database (30).

Characteristics of the sample included in the main analysis (ie, participant with available visual acuity data) were described and compared according to visual status using chi-square/Fisher's tests for qualitative variables and Kruskal–Wallis test for quantitative variables. In addition, a secondary analysis comparing baseline characteristics of the participants included in the main analyses and those non-included was performed.

We modeled the probability of having VI (visual acuity <20/40) and investigated the different associations using logistic regression models. Minimal adjustment on age, sex, and residence area was first performed to investigate separately the link between each determinant of poor cardiovascular health and VI. All variables that had a p value less than .2 were then included in multivariable analyses to investigate independent relationships after the interactions between these variables were tested. The model was adjusted on additional sociodemographic factors (marital status and education level). To address the eventuality that there were participants with congenital blindness among our blind participants, we conducted a sensitivity analysis removing those with blindness. Odds ratio and their confidence intervals (CIs) were reported and a p value less than .05 was considered as statistically significant. All analyses were performed using the software R (version 3.6.2).

Results

Among the 1029 Congolese participants included in the baseline survey (EPIDEMCA), 660 (64%) participated in the follow-up (first year). Of them, 549 participants had available data regarding their vision (12 were blind and 537 had data from the Parinaud test) and constituted our study sample. A flow chart details the selection process (Figure 1).

Participants' median age was 72 years (interquartile range: 68–78 years), 331 (60.3%) were females and 278 (50.6%) lived in rural areas. Of the 549 participants, 227 (41.6%) had a partner and 362 (66.3%) had no formal education. Regarding the distribution of determinants of poor cardiovascular health, 114 (21.9%) participants had a BMI of at least 25 kg/m^2, 360 (66.3%) had hypertension, and 428 (78.8%) were physically inactive. More than 10% were diabetics, consumed alcohol regularly, and were current smokers. Table 1 displays the baseline characteristics of the sample according to the 3 visual status groups.

A total of 378 participants had near VI (328 had mild/moderate near VI, 50 had severe VI including 12 blind participants). The crude global prevalence of near VI was estimated at 68.9% (95% CI 64.9%–72.7%). It was similar in males (71.1%; 95% CI 65.1%–77.1%) and females (67.4%; 95% CI 62.3%–72.4%), p = .356. Standardized on age, near VI prevalence was 69.9% (95% CI 59.2%–81.6%) among males and 66.9% (95% CI 58.0%–75.8%) among females. Compared to normal vision participants, those with near VI lived more often in the rural area (for more than 60% vs less than 15% for participants without VI; p < .001) and had more often no formal education (for more than 70% vs less than 55% for participants without VI; p < .001). The distribution of determinants of poor cardiovascular health was not significantly different according to the VI group (Table 1).

In the secondary descriptive analysis comparing baseline characteristics of the participants included in main analyses and those non-included, we found that the proportion of people with a BMI of at least 25 kg/m^2 was significantly higher in the included sample than in the excluded sample (21.9% vs 16.1%). There was no significant

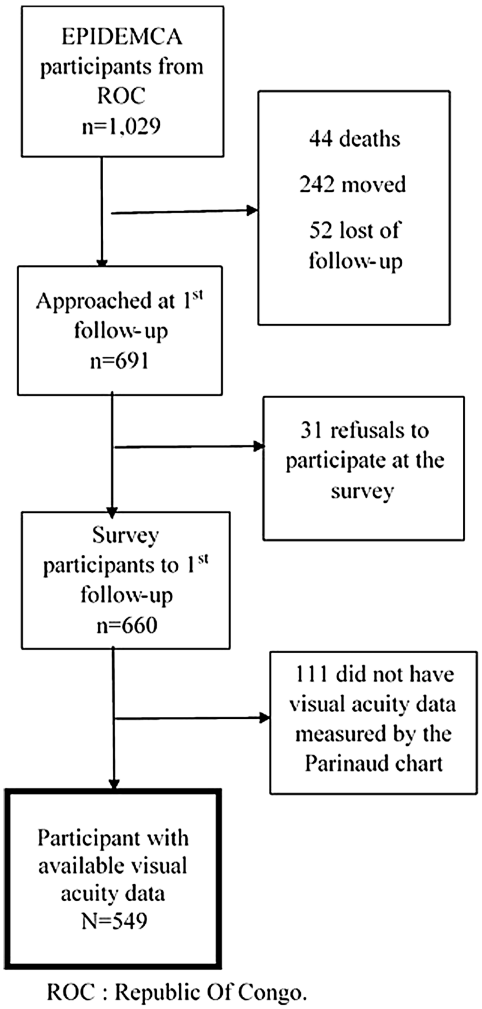

Figure 1. Flow chart.

difference between these 2 samples on all the other characteristics present in our multivariable model (Table 2).

Association Between Determinants of Poor Cardiovascular Health and VI

Table 3 presents separate associations between each determinant of poor cardiovascular health and VI with minimal adjustment on age, sex, and residence area. Only high BMI, hypertension, and diabetes were significantly associated with VI. Indeed, having a BMI of at least 25 kg/m^2 was strongly associated with VI (odds ratio = 2.38 [95% CI 1.42–3.98]). The odds of having VI were 1.74 (95% CI 1.11–2.74) and 2.20 (95% CI 1.13–4.25]) among participants with hypertension and diabetes, respectively. On the contrary, hypercholesterolemia, consumption of tobacco and alcohol, stroke history, and pathological ABI were not significantly associated with VI in our sample.

No interactions between BMI, diabetes, and hypertension for the risk of VI were found (high BMI × diabetes: p = .318; high BMI × hypertension: p = .431; and diabetes × hypertension: p = .419). Multivariable analysis taking into account BMI, diabetes, and hypertension together and adjusted on sociodemographic factors showed that these 3 factors were independently associated with VI. Indeed, the probability of having VI was 2.15 fold higher (95% CI 1.25–3.68) among participants with BMI of at least 25 kg/m^2 and was multiplied by 1.64 (95% CI 1.02–2.64) and 2.12 (95% CI 1.06–4.25), respectively, for participants with hypertension and diabetes (Table 3). In the sensitivity analysis removing the 12 participants with blindness, we found that only a high BMI remains associated with near VI. Diabetes and hypertension were borderline significant even if the strength of their association had not changed much compared to the main results (Supplementary Table S2).

Discussion

Our study shows a high prevalence of near VI among older adults in the EPIDEMCA-FU population-based study. In addition, we found that having a high BMI (≥25 kg/m^2), diabetes, and hypertension were associated with near VI in this population.

Prevalence of near VI found in this study among Congolese older adults was higher than in other studies performed in LMIC (2,9,31–33). It should be noted that near VI is little studied in LMIC especially in Africa and among studies exploring this impairment, almost all included people aged at least 40 years or at least 50 years (2,8,9,31,32). For example, from other data focusing on SSA adults aged at least 50 years, Bourne et al. (2) had estimated the age-standardized prevalence of functional presbyopia at 58.5%. It has been recognized that aging plays an important role in near VI whose probability increases with age (34), this could explain a large part of the difference. Another study reported a much lower prevalence than ours. Indeed, Ehrlich et al. (31) recorded a lower prevalence of near VI in Ghana of 28.5% and in South Africa 35.5% among adults aged 50 years and older. Beyond aging, the socioeconomic level and/or health care systems are potentially better in these countries than in ROC, which also contributes to this large difference. Moreover, consistently with the literature, we found that participants who had a low education level and who were living in the rural area were more affected by VI (7). These factors may contribute to a higher occurrence and/or progress of VI in SSA and could reflect the difficulties in accessing health care due to socioeconomic status.

We found a lower prevalence of near VI compared to a Brazilian study (7). The frequency of presenting near VI (visual acuity ≤20/40 at 40 cm) was 88.1% (7). Difference in assessment distance (at 40 cm vs 30 cm in our study), measure instruments (E chart vs Parinaud chart), and probably a threshold (≤20/40 vs <20/40 in our study) (7) may explain such differences. However, we found a slightly similar prevalence to the one from a study conducted by Burke et al. (8) in Tanzania, the presbyopia prevalence (visual acuity <20/50 at 40 cm) was 72.4% among participants aged at least 65 years.

Comparing our results to studies performed in HIC may not be appropriate. Indeed, beyond a lower exposure to ultraviolet from sunlight, accessibility to health care, diagnosis, and management of VI are potentially better in these countries than in ROC. In addition, older adults living in HIC often wear a correction at assessment, either glasses or contact lenses and undergo monitoring check-up (35) which can improve their visual acuity, especially near acuity. A contrasting and worrying situation was observed in rural Tanzania where up to 94% of adults aged 40 years and older with presbyopia did not have corrective near vision glasses (21).

As highlighted in the world report on vision (3), lifestyle behaviors and some health conditions are involved in VI onset. Few studies explored the relationship between the determinants of poor cardiovascular health and VI (10,11,13–15) while their association with specific ocular conditions/diseases has been well documented

Table 1. Baseline Characteristics of the Participants According to Their Visual Status, EPIDEMCA-FU Study, 2011–2013 ($N = 549$)

Characteristics	*n* (%)	Visual Status			*p* Value	MD
		Normal Vision ($n = 171$)	Mild/Moderate VI ($n = 328$)	Severe VI/Blindness ($n = 50$)		
Age* (years)	72 (68–78)	71 (67–77)	72 (68–78)	72.0 (68.3–79.0)	.371	—
Sex					.585	—
Female	331 (60.3)	108 (63.2)	192 (58.5)	31 (62.0)		
Marital status					.563	3
Partnered	227 (41.6)	66 (38.8)	142 (43.4)	19 (38.8)		
Residence area					<.001	—
Gamboma (rural)	278 (50.6)	25 (14.6)	221 (67.4)	32 (64.0)		
Brazzaville (urban)	271 (49.4)	146 (85.4)	107 (32.6)	18 (36.0)		
Education level					<.001	3
No formal education	362 (66.3)	93 (54.7)	234 (71.6)	35 (71.4)		
Body mass index, kg/m^2					.254	28
<25	407 (78.1)	126 (76.8)	239 (77.3)	42 (87.5)		
≥25	114 (21.9)	38 (23.2)	70 (22.7)	6 (12.5)		
Hypertension					.309	6
Yes	360 (66.3)	105 (61.8)	220 (68.1)	35 (70.0)		
Ankle–Brachial index					.967	46
Pathological	106 (21.1)	34 (21.4)	62 (20.7)	10 (22.2)		
Physical inactivity					.063	6
Yes	428 (78.8)	141 (83.9)	246 (75.5)	41 (83.7)		
Hypercholesterolemia					.119	89
Yes	54 (11.7)	22 (16.2)	29 (10.4)	3 (6.5)		
Diabetes					.332	12
Yes	67 (12.5)	16 (9.5)	43 (13.5)	8 (16.0)		
Frequency of alcohol consumption					.120	5
None	455 (83.6)	135 (79.4)	275 (84.4)	45 (93.8)		
Sometimes	21 (3.9)	6 (3.5)	14 (4.3)	1 (2.1)		
Regular	68 (12.5)	29 (17.1)	37 (11.3)	2 (4.2)		
Stroke history					.550	3
Yes	28 (4.1)	11 (6.5)	16 (4.9)	1 (2.0)		
Smoking status					.710	5
Never smokers	433 (79.6)	138 (81.7)	258 (79.1)	37 (75.5)		
Former smokers	32 (5.8)	11 (6.5)	18 (5.5)	3 (6.1)		
Current smokers	79 (14.4)	20 (11.8)	50 (15.3)	9 (18.4)		
Other factors						
Cognitive disorders					.781	29
Yes	63 (12.1)	18 (10.8)	40 (12.9)	5 (11.1)		
Eye disease (cataract)					.025	389
Yes	120 (75.0)	41 (89.1)	67 (69.1)	12 (70.6)		
No	40 (25.0)	5 (10.9)	30 (30.9)	5 (29.4)		

Note: MD = missing data; VI = visual impairment.

*Median and interquartile range; unless specified, numbers are *n* (%).

Table 2. Comparison of the Characteristics (only for those in the multivariable model) Between Participants Included in the Study and Excluded Participants, EPIDEMCA-FU Study, 2011–2013 (n = 1029)

Characteristics*	Included (n = 549)	Excluded (n = 480)	p Value	MD
Sociodemographic factors				
Age† (years)	72.0 (68.0–78.0)	73.0 (68.0–78.3)	.111	—
Sex			.388	—
Male	218 (39.7)	178 (37.1)		
Female	331 (60.3)	302 (62.9)		
Marital status			.059	3
Non-partnered	319 (58.4)	308 (64.2)		
Partnered	227 (41.6)	172 (35.8)		
Residence area			.596	—
Gamboma (rural)	278 (50.6)	251 (52.3)		
Brazzaville (urban)	271 (49.4)	229 (47.7)		
Education level			.119	3
No formal education	362 (66.3)	340 (70.8)		
Formal education	184 (33.7)	140 (29.2)		
Determinants of poor cardiovascular health				
BMI, kg/m^2			.024	68
<25	407 (78.1)	369 (83.9)		
≥25	114 (21.9)	71 (16.1)		
Hypertension			.172	8
Yes	360 (66.3)	336 (70.3)		
No	183 (33.7)	142 (29.7)		
Diabetes			.298	20
Yes	67 (12.5)	49 (10.4)		
No	470 (87.5)	423 (89.6)		

Notes: BMI = body mass index; MD = missing data. Unless specified, numbers are n (%).
*Only variables presented in multivariable analysis.
†Median and interquartile range.

(36–42). In agreement with previous studies (11,39,43), our study has retrieved significant associations between certain determinants of poor cardiovascular health and VI among older adults. Having a high BMI increased the probability to have VI (39,43). To date, a direct implication of high BMI or obesity in VI is not clearly demonstrated, because clinical evidence is limited (43). Nevertheless, high BMI is known to be involved in ocular conditions (eg, elevated intraocular pressure, age-related maculopathy) and eye diseases (eg, cataract, glaucoma, and diabetic retinopathy) (39). Several theories on pathophysiological mechanisms have been formulated to explain the links between high BMI and these eye conditions (39). The latter is closely linked to visual acuity decline. Therefore, the relationship between a high BMI and VI may be mediated by the occurrence of ocular conditions/diseases. Other underlying mechanisms are possible. Indeed, a high BMI is one of the consequences of physical inactivity and unhealthy diet. These factors are strongly associated with VI (10) and eye diseases among older adults (13,40,44). However, we did not find any significant association between physical inactivity (walking/jogging and cycling—more commonly performed among Congolese older people) and VI. Two hypotheses could explain this result. The first is the social desirability effect due to the self-reported nature of the responses on this variable. The second is the assessment period (in the last week), as someone could be active in the previous weeks or months but not in the week prior to the survey. Furthermore, investigating the relationship between diet and VI among SSA older adults would be relevant considering that tropical diets may vary and be very specific which could affect VI occurrence.

Diabetes was strongly associated with VI in our population. Diabetes is involved in eye conditions occurrence (eg, damages of the retinal blood vessels, macular edema) and their evolution to ocular diseases (eg, diabetic retinopathy) (45). The pathophysiology of the relationship between diabetes and eye diseases is well documented in the literature (42,46). Diabetes would affect the retinal or/and the macular, whereas damage to one or both eye elements leads to loss of vision and long-term blindness. Although the prevalence of diabetes in our sample (12.5%) is slightly lower than in the SSA studies (13.8%) (47), it has been reported in previous studies that most patients with diabetes have diabetic retinopathy and/or diabetic macular edema (11,19,45). Indeed, in clinical practice, these eye damages are observed most often at the diagnostic time (20).

Hypertension was associated with VI in this study. This result is consistent with the evidence showing that hypertension plays a role in VI onset. Indeed VI could be the result of certain eye conditions such as the growing of intraocular pressure (ocular hypertension) and blood pressure in vessels retinal (hypertensive retinopathy) (48). These conditions are the consequences of hypertension (48,49). In addition, one of the major ocular consequences of hypertension is glaucoma that is involved in VI (38). Prevalence of hypertension was very high (66.3%) in our study population, and it is also recognized that hypertension is involved in the incidence and evolution of eye diseases such as AMD and diabetic retinopathy for which pathophysiological mechanisms are well known (37,38,50).

The different mechanisms mentioned above regarding the relationships between diabetes, hypertension, and ocular conditions/diseases could explain the associations with VI identified in this study. Nevertheless, it should be noted that in our study, we cannot confirm the presence of these ocular conditions (eg, macular damage, ocular hypertension) or diseases (eg, diabetic retinopathy, glaucoma) among our participants as we did not perform detailed ocular exams.

Table 3. Associations Between the Determinants of Poor Cardiovascular Health and Visual Impairment, EPIDEMCA-FU Study, 2011–2013

	Separate Models		Multivariable Model (n = 516; AIC = 505.88; p^c = 0.793)	
Determinants of Poor Cardiovascular Health	OR* (95% CI)	p Value	OR† (95% CI)	p Value
BMI, kg/m²		<.001		**.005**
<25	1		1	
≥25	2.38 (1.42–3.98)		**2.15 (1.25–3.68)**	
Hypertension		.015		**.040**
No	1		1	
Yes	1.74 (1.11–2.74)		**1.64 (1.02–2.64)**	
Ankle–Brachial Index		.972		
Normal	1		—	
Pathological	1.01 (0.59–1.72)		—	
Physical inactivity		.436		
No	1		—	
Yes	0.80 (0.46–1.39)		—	
Hypercholesterolemia		.281		
No	1		—	
Yes	1.42 (0.75–2.69)		—	
Diabetes		.020		**.029**
No	1		1	
Yes	2.20 (1.13–4.25)		**2.12 (1.06–4.25)**	
Frequency of alcohol consumption		.541		
None	1		—	
Sometimes	0.78 (0.25–2.43)		—	
Regular	0.72 (0.39–1.33)		—	
Smoking status		.881		
Never smokers	1		—	
Former smokers	1.23 (0.53–2.85)		—	
Current smokers	1.06 (0.56–1.98)		—	
Stroke history		.339		
No	1		—	
Yes	1.50 (0.65–3.42)		—	

Notes: BMI = body mass index; n = number of participants in the model; p^c = p value of the goodness of fit (GOF) of Hosmer and Lemeshow test; AIC = Akaike information criterion; OR = odds ratio; CI = confidence interval.

*Odds ratio adjusted on age, sex, and residence area separately for each factor.

†Multivariable model: BMI, hypertension, and diabetes were adjusted on age, sex, residence area, marital status, and education level.

No association was found between alcohol consumption and VI in our population. This relationship remained inconsistent in the literature (12,14,15). Indeed, some evidence shows that heavy alcohol drinking is associated with AMD (36), and moderate drinking (especially for wine) would have a protective effect on the occurrence of eye diseases (14,15). We did not differentiate the types of alcohol consumed. We can hypothesize that type of alcohol consumed may have influenced the relationship. In contrast with a study performed by Merle et al. (10), we did not find any significant association between tobacco consumption and VI. However, this result corroborates other studies (12) and reflects the inconsistent evidence on this relationship. Diversity of smoking assessment methods (ie, precision and temporality in the evaluation of pack-year/lifetime amount/solely smoking status) may explain this (10,12). It is relevant to note that, in alcohol and/or tobacco consumption, one challenge is to quantify the consumption and to determine the real status (current consumers vs former consumers, amount weekly/daily intake) properly because the profile may be different and lead to various results.

One strength was the use of data from an African population-based survey. In addition, visual acuity was assessed using a chart used in clinical practice. To our knowledge, this study is the first to explore the association between several determinants of poor cardiovascular health and near VI among people aged at least 65 years in SSA. Because comparisons of the baseline characteristics between participants included in the main analysis and those excluded showed that only high BMI had a significantly different distribution on all characteristics, this difference may have influenced the strength of the association found between high BMI and VI. Some limitations should be considered when interpreting our results. First, although we used a cohort design, we are not able to prove a causal association because it is possible that some people presented VI before inclusion. This limit makes the results largely cross-sectional. Hence, it is important to emphasize that our measures of association (odds ratio) do not reflect the effect of these determinants on VI incidence. Therefore, further studies using longitudinal design excluding people with VI at baseline are required to estimate the hazard ratios of these determinants of poor cardiovascular health on the incident VI in an African population. Second, there is a potentially residual confounding bias. Indeed, as mentioned in the Method section, some participants had their own correction. In these participants, the VI measured could be confounded by access to correction. Although we are unable to provide the exact number of participants concerned, we believe this

number is very low. Hence, we are confident that this potential bias does not question the premise that VI might be reduced by cardiovascular health improvements. Third, we have no accurate/formal diagnosis for the ocular diseases in our population study as exploring eye conditions was not the main aim of the EPIDEMCA study.

In research perspectives, on the one hand, nearly all studies explain the mechanisms between the determinants of poor cardiovascular health and VI by the presence of some eye conditions/eye diseases (11,39). It would be interesting in further studies to perform mediation analysis to investigate direct and indirect (through the occurrence of eye diseases) effects of these determinants on VI using a longitudinal design. Additionally, analyses for each specific eye disease would allow a better understanding of the implication of these determinants. On the other hand, because the factors of the lack of access to health care may also contribute to the presence of both near VI and cardiovascular risk factors, the role (confounding or moderating) of these factors could be considered in future studies.

Conclusion

Overall, the prevalence of near VI was high among Congolese older adults, and determinants of poor cardiovascular health such as a high BMI, diabetes, and hypertension were independently associated with VI in older adults. These results confirm the great burden of morbidity linked to determinants of cardiovascular risk factors in this vulnerable population. Adequate public policies are required and/or should be strengthened to reduce the impact of these determinants. Although already recommended at the time of diagnosis of diabetes, an eye examination should be required when these determinants are present to detect ocular conditions, even if better management remains the main challenge. Furthermore, public measures facilitating access to geriatric health care for older adults are required to reduce their dependence.

Supplementary Material

Supplementary data are available at *The Journals of Gerontology, Series A: Biological Sciences and Medical Sciences* online.

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Human Participants: Human participants were included in this study. The IRB/ethics committee of each participating university approved this study. The ethics committee of each participating university (as outlined in the Method section) approved the research. All research adhered to the tenets of the Declaration of Helsinki. All participants provided informed consent. No animal subjects were included in this study.

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Conflict of Interest

None declared.

Author Contributions

Conception and design for this current study: A.G, P.-M.P., M.G, and D.H. Analysis and interpretation: A.G., C.H., C.D., F.B., V.A., P-M.P, and M.G. Conception, design, and acquisition of data for the EPIDEMCA and EPIDEMCA-FU studies: M.G., P-M.P., B.N.-B., P.M., H.S., G.K., I.D., P.L., V.A., and J.-F.D. Writing—original draft: A.G. Writing and original draft reviewing for important intellectual content: all authors. Obtained funding: M.G. and P.-M.P. Supervision: M.G. and P-.M.P. Final approval of the version to be published: all authors.

References

1. WHO. *World Report on Ageing and Health 2015*. World Health Organization; 2015. https://apps.who.int/iris/bitstream/handle/10665/186463/9789240694811_eng.pdf?sequence=1. Accessed May 6, 2019.
2. Bourne RRA, Flaxman SR, Braithwaite T, et al. Magnitude, temporal trends, and projections of the global prevalence of blindness and distance and near vision impairment: a systematic review and meta-analysis. *Lancet Glob Health*. 2017;5:e888–e897. doi:10.1016/S2214-109X(17)30293-0
3. WHO. *World Report on Vision*. WHO; 2019. https://www.who.int/publications-detail/world-report-on-vision. Accessed October 21, 2019.
4. Chou CF, Frances Cotch M, Vitale S, et al. Age-related eye diseases and visual impairment among U.S. adults. *Am J Prev Med*. 2013;45:29–35. doi:10.1016/j.amepre.2013.02.018
5. WHO. Vision impairment and blindness. Published 2019. https://www.who.int/news-room/fact-sheets/detail/blindness-and-visual-impairment. Accessed April 29, 2019.
6. Sherwin JC, Lewallen S, Courtright P. Blindness and visual impairment due to uncorrected refractive error in sub-Saharan Africa: review of recent population-based studies. *Br J Ophthalmol*. 2012;96:927–930. doi:10.1136/bjophthalmol-2011-300426
7. Cunha CC, Berezovsky A, Furtado JM, et al. Presbyopia and ocular conditions causing near vision impairment in older adults from the Brazilian Amazon region. *Am J Ophthalmol*. 2018;196:72–81. doi:10.1016/j.ajo.2018.08.012
8. Burke AG, Patel I, Munoz B, et al. Population-based study of presbyopia in rural Tanzania. *Ophthalmology*. 2006;113:723–727. doi:10.1016/j.ophtha.2006.01.030
9. Marmamula S, Khanna RC, Kunuku E, Rao GN. Near visual impairment and spectacle coverage in Telangana, India. *Clin Exp Ophthalmol*. 2017;45:568–574. doi:10.1111/ceo.12943
10. Merle BMJ, Moreau G, Ozguler A, et al. Unhealthy behaviours and risk of visual impairment: the CONSTANCES population-based cohort. *Sci Rep*. 2018;8:6569. doi:10.1038/s41598-018-24822-0
11. Danet-Lamasou M, Pérès K, Matharan F, et al. Near visual impairment incidence in relation to diabetes in older people: the three-cities study. *J Am Geriatr Soc*. 2018;66:699–705. doi:10.1111/jgs.15266
12. Klein R, Lee KE, Gangnon RE, Klein BEK. Relation of smoking, drinking and physical activity to changes in vision over a 20-year period: the Beaver Dam eye study. *Ophthalmology*. 2014;121:1220–1228. doi:10.1016/j.ophtha.2014.01.003
13. Ong SR, Crowston JG, Loprinzi PD, Ramulu PY. Physical activity, visual impairment, and eye disease. *Eye (Lond)*. 2018;32:1296–1303. doi:10.1038/s41433-018-0081-8
14. Li Z, Xu K, Wu S, et al. Alcohol consumption and visual impairment in a rural Northern Chinese population. *Ophthalmic Epidemiol*. 2014;21:384–390. doi:10.3109/09286586.2014.967360

15. Fan AZ, Li Y, Zhang X, et al. Alcohol consumption, drinking pattern, and self-reported visual impairment. *Ophthalmic Epidemiol*. 2012;19:8–15. doi:10.3109/09286586.2011.591037
16. Fricke TR, Tahhan N, Resnikoff S, et al. Global prevalence of presbyopia and vision impairment from uncorrected presbyopia: systematic review, meta-analysis, and modelling. *Ophthalmology*. 2018;125:1492–1499. doi:10.1016/j.ophtha.2018.04.013
17. Keates AK, Mocumbi AO, Ntsekhe M, Sliwa K, Stewart S. Cardiovascular disease in Africa: epidemiological profile and challenges. *Nat Rev Cardiol*. 2017;14:273–293. doi:10.1038/nrcardio.2017.19
18. Mudie K, Jin MM, Tan, et al. Non-communicable diseases in sub-Saharan Africa: a scoping review of large cohort studies. *J Glob Health*. 2019;9:020409. doi:10.7189/jogh.09.020409
19. Kahloun R, Jelliti B, Zaouali S, et al. Prevalence and causes of visual impairment in diabetic patients in Tunisia, North Africa. *Eye (Lond)*. 2014;28:986–991. doi:10.1038/eye.2014.131
20. Jingi AM, Nansseu JR, Noubiap JJ, Bilong Y, Ellong A, Mvogo CE. Diabetes and visual impairment in sub-Saharan Africa: evidence from Cameroon. *J Diabetes Metab Disord*. 2015;14:21. doi:10.1186/s40200-015-0151-4
21. Patel I, Munoz B, Burke AG, et al. Impact of presbyopia on quality of life in a rural African setting. *Ophthalmology*. 2006;113:728–734. doi:10.1016/j.ophtha.2006.01.028
22. Holden BA, Tahhan N, Jong M, et al. Towards better estimates of uncorrected presbyopia. *Bull World Health Organ*. 2015;93:667. doi:10.2471/BLT.15.156844
23. Guerchet M, Mbelesso P, Ndamba-Bandzouzi B, et al.; EPIDEMCA Group. Epidemiology of dementia in Central Africa (EPIDEMCA): protocol for a multicentre population-based study in rural and urban areas of the Central African Republic and the Republic of Congo. *SpringerPlus*. 2014;3:338. doi:10.1186/2193-1801-3-338
24. Parinaud H. *Echelle optométrique; acuité visuelle, perception de la lumière et des couleurs*. Roulot; 1888.
25. Zanlonghi X. Acuité visuelle, sensibilité aux contrastes dans le cadre des pathologies rétiniennes. In: Rétine. Salomon Yves Cohen, Alain Gaudric. Médecine Sciences Publications; 2012. (Collection RETINE; vol. 1). ISBN: 978-2-257-20500-1
26. Aboyans V, Criqui MH, Pierre A, et al. Measurement and interpretation of the Ankle-Brachial Index. *Circulation*. 2012;126:2890–2909. doi:10.1161/CIR.0b013e318276fbcb
27. WHO. *Global Report on Diabetes*. World Health Organization; 2016. https://apps.who.int/iris/bitstream/handle/10665/204871/9789241565257_eng.pdf?sequence=1. Accessed October 9, 2019.
28. WHO. *Global Recommendations on Physical Activity for Health*. WHO; 2010.
29. American Psychiatric Association. Manuel diagnostique et statistique des troubles mentaux texte révisé - DSM-IV-TR (French Edition). 4th ed. Paris: Elsevier Masson; 2003. 1002 p. ISBN-13: 978-2-294-00663-0.
30. United Nations. World population prospects—population division—United Nations. https://population.un.org/wpp/Download/Standard/Interpolated/. Accessed September 23, 2019.
31. Ehrlich JR, Stagg BC, Andrews C, Kumagai A, Musch DC. Vision impairment and receipt of eye care among older adults in low- and middle-income countries. *JAMA Ophthalmol*. 2019;137:146–158. doi:10.1001/jamaophthalmol.2018.5449
32. Cheng F, Shan L, Song W, Fan P, Yuan H. Distance- and near-visual impairment in rural Chinese adults in Kailu, Inner Mongolia. *Acta Ophthalmol*. 2016;94:407–413. doi:10.1111/aos.12808
33. He M, Abdou A, Naidoo KS, et al. Prevalence and correction of near vision impairment at seven sites in China, India, Nepal, Niger, South Africa, and the United States. *Am J Ophthalmol*. 2012;154:107–116.e1. doi:10.1016/j.ajo.2012.01.026
34. Han X, Ellwein LB, Guo X, Hu Y, Yan W, He M. Progression of near vision loss and incidence of near vision impairment in an adult Chinese Population. *Ophthalmology*. 2017;124:734–742. doi:10.1016/j.ophtha.2017.01.020
35. Naël V, Moreau G, Monfermé S, et al. Prevalence and associated factors of uncorrected refractive error in older adults in a population-based study in France. *JAMA Ophthalmol*. 2019;137:3–11. doi:10.1001/jamaophthalmol.2018.4229
36. Wang S, Wang JJ, Wong TY. Alcohol and eye diseases. *Surv Ophthalmol*. 2008;53:512–525. doi:10.1016/j.survophthal.2008.06.003
37. Erke MG, Bertelsen G, Peto T, Sjølie AK, Lindekleiv H, Njølstad I. Cardiovascular risk factors associated with age-related macular degeneration: the Tromsø Study. *Acta Ophthalmol*. 2014;92:662–669. doi:10.1111/aos.12346
38. Fraser-Bell S, Symes R, Vaze A. Hypertensive eye disease: a review. *Clin Experiment Ophthalmol*. 2017;45:45–53. doi:10.1111/ceo.12905
39. Cheung N, Wong TY. Obesity and eye diseases. *Surv Ophthalmol*. 2007;52:180–195. doi:10.1016/j.survophthal.2006.12.003
40. Praidou A, Harris M, Niakas D, Labiris G. Physical activity and its correlation to diabetic retinopathy. *J Diabetes Complications*. 2017;31:456–461. doi:10.1016/j.jdiacomp.2016.06.027
41. Pérez-de-Arcelus M, Toledo E, Martínez-González MÁ, Martín-Calvo N, Fernández-Montero A, Moreno-Montañés J. Smoking and incidence of glaucoma. *Medicine (Baltimore)*. 2017;96:e5761. doi:10.1097/MD.0000000000005761
42. Cheung N, Mitchell P, Wong TY. Diabetic retinopathy. *Lancet*. 2010;376:124–136. doi:10.1016/S0140-6736(09)62124-3
43. Bergman B, Nilsson-Ehle H, Sjöstrand J. Ocular changes, risk markers for eye disorders and effects of cataract surgery in elderly people: a study of an urban Swedish population followed from 70 to 97 years of age. *Acta Ophthalmol Scand*. 2004;82:166–174. doi:10.1111/j.1600-0420.2004.00182.x
44. Delcourt C, Korobelnik JF, Barberger-Gateau P, et al. Nutrition and age-related eye diseases: the Alienor (Antioxydants, Lipides Essentiels, Nutrition et maladies OculaiRes) Study. *J Nutr Health Aging*. 2010;14:854–861. doi:10.1007/s12603-010-0131-9
45. Kyari F, Tafida A, Sivasubramaniam S, Murthy GV, Peto T, Gilbert CE; Nigeria National Blindness and Visual Impairment Study Group. Prevalence and risk factors for diabetes and diabetic retinopathy: results from the Nigeria national blindness and visual impairment survey. *BMC Public Health*. 2014;14:1299. doi:10.1186/1471-2458-14-1299
46. Vieira-Potter VJ, Karamichos D, Lee DJ. Ocular complications of diabetes and therapeutic approaches. *Biomed Res Int*. 2016;2016:3801570. doi:10.1155/2016/3801570
47. Werfalli M, Engel ME, Musekiwa A, Kengne AP, Levitt NS. The prevalence of type 2 diabetes among older people in Africa: a systematic review. *Lancet Diabetes Endocrinol*. 2016;4:72–84. doi:10.1016/S2213-8587(15)00363-0
48. Wang S, Xu L, Jonas JB, et al. Major eye diseases and risk factors associated with systemic hypertension in an adult Chinese population: the Beijing Eye Study. *Ophthalmology*. 2009;116:2373–2380. doi:10.1016/j.ophtha.2009.05.041
49. Wong T, Mitchell P. The eye in hypertension. *Lancet*. 2007;369:425–435. doi:10.1016/S0140-6736(07)60198-6
50. Bhargava M, Ikram MK, Wong TY. How does hypertension affect your eyes? *J Hum Hypertens*. 2012;26:71–83. doi:10.1038/jhh.2011.37