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ORIGINAL RESEARCH

Regular, high, and moderate intake of vegetables rich in antioxidants may reduce cataract risk in Central African type 2 diabetics

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Background: Antioxidant nutrients found in popularly consumed vegetables, including red beans, are thought to prevent diabetic complications. In this study, we assessed the frequency and contributing factors of intake of fruits and vegetables rich in antioxidants, and we determined their impact on the prevention of diabetes-related cataract extraction.

Methods: This was a cross-sectional study, run in Congo among 244 people with type 2 diabetes mellitus. An intake of ≥three servings of vegetables rich in antioxidants/day, intake of red beans, consumption of fruit, and cataract extraction were considered as dependent variables.

Results: No patient reported a fruit intake. Intake of red beans was reported by 64 patients (26.2%), while 77 patients (31.6%) reported ≥three servings of vegetables rich in antioxidants. High socioeconomic status (OR = 2.3; 95% CI: 1.1–12.5; $P = 0.030$) and moderate alcohol intake (OR = 4; 95% CI: 1.1–17.4; $P = 0.049$) were the independent determinants of eating ≥three servings of vegetables rich in antioxidants. Red beans intake (OR = 0.282; 95% CI: 0.115–0.687; $P < 0.01$) and eating ≥three servings of vegetables rich in antioxidants (OR = 0.256; 95% CI: 0.097–0.671; $P = 0.006$) were identified as independent and protective factors against the presence of cataracts (9.8% n = 24), whereas type 2 diabetes mellitus duration ≥3 years was the independent risk factor for cataract extraction (OR = 6.3; 95% CI: 2.1–19.2; $P < 0.001$ in the model with red beans intake and OR = 7.1; 95% CI: 2.3–22.2; $P < 0.001$ in the model with ≥three servings of vegetables rich in antioxidants).

Conclusion: Red beans intake and adequate quantity of intake of vegetables rich in antioxidants were found to be associated with reduced risk of cataract in these Congolese with type 2 diabetes mellitus. Education on nutrition and health promotion programs are needed to encourage people to eat vegetables and fruit.

Keywords: red beans, cataract extraction, socioeconomic status, public health implications

Introduction

Diabetes mellitus (DM) is defined by chronic hyperglycemia which induces reactive oxygen species and reactive nitrogen species via protein kinase C and nitrogen-activated protein kinase. The concept of oxidative stress corresponds to an abnormal metabolism with an imbalance between the oxidant production rate and the rate of oxidant degradation.

The role of reactive oxygen species-related oxidative stress in the pathogenesis of cataracts is well documented in the literature.[1]

Dietary antioxidants may prevent cataract formation.[2] In the Democratic Republic of Congo (DRC), our country, adults do not eat salads and cabbage or fresh green vegetables because of cultural reasons and the low socioeconomic status (SES) of

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the majority of the population.[2] They prefer burned and well-cooked vegetables that are poor in carotenoids and retinoids. They do not consume fruit, as fruits are thought to be harmful for people with type 2 diabetes mellitus (T2 DM). Fortunately, red beans are considered the "meat" of the Congolese population, and are cooked mixed with different vegetables also rich in antioxidants. Dietary antioxidants prevent cataract formation by preventing the oxidation of proteins or lipids within the lens in general and during aging also related to oxidative stress. There is a lack of African studies and health policy about the role of red beans in the prevention of cataracts among people with T2 DM.

Therefore, the aims of this study were to assess the levels and the factors associated with adequate intake of vegetables rich in antioxidant intake, and to determine their impact in the prevention of DM-related cataract extraction.

Material and methods

This was a cross-sectional study, conducted among 244 consecutive Congolese patients managed for T2 DM at the Diabetes Outpatients Clinic of the General Hospital of Kinshasa, DRC, between October 2008 and March 2009. The study protocol was approved by the local Ethics Committee and was conducted according to the principles of Helsinki Declaration II. After informed and verbal consent (the majority of participants had low levels of education), examination methods included an interviewer-administered structured and standardized questionnaire and measurement of weight and height. Self-reported items included age, gender, profession, ethnicity, residence, education level, rural–urban migration, personal history of cataract extraction, and other lifestyle factors.

Dietary assessment

To assess dietary intake, a qualitative-type questionnaire about the frequency of vegetable consumption was used. We also used a semiquantitative food-frequency questionnaire adapted from the World Health Organization STEPwise approach.[3] The participants were asked about the average number of servings of vegetables rich in antioxidants including red beans they consumed per day in a typical week.[3]

Definitions

Vegetables rich in antioxidants were defined by source, total antioxidant capacity per serving size and by their composition in vitamins C, E, A, carotenoids, lycopenes and/or eaten crude or green included Brassica oleracea (garden cabbage), lettuce, Colocasia antiquorum (feuille de taro), Psophocarpus scandens (kikalakasa), fougère (bracken), Phaseolus vulgaris (beans), Lycopersicum esculentum (tomato), Musa acuminata (plantain), and Solanum aethiopicum (Ethiopian eggplant named solo in Lingala language of DRC). Qualitatively, a regular intake of fruits or red beans mixed with vegetables rich in antioxidants was contrasted with no intake of the same. Daily smoking of one cigarette and alcohol intake (beer: excessive intake, ≥four glasses/day in men and ≥three glasses/day in women; moderate intake, one to three glasses/day) were defined according to WHO STEPwise approach.[3] Self-reported ethnicity included the Kongo tribe from the south-west of DRC, the Ngala tribe from the north-west of DRC, the Luba tribe from the centre of DRC, and the Swahili people from the eastern part of DRC. Residential environment was rural for the Lukunga and Tshangu districts, and urban for the Funa and Mont Amba districts. Educational level included illiteracy, primary school, high school, and university. Obesity was defined by body mass index (=weight in kg/height in m^2) ≥30 kg/m^2. SES included low (lack of income, unemployment) and high SES.

Statistical analysis

The unit of analysis was individuals, rather than eyes, because eyes were not examined independently. Data were reported as proportions (%) for categorical variables and mean ± standard deviation for continuous variables. The Chi-square test was used to compare proportions (%), while comparisons of means between groups were performed using the Student's *t*-test. The univariate risk of cataract extraction was assessed by calculating the odds ratio (OR) with 95% confidence intervals (95% CI). Multivariate analysis such as the logistic regression model was used to assess the independent effect of selected variables on regular intake of vegetables and the presence of cataract extraction after adjusting for the effect of other potential confounders.

A P-value <0.05 was considered significant. Data analysis was carried out using the Statistical Package for Social Sciences (SPSS) for Windows version 13 (SPSS Inc, Chicago, IL).

Results

Two hundred and forty four patients with T2 DM were finally assessed, and their findings were subjected to statistical analysis. The mean age of all participants was 48 ± 16 years (range: 12 years to 80 years). The median DM duration

was 3 years, DM duration ≥3 years being considered long. The general characteristics of the study population were dominated by low educational level, low SES, rural–urban migration, and Kongo ethnic group (see Table 1).

No patient (0%) reported intake of fruits. Intake of red beans was reported by 64 patients (26.2%), while 77 patients (31.6%) recognized eating ≥three servings of vegetables rich in antioxidants.

In univariate analysis, moderate alcohol intake, high SES, high educational level, and urban residence were the factors associated significantly and positively with the consumption of vegetables rich in antioxidants (see Table 2).

After adjusting for gender, age, migration, total obesity, smoking, residential environment, and ethnicity, only high SES and moderate alcohol intake were identified as independent and significant determinants of the consumption of vegetables rich in antioxidants (see Table 3).

Intake of red beans (OR = 0.3; 95% CI: 0.1–0.7; $P = 0.003$) and intake of ≥three servings of vegetables rich in antioxidants (OR = 0.29; 95% CI: 0.1–0.6; $P = 0.009$) were negatively and significantly associated with the presence of cataracts. Rural residence (OR = 1.6; 95% CI: 1.1–4.3; $P = 0.036$), cigarette smoking (OR = 1.5; 95% CI: 1.2–6.8; $P = 0.040$), DM duration ≥3 years (OR = 4.2; 95% CI: 2.1–20.2; $P < 0.0001$), and rural–urban migration (OR = 1.4; 95% CI: 1.08–11.2; $P = 0.047$) were the univariate factors for cataract extraction.

When the number of servings of vegetables rich in antioxidants was not introduced in the first logistic regression analysis (Model 1) which was adjusted for residence, cigarette smoking, and migration, only red beans intake (protective role) and DM ≥3 years (conferring sixfold risk) were independently and significantly associated with the presence of cataract extraction (see Table 4).

The second logistic regression analysis (Model 2) did not include red beans intake and was adjusted for residence, cigarette smoking, and migration (see Table 5). Only DM duration ≥3 years (sevenfold risk) and intake of ≥three servings of vegetables rich in antioxidants/day (protective role) were independently and significantly associated with the presence of cataract extraction (see Table 5).

Table 1 General characteristics of the study population

Variables	n	%
Gender		
Males	106	43.4
Females	138	56.6
Low socioeconomic status	190	77.9
Rural–urban migration	151	61.9
Ethnicity		
Kongo	147	60.2
Luba	45	18.4
Swahili	28	11.5
Ngala	24	9.8
Rural residential environment	137	56.2
Low educational level	191	78.3
Cigarette smoking	32	13.1
Moderate alcohol intake	34	13.9
Cataract extraction	24	9.8
Total obesity	37	15.7

Table 2 Factors associated with consumption of ≥three servings of vegetables rich in antioxidants

Variables of interest	Intake of vegetables rich in antioxidants n (%)
Gender	
Male	9 (8.5%)
Female	11 (8%)
P-value	>0.05
Residential environment	
Rural	9 (6.6%)
Urban	11 (10.3%)
P-value	0.040
Educational level	
Low	15 (7.9%)
High	5 (9.4%)
P-value	0.031
Ethnicity	
Kongo	11 (7.5%)
Ngala	2 (8.3%)
Luba	4 (8.9%)
Swahili	3 (10.7%)
P-value	0.947
Socioeconomic status	
Low	21 (11.1%)
High	2 (3.8%)
P-value	0.029
Alcohol intake	
Moderate	21 (61.8%)
Abstinence	21 (10%)
P-value	<0.0001

Discussion

To our knowledge, this is the first African study of the prevention of cataracts by vegetables rich in antioxidants in general, and by red beans in particular.

Table 3 Independent determinants of consumption of vegetables rich in antioxidants

	OR (95% CI)	*P*-value
Independent variables		
High socioeconomic status	2.3 (1.1–12.5)	0.030
Moderate alcohol intake	4 (1.1–17.4)	0.049

Abbreviations: CI, confidence interval; OR, odds ratio.

Table 4 Independent determinants of presence of cataract extraction in model 1

Independent variables	Beta coefficient	Standard error	OR (95% CI)	*P*-value
Red beans intake				
Yes vs no	−1.268	0.455	0.282 (2.3–22.2)	<0.01
DM duration				
≥3 years vs <3 years	1.837	0.571	6.3 (2.1–19.2)	<0.0001

Abbreviations: CI, confidence interval; DM, diabetes mellitus; OR, odds ratio.

This cross-sectional and analytic survey has estimated the frequency of cataract extraction among young adults with type 2 DM. Poverty and low educational level were noticeable in these patients.

Intake of fruits, salads and cabbage or fresh green vegetables was not reported in these T2 DM patients, as some fruit and vegetables are thought to be harmful for people with T2 DM. A very low proportion of these patients reported consumption of ≥three servings of vegetables rich in antioxidants including red beans. Cultural reasons, high proportions of low SES and low educational level may explain this dietary habit. Westernization with nutrition transition may explain the higher vegetable intake observed in those with an urban residence, high educational level, and moderate alcohol intake. After rural–urban migration, Congolese people prefer refined sugar, fats, salt, and burned and well-cooked vegetables that are poor in antioxidants.

Univariate analysis identified red beans intake and consumption of ≥three servings of vegetables rich in antioxidants/day as potential protective factors against cataract extraction, but rural residence, DM duration ≥3 years, cigarette smoking, and rural–urban migration conferred a higher and significant risk of cataract extraction. However, in multivariate analysis, cigarette smoking, rural residence, and rural–urban migration were no longer associated with the presence of cataract extraction. The most important and independent protective determinants of the presence of cataract extraction were red beans intake, whereas DM ≥3 years multiplied by six and seven times the risk of cataract extraction.

Table 5 Independent determinants of presence of cataract extraction in model 2

Independent variables	Beta coefficient	Standard error	OR (95% CI)	*P*-value
DM duration				
≥3 years vs <3 years	1.966	0.578	7.1 (2.3–22.2)	<0.001
Number of servings of vegetables rich in antioxidants				
≥three/day vs <three/day	−1.364	0.492	0.256 (0.097–0.671)	0.006
Constant	−2.487	0.576		<0.0001

Abbreviations: CI, confidence interval; DM, diabetes mellitus; OR, odds ratio.

Accelerated formation of cataracts may be explained by an imbalance of oxidative stress/antioxidant status, despite reported neutral effects and inconsistent results of antioxidants in cataract formation in human beings.[4,5] However, several studies from the literature suggest that dietary antioxidants such as red beans and vegetables prevent cataract formation by preventing oxidation of proteins and lipids within the lens.[6–8]

The present study is consistent with other studies which have also incriminated rural residence as a risk factor of cataract.[9,10]

Clinical perspectives and implications for public health

The subject of antioxidants in food has become a hot topic over the last few years, and for good reason.

The present study adds support for recommendations to consume vegetables rich in antioxidants, including red beans. Indeed, carotenoids, retinoids, lutein, and zeaxanthin may decrease the risk of developing cataracts severe enough to require surgical extraction. Clinicians could educate and prescribe dietary supplements rich in antioxidants both for the general public and for diabetic patients.[12,13]

A public health message must be tailored to improve adherence by the Kinshasa population, in particular. Education about appropriate diet and the protective effects of moderate alcohol intake should be promoted among patients with T2 DM. The Government is invited to relieve poverty.

Limitations

The present study may be limited to some degree because of its cross-sectional design which is not capable of demonstrating a causal association between the identified determinants and cataract extraction. Endogenous biomarkers of oxidative stress and antioxidant status were not measured in blood samples of these Congolese patients with T2 DM.

Dietary assessment based on single self-report may introduce measurement errors and attenuate the association between variables.

Conclusion

In conclusion, cultural beliefs and poverty do not facilitate the intake of vegetables rich in antioxidants which may be protective against cataract formation.

Disclosures

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