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Original Research Article

Dietary Habits, Knowledge, Attitude and Practice in relation to Type 2 Diabetes Mellitus in the Republic of Congo

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Abstract: *Background*: Overweight and obesity are conditions related to Type 2 Diabetes Mellitus (T2DM). T2DM cases have increased in line with the overall increase in the incidence of overweight and obesity. *Aim of the Study*: To investigate the role of local nutrition in the onset and diffusion of T2DM in the Republic of Congo. *Methods*: Clinical and nutritional information have been recorded for 40 male Congolese subjects. In the non-diabetic group, a *Diabetes risk score* was submitted to assess the risk of developing T2DM within 10 years; the *Knowledge-Attitude-Practice (KAP) questionnaire* was submitted to the T2DM diagnosed group. *Results*: results show a high level of daily calories intake, not justified by physical activity level. The role of nutrition in the treatment of T2DM is not recognized and the pathology remains not well known despite the data confirming its spread among the population. The analysis of clinical data shows a high prevalence of overweight/obesity and hypertension among those at risk of developing T2DM and those diagnosed with T2DM. *Conclusion*: The goal of this study aimed to implement future projects and strategies to induce local health care staff to focus more attention on changing food style and to increase nutritional re-education therapy in both diabetics and people at risk.

Keywords: Diabetes Prevention, Dietary Habits, KAP, Republic of Congo, Type 2 Diabetes Mellitus, Vulnerable Groups.

INTRODUCTION

The prevalence of diabetes mellitus, especially type2 (T2DM) is increasing worldwide, becoming a pandemic. In some regions, this prevalence is expected to double in the next decade due to increase in ageing population, thereby adding to the already existing burden for healthcare providers, especially in low-resourced countries. Referring to World Health Organization (WHO) data, 422 million people worldwide are diabetic and 80% of them come from low and middle-income countries [1]. T2DM, which accounts for ~90–95% of those with diabetes, encompasses individuals who have insulin resistance and usually have relative insulin deficiency [2]. At least initially, these individuals do not need insulin treatment to survive. Body fat distribution, in particular visceral fat, is associated with a condition of insulin resistance; therefore obesity is considered to be closely associated with the T2DM and the new term "*diabesity*", has been coined by Sims *et al.*, 1973 [3, 4], to indicate a modern epidemic, which indicates the coexistence of both diabetes and obesity [5]. The condition is also stated to be a link between obesity and diabetes, being characterized as a serious public health issue gradually leading to be an epidemic [6, 7].

The Republic of Congo is located in the central part of Sub-Saharan Africa, with its 5,492,000 inhabitants it is considered one of the least populous African countries. The population is undergoing a demographic change with migration to urban areas [8].

Last decades in Congo, in the WHO-STEPS Survey in Brazzaville [9], hypertension and diabetes were respectively found at the prevalence of (33%) and (7%) and obesity /overweight (27%). Another screening study in 2009 found a prevalence of T2DM in 13% of the population associated with hypertension and obesity. [10].

Other studies in the neighboring and more well-known Democratic Republic of Congo (DRC), revealed an increasing spread of T2DM related with an exponential increase of hypertension and obesity [11]. Recent studies in the DRC show an "*epidemic rate of glucose intolerance*" and identify the need for primary prevention in changing lifestyles to control T2DM [12-14]. The alarming increase is justified by further data suggesting that less economically developed countries are the target of such pathologies. To weigh on this primacy is the presence of severe undernutrition in the recent past (for some areas still contemporary) and the frequency of low birth weight infants, given as a risk factor over time for the development of T2DM [15]. In the context of the ongoing trend in low-resourced countries, the thrifty phenotype and thrifty genotype hypotheses are of particular significance. The implications are that if the conditions of poverty and chronic hunger are replaced by nutritional abundance, then thrifty phenotypes may be especially vulnerable to diseases of affluence, including T2DM and CVD [16-18].

Over the centuries, when the food was insufficient, long periods of famine selected individuals with a high efficiency in nutrition absorption and energy saving; with time this gene has become a constraint rather than a resource [19]. This justifies the 7% increase in childhood obesity (children under 5 years) from 1987 to 2005; to date the overweight rate estimated in children corresponds to 20%, while obesity to about 5% [20].

In addition to genetic factors, research studies should be combined with the study on the role of environmental factors, as poor and unbalanced diet, particularly rich in carbohydrates represents an additional risk factor in developing T2DM in these countries. Moreover, there are worrying beliefs, strongly spread by the population, sometimes also by healthcare professionals, who associate diabetes with punishments from mystical rites which often leads to the removal of patients from medical care. This often involves, even on arrival in the hospital of emergency patients with the addition of severe abrasive wounds and burns throughout the body, additional late diagnosis. In children and adolescents there are further psychological traumas, often associated with post-diagnosis of family abandonment.

Aim of the Study: To investigate the role of local nutrition in the onset and diffusion of T2DM in the Republic of Congo.

To provide data that can be useful for the development of extensive research projects across the population in the Republic of Congo, focusing on a pathology often associated only with Western countries.

METHODS

Forty adult Congolese male subjects, 20 non-diabetics and 20 T2DM diagnosed were recruited through the medical staff of the ENI Medical Center in Pointe Noire (healthy volunteers) while the remaining sample of diabetic patients was recruited at the Department of Diabetology of the Public Hospital "*Adolphe Sice*" located in Pointe-Noire. A free and informed consent form was signed by all volunteers.

Clinical History Questionnaire

A clinical history questionnaire was submitted to collect general and physiological information, Food Pyramid knowledge, physical activity level, and diabetes history. The questionnaire consisted in a modified version of two similar studies conducted in the Democratic Republic of the Congo and on African American T2DM patients [21].

Food Consumption Assessment

The food history was conducted through a 24h Recall questionnaire. Each subject accurately records his daily food and beverages consumption in the 24 hours prior to the interview. The questionnaire includes specific questions regarding the preparation of the recipes, in order to trace the composition and amount of the ingredients.

Nutrient calculation was performed using the FAO food composition tables for Africa [22], and for missing values the FAO Food Composition Tables for West Africa [23], and INRAN tables [24], when certain European traditional foods were used.

Nutritional Anthropometry

Body weight and stature were measured with a mechanical balance with altimeter (Salus) with accuracy of 0.5 kg and 0.1 cm respectively; for the measurement of waist circumference an non-elastic metric tape (Malesci) was used, precision 0.1 cm; blood pressure was detected by means of a sphygmomanometer and phonendoscope (Egima) with a scale of 0-300 mmHg. The Body Mass Index (BMI) was calculated as the ratio between body weight (kg) and height (m^2). All measures were taken by two standardized healthcare providers. In addition data on the two most recent basal blood glucose for each diabetic patient were recorded.

Diabetes Risk Score

The "*Diabetes Risk Score*" is a non-invasive tool used to identify high risk T2DM subjects. The score is calculated on the basis of age, BMI, waist circumference, antihypertensive pharmacological treatment, daily consumption of fruit and vegetables, daily physical activity, familiarity, frequency of glycemic control. A score of 0 to 5, reflecting a more or less T2DM risk, was assigned to each subject. The questionnaire was provided in French by the International Diabetes Federation [25].

KAP Questionnaire

The KAP is a valid tool to assess knowledge about the pathology, the perception of patients and their practice. Compared to other methods of investigation, KAP has the peculiarity to investigate specific topics, in particular [26].

Knowledge was measured using a 21-item questionnaire relating to general knowledge of diabetes (diet patterns, medications, investigations, exercises) and it provides three possible answers, ranging from the "true - false - not know"

Attitude was measured using a 13-item questionnaire. Example of the questions asked "I believe that: controlled diet and regular exercise helps in maintenance of blood glucose" and the three possible answers were "I agree - I do not agree - I am not sure".

Practice was measured using a 12-item questionnaire with mixed type of response ranging "always" to "never".

Statistical Analysis

Statistical analysis was performed with the Statistics 8.0 (Stat Soft, Italy srl). Data are presented as mean and standard deviation (mean ± ds). The t-test and the χ^2 test were used for comparing the data and a significance level of $P < 0.05$ was used.

RESULTS

Clinical History Questionnaire

The characteristics of the study population are shown in **Table 1**

Table 1: Physical characteristics of the sample

	Diabetics	Non-diabetics	*P*	Total
n°	20	20	*ns*	40
Age (years)	53 ± 12	36 ± 9	*0.000*	45 ±13
Body weight (kg)	79 ± 22	74 ± 16	*ns*	77 ± 20
Stature (cm)	1.73 ± 0.06	1.72 ± 0.03	*ns*	1.73 ± 0.05
BMI (kg/m^2)	26.4 ± 7.4	24.0 ± 6.0	*ns*	25.9 ± 7.1
Waist circumference (cm)	95 ± 15	86 ± 11	*ns*	93 ± 15
Systolic pressure (mmHg)	133 ± 16	113 ± 16	*ns*	132 ±16
Diastolic pressure (mmHg)	84 ± 15	80 ± 14	*ns*	82 ± 14

P= Student T-test

45% of the total sample is overweight or obese. The waist circumference is slightly higher in diabetic subjects (95 ± 15 cm), compared to the limit value of 94 cm suggested by the International Diabetes Federation [27].

Results from clinical history questionnaire show that among the major T2DM related diseases, there is a worrying familiarity with obesity, hypertension and T2DM in both groups, although there are no significant differences.

There is also a considerable familiarity with pathologies such as heart diseases and blindness.

Physiological history of the subjects indicates that polyuria and nocturia are common in both diabetics and non-diabetic groups, while 20% of diabetics and 25% of non-diabetics assert to have a polydipsia problem. Fifty five percent of the total sample states to suffer from constipation and diarrhea.

As regard smoking attitude, 13% of the total sample declares smoking, and 100% of diabetic smokers and 13% of non-diabetic smokers' state that they have been smoking for more than 10 years.

The consumption of alcohol declared by the subjects shows a worrying spread of alcohol intake in both groups: 60% of diabetics and 85% of non-diabetics declare to consume alcohol weekly, preferring beer.

The amount consumed vary from 1-2 bottles per week to 10-20 bottles per week (in 42% of diabetics and 6% for non-diabetic) to the worrying trend of more than 20 weekly bottles for 8% of diabetics and 12% of non-diabetics.

Concerning physical activity 80% of non-diabetics declare to exercise weekly but the percentages decrease in the diabetic group. Big perplexity about knowledge of the Food Pyramid: the total sample of both groups declares that they have never heard about it. Thirty percent of diabetics declare to follow a specific diet prescribed by the health care professional, while 17% declare to follow a self-prescribed diet, the remainder state they have never followed a diet throughout their life.

Periodic blood tests shows that diabetic patients have controlled their basal blood glucose at least once, while in the non-diabetic group 85% have never controlled it. Baseline insulin findings show that 5% of diabetics and 10% of non-diabetics have never performed this examination. None of the two groups ever performed an Oral Glucose Tolerance Test and 60% of the total sample never did any other blood check. Half of the total sample have never heard and don't know the

meaning of glycemia and 8% of the total sample doesn't know insulin.

Information on diabetic history have been requested to the diabetics. Among the reasons leading to the diagnosis, the main reason was the onset of symptoms (40%), and only one-fifth of them declare that they have received a specific and personalized dietary therapy but have never made any further checks. The alarming figure is that most of the sample has never received a diet therapy or nutritional advice regarding foods or beverages to be limited or avoided.

Food History

Table 2: shows the calories intakes, and the main macronutrients expressed as grams as well as energy contribution

	Diabetics	Non-diabetics
Energy (kcal)	3633 ± 1422	4105 ± 1822
Total protein (gr)	119.9 ± 51.8	116.9 ± 52.0
	13%	*11%*
Animal protein (gr)	*75.4 ± 36.2*	*63.7 ± 29.3*
Vegetal protein (gr)	*44.4 ± 27.2*	*53.2 ± 33.5*
Total lipids (gr)	125.6 ± 72.5	144.9 ± 70.7
	31%	*32%*
Animal lipids (gr)	*37.8 ± 37.0*	*36.3 ± 38.7*
Vegetal lipids (gr)	*87.8 ± 50.3*	*108.7 ± 53.3*
Total CHO (gr)	471.2 ± 193.9	565.1 ± 286.3
	52%	*55%*
Fibre (gr)	36.2 ± 20.2	39.3 ± 26.4
Alcool (gr)	53.0 ± 48.7	37.1 ± 17.7
	4%	*2%*
Frequency of consumption of selected food and beverages (%)		
Meat	40	85
Fish	100	100
Vegetables	90	90
Fruits	60	55
Beer	40	45
Wine	25	5

Table 2: Dietary macronutrients intake and frequency of consumption of selected food
An average balanced diet is followed in both groups (30% en. from lipid, 12% en. from protein, 52% en. from carbohydrates in the diabetic group and 55% en. for non-diabetics).

A detailed analysis has shown that among the most consumed foods in both groups prevail cassava flour, cassava, baguette, peanut oil, powdered milk and butter; among the dressings, the most used is peanut oil, especially in the non-diabetic group, as well as peanut paste and butter; in the diabetic group, palm oil, butter, margarine, but also extra virgin olive oil are more consumed. Congolese diet has a strong presence of native cassava meal products: cassava flour and manioc. There is also a discrete consumption among diabetics of plantain banana, taro and whole wheat bread.

The percentages referring to the consumption of simple sugars reflect a large consumption of sugar beet and cane sugar, especially among non-diabetic (40%), equivalent to the consumption of saccharine among diabetics (40%).

Moreover 35% of the total sample also consumes sugary drinks (cola soda, tea, orange soda).

During data analysis, there was also an irregularity in the distribution of meals: 5% of diabetics and 25% of non-diabetics skip breakfast and 10% of diabetics and 20% of non-diabetics lunch or dinner. Half the sample in both groups does not consume the morning and afternoon snack.

Diabetes Risk Score
Through the "Diabetes Risk Score", submitted to non-diabetic subjects, the risk of developing T2DM within 10 years was calculated and **figure 1** shows that one fifth of the sample is found to have a high risk.
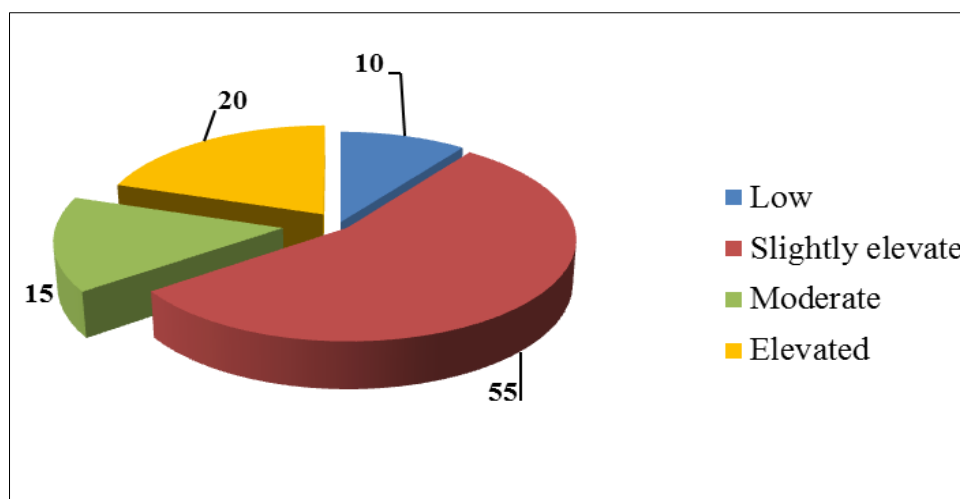
Figure 1: Diabetes Risk score (%)

From a detailed analysis of risk factors, it appears that 45% of the sample has an BMI ≥ 25 and a waist circumference ≥ 94 cm; 33% of them buy medicines for high blood pressure, 88% do not eat fruits and vegetables every day, do not practice physical activity for at least 30 minutes and never controlled their basal blood glucose. Nearly half of this sub-sample, particularly vulnerable, is at high risk of developing T2DM.

In contrast, those with low risk of developing T2DM, the totality of the sample is less than 45 years, an BMI <25, a waist circumference <94 cm and does not take any hypertension medication; even those who are more at risk, have never controlled their blood glucose and do not exercise any physical activity or regularly eat fruits and vegetables.

Knowledge-Attitude-Practice (KAP)

Table 3a: shows the results of analysis carried out in the KAP section on T2DM Knowledge

n°	Questions	True (%)	False (%)	Don't know(%)
1	Regular physical activity can reduce body weight	79	5	16
2	Higher risk in children with diabetic parents	42	21	37
3	In diabetics fasting glycemia <140 mg/dl	37	11	53
4	In diabetics pre-meal glycemia <180 mg/dl	5	21	74
5	Fasting blood glucose in diabetic is higher than a non-diabetic patient	42	32	26
6	Fasting for 8 hours before blood collection	53	5	42
7	Physical activity reduces T2DM risk	68	11	21
8	Diabetes causes glaucoma	21	5	74
9	Diabetes causes kidney problems	79	11	11
10	Diabetes can lead to foot ulcers	58	11	32
11	Diabetic can eat foods such as cassava flour and cassava	37	53	11
12	Diabetes increases blood sugar levels	84	0	16
13	Diabetic always on a diet even if blood sugar levels become normal	89	0	11
14	Foods rich in fiber are optimal for diabetics	79	0	21
15	Foods rich in starch and sugar can be consumed	26	53	21
16	Alcoholic beverages can be drunk	16	79	5
17	Fats, oils and sweets are at the upper level of food pyramid, therefore they are to be avoided	58	0	42
18	All kind of vegetables can be eaten in unlimited quantities	84	0	16
19	Diabetics should not eat snacks or have irregular meals	53	5	42
20	Supplements or soft drinks may be required if diabetics practice physical activity	11	37	53
21	Beer can be consumed as a beverage	5	84	11

Table 3a - KAP: Knowledge on Diabetes

There is an uncertainty about basal blood glucose (53%) and pre-meal glycaemia (74%) and 16% of the diabetic sample does not know if the T2DM does or does not raise blood sugar levels.

Table 3b: shows the Attitude as results of the second part of the KAP.

n•	Questions	Agree (%)	Not sure (%)	Not agree (%)
1	T2DM can be prevented by lifestyle change	47	16	37
2	No possibility of avoiding a worsening of the disease once diagnosed	32	42	26
3	High prolonged blood sugar may damage the eyes, kidneys and blood vessels	84	0	16
4	Through the diet, you can have an optimal blood sugar level	74	5	21
5	Fat consumption is ideal for a diabetic's diet	16	53	32
6	Diabetics should limit the amount of food and sweets	84	0	16
7	In order to control and prevent complications, one should control feeding, exercise and an exact pharmacological therapy	89	0	11
8	Snack before a physical activity prevent hypoglycemia	42	5	53
9	Sport is a waste of time	26	42	32
10	It is important to not skip meals	74	5	21
11	Potatoes, pasta and cereals are protein sources	47	0	53
12	Dried beans, fish and chicken are fat sources	32	5	63
13	In week end days a diabetic can consume peanuts and fried bananas and bignes	21	42	37

Table 3b - KAP: Attitude on Diabetes

Participants were asked a set of twelve questions on good practices for avoiding or delaying the onset of diabetes (**Table 3c**).

Table 3c: KAP: Practices on Diabetes

n•	Questions	Always Often (%)	Occasionally (%)	Rarely Never (%)
1	I follow a planned and controlled diet	47	5	47
2	I consume 3 meals and 2 snacks a day	21	21	58
4	I eat vegetables	74	26	0
5	I drink less than 6 glasses of water daily	68	21	11
6	I practice physical exercise less than 15 minutes/day	32	26	42
7	If I'm thirsty I drink beer	5	5	89
8	If I'm hungry and feel weak I eat sweets	5	26	68
9	When I go out with friends, I drink 2 or more beers	0	32	68
10	I eat very ripe fruit	26	53	21
11	I have a weekly food plan	21	26	53
12	I usually drink carbonated drinks	16	26	58

DISCUSSION

We discuss essentially the main findings regarding dietary habits. The high BMI values are in part understandable considering high caloric diet (diabetics: 3633 ± 1422 kcal/day; non-diabetic: 4105 ± 1822 kcal/day). Generally, energy contribution expressed as percentage appears to be balanced, but if considering the amounts per day, it can be seen how the diet looks rich in proteins that reach 119.9 ± 51.8 grams/day in diabetics and 116.9 ± 52.0 grams/day in non-diabetics. It is probably due to the high daily consumption of fish in both groups, because of the geographical location of the city and the easy access to fresh fish. Between meat consumption white meat is clearly privileged, in particularly chicken consumption is spread throughout the country, favored by domestic poultry breeding and the high cost of red meat, especially beef. There is also a high daily consumption of eggs, with a total average of 2.0 ± 0.7 per person. An important contribution between vegetable proteins is given by consumption of "*madesu*", based on beans, a traditional Congolese dish.

As regard total lipid, most of the contribution comes from vegetable origin, mainly from peanut oil and palm oil, rich in long chain saturated fatty acids and palmitic acid, which is attributed to atherogenic and hyper-cholesterolemic effect. An important contribution among vegetable lipids is also given by peanut paste, widely used in Congo and major ingredient in the preparation of typical dishes as a substitute of oil or butter.

Animal lipids come from butter, margarine and powdered milk, privileged by 50% of those who drink milk. The consumption of fresh milk is limited due to the hot temperatures that compromise the optimal conservation, making it a product of difficult commercialization, at a much higher price than the powdered milk, accessible on the contrary by all the social ranges, rich in proteins and animal fats.

Concerning carbohydrates intakes due to incomplete food composition tables, it was not possible to differentiate simple and complex carbohydrates. However, it was possible to identify a high daily consumption of glucose rich foods, such as cassava flour and manioc, which is around 500 grams per day (459.2 ± 197.4 grams for diabetics and 440.6 ± 178.8 for non-diabetics), as confirmed by the study of FAO Food Balance Sheets [28].

The high consumption of meals of these foods is justified by the quick satiety they provide. Alternatively, plantain, fried or boiled bananas, and boiled basmati rice is often eaten inside a meal in lieu of bread.

It is not unlikely that KAP has obtained percentages that reflect a poor knowledge of food groups and some insecurity in the consumption of certain foods. Moreover, from the KAP and from the clinical history questionnaire, it was possible to observe how the Food Pyramid is not known in Congo. This basic knowledge would lead to controlled consumption of these complex carbohydrates. Among the snacks, most of the samples do not consume them, while sweet peanuts (toasted peanuts and sugar), white yogurt (made with powdered milk and sugar) and fried Congolese donuts (prepared with flour 00, sugar and banana) are preferred. Their free consumption is justified on the weekend by 21% of diabetics and 42% remains uncertain. During snacks or meals sugary drinks such as cola soda, orange soda and tea are preferred to water because they are easier to buy and have the same cost of a bottle of water. In Congo water is mainly distributed in 5- or 10-liter containers, but it results uncomfortable to use and not as fresh as alternative drinks and this also justifies the widespread consumption of beer. 32% of the diabetic sample says they drink "occasionally" and "rarely-never" six glasses of water per day.

Absence of nutritional therapy in 95% of the diabetic sample, irregular meals in 20% of diabetics, the wide consumption of sugary and alcoholic beverages, the poor physical activity, especially among diabetics although recognizing its therapeutic importance, partially justify the last two baseline blood glucose values of 200±122 mg/dl and 199±86 mg/dl.

These values are even more crucial if considering that 35% of the patients declare that the last stick to measure basal glycemia was performed more than three months before the interview. 90% of the diabetic sample never did postprandial blood glucose, nor basal insulin, and that 60% never controlled other blood values. Even the familiarity study suffers from this deficiency: seldom checks are carried out, rarely a diagnosis is performed, often "incomprehensible" deaths are attributed to local superstitions.

CONCLUSION

This pilot study analyzed a limited number of people to provide significant data that could justify future projects with a larger number of populations in Congo.

Results show the need for T2DM screening throughout the population to promote the prevention or delay of the disease in the most exposed areas.

There is a need for a food education involving every age group and based on simple and easy-to-understand models that could be utilized a Food Pyramid related to Congolese food.

The reduction of alcohol consumption, especially beer, encouraging regular physical activity, re-balancing meals and snacks are additional goals provided by the results obtained from this study.

At the same time, there is a need for training of healthcare personnel who need to understand the central importance of nutritional therapy in T2DM care and who knows how to follow T2DM patients more precisely from a nutritional point of view. The country would also need an important Health Reform to open access to basic medical care, faster and lower costs, such as glycemic stick. Moreover, the Congolese government should consider providing access to regular meals and regular blood checks for hospitalized hospital care as a hospital service, which would also facilitate the work of medical staff. However, the most relevant data are 45% of overweight-obesity and a high-hypertension found in both groups and it clearly confirm the need to re-evaluate Congo, and probably many other African countries, from a scientific-health point of view, beginning to act in advance on these pathologies.

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