**Abstract**

In order to establish a link between staple foods and prevalence of diabetes in populations, a preliminary survey aiming at diabetes frequencies has been executed with 16 diabetics. Glycaemia was evaluated in clinical laboratory and survey slip was used to collect information from patients. Results were analyzed at a threshold $a = 0.05$ with XLSTAT. Frequencies of higher glycaemia in diabetics for staple food were found in this ranking order: rice $>$ sorghum $>$ wheat $>$ maize $>$ millet $>$ others. Such foods were eaten during a long period before diabetes symptoms. Patients of 36-40 years old were numerous in proportion $(31.25\%)$. Others cases of age groups go from $0.0\%$ to $6.25\%$ frequencies. Type 1 diabetes is found in sedentary persons and sellers with positive and significant correlation with glycaemia over $1.25$ g/L ($r=0.785-0.850$) because of consummation of sorghum ($r=0.755$) and wheat ($r=0.674$) for social reason ($r=0.738$). Type 2 diabetes is linked to economic reason ($r=0.688$). Only cultivators have glycaemia between $1$ g/L and $1.25$ g/L. Contrary, sedentary, salaried and seller people showed glycaemia over $1.25$ g/L. Consequently, significant correlations indicate wheat ($r=0.851$), rice ($r=0.815$), sorghum ($r=0.753$), maize ($r=0.655$) and tea ($r=0.646$); all are correlated social reasons ($r=0.825$). Thus, many factors especially foods and life system contribute in releasing diabetes.

Keywords: Diabetes, releasing, factors, food, life, system.

---

**1 | INTRODUCTION**

Initially regarded as an epidemic of industrialized countries, today diabetes mellitus is a disease that affects all countries of the world (FID, 2013; Cho et al., 2018). Diabetes is defined by a glycaemia $\geq$ à $1.3$ g/L with nothing eaten or a glycaemia $> 2$ g/L at any moment of the day, value measured at least with 2 recoveries. Diabetes is a disease due to an absolute or relative deficiency of insulin in the body (Dirlewanger et al., 2008; Canavan et al., 2008; Tracey et al., 2016). Insulin is produced by pancreas, digestive organ located under the stomach. Insulin is necessary for the use of food especially carbohydrates and lipids. Currently, the glycaemia is considered as normal when it ranges from $0.70$ to $1.05$ g/L (Gagné et al., 2017; Monnier, 2018).
There are great types of diabetes mellitus (Dirlewanger et al., 2008). Type 1 diabetes mellitus (T1DM) is insulinodependent. It results from autoimmune destruction of pancreatic β-cells by a major or an even total deficiency of insulin production in the body. Are distinguished a T1DA (autoimmune destruction of β cell after an asymptomatic period over years) and a T1DB (idiopathic). The age of young patient often is under 30 years (FID, 2013). But for the type 2 diabetes (T2D), called also non insulinodependent diabetes (NIDD), it is due either to relative deficiency in insulin production by loosing of functional β cells, or to resistance to insulin action, or the both. Generally, that type of diabetes appears in patients having more than 30 years, often with overweight and having diabetic familial antecedents (Cho et al., 2018).

Epidemics that are close to type 2 diabetes and the gestational diabetes can partially explain the spectacular increase of diabetes prevalence in infants and adolescents (Marre, 2008; Cho et al., 2018; Monnier, 2018).

According to Dirlewanger et al. (2008), specific diabetes or the monogenic ones are composed of some, among others, of mitochondria and neonatal diabetes, and of the MODY (Maturity Onset Diabetes of the Young). The MODY exists in seven sub-groups where the MODY3 (58% with 3.06 g/L) and MODY2 (22% with 1.98 g/L) are major versus lower proportions (<1% à 5%) in the other MODYs. They are related to genetic defects of the pancreatic beta cell function such as mutation of glucokinase gene (Dirlewanger and Schwitzgebel, 2008; Schwitzgebel, 2016). Furthermore, secondary diabetes are in majority linked to the existence of pancreatopathies (pancreatitis, neoplasia, cystic-fibrosis, hemochromatosis, chirurgical exaeresis), of endocrinopathies responsible of hyperglycaemia hormone hypersecretion (cortisol, growth hormones, glucagon, thyroid hormones, pheochromocytome) and to iatrogenic causes (corticosid, interferon, antiretrovirals....) (Schwitzgebel, 2016).

According to authors (Marre, 2008; Fosse-Edoh and Mandereau-Bruno, 2015), diabetic complications can be acute (mere hyperglycaemia or hyperglycaemia) with or without a ketonuria, or chronic (affection of eyes, kidneys, heart, nerves, feet...). About hypoglycaemia (Marre, 2008; Raja et al., 2013), these complications are due to an excessive consomption of medicines, or to a catch of drug without being accompanied by food. As for the hyperglycaemia, it is of an insufficient catch of drug or an excessive catch of food especially sweetened. These complications may become acute or chronic. In general, they are due to a chronic hyperglycaemia and essentially affect kidneys, eyes (blindness), feet, heart, blood vessels, nerves. Consequently, they can lead to the heart failure or to sexual impotence in the man and to the loss of sexual desire in the woman, to pains and wounds at feet (Simon and Eschwege, 2002; Marre, 2008; Bianchi-Demicheli et al, 2010; Guimet et al., 2012).

In the world, FID report indicated (2013) 382 millions of diabetic persons (20-79 years) from which 46% were not diagnosed (175 millions de diabetic cases). In 2035, those numbers shall reach the rate of 55% corresponding to 592 millions of diabetics.

Today, one person dies of diabetes per six second. In Africa, 19.8 millions of diabetes cases were registred versus 381.8 millions on the worldwide scale. In relation to report of 2013, the number increase of diabetics in Africa shall be 109% in 2035. The study realized by FID in 2013 has shown 80% diabetic persons are living in countries with low and average income, and/or in the rural zones where the humanitarain aid in food has replaced the local food. Moreover, the type 2 diabetes increases in all countries where many people reached by the epidemic. At the very moment, those data are going on according to the projections for the period from 2017 to 2045 (Cho et al., 2018).

Although epidemiologic knowledge is very fragmentary in many African countries, the morbimortality

---

**Supplementary information** The online version of this article (https://doi.org/10.15520/jmrhs.v6i7.209 ) contains supplementary material, which is available to authorized users.

**Corresponding Author:** Collinlaw Joseph Ndouyang

Collinlaw Joseph Ndouyang

Email: ndouyang@yahoo.fr
due to the diabetes is increasing these ten last years in Chad. Nowadays, the diabetes is regarded as civilization pathology in all the social level. The diabetes in Chad is in a difficult socio-cultural context; Chadians consider it as a drama and it could be a subject of an education (DESG, 2001). Knowing that the cause of the diabetes dictates the treatment, control of its releasing factors constitute measures of prevention of the diabetes complications. In the view of preliminary research on starting factors of the diabetes, that the present study is structured and whose results try to emphasize some short response.

1. Biological material

Biological material was constituted of 16 diabetic patients whose cause of complaint were treated by the medical service of district hospital of Koyom.

2. Methods

The glycaemia has been determined d’un spectrophotometer UV visible (model 6305) using a glycaemia kit (GOD Assay Reagent – GAGO20). Gathering of informations has been carried out by adaptation of the method of Banu et al. (2018) according to a survey slip of investigation or ‘Questionnaires’ that were administered to patients. Questionnaires’ were an essential element of data-gathering. Responses to structured questionnaires were obtained from patients through the help of the hospital responsibles. Patients were asked to indicate their preference with respect to how they frequently are nourished. Patients were also asked to indicate theirs staple foods. Briefly, the questionnaires permitted to collect information as enough as possible. The boxes in front of questions were notched for a later examination.

3. Statistic Analysis

Data were analyzed and expressed in percentage (%). Correlation table of Pearson was obtained thanks to XLSAT, a component of Excel, in order to know the degree of relationship between tested variables.

4. Results

Results that were obtained are presented in the tables and figures that follow for 16 diabetic patients. Thus, in Table 1, the major part of patients was composed of men (75.00%). Patient’s frequency in-group O was 31.25%, and 43.75% of diabetics ignored their membership in ABO blood system. In addition, 18.75% ignore if their Great-grandparents were diabetic. Moreover, the type 2 diabetes prevalence (56.25%) is above the one of type 1 diabetes.

TABLE 1: Frequencies of sexual membership, heredity and diabetestypes

| Rubrics                        | Sub-rubrics | Totals | Frequencies (%) |
|--------------------------------|-------------|--------|-----------------|
| Sexual membership             |             | 16     |                 |
| Women                         | 04          | 25.00  |                 |
| Men                           | 12          | 75.00  |                 |
| Patient blood group for ABO system | 16    |        |                 |
| O                              | 05          | 31.25  |                 |
| A                              | 02          | 12.50  |                 |
| B                              | 02          | 12.50  |                 |
| AB                             | 00          | 0.00   |                 |
| Unknown                        | 07          | 43.75  |                 |
| Diabetic Great-grandparents    |             | 16     |                 |
| Yes                            | 01          | 6.25   |                 |
| Non                            | 12          | 75.00  |                 |
| Unknown                        | 03          | 18.75  |                 |
| Types of diabetes              |             | 16     |                 |
| Type 1 (T1D)                   | 07          | 43.75  |                 |
| Type 2 (T2D)                   | 09          | 56.25  |                 |

Table 2 show pre-diabetics (glycaemia 1-1.25 g/L) with low proportion of 37.5% compared to diabetics whose glycaemia is higher than 1.25 g/L. Those diabetics pee from 4 to 6 times a day (61.54%).

TABLE 2: Glycaemia and frequencies of urines

| Rubrics | Sub-rubrics | Totals | Frequencies (%) |
|---------|-------------|--------|-----------------|
| Glycaemia |             | 16     |                 |
| Glycaemia <1 g/L | 00 | 0.00   |                 |
| Glycaemia ≤[1;1.25] g/L | 06 | 37.50  |                 |
| Glycaemia >1.25 g/L | 10 | 62.50  |                 |
| Frequencies of urines |             | 13     |                 |
| <4 times/day | 04 | 30.77  |                 |
| [4, 6] times/day | 08 | 61.54  |                 |
| >6 times/day | 01 | 7.69   |                 |
Food is an important parameter in releasing diabetes. The food and drinks proportions (Table 4) seem not to decide between the opinions on the release of the diabetes.

There is equality between the consumption of meat products on one hand, and food of animal origin on the other. However for drinks, 53.33% of patients were regular drinkers of soft beverage, and 40% were tea drinkers. Nevertheless, preferred foods were the local ones and used by diabetics up at 71.43%. The consumption of products obtained by non-industrialized transformation was at low frequency.

**TABLE 4: Frequent foods and drinks, and preferred foods**

| Rubrics                  | Sub-rubrics | Totals | Frequencies (%) |
|--------------------------|-------------|--------|-----------------|
| Origin of frequent foods |             | 26     |                 |
| Animal                   | 13          | 50.00  |                 |
| Vegetable                | 13          | 50.00  |                 |
| Frequent drinks          |             | 15     |                 |
| Alcohol                  | 01          | 6.67   |                 |
| Soft drinks              | 08          | 53.33  |                 |
| Tea                      | 06          | 40.00  |                 |
| Preferred foods          |             | 21     |                 |
| Imported                 | 01          | 4.76   |                 |
| Local                    | 15          | 71.43  |                 |
| non-industrialized       | 05          | 23.81  |                 |

Moreover, it would be possible that the release of the diabetes individually is the fact of basic food. According to this study (Figure 2), the classification on a decreasing ranking order of consumption is such as Rice > Sorghum > Wheat > Maize > Millet > Others. The first four foods or cereals would be there responsible of diabetes releasing in 82.92% cases. This order can be submitted to the following hypothesis:

(i) this order would be a coincidence;
(ii) this order would depend on the reducing sugar content in each food;
(iii) this order would depend on both coincidence and reducing sugar content in each food. However, such hypothesis needs further investiga-tion neatly on food consummation in connection with which has occurred of the diabetes.
Lastly, table 5 shows that the diabetes releasing took place after at least several months or years of incubation (43.75%+18.75%) when eating releasing food leads to the first symptoms of diabetes. The duration of consummation of staple food also run on several months and years (93.75%), essentially for economic reasons (59.09%) and with no idea about effect on consumer’s organism (53.83%).

2.5. Discussion

At the end of the presentation of results, a discussion based on correlations between the variables is necessary. In table 6, the type 1 diabetes, revealed by glycaemia values higher than 1.25 g/L, is met among sedentary sellers consuming sorghum and corn for corporate name (R = 0.674 to 0.850). However, for the type 2 diabetes, it appears in individuals whose staple food is justified by an economic reason (R = 0.688) contrary to a political one (R = -643). Cultivators are essentially pre-diabetic with a glycaemia going from 1 g/L to 1.25 g/L. Glycaemia is higher (over 1.25 g/L) in patients who are sedentary, salaried employees and the sellers (r = 0.704 à 0.914). Those people are tea drinkers, and consumers of sorghum, rice, maize and wheat (=0.646 à 0.851) for social reason (r = 0.826). Sedentarism constitutes a calamity for the sellers (r = 0.900) whose diet is guided by economic and social reasons (r = 0.841 à 0.855). According to their purchasing power, employees appear interested by rice and corn (r = 0.722 à 0.729). According to these analysis, farmers are pre-diabetics thanks to the millet consumption and their living conditions (r = 0.648) that maintain the glycaemia under a diabetes major risk side. About the effects of consumption of any source of energy on diabetes, the soft drinks are comparable to sorghum, rice, and corn; tea to maize; sorghum to wheat. The consumption reason of all these foods and drinks is either economic, or social, or the both, and for which health is neglected.

In connection with results of this study, easy comprehension is released from principles of individual diet reported by authors (DESG, 2001.) consisting chiefly in reducing or suppressing soft drinks that leads to a rapid and uncontrollable hyperglycaemia. We can list foods such as cane with sugar, sweetens of table, candies, honey, jams, the chocolate, bis-cuits, cakes, of dates, the drinks such as beer, soft drinks, condensed milk, ice, fruits in excessive quant-ity. In addition, many foods to be consumed with moderation are advised and which are oil, cheese,
butter, dry beans, millet, pastes, beans, groundnuts, carrot, yam, sweet potatoes, avocado, green apple, grapefruit, orange, mango, papaw, pineapple, guava. On the other hand, authorized foods are meat, fish, and chicken, powder of fish, egg, reptile, unsweetened milk, shrimp, bean, aubergine, vegetal leaves, okra, cucumber, mushrooms, pepper, onions, and crayfish. Such education could be considered as welfare without a lot of money. In this way, importance of regulation of daily water intake to prevent diabetic eye disease has been demonstrated (Ratheesh et al.,2018).

In this context, present report reveals the need for food choice in order to avoid releasing diabetes especially in the persons with favorable conditions for the diabetes. Indeed, the study of correlation shows a connection between the staple food and occurred diabetes mellitus. However, an investigation is necessary to elucidate diabetes mellitus prevalence using in vivo a fitted experimental design.

### TABLE 6: Pearson correlation between different tested variables

| Variables          | Type 1 Diabetes | Type 2 Diabetes | Gly >1.25 g/L | Sedentary | Salted | Cultivator | Soft drinks | Tea | W/Y Sorghum | Millet | Rice | Wheat | Economic reason | Politic reason | Social reason |
|--------------------|-----------------|-----------------|---------------|-----------|--------|------------|-------------|-----|-------------|--------|------|-------|----------------|----------------|--------------|
| Type 1 Diabetes    | 1               |                 |               |           |        |            |             |     |             |        |      |       |                |                |              |
| Type 2 Diabetes    | -0.043          | -0.330          | 0.345         | 1         |        |            |             |     |             |        |      |       |                |                |              |
| Gly ≥1.25 g/L      | 0.850           | 0.239           | -0.594        | 1         |        |            |             |     |             |        |      |       |                |                |              |
| Sedentary          | 0.813           | 0.548           | -0.075        | 0.881     | 1      |            |             |     |             |        |      |       |                |                |              |
| Salted             | 0.398           | 0.429           | -0.452        | 0.704     | 0.583  | 1          |             |     |             |        |      |       |                |                |              |
| Cultivator         | 0.785           | 0.415           | -0.376        | 0.914     | 0.900  | 0.633      | 1          |     |             |        |      |       |                |                |              |
| Soft drinks        | 0.616           | 0.623           | 0.208         | 0.586     | 0.879  | 0.401      | 0.762       | -0.107 |             |        |      |       |                |                |              |
| Tea                | 0.326           | 0.062           | -0.283        | 0.646     | 0.625  | 0.625      | 0.713       | -0.220 | 0.430        | 1      |      |       |                |                |              |
| W/Y Sorghum        | 0.755           | 0.361           | -0.109        | 0.753     | 0.845  | 0.542      | 0.650       | 0.056 | 0.718        | 0.432  | 1    |       |                |                |              |
| Millet             | 0.195           | -0.218          | 0.395         | -0.134    | 0.056  | -0.527     | -0.272      | 0.648 | -0.100       | -0.375 | 0.184 | 1    |                |                |              |
| Rice               | 0.631           | 0.465           | -0.562        | 0.815     | 0.800  | 0.720      | 0.926       | -0.616 | 0.748        | 0.580  | 0.537 | -0.440 |                |                |              |
| Maize              | 0.564           | 0.587           | -0.034        | 0.655     | 0.815  | 0.444      | 0.877       | -0.330 | 0.816        | 0.711  | 0.441 | -0.267 | 0.800        |                |              |
| Wheat              | 0.674           | 0.429           | -0.169        | 0.851     | 0.815  | 0.722      | 0.784       | 0.503 | 0.888        | 0.538  | 0.709 | -0.267 | 0.800        | 0.630          |              |
| Economic reason    | 0.325           | 0.608           | 0.311         | 0.525     | 0.841  | 0.459      | 0.572       | 0.107 | 0.842        | 0.466  | 0.801 | 0.100  | 0.531         | 0.366          | 0.714         |
| Politic reason     | 0.149           | -0.643          | -0.452        | 0.044     | -0.250 | 0.250      | 0.000       | 0.000 | -0.156       | -0.459 | -0.156 | -0.561 | 0.218         | -0.129        | -0.111        |
| Social reason      | 0.738           | 0.405           | -0.263        | 0.826     | 0.855  | 0.491      | 0.815       | -0.204 | 0.776        | 0.477  | 0.841 | -0.190 | 0.767         | 0.382          | 0.824         |

Numbers in bold are statistically significant at a threshold α = 0.05; Gly = glycaemia; W/Y Sorghum= White or Yellow Sorghum.
Diabetes mellitus becomes an epidemic in developing countries since the last decade. The frequent form remains by far the standard type 2 diabetes. Whatever the form, diabetes often involves in acute and chronic complications. Although its complete elimination is not possible nowadays, diabetes can be balanced with existing treatments. And one can thus delay or prevent the emergence of chronic complications of diabetes.

The policy implications of present work are to emphasize on the utility of nutrition in preventing physiological disasters. Also, the prevention of complications passes by a regular follow-up with an adequate self-monitoring. Because the treatment of the chronic complications still remains very expensive for our countries. The whole of the control and of the follow-up of the diabetic master key by the food that must be adequate for the patient. If people are led to an adequate food education about diabetes, avoiding foods that enhance glycaemia, health by food in case of diabetes and of other metabolic diseases shall integrate our life system and become a model for future generations. Further investigation is necessary to enhance the field of the present study.

3 | ACKNOWLEDGEMENT

The authors would also like to express their gratitude to district hospital of Koyom, Mayo-Kebbi (Chad) for clinical analysis and the availability of data.

4 | REFERENCES

1. Banu R. A., Ansia E. D. O., Akrong M. O., Ansa G. A. And Bello M. (2018). Microbial water quality assessment of packaged drinking water of pre-school children in some parts of accra. Ghana J. Sci.; 59 : 31-40.
2. Bianchi-Demichelli F., Ortigue S., Meyer P. (2010). Désir sexuel hypoactif chez l’homme : prise en charge en médecine sexuelle. Rev Med Suisse; 6 : 614-619
3. Canavan RJ., Unwin NC., Kelly WF., Connolly VM., (2008). Diabetes- and Nondiabetes-Related Lower Extremity Amputation Incidence Before and After the Introduction of Better Organized Diabetes Foot Care. Diabetes Care; 31(3): 459-463.
4. Cho N.H., Shaw J.E., Karuranga S., Huang Y., da Rocha Fernandes J.D., Ohlrogge A.W., Malanda B.(2018). IDF Diabetes Atlas: Global estimates of dia-betes prevalence for 2017 and projections for 2045. Diabetes Research and Clinical Practice (2018).
5. DESG (2001). Diabète Éducation. Journal du D.E.S.G de langue française, 11(2) : 21-32.
6. Dirlewanger M., Klee P., Schwitzgebel V.M. (2008). La cause du diabète dicte le traitement. Pri-orité, 18-23.
7. FID (2013). Atlas du diabète de ma FID. Fédéra-tion Internationale du diabète, 6e éd, 160 p.
8. Fosse-Edorh S, Mandereau-Bruno L. Suivi desexamens recommandés dans la surveillance du dia-bète en France en 2013. Journée mondiale du diabète 2015, Suivi du diabète et poids de ses complications sévères en France, 2015 ; 34-35 : 645-654.
9. Gagné A, St-Jean J, Savard V. Guided’ alimentation pour la personne diabétique, 2017, 66p.
10. Guimet P, Pasquier E, Olchini D, Joyeux F. Le diabète et les autres facteurs de risque cardiovasculaire, 2012 ; 106p.
11. Kharbade S., Asnani A., Pratyush K. Development and validation of UV spectrophotometric method for simultaneous estimation of metformin hcl and repaglinide in pharmaceutical formulation. Journal of Drug Delivery & Therapeutics. 2019; 9(3):344-347
12. Marre M. Gare aux complications diabète de type2 : Recherche & santé, 2008 ; 114 :13-20.
13. Monnier L. Définir et expliquer les différents types de diabètes sucrés, in : Manuel de nutrition pour le patient diabétique, Elsevier Masson SAS, 2018 ; 11-20.

14. Mupangu M, Nsakala N. Les facteurs de décompensation du diabète sucré au Congo. Médecine d’Afrique Noire, 1991 ; 38 (11) : 764-766.

15. Orch H, Douira A, Zidane L. Étude ethnobotanique des plantes médicinales utilisées dans le traitement du diabète, et des maladies cardiaques dans la région d’Izarène (Nord du Maroc). Journal of Applied Biosciences, 2015 ; 86 :7940– 7956.

16. Raja Reddy P, Reethesh RP, Mahesh V. The association between estimated average glucose levels and fasting plasma glucose levels in a rural tertiary care centre. Global Journal Of Medicine And Public Health, 2013; (21): 1-5.

17. Ratheesh P, Surendran E, Sudhakar D., Surendran E, Sumedhan V, Meghna PP, Sudhakar D, Srini-vasan M, Abhayadev A, Meghna PP, Abhayadev A. Importance of regulation of daily water intake to prevent diabetic eye disease. International Journal of Current Research, 2018, 10(08) : 72172-72175.

18. Schwitzgebel VM. Diabètes monogéniques: de la génétique vers une médecine personnalisée. Pae-diatricha, 2016 ; 27(1) : 6-10.

19. Simon D., Eschwege E. Données épidémiologiques sur le diabète de type 2. BEH, 2002 ; 20- 21:86.

20. Tracey ML, Gilmartin M, O’Neill K, Fitzgerald AP, McHugh SM, Buckley CM, Canavan RJ and Kearney PM, (2016). Epidemiology of diabetes and complications among adults in the Republic of Ireland 1998-2015: a systematic review and meta-analysis. BMC Public Health 16:132-147.