



## RESEARCH ARTICLE

### Dietary Habits Associated with Sociodemographic and Clinical Parameters of Diabetic Patients in Algeria

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#### ABSTRACT

Diabetes is the leading cause of disability and death in the world and is currently a major public health problem. Nutrition plays a major role in the evolution of this epidemic and in the prevention of cardio-metabolic risks. The objective of this study was to evaluate the association of dietary habits with socio-demographic and clinical parameters of diabetic patients. It is a cross-sectional study with a descriptive aim recruiting 101 patients received in consultation at the level of the house of the diabetics for the inhabitants of Mascara of Algeria. The present work focused on an assessment of dietary behavior and knowledge of their diet according to a questionnaire established and designed specifically for this analysis as well as a measurement of anthropometric parameters for each patient. The average age of study participants was 59.40 years with a female predominance (87.12%). Type 2 diabetes was present in 95.04% of cases. The average body mass index was 29 kg/m<sup>2</sup>, most were overweight (43.56%) or obese (30.69%). Therapeutically, 30.69% were under antihypertensive treatment and 25.74% under hypolipidemic treatment. The hygienic and dietary management of diabetes appears to be difficult, which fully justifies the development of therapeutic education programs aimed at accompanying patients in the nutritional management of such metabolic disorders.

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#### INTRODUCTION

Diabetes is a chronic disease with constant progression (Anonymous, 2019). The global prevalence has increased significantly in recent years. In 2019, 231.9 million people, or half of the diabetic population, were unaware of their disease (Jaffiol, 2021). On the other hand, nutritional imbalances and sedentary lifestyle are increasingly contributing in the spread of Type 2 diabetes (T2DM) (Anonymous, 2019), which accounts for about 90% of diabetes cases. Nutritional diagnosis is still weaker of the evaluation procedures in the current clinical practice because of a lack of knowledge of the nutritional problems and their repercussion on the health of the patients on the part of the nursing teams. Nutritional pathologies are often perceived as secondary to the disease that caused the hospitalization (Beck et al., 2001). The nutritional profile allows a good evaluation of diabetic patients, in terms of diet monitoring or lifestyle changes (Anonymous, 2019). Since diabetes can lead to serious problems, proper care

is crucial. This one involves making improved dietary choices and engaging in regular physical activity before any medication is used. Indeed, a healthy and varied diet favors the maintenance of a healthy weight, as well as a relatively stable glycaemia throughout the day (Sackett et al., 1978). Medical goals are to be considered in the short, medium and long term in order to prevent and limit complications. To achieve them, it is essential to inform and educate patients and their families in order to obtain their active participation in the management of the disease. The hygienic-dietary measures are part of the important information and advice that must be taught and explained to patients (Evert et al., 2014). The objective of our study is based on the evaluation of dietary habits associated with socio-demographic and clinical parameters of diabetic patients referred to the diabetic house of polyclinic of Mascara - Algeria. The aim is to assess their level of knowledge in relation to the hygienic and dietary advice given by health professionals. This study will make it possible to enumerate the many difficulties encountered

in the daily life of the patients, and which constitute an obstacle to the follow-up of the treatment. The knowledge of all these elements is fundamental because it will allow to establish a better strategy of global management of diabetic patients in general and of each patient in particular.

## MATERIALS AND METHODS

The present study first constructs a questionnaire based on dietary knowledge and eating habits in order to understand the nutritional behavior of sample population. It was a cross-sectional study with a descriptive goal. We included all patients with diabetes mellitus who agreed to participate, and excluded those without diabetes and children. These patients were recruited progressively following inclusion and exclusion criteria from the house of the diabetics of polyclinic Mascara of Algeria during 2021. The study variables include sociodemographic characters (sex, age and level of study) and clinical parameters (type of diabetes, BMI, abdominal perimeter and treatment with cardiovascular aim) (Safi et al., 2020; Ghosh and Bandyopadhyay, 2012; Jemel et al., 2018; Benabadji et al., 2014). The nutritional survey includes data collected on an individual form using questionnaire specifically adapted to our study, predefined to assess nutritional profile (Hallab et al., 2012; Sidibé et al., 2017; Azzoug et al., 2020).

### Ethical considerations

The protocols of this study followed the ethical guidelines of the Declaration of Helsinki, developed by the World Medical Association (WMA) in 2013. All participants gave their informed consent after being fully aware of the study objectives. The obtained data was treated as anonymous and confidential thus protecting the patients' privacy.

### Data analysis

Data were entered using Excel 2010 and analyzed with SPSS 20 software. The Chi-square test was applied to compare frequencies. The chi-square test function in R was used (R Core Team, 2020). A 95% confidence interval estimated and a significance level of 0.05.

## RESULTS AND DISCUSSION

### Distribution of diabetic patients according to their socio-demographic characteristics

A good diet is extremely important to preserve the quality of life of patients. The treatment must be complemented by an adaptation of the diet and it is important to respect as much as possible their dietary regime (Dyson et al., 2018). The results of sociodemographic characters showed that the average age of study participants was  $59.40 \pm 11.48$  years, and the majority were female (87.12%). While most of the participants (42.57%) were uneducated (Table 1).

**Table 1: Distribution of diabetic patients by socio-demographic characteristics**

Socio-demographic characteristics	%
Gender	
Men	12.8
Women	87.1
Level of education	
No education	42.5
Primary	20.7
Average	16.8
Secondary	10.8
Higher	8.9

**Table 2: Clinical parameters**

Clinical parameters	%	95% Confidence Interval (CI)
Type of diabetes		
Diabetes type 1	4.9	1.8% - 11.7%
Diabetes type 2	95.0	88.3% - 98.2%
Cardiovascular treatment		
Antihypertensive	30.6	22.1% - 40.8%
Hypolipidemic	25.7	17.8% - 35.6%
Antihypertensive and hypolipidemic	25.7	17.8% - 35.6%
Body Mass Index(BMI)		
Denutrition	2.9	0.78% - 9.1%
Normal weight	22.7	15.3% - 32.3%
Overweight	43.5	33.8% - 53.8%
Obese	30.6	22.1% - 40.8%
Abdominal Obesity	73.2	63.4% - 81.3%

Our results are consistent with those recorded by Safi et al. (2020) who noted that the average age in the study population was  $59.49 \pm 9.2$  years with a female predominance (65.3%). Corroborating our results with those demonstrated by Hallab et al. (2012) a study conducted on the Moroccan population on the socioeconomic characteristics of T2DM patients, about 52% had no schooling. This study suggests that the burden of diabetes is accentuated in the elderly population and is a factor of accelerated aging, increasing functional limitations and altering the quality of life (Sobngwi and Halimi, 2017). Thus, the distribution of diabetes by sex reveals a predominance of women, probably related to the high longevity of women in North Africa and in other regions of the world (Anonymous, 2018). Women are either more likely to join diabetic associations than men and therefore more registered with the relevant structures, or they are more sedentary in our society, which is a risk factor for obesity and therefore for the onset of diabetes. In addition, the level of education could lead to a better understanding of the disease, and therefore a better follow-up of the diet (Anonymous, 2018). The lack of adequate nutrition education tools for patients poses the problem of reading and understanding, given the high rate of non-education.

### Clinical parameters

T2DM was more common (95.04%) compared to type 1 diabetes (4.95%) (Table 2). These results were comparable to those of Safi et al. (2020) who found

only 2.7% of the patients of type 1 diabetes. Indeed, the mean BMI of the patients was  $29.01 \pm 5.09 \text{ kg/m}^2$ . This result is relatively lower than that brought by Safi et al. (2020) who found a mean BMI of  $31.4 \pm 6.1 \text{ kg/m}^2$  of the patients with diabetes mellitus in Tunisia. The prevalence of overweight and obesity among diabetic patients in our sample were 43.56% and 30.69% respectively (Table 2). These results are slightly similar to those reported by Sidibé et al. (2017) who found 40% overweight and 24% obese patients in their sample during a study of diabetic patients in Donka Conakry (Guinea). Similarly, for abdominal perimeter, we noted that the average of all patients was  $105.48 \pm 12.05 \text{ cm}$ . This result is higher than that reported by Ghosh and Bandyopadhyay (2012) who had found an average abdominal perimeter of  $89.80 \pm 9.19 \text{ cm}$  of diabetic patients in West Bengal, India. The prevalence of abdominal obesity in diabetic patients in our sample was 73.26% (Table 2). These results are different from those shown by Jemel et al. (2018) who mentioned that 40.9% patients presented abdominal obesity in their sample during a study on diabetic patients in Tunisia. In addition, we recorded that 82.17% of diabetics are under cardiovascular treatment or the prevalence of treatment associated antihypertensive and hypolipidemic is 25.74% (Table 2). Similarly, the prevalence of each treatment, 30.69% antihypertensive and 25.74% hypolipidemic (Table 2). These results are different from those reported by El Aassri et al. (2014) who found 26.32% patients under antihypertensive treatment during a study of diabetic patients in Morocco. Nevertheless, Benabadji et al. (2014) found 28.1% of patients under hypolipidemic treatment during a study on diabetic patients in Oran of Algeria.

#### **Evaluation of the nutritional profile**

##### **Dietary habits of diabetics treated in the diabetic house of the polyclinic of Mascara - Algeria**

The diet could induce diabetes through the mediators of inflammation, foods with high glycemic index cause a rapid increase in blood glucose (Hallab et al., 2012). On the nutritional plan of our patients at the time of study, the majority of diabetics or 85.14% declare that they encounter difficulties to follow the "nutritional recommendations", the adaptation of the diet according to the self-controls has been objective for 33.66%. The majority of the study population, i.e. 74.25%, knew the foods that can be consumed freely, as opposed to only 34.65% of the patients who knew the foods that are strictly forbidden for diabetics. Thus, 98.01% of the patients were unaware of the concept of "food equivalents", and the same was true for the concept of "artificial sugar without calories" (sweetener), i.e. 96.03% of the patients (Table 3). It appears that the nutrition of our study population, had a hyperlipidic and hyperglucidic character was also observed in these patients (Table 3), all these nutritional habits were summarized as follows:

Excitants were consumed once a day or 66.33%, consumption quite low for whole meal bread (6.93%), for starchy foods (30.69%), fish (34.65%) and soft drinks (33.66%) (Table 3). Thus, 76.23% of them took bread ( $\frac{1}{4}$  of a baguette) more than 3 times a day (Table 3) knowing that an excessive intake of bread significantly increases the risk of overweight and cardiovascular diseases because of their high glycemic index confirmed in a study on the consumption of bread and cardiometabolic risk in Algeria (Azzoug et al., 2020). Other obesity risk behaviors confirmed in our study were found in these diabetic patients, especially in relation to the consumption of French fries, pasta and ice cream / pastries, we had a high percentage as 51.48% and 87.12% and 38.61% respectively were taken more than 3 times a week (Table 3). In the same context, it should be mentioned that the rate of snacking of patients between meals was 53.46% (Table 3). This result is slightly lower with those shown by Hallab et al. (2012), who had recorded 65.9% of patients who snacked during a study interested particularly in dietary practices in Moroccan obese T2DM in Casablanca. For fruits were rarely consumed (51.48%). Moreover, 48.51% of patients consume green vegetables at least once a day (in raw vegetables, dish or soup). Meats and derivatives were consumed once a week (60.39%) of which white meats are the most consumed (78.28%) (Table 3).

In addition, it was revealed that 43.56% of patients consume dairy products at least once a day (Table 3). Knowing that these foods are highly nutritious and can play an important role in the diet that are available at each meal, they are also a good source of riboflavin and vitamin A. Hence the interest to maintain imperatively the daily intake of calcium at least 3 to 4 servings of dairy products per day to have an adequate intake of calcium (bone renewal) and secondarily in protein of good quality (renewal of all tissues of the body) and these products will be sweetened with table sugar if at all (Santé Canada, 2015). On the other hand, the consumption of fish was almost negligible by our patients either (63.36%) who rarely consume them. It should be remembered that the benefits of poisons for health especially fatty poisons, have been widely demonstrated: their high levels of unsaturated fats or even omega-3 help to regulate cholesterol levels, prevent the onset of cardiovascular disease (Eckel et al., 2014). These findings were confirmed in our study in which most of the diseases were under cardiovascular treatment including lipid-lowering and antihypertensive drugs. Spanish researchers from the Universitat Oberta de Catalunya (UOC), in partnership with the Institute of Biomedical Research (IDIBAPS) (Díaz-Rizzolo et al., 2021), found that regular consumption of sardines also prevents the onset of T2DM (Díaz-Rizzolo et al., 2021). Another study showed the effect of the consumption of

**Table 3: Dietary habits of diabetics treated in the diabetic house of the polyclinic of Mascara - Algeria**

Dietary habits	%	CI 95%		%	CI95%		%	CI 95%
Difficulties in following nutritional recommendations			Knowledge of the concept of artificial calorie-free sugars (Sweetener)			Frequency of French fries		
Yes	85.1	76.3 - 91.1	Yes	3.9	1.2 - 10.4	At least once a week	12.8	7.3 - 21.3
No	14.8	8.8 - 23.6	No	96.0	89.5 - 98.7	≥ 3 times / week	87.1	78.6 - 92.6
Non-adaptation of diet based on self-checks			Snacks between meals			Frequency of bread consumption (¼ of a baguette) / day		
Yes		24.7 - 43.8	Yes		43.3 - 63.3	Once a day	8.9	4.4 - 16.6
No	33.6	56.1 - 75.2	No	53.4	36.6 - 56.6	2 times / day	14.8	8.8 - 23.6
Knowledge of free foods for the diabetic			Consumption of green vegetables at least once a day (in raw vegetables, in a dish or in a soup)			≥ 3 times / day	76.2	66.5 - 83.9
Yes		64.4 - 82.2	Yes		38.5 - 58.6	Type of bread most consumed on a regular basis		
No	25.7	17.7 - 35.5	No	51.4	41.3 - 61.4	White bread	93.0	85.7 - 96.9
Knowledge of foods for consumption strictly prohibited for diabetics			Consumption at least once a day of a dairy product (milk, cheese, yoghurts, cream, custard ...)			Whole meal bread (oats, barley, rye, wheat)	6.9	3.0 - 14.2
Yes		25.6 - 44.8	Yes		33.8 - 53.7	Frequency of ice cream /pastries consumption		2.4 - 12.9
No	34.6	17.7 - 35.5	No	43.5	46.2 - 66.1	Nothing	5.9	
Knowledge of the concept of " food equivalents "			Frequency of eating pasta			Rarely	11.8	6.5 - 20.2
Yes	1.9	0.3 - 7.6	Nothing	00	0 - 4.5	Once a week	18.8	11.9 - 28.0
No	98.0	92.3 - 99.6	Rarely	12.8	7.3 - 21.3	2 times / week	24.7	16.9 - 34.5
Consumption of Starches + Vegetables (high in fiber), at each meal			Once a week	19.8	12.7 - 29.1	≥3 times / week	38.6	29.2 - 48.8
Yes		43.3 - 63.3	2 times / week	15.8	9.6 - 24.7	Preferred cooking method for food		
No	69.3	36.6 - 56.6	≥3 times / week	51.4	41.3 - 61.4	Steamed	2.9	0.7 - 9.0
Consumption of soft drink			Frequency of consumption of meat awnd derivatives			With butter	7.9	3.7 - 15.4
Yes		24.7 - 43.8	Nothing	00	0 - 4.5	With margarine w	3.9	1.2 - 10.4
No	66.3	56.1 - 75.2	Rarely	27.7	19.5 - 37.6	With vegetable oil	74.2	64.4 - 82.2
Frequency of fish consumption			Once a week	60.3	50.1 - 69.8	With olive oil	10.8	5.8 - 19.0
Nothing	1.9	0.3 - 7.6	2 times / week	6.9	3.0 - 14.2	Practice of physical activities		
Rarely	63.3	53.1 - 72.5	≥3 times / week	4.9	1.8 - 11.7	Yes	29.7	21.2 - 39.7
Once a week	17.8	11.1 - 26.9	Most eaten type of meat			No	70.2	60.2 - 78.7
			Red meat	21.7	14.4 - 31.3	Type of sport Practiced		
			White meat	78.2	68.6 - 85.5			
			Fruit consumption					

2 times / week	8.9	4.4 - 16.6	Nothing	00	0 - 4.5	Walking	29.7	21.2 - 39.7
≥3 times / week	7.9	3.7 - 15.4	Rarely	51.4	41.3 - 61.4	Swimming pool	00	0 - 4.5
Frequency of consumption of stimulants			Once a week	21.7	14.4 - 31.3	Bike	00	0 - 4.5
Nothing	00	0 - 4.5	2 times / week	15.8	9.6 - 24.7	Race	00	0 - 4.5
Rarely	00	0 - 4.5	≥3 times / week	10.8	5.8 - 19.0			
Once a day	20.7	13.6 - 30.2	Favorite taste					
2 times / day	66.3	56.1 - 75.2	salty taste	5.9	2.438 - 12.993			
≥ 3 times / day	12.8	7.3 - 21.3	sweet taste	90.0	82.133 - 94.889			
			fatty taste	2.9	0.77 - 9.065			
			salty-fatty taste	00	0 - 4.566			

fish on the lipid profile of type 2 diabetics, it was mentioned that the decrease of TG and the improvement of the lipid profile could be explained by the effect of polyunsaturated fatty acids, originating from fish, on the enzymes of the liver microsomes. The consumption of fishes seems to be more beneficial in elderly subjects (Franz et al., 2010; Abdelhamid et al., 2018). However, foods of animal origin are often relatively expensive, too costly for families with limited purchasing power in developing paid (Anonymous, 2019).

The majority of the patients preferred the sweet taste (90.09%) and cooking with vegetable oil (74.25%) against only (10.89%) patients who preferred cooking with olive oil (Table 3). Most of them were not interested in steaming (2.97%) (Table 3). On the other hand, 70.29% of patients do not practice physical activity (Table 3), in the same sense, many diabetics avoid or stop all sports activities for fear of hypoglycemia. However, physical activity has well established beneficial effects (Casillas et al., 2009; Duclos and Gautier, 2009). It has been shown that the majority of patients do not practice physical activity (70.29%), but the risk of cardiovascular accident decreases with the regularity of physical activity (Eriksson and Lindgarde 1991; American Diabetes Association, 2019). This result is relatively lower according to the study of Hallab et al. (2012), declares that the practice of physical activity was in 82.6% of participants. This low practice could be explained by socio-cultural factors: the majority, 87.12% of patients were relatively old women and not educated. To this, we can probably add the lack of knowledge of the beneficial effect of physical activity in the management of diabetes and obesity (Hallab et al., 2012). These results are consistent with ours where we found that physical activity represents 29.71% (Table 3) of diabetics in our study, this can be explained by the use of motorized means of transport, the time spent in front of a screen, sedentary lifestyle seems to be an important factor in the phenomenon of insulin resistance of muscle tissue since most of the patients in this study were type 2 diabetics (95.04%).

#### **Dietary habits associated with BMI status, abdominal circumference, and cardiovascular treatment of patients at the time of the study**

In the multivariate analysis, snacking between meals of diabetic patients increases significantly in all diabetics who were obese/overweight ( $p < 0.001$ ), also had abdominal obesity ( $p < 0.001$ ) and under cardiovascular treatment is 100% ( $p < 0.05$ ) (Table 4). This type of population are at greater risk of developing degenerative complications. Indeed, patients who were not adapted with their diet were more likely to be overweight / obese or 92.53% of patients ( $p < 0.001$ ), 76.11% had abdominal obesity or ( $p < 0.001$ ) and under cardiovascular treatment or 97.01% ( $p < 0.001$ ) (Table 4). The patients consuming the pasta were all overweight / obese i.e. 100% patients ( $p < 0.001$ ) had abdominal obesity i.e. 98.07% ( $p < 0.001$ ) and under treatment with cardiovascular target i.e. 100.0% ( $p < 0.05$ ) (Table 4). BMI, abdominal circumference were also high in all patients who consumed bread that is 92.20% ( $p < 0.001$ ), 96.10% patients ( $p < 0.001$ ), French fries (85.22%) ( $p < 0.001$ ), (79.54 patients) ( $p < 0.001$ ) more than three times in a week and those who preferred sweet taste 80.21% ( $p < 0.001$ ), 78, 02% ( $p < 0.001$ ) and cooking with vegetable oil 85.33% ( $p < 0.05$ ), 62.66% ( $p < 0.05$ ) similarly, they were all under a cardiovascular treatment which are respectively 97, 40% ( $p < 0.001$ ), 90.90% ( $p < 0.001$ ), 89.01% ( $p < 0.001$ ) except for cooking with vegetable oil 54.66% ( $p > 0.05$ ) (Table 4).

The patients who prefer cooking with olive oil that is 9.09% were in normal weight (Table 4). The mode of cooking with vegetable oil was not positively correlated with that of cardiovascular treatment ( $p = 0.9126$ ) (Table 4). The majority of patients were not interested in steaming (2.97%) (Table 4). It is imperative to note that this method of cooking allows to keep all the nutrients, vitamins, minerals, preserving the taste qualities and avoiding the formation of toxic compounds. It is the healthiest for the body, dietetic, it prevents weight gain it is recommended in all diets including the diet of diabetics (Eckel et al., 2014).

**Table 4: Dietary habits associated with BMI status, abdominal circumference, and cardiovascular treatment of patients at the time of the study.**

Dietary habits	Malnourished n=3	BMI		P-value (Overweight /Obese)	Abdominal perimeter	P-value (Abdominal obesity)	Cardiovascular therapy	P-value (Cardiovascular therapy)
		Normal Weight n=23	Overweight n=75		Abdominal obesity n= 74		Cardiovascular therapy n= 83	
Non-adaptation of diet based on self-checks.				0.000000000				
n= 67	4.4%	2.9%	92.5%	196	76.1%	0.001134	97.0%	0.0000002484
Eating pasta ≥3 times / week	0.0%	0.0%	100.0%	54	98.0%	0.001134	100.0%	0.02116
n=52								
Snacks between meals				0.000000001				
n= 54	0.0%	0.0%	100.0%	83	100.0%	0.0000773	100.0%	0.006068
Frequency of French fries ≥3 times / week	3.4%	11.3%	85.2%	01029	79.5%	0.000000000 00001689	90.9%	0.00000000000000022
n=88								
Frequency of bread consumption (¼ of a baguette) / day				0.000000000		0.000000000		0.0000000000001921
≥ 3 times / day	0,0%	7.79%	92.20%	000837	96.1%	3139	97.4%	
n=77								
Favorite taste				0.000000006		0.000000000		0.00000000000000022
sweet taste	3.2%	14.2%	82.4%	709	78.0%	000002683	89.0%	
n= 91								
Preferred cooking method for food								
With vegetable oil	4.0%	14.6%	81.3%	0.003329	62.6%	0.02007	54.6%	0.9126
n=75								
With olive oil	9.0%	81.8%	9.0%	0.000001059	0.0%	0.000000000 00000022	0.0%	0.00000000000000022
n=11								

\*Correlation significant at p<0.05, \*\* Correlation is significant at p<0.01: \*p<0.05, \*\*p<0.01,\*\*\*p<0.001

Similar results were also reported in the study by Diallo et al. (2013) on diabetic eating habits in Guinea. However, many researches have concluded that diabetic patients can consume sugars without affecting their metabolic control, most diabetic subjects think that if a diabetic is taking medication, he/she does not need to pay attention to his/her diet so an unhealthy

consumption causes the increase in the incidence of T2DM (Hallab et al., 2012). Unfortunately, the assessment of dietary habits reveals that more than half of the patients do not respect their diets, the imbalance is observed almost at the level of all foods by abusing the consumption of pasta, French fries and white bread therefore could nuance the effect on the risk of obesity

from which most of our diabetic patients suffer. What shows from these results that the patients of our study are undisciplined when it comes to the evaluation of the nutritional profile, from which we conclude the poor compliance with the dietary behavior normally imposed in this category of patients whose cardiovascular risk is very high and can lead to an increase in mortality risk.

### Conclusion

This study highlighted the imperative need for a strict and controlled diet to maintain a good nutritional status in a patient with diabetes mellitus. The overall intention was to propose nutritional education programs and hygienic-dietary measures specifically designed for diabetics to modify their behavior, habits, and ensure a life free of diabetes complications.

### Authors' Contribution

All authors contributed equally to this study.

The authors declared that there is no conflict of interest.

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### REFERENCES

- Abdelhamid AS, TJ Brown, JS Brainard, P Biswas, GC Thorpe, HJ Moore, KH Deane, FK Al Abdulghafoor, CD Summerbell, HV Worthington, F Song and L Hooper, 2018. Omega-3 fatty acids for the primary and secondary prevention of cardiovascular disease. *The Cochrane database of Systematic Reviews*, 11:3177.
- American Diabetes Association, 2019. Lifestyle Management: Standards of Medical Care in Diabetes. *Diabetes Care*, 42:46–60.
- Azzoug S, N Dridi and D Meskine, 2020. Bread consumption and cardio-metabolic risk. *Annals of Endocrinology*, 81: 457.
- Beck AM, UN Balknas, P Fürst, K Hasunen, L Jones, U Keller, JC Melchior, BE Mikkelsen, P Schauder, L Sivonen, O Zinck, H Øien and L Ovesen, 2001. Food and nutritional care in hospital: how to prevent under nutrition – report and guidelines from the Council of Europe. *Clinical Nutrition*, 20: 455–460.
- Benabadjji N, Z Benzian, MEA Amani, I Benyamina Douma, M Betil, F Salah, FA Soufir, R Tafoukt and L Zemmour, 2014. Dislipidemia and lipid targets under stains in Type 2 diabetic patients. *Annals of Endocrinology*, 75: 452.
- Casillas JM, C Denis, JL Philip, Y Laurent and V Gremeaux, 2009. Activité physique, atherome et atherothrombose. *Medecine des Maladies Metaboliques*, 3: 15–19.
- Core Team R, 2020. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria.
- Anonymous, 2019. IDF Diabetes. 9<sup>th</sup> Edition. International Diabetes Federation, Brussels, Belgium.
- Anonymous, 2018. Éducation thérapeutique du patient (ETP): Évaluation de l'efficacité et de l'efficience dans les maladies chroniques'. Haute Autorité De Santé, France ([www.has-sante.fr](http://www.has-sante.fr)).
- Diallo AM, M Mansour Diallo, A Camara, A Bah, A Sadio Bah, T Saidou Diallo and N Moussa Baldé. 2013. Habitudes alimentaires des diabétiques en Guinée. *Diabetes and Metabolism*, 39 :117-118.
- Dyson PA, D Twenefour, C Breen, A Duncan, E Elvin, L Goff, A Hill, P Kalsi, N Marsland, P McArdle, D Mellor, L Oliver and K Watson, 2018. Diabetes UK evidence-based nutrition guidelines for the prevention and management of diabetes. *Clinical Nutrition*, 35:541-547.
- Díaz-Rizzolo DA, A Serra, C Colungo, A Sala-Vila, A Siso-Almirall and R Gomis, 2021. Type 2 diabetes preventive effects with a 12-months sardine-enriched diet in elderly population with pre-diabetes: An interventional, randomized and controlled trial. *Clinical Nutrition*, 40: 2587-2598.
- Duclos M, JM Oppert, B Vergès, V Coliche, JF Gautier, CY Guezennec, G Reach and G Strauch, 2012. Activite physique et diabete de type 2. *Medecine des Maladies Metaboliques*, 3: 31-38.
- Eckel RH, JM Jakicic, JD Ard, JM Jesus, NH Miller, VS. Hubbard, IM Lee, AH Lichtenstein, CM Loria, BE Millen et al., 2014. AHA/ACC guideline on lifestyle management to reduce cardiovascular risk: a report of the American College of Cardiology/American Heart Association task force on practice guidelines. *Circulation*, 129:76-99.
- El Aassri H, G El Mghari and N El Ansari, 2014. Hypersensitivity type 2 diabetic patients: Do they prefer to treat diabetes or high blood pressure? *Pan African Medical Journal*, 17: 193.
- Eriksson KF and F Lindgarde, 1991. Prevention of type 2 (non-insulin dependent) diabetes mellitus by diet and physical exercise. The 6-Year Malmo feasibility study. *Diabetologia*, 34: 891–898.
- Evert AB, JL Boucher, M Cypress, SA Dunbar, MJ Franz, EJ Mayer-Davis, JJ Neumiller, R

- Nwankwo, C LVerdi, P Urbanski and WSJR Yancy, 2014. Nutrition therapy recommendations for the management of adults with diabetes. *Diabetes Care*, 37: 120 - 143.
- Franz MJ, MA Powers, C Leontos, LA Holzmeister, K Kulkarni, A Monk, N Wedel and E Gradwell, 2010. The evidence for medical nutrition therapy for type 1 and type 2 diabetes in adults. *Journal of American Dietetic Association*, 110: 1852-1889.
- Ghosh JR and AR Bandyopadhyay, 2012. Abdominal Circumference as a Screening Measure for Type 2 Diabetes. *Kathmandu University Medical Journal*, 10:12-15.
- Hallab A, A Chadli, D Nsame, S Elaziz, H El ghomari and A Farouqi, 2012. Croyances et pratiques alimentaires chez les diabétiques de type 2 obèses marocains. *Medecine des Maladies Metaboliques*, 6: 244-248.
- Jaffiol C, 2021. Diabetes in 2021: Progress and Paradoxes. News Letter March 2, 2021), The Academy of Moral and Political Sciences, France
- Jemel M, H Sayadi and I Khochtali, 2018. Cardio-metabolic risks in elderly diabetics. *Annals of Endocrinology*, 79: 488
- Sackett DL, RB Haynes, ES Gibson, DW Taylor, RS Roberts and AL Johnson, 1978. Patient compliance with antihypertensive regimens. *Patient Counseling and Health Education*. 1:18-21.
- Safi E, Y Htira and F Ben Mami, 2020. Metabolic profile of a Tunisian diabetic population under fenofibrate. *Annals of Endocrinology*, 81: 469.
- Santé Canada, 2015. Examen des données probantes à la base des recommandations alimentaires: rapport technique. Ottawa, Santé Canada.
- Sobngwi E and S Halimi, 2017. Le Diabète en Francophonie: disparités et similitudes. *Médecine des Maladies Métaboliques*, 11:101-102.
- Sidibé S, A Delamou, A Camara, A Touré, AT Samake, S Dindinda, S Diallo, AS Magassouba and FB Magassouba, 2017. Profil nutritionnel des patients diabétiques de type 2 au service de diabétologie de l'hôpital national Donka Conakry (Guinée). *Guinée Médicale*, 89: 5-10.