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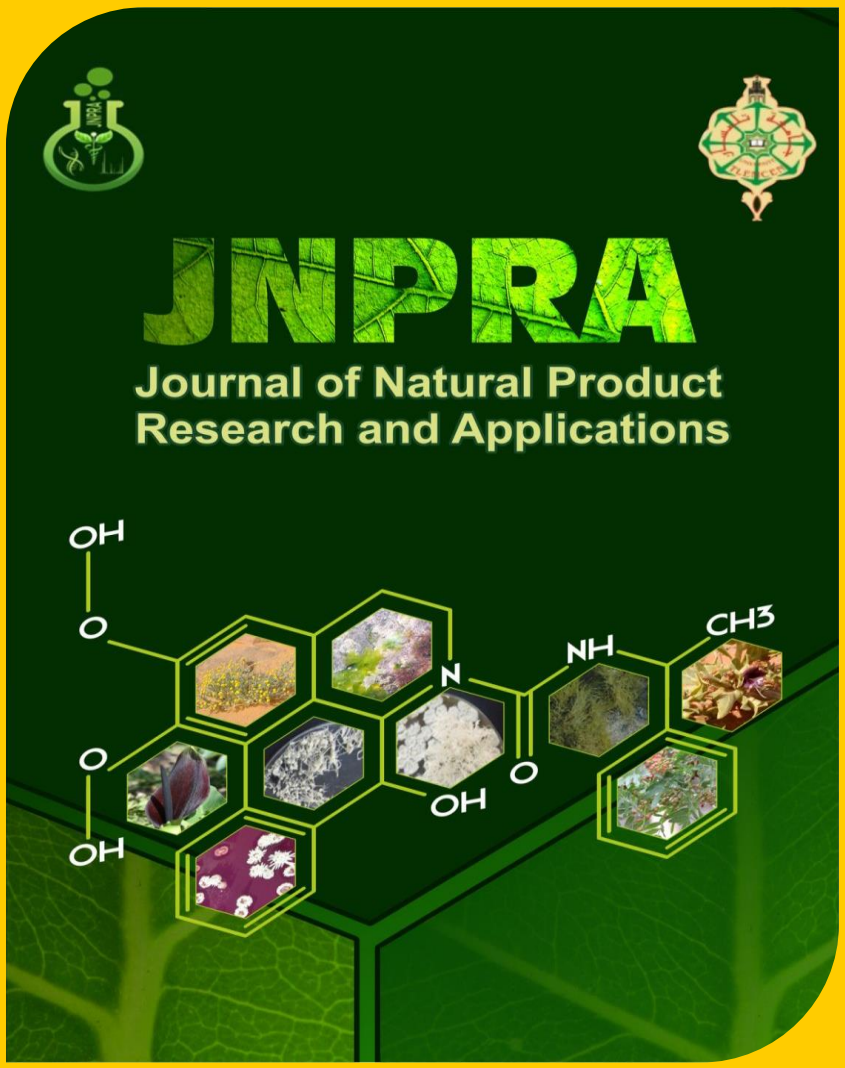

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Research Article

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Impact of nutrition coaching on glycemic balance in diabetic patients

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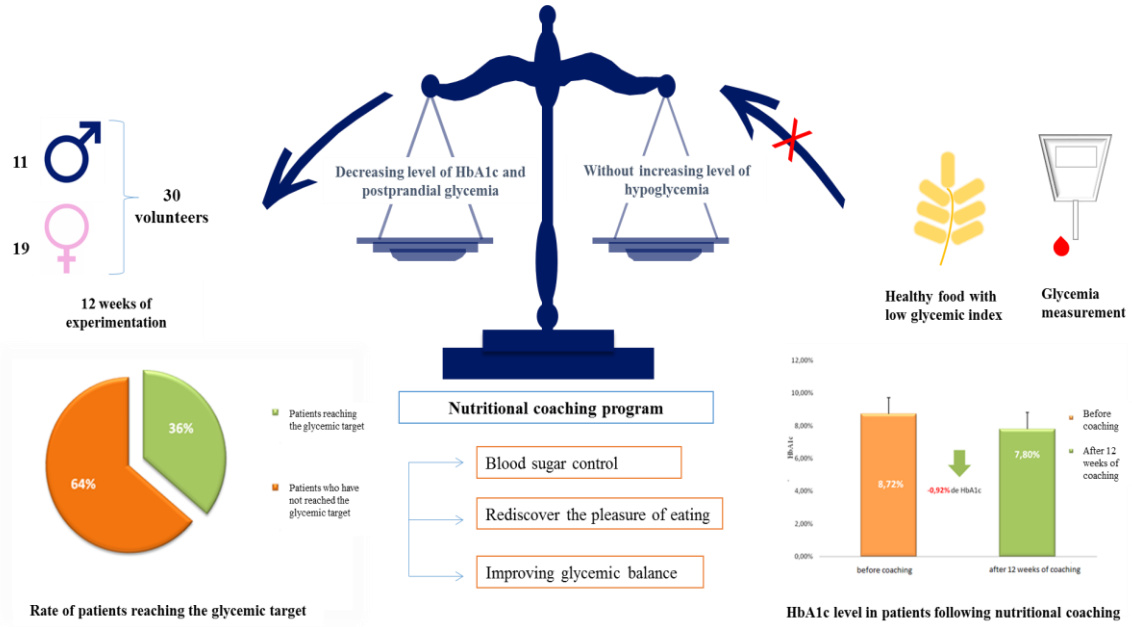
Highlights

-Nutrition coaching based on a low glycemic index (GI) diet ;
-The main advantage of the low GI diet is to reduce postprandial glycemia ;
-The nutritional coaching program improve a significant reduction of the HbA1c .

Graphical Abstract



Abstract
Regardless of the associated pharmacological treatment modality, hygienic-dietary measures, focusing on lifestyle modification (diet and physical activity), represent the basis of the management of type 1 and type 2 diabetes. In order to ensure that these dietary measures are effective and long lasting, their implementation and follow-up require guidance. This work focuses on nutrition coaching based on a low glycemic index (GI) diet proposed to type 2 diabetics with the aim of reducing postprandial glycemia in the direction of a better balance to help prevent micro and macro-vascular complications.
This method is easy to follow and does not require high restrictions, it allowed us to significantly lower glycated hemoglobin (HbA1c) by 0.92% after a 12-week follow-up ($P < 0.05$). However, the control diabetic patients who did not benefit from the coaching did not show any significant difference before and after the 12-week experiment.

Keywords: Diabetes; nutrition; nutrition coaching; HbA1c; glycemic index.

1. Introduction

Diabetes is a major public health problem. In recent decades, there has been a steady increase in the number of cases of diabetes and the prevalence of the disease.
Globally, 442 million adults suffer from diabetes, that is to say, one in 11 persons. Diabetes can cause multiple complications such as blindness, stroke, kidney failure, and even amputation (WHO, 2015).
Type 2 diabetes is linked to several factors including; population ageing, high-calorie diets, obesity, and lifestyle changes characterized mainly by sedentary lifestyle. There is an extreme heterogeneity in the prevalence of diabetes across countries (Malek, 2011).
In Algeria, diabetes poses a real public health problem due to its prevalence and the burden of its chronic complications essentially by cardiovascular complications, diabetic foot, chronic renal failure and retinopathy (Malek, 2011).
A study conducted by the Ministry of Health, in coordination with WHO, between (2016) and (2017) revealed that 14.4% of Algerians aged 18-69 years have diabetes. The prevalence rate of diabetes increased from 8% in 2003, to 10% in 2012 to reach 14% in 2017. The survey was conducted on a sample of 7450 participants. These findings indicate a strong increase in diabetes among Algerians, but this conclusion must be qualified. In 2017, one out of two diabetics was not known (or diagnosed); whereas in 2003, for each known diabetic, two were not.
Diabetes is increasing in Algeria. In 2018, high learned societies namely the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD), published a consensus recommendation on the management of hyperglycemia, where they emphasized the necessity of patient-centered care; where, patient becomes a direct actor of his support, with a modification of the lifestyle that is based on the change of dietary habits, quitting smoking, the fight against sedentary lifestyle and the implementation of an adapted physical activity. The effect of these measures must be assessed after 3 to 6 months before proposing drug therapy (Chami et al., 2015).
In the prevention and monitoring of diabetes, diet plays key role. Indeed, a good diet could largely help the diabetic patient to achieve better control of his glycemia (Ceriello and Colagiuri, 2008).
In this context, we have carried out this work on nutrition coaching to help diabetics to better

manage their daily life by proposing a low GI diet with a controlled daily glycemic load (GL) during 3 months, in order to see the impact of this diet on the decrease of HbA1c.

2. Materials and methods

2.1. Diabetes nutrition coaching

The basis of the support of type 1 and type 2 diabetes is hygienic-dietary measures, focusing on lifestyle modification (diet and physical activity). To ensure that these dietary measures are effective and long-lasting, their implementation and follow-up require assistance.
Nutrition coaching is a customized assistance to allow diabetic patients to smoothly change their diet. This assistance is based on a dietary reform (and not a diet).
For whom this diet is recommended? To all diabetic patients, male and/or female.

2.1.1. Why nutrition coaching?

- Because the daily life of a diabetic is not easy to manage
- Because answering the question "What should I eat is not easy?
- To combine food pleasure and diabetes
- Eating well can help you considerably to obtain better control of your glycemia

The aim of nutrition coaching is to help diabetics manage their blood sugar levels through food and to find the pleasure to eat while still improving their glycemic balance. This is the challenge that we propose to diabetics.

2.1.2. Establishing nutrition coaching

The implementation is done under the control of a specialist and does not replace the medication.

2.2. The principles of Nutrition Coaching method

2-2-1. Distribution of carbohydrates

The distribution of carbohydrates is set for each day, an amount of carbohydrates according to the calories you need to ingest, knowing that 50% to 55% of the calories we need come from carbohydrates **(**FAO FOOD, 1998).
We have ensured that we respect a good distribution of carbohydrates intake per meal.
Breakfast: 20%.
Lunch: 35
Dinner: 35%.
Our program is designed to achieve a controlled GL (glycemic load) each day. We have designed menus with a controlled daily GL which is 90. It is distributed according to the different meals in order to respect the carbohydrates distribution.

Table 1. Distribution of daily GL.

	GL Total	GL Breakfast	GL Lunch	GL Dinner
Distribution	90	20	35	35

A) Steps of the method

*** Step 1**

I discover my food structure according to Table 2.

Table 2. Example of a CG 90/day menu.

breakfast GL≈ 20		**lunch GL≈ 35**		**Diner GL ≈35**	
Coffee with milk or tea without sugar	0	Protein (meat, fish or eggs)	0	Protein (meat, fish or eggs)	0
3 Slices of bran bread (90g)	21	Vegetables (chosen) 250g	2	Vegetables (chosen) 250g	2
10g butter	0	Starchy foods (quantity see Table 5)	25	Starchy foods	25
1 Yogurt	1	Seasonal fruit (Table 6)	6	Seasonal fruit	6
		1 Yogurt	1	1 Yogurt	1

NB : If you would like to have a snack, you can have, ad libitum drinking (water, tea or coffee without sugar), almonds or hazelnuts 10/day.

* **Step 2**

I choose the appropriate amount of starchy foods. The amount of cooked starchy foods (lunch and dinner) has a GL of about 25 (GL≈25). Starchy foods include a wide variety such as cereals, pulses, and potatoes (Table 3).

Table 3. Recommended amount of starchy foods.

Starchy foods	**Amount**
Bulgur	230g= 9 tbsp
Wheat	210 g= 8,5 tbsp
Noodles	150g=6 tbsp
Rechta (traditional pasta)	200g=8 tbsp
Sweet potato	300 g =12 tbsp
Potatoes	140 g = 3 potatoes
Basmati or whole grain rice	130g=5 tbsp
Classic rice	120g=5 tbsp
Couscous semolina	170g=7 tbsp
Bran bread	60g = 2 slices

tbsp: table spoon.

NB : Pulses such as flageolet, green beans, white and red beans, lentils, split peas and chickpeas could be consumed because they have a very low GL.

* **Step 3**

I choose the amount of fruit according to Table 4. GL of about 6 (≈6)

Table 4. Quantities of fruit (GL≈6).

Fruits	Quantity (portion)
Apricots	2
Plums	3
Dried figs	1
Dried date	1
Banana	½
Pear	1
Pineapple slice (90 g)	1
Cherries	9
Strawberries	12
Lychee	100 g
Pomegranate	100g
Fresh Figs	100 g
Grapes	100 g
Clementines	3
Kiwi	1
Nectarine	1
Mandarin	1
Watermelon	90g
Medium Melon	½
Grapefruit	1
Peach	1
Apple	1

NB : you can add a little treat to your menu with the list below, twice a week.

* **Step 4 :**

I choose my small treats of a GL of about 15 (≈15) from the suggestions in (Table 5).

Table 5. Quantity of small treats (CG≈15).

Little pleasure	Quantity(portion)
grape, apple or orange juice	1 cup
Dates	3
Biscuits	3
Dried figs	3
Chocolate bread	½
Ice cream balls	3
One slice of cake	1
Dark chocolate squares	4
Milk chocolate squares	2

2.2 Study of Nutrition Coaching

2.3.1 Goal of the study

The main objective of this work is to study the impact of nutrition coaching on the glycemic balance of type 2 diabetic patients.

2.3.2. Description of the study

We conducted a monocentric study, which lasted 12 weeks. The number of patients was 30 (19 women and 11 men) with type 2 diabetes.

The patients followed a nutrition coaching over 12 weeks, we also recruited 10 patients with type 2 diabetes who did not follow the coaching (control). They were provided only with usual nutrition advice.

We assessed HbA1c before and after 3 months in both groups.

The study was conducted at the internal medicine department of EPH Ghazaouet (Tlemcen) during the period of January 2019 to June 2019.

2.3.3 Inclusion criteria

We included : Patients with type 2 diabetes (men+women) from at least 6 months of treatment, insufficiently controlled on oral antidiabetics (sulfonylureas, biguanides, glitazone, alpha glucosidase inhibitors) or oral antidiabetics + basal insulin therapy, interested in the program, age of patients > 34 years and who needed a guidance for their food habits.

2.3.4. Assessment criteria

- **Primary criteria**

To evaluate the change in HbA1c after 12 weeks of nutrition coaching.

- **Secondary criteria**

To see the number of patients who reached the glycemic aim of HbA1c defined by the treating doctor

2.3 Dosage of HbA1c

The analysis of HbA1c was performed in private laboratories using the HPLC technique.

3. Statistical analysis

Statistical analysis of the experimental results and the graphical representation were performed by the software: Microsoft Office Excel 2010. To study the significance, we used analysis of variance (ANOVA). The significance threshold considered was 5% ($P < 0.05$).

4. Results

4.1 Determination of HbA1c level in patients after nutritional coaching

As shown in Figure 1, patients who followed the nutritional coaching program after 12 weeks had an improved glycemic balance with a significant decrease in HbA1 of 0.92%.

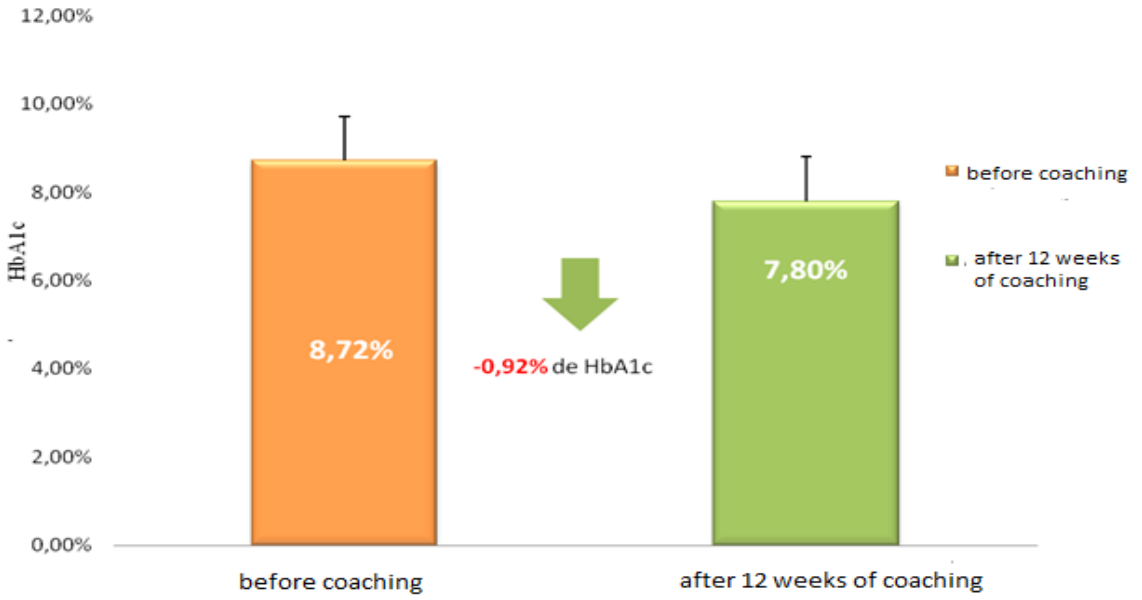


Figure 1. Results of nutritional coaching.

4.1.1. Determination of HbA1c level in control patients

Figure 2 represents the results of the control patients who did not receive nutritional coaching.

We found that after 12 weeks, the difference in HbA1c level was not significant, which confirms the impact of the nutritional coaching on the improvement of glycemic balance in diabetic patients.

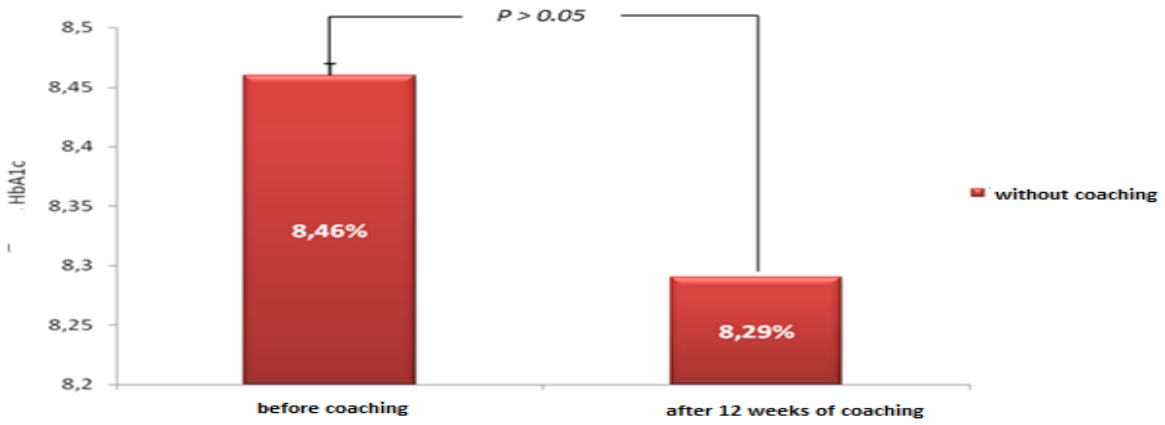


Figure 2. Results of controls.

4.2.2. Comparison of HbA1c level between experimental and control patients

Comparison between the two groups (experimental group with the coaching program and control group), clearly shows the impact and the role of nutrition coaching in the decrease of HbA1c, hence the improvement of glycemic balance in patients with diabetes receiving nutrition coaching during the 12 weeks of experimentation (Figure 3).

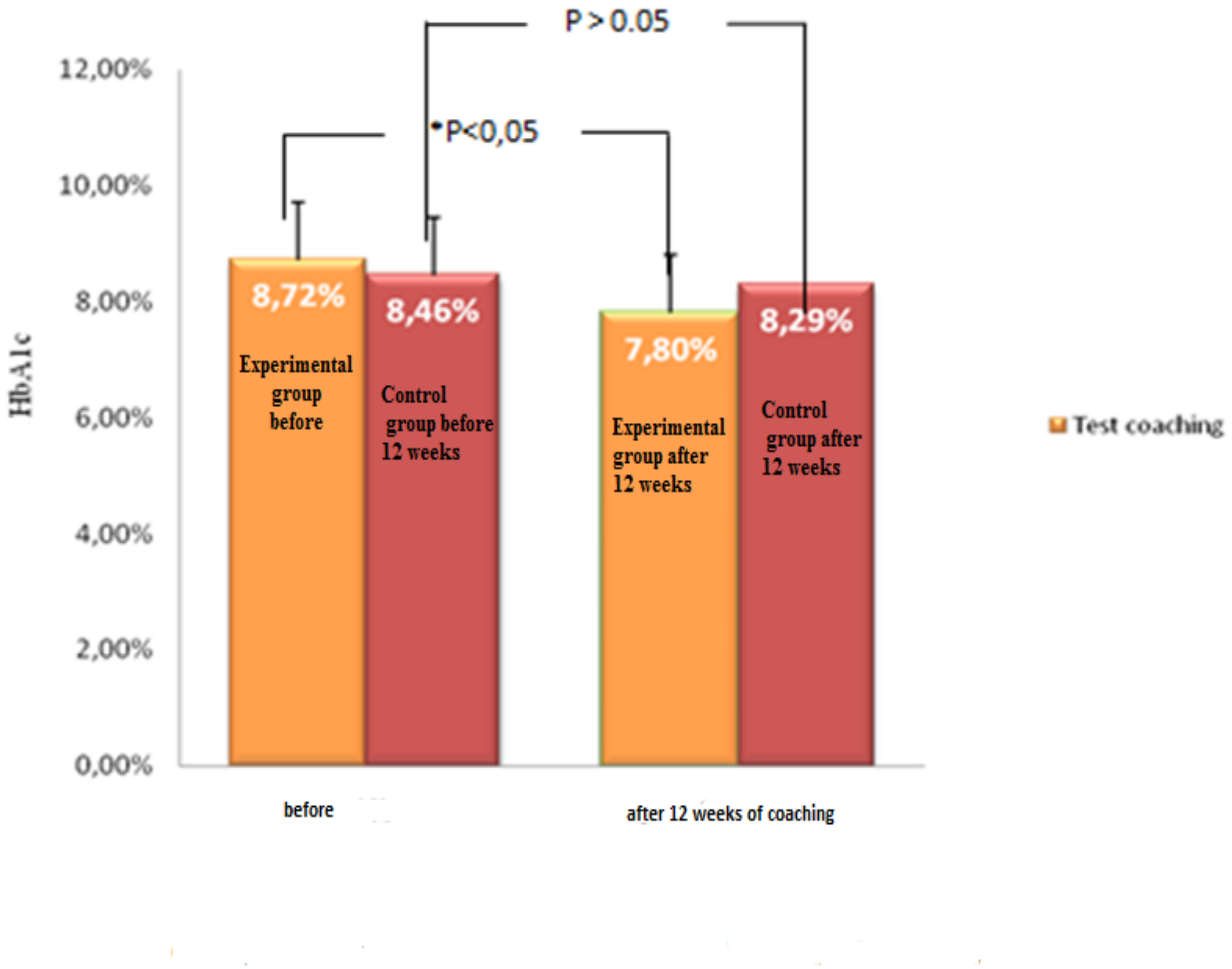


Figure 3. Comparison between the two groups of patients (control and experimental).

4.3. Discussion

Epidemiological studies show a positive association between GI and risk of type 2 diabetes (Barclay et al., 2008). Previous studies reported that GL is also correlated with the risk to develop type 2 diabetes (Livesey et al., 2013). The pathophysiological hypothesis suggested is that food with low GI lead to a decline in postprandial glycemia (Bao et al., 2011). Thus, beta-cells function would be preserved, resulting in a decrease in the development of type 2 diabetes (Solomon et al., 2010). On the other hand, it has been shown, that a low GI diet, decreases insulin secretion and reduces the development of insulin resistance in normoglucotolerant or glucose intolerant patients (Liu et al., 2012). In this study, authors deduced that beta-pancreatic function is preserved by low GI diet. Moreover, in 2013, the study of Van Der Sluijs et al. did not find an increase in the risk to develop type 2 diabetes over a 12-year follow-up of more than 16,000 people taking nutrition coaching.

In diabetic patients, a low GI diet reduces HbA1c levels compared to a high GI diet. A first meta-analysis of 14 studies (356 subjects) reported a rate of 0.43% decrease in HbA1c during the following of low GI diet for 12 days to 12 weeks (Brand-Miller et al., 2003). A second meta- analysis, including studies on type 1 and type 2 diabetics, on 402 patients, reported a reduction of 0.5% on average by low GI diets and a decrease in hypoglycemic episodes (Thomas et al., 2016).

However, the various studies involved small numbers of subjects and, in the case of the impact of GI on the occurrence of type 2 diabetes, the data were from observational studies.

In 2015, the American Diabetes Association proposed raising awareness of the GI in the diabetic population (ADA, 2015). It was also emphasized by many studies that low GI diet decreases cardiovascular risk, with a positive impact on blood sugar, blood pressure, cholesterol and triglycerides (Thomas et al., 2016), and a decrease in the risk of certain cancers (Siérie, 2007) and inflammation-related diseases (Liu, 2002).

4.4. Correlation between HbA1c and chronic diabetes complications

HbA1c is a fundamental criterion of glycemic control. It is essential to assess the risk of complications.

Decreasing blood glucose levels in diabetic patients reduces macrovascular and especially microvascular complications. HbA1c is an easy parameter to obtain estimation of the average blood glucose level over the last two months. HbA1c allows doctors and patients to assess glycemic control and set treatment aims (in conjunction with self-monitoring of blood sugar).

Two randomized studies have clearly shown the link between an increase in HbA1c (reflect average blood glucose) and an exponential increase in the risk of complications mainly microvascular complications: The study DCCT (the Diabetes Control and Complications Trial) on type 1 diabetes and the study UKPDS (the United Kingdom Prospective Diabetes Study) on type 2 diabetes. Generally, for every 1% increase in HbA1c, there is a 30% relative increase in microvascular complications.

In the UKPDS study, a decrease of about 1% in HbA1c resulted in a 30% reduction in microvascular complications over a 10-year follow-up (retinopathy and albuminuria). Since this refers to a relative reduction applied to an exponential risk, it is important to realize that for an identical decreasing of HbA1c, the absolute benefit will be greater (Philipov and Phillips, 2005).

5. Conclusion

The main advantage of the low GI diet for diabetic patients is to reduce postprandial glycemia, which leads to a better balance, enhanced by fibers contained in low GI carbohydrates (fruits,

vegetables, legumes, etc.), which reduce the absorption of carbohydrates, thus decreasing blood sugar levels.

The nutrition coaching program, tested on patients with type 2 diabetes, for a period of 12 weeks, allowed us to improve the glycemic balance of diabetic patients by a significant reduction of the HbA1c (-0.91%), in particular the improvement of their nutrition habits, which reflects the positive impact of nutrition coaching on glycemic balance and thus a contribution to the prevention of micro and macro-vascular complications.

Medical stuff and diabetic patients have every interest in according importance to the concept of low GI to better get prepared against this epidemic that is constantly increasing, namely diabetes and obesity with their cardiovascular and metabolic consequences.

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