

## Viability and effectiveness of a multidisciplinary weight-loss program in primary care clinics.

Andreu Altés Boronat<sup>1</sup>, Eva Calvo Rosa<sup>1</sup>, Salvador Sitjar Martínez-De Sas<sup>3</sup>, Germán Guzmán<sup>2</sup>, Ignacio Sajoux<sup>2</sup>

<sup>1</sup>Centre d'Atenció Primària de Sants. <sup>2</sup>Medical Department. Pronokal Barcelona. <sup>3</sup>Centre d'Atenció Primària Les Corts.

E-mail: German.G@pronokal.com

Received (first version): February 21, 2020

Accepted: March 3, 2020

Published online: October 2020

### Summary:

**Introduction.** Given the difficulties involved in the effective treatment of obesity in the primary health care setting, it is important to evaluate therapeutic alternatives, including those that are not funded.

**Objectives:** The main objective of the study was to evaluate the effectiveness of the treatment and a functional obesity unit in actual clinical practice in primary care. Likewise, the main metabolic parameters related to associated comorbidities (type 2 diabetes, hypertension and dyslipidemia) and the needs for pharmacological treatment were assessed.

**Methods:** Obese patients who chose to be treated with a marketplace method were included, after receiving information about all the therapeutic possibilities (dietary advice, drugs, surgery). The method consisted of a multidisciplinary program that combines an initially ketogenic diet, physical exercise and emotional support.

**Results:** 87.5% (84/96) of the patients accepted the proposed program, out of which 69% completed the period of ketogenic diet (step 3) and 38.1% reached the maintenance stage (Step 6). The average weight loss at the end of step 3 was 21.40 (7.61) kg and 24.13 (8.13) kg upon reaching step 6 (both  $p < 0.0001$  vs. initial weight). There was a significant improvement in blood pressure, triglycerides, GOT, GPT and GGT figures and the prescription of anti-hypertensive drugs was reduced in 15/18 patients and that corresponding to statins in 4/13 patients. The treatment was safe and well tolerated.

**Conclusions:** The implementation of the multidisciplinary program to lose weight has shown to be a viable alternative in the Primary Care consultation for the treatment of patients with obesity, showing efficacy in real conditions despite the fact that this therapeutic option is not funded by the public health system

### Keywords:

- Obesity
- Primary Care
- Ketogenic diet
- PnK® Method

### Introduction

Obesity is one of the biggest health problems worldwide [1].

Characterized by an increase in the proportion of body fat, it is generally defined from the body mass index (BMI), which ranges describe overweight between 25 and 29.9 kg / m<sup>2</sup> and obesity from 30 kg / m<sup>2</sup>. However, there is also another definition according to which the obese subject is someone who presents a percentage of body fat above the normal values, that is, above 20% in men and 30% in adult women [2].

Its tendency to increase throughout the world and its relationship with the increase in morbidity and mortality [3] have made obesity a priority objective for public health. In Spain, the most recent studies show the same trend with a significant increase in the prevalence of overweight and obesity in the last 25 years [4].

Excess body fat, especially intra-abdominal or visceral fat, is the origin of many inflammatory disorders and processes (lipo-inflammation) that contribute to the development of comorbidities, such as insulin resistance, diabetes or hypertension (5). Therefore, the treatment of obesity requires a multidisciplinary approach and the

adoption of customized strategies to achieve progressive weight loss, focusing on losing body and visceral fat, which can be kept in the long term. Health promotion and education to fight obesity, also promoted by institutions and Health Counseling Agencies [6-9], contribute to promoting self-care and preventing the development of diseases associated with excess weight. However, despite the multiple dietary options and the efforts at the institutional and professional level to improve habits and treat and prevent overweight and obesity, the results are not encouraging, as it seems that the problem is rising.

In the Primary Care consultation, the approach to obesity begins with the diagnosis of the disease, the assessment of comorbidities and cardiovascular risk, the anamnesis on lifestyle and eating habits, the prescription of treatment combining all available resources (diet, increased physical activity, psychological support, pharmacological treatment if necessary, nutritional education) and short and long-term follow-up [10,11].

However, there is low encouragement to treatment, probably due to a lack of awareness and motivation that makes it difficult to change the patients' diet and lifestyle [12].



Furthermore, regardless of the efficacy and adherence levels of the different types of diets, around 95% of the treated subjects regain the weight lost in a few years and even 2 out of 3 regain more weight than was initially lost [13]. This therapeutic failure is a complex and multifactorial phenomenon, in which dissatisfaction and diverse motivations are mixed, not always associated with health. In fact, many patients report repetitive and unsuccessful attempts at weight control with different diets, which succession of failures with cyclical weight gains and losses are detrimental both medically and psychologically [13].

In general, the guidelines for the management of obesity present diets with a moderate calorie restriction (500-1,000 Kcal / day with regard to the usual diet), keeping a minimum contribution of 1,000-1,200 Kcal / day in women and 1,200-1,600 Kcal / day in men, to achieve a weight loss of 0.5-1 kg / week, in addition to the increase in physical activity and changes in habits that should be kept for life [9, 14]. However, when these recommendations do not achieve results, there are few treatment options to offer the patient, aside from pharmacological treatments or bariatric surgery, that are only indicated in certain situations.

Given the difficulties of the therapeutic options for the obese patient who does not respond to the usual hygienic-dietary treatment, and considering the acceptance by the users of the Primary Care Center (CAP) of a treatment to quit smoking despite not being funded, it was proposed to create a pilot functional obesity unit similar to the tobacco addiction unit and where to offer patients an alternative weight loss treatment. Within this context, the main objective of the study was to evaluate the effectiveness of the treatment and of the obesity functional unit in the actual clinical practice in primary care. As secondary objectives, the evolution of metabolic parameters related to associated comorbidities (type 2 diabetes, hypertension and dyslipidemia) and the needs for drug treatment were recorded.

## Material and methods

A retrospective observational study based on the registry of data from primary care patients with obesity, who underwent treatment between February 2013 and September 2016 with a standardized multidisciplinary weight loss program, not funded by the National Health System. The data corresponding to the first 4 years of the start-up of this initiative in the Primary Care unit of CAP Sants in Barcelona (Providing Unit 8471) are included. This study has been evaluated and approved by the committee of the Barcelona Health Region.

## Methods and patients

The data were recorded from the patients' medical records. The patients, who came to the consultation directly or were referred by another doctor from the center, were recruited by the prescribing doctor, who was previously trained and had extensive experience in applying the weight loss program methodology. Before the start of this initiative, informative meetings were organized in the center, with the assistance of doctors and nurses and with the support of the reference endocrinologist, to explain the proposal (treatment

program, duration, type of patient, cost) and establish a referral circle from the different consultations of the center to the doctor's office who would guide and monitor the multidisciplinary treatment.

The inclusion criteria of the patients were: subjects of both sexes with obesity (BMI  $\geq 30$  kg / m<sup>2</sup>) or with overweight (BMI: 25-29.9 kg / m<sup>2</sup>) associated with comorbidities, who voluntarily agreed to perform the treatment. The different therapeutic options were explained to all patients: if they wanted dietary advice, they were referred to the nursing consultation, if they wished to undergo bariatric surgery, they were referred to the endocrinology consultation for evaluation and, in case of choosing the unfunded multidisciplinary treatment, they had to sign an informed consent. The treatment exclusion criteria were all those health conditions that contraindicated or discouraged follow-up of a ketogenic diet: pregnancy or lactation, eating disorders, alcoholism, drug addiction, severe psychological disturbance (schizophrenia, bipolarity, major depression), hepatic insufficiency, kidney failure, type 1 diabetes, treatment with thiazides, furosemide, acenocoumarol or oral corticosteroids, adrenal disorders, cancer (until the cancer discharge), acute cardiovascular or cerebrovascular diseases (heart rhythm disorders, acute myocardial infarction in the last 6 months, unstable angina, decompensated heart failure, vascular accident in the last 6 months), gout, kidney stones, cholelithiasis, hematitis, diverticulitis, depression, insulin-dependent type 2 diabetes, electrolyte disorders, orthostatic hypotension and acenocoumarol.

## Intervention

The treatment consisted of a weight loss program (PnK® method) [15] that combines diet, physical exercise, and emotional support (Figure 1). It is a standardized multidisciplinary treatment, the efficacy and safety of which have been shown in various clinical trials, the results of which show significantly higher average weight loss than conventional low-calorie diets in the short, medium and long term (approx. 14-15 kg in 2 months, -20 kg at 4-6 months and -12.5 kg at 24 months) [16-18], mainly at the expense of fat tissue [19].

80% of weight to lose			20% of weight to lose		Maintenance
Multidisciplinary team (dietary advice / physical activity / emotional support)					
Weight loss moment					"My new lifestyle" moment
Step 1	Step 2	Step 3	Step 4	Step 5	
Low-fat ketogenic diet (very low-calorie-ketogenic diet) 600-730 kcal / day			Low calorie diet (800-1500 kcal / day)		Controlled diet Adapted
<b>INTERVENTION</b> Supplementation Vitamins, trace elements OMEGA BALANCE: 700 DHA / 500 EPA			<b>KEY OF SUCCESS</b> Supplementation Vitamins, trace elements DHA VITA: 500 DHA / 100 EPA		DHA VITA: 500 DHA/100 EPA

Figure 1. Structure of PnK® Method, standardized method of weight loss

The treatment was planned and controlled by the prescribing physician. The dietary guideline, according to the program, consisted of a ketogenic diet low in fat and very low in calories (600-750 kcal / day) based on the intake of protein products of high biological value and natural foods, followed by a low-calorie non-ketogenic diet

and finally, a controlled diet to keep the lost weight. The ketogenic diet was divided into 3 steps and provided: <50 g per day of carbohydrates (mostly in the form of vegetables), between 0.8 and 1.2 g of protein per day for each Kg of ideal body weight to ensure the minimum requirements of the body and prevent loss of lean mass, a small amount of lipids (only 10 g of olive oil per day) and a minimum of 500 mg / day of docosahexaenoic acid (DHA) [16,17]. Each protein preparation contained: 15 g of high biological value protein formulated together with 50 g of DHA, 4 g of carbohydrates and 3 g of fat, providing a total of 90-100 kcal. In step 1, patients took the protein preparations five times a day accompanied by low-glycemic vegetables. In step 2, one of the protein formula feedings is replaced by a natural protein (e.g. meat and fish) either at lunch or dinner. In step 3, a second protein preparation is replaced by a second natural protein intake. Throughout these ketogenic steps, trace elements, vitamins, and minerals (K, Na, Mg, Ca), as well as omega-3 fatty acids (DHA and EPA) are given according to international recommendations [20 ,twenty-one]. In this program, the ketogenic diet is kept until the patient loses most of the weight loss goal (ideally 80%) [22], so its duration may vary depending on the individual and weight loss. From this point on, patients switch to a low-calorie diet with the incorporation of different food groups progressively, in order to improve the physiological adaptation to dietary changes and facilitate long-term weight maintenance. Once the target weight is reached, a maintenance stage begins in which it is recommended to follow a controlled diet, adapted to the expenditure and activity of each individual, with the aim of not regaining weight.

The program is completed with physical activity scheduled by the doctor through resistance and cardiovascular exercise tables, progressive in intensity and duration, and psychological support offered by the doctor himself and an external group of dietitians, both trained in coaching tools. Throughout the treatment, the doctor made periodic control visits every 15 days, while the patients were on a ketogenic diet, and later he made visits every 30-45 days. In addition to the physical examination with control of weight and systolic (SBP) and diastolic (DBP) blood pressure periodically, and coinciding with the completion of the program steps, an analytical control was performed. During controls, possible adverse effects reported by patients in relation to diet were also recorded.

### Statistical analysis

A descriptive analysis of the data recorded from the medical records has been performed; they are presented as average and standard deviations (SD) for quantitative variables and as frequencies (n) and percentages (%) for categorical or ordinal variables. . In regard to the analysis of the objectives, the evolution of the weight variables, blood pressure and metabolic parameters (glycemia, HbA1c, total cholesterol, LDL cholesterol, HDL cholesterol, triglycerides, GOT, GPT and GGT) has been studied, using the Student t test for paired data. In regard to the categorical variables of pharmacological treatment, the Chi square test has been applied. The tolerability study has included the description of the side effects reported by the patients in the control visits. The data have been analyzed

with the statistical program SAS version 9.1.3 Service Pack 4 (SAS Institute). The level of statistical significance has been established at  $p < 0.05$ . in all tests.

### Results

In the 3.5 years of the study , 96 subjects were identified to whom the treatment with the multidisciplinary program to lose weight was proposed , out of whom 12 (12.5%) rejected it and 84 (87.5%) accepted and started treatment. 69.0% (58/84) completed the first three steps of the ketogenic diet and 38.1% (32/84) reached the maintenance phase (Figure 2). The average (SD) age of the patients was 47.07 (8.60) years, the majority (73.8%) being women. 19.0% were type 2 diabetic, 38.1% were hypertensive, and 38.1% had dyslipidemia, although not all of them were on drug treatment. The average BMI at the beginning of treatment was 35.89 (4.64) kg / m<sup>2</sup> (Table 1). The average duration of the treatment was 3.6 (1.4) months with the ketogenic diet and 5.4 (1.9) months from the start to the maintenance period.

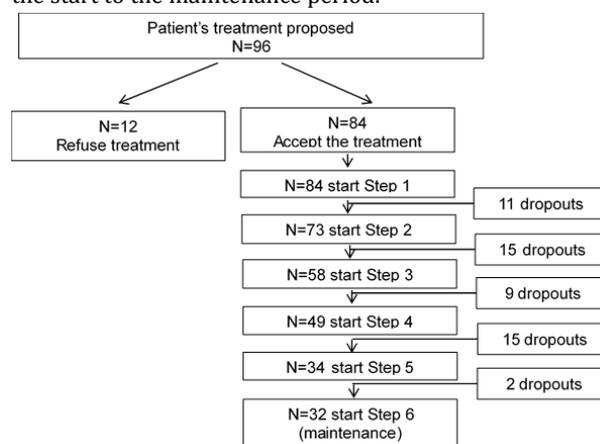


Figure 2. Patient Flow

	Total sample (n=84)	
	n	(%)
<b>Gender</b>		
Men	22	26,2%
Women	62	73,8%
<b>Age and anthropometric data</b>	<b>Average (SD)</b>	<b>[Max – Min]</b>
Age (years)	47,07 (8,60)	[24 – 62]
Weight (kg)	100,82 (17,41)	[71,5 – 147,7]
Height (cm)	167,00 (8,65)	[155,0–189,0]
BMI (kg/m <sup>2</sup> )	35,89 (4,64)	[22,6 – 44,8]
<b>Comorbidities</b>	<b>n</b>	<b>(%)</b>
Diabetes	16	19,0%
Arterial Hypertension	32	38,1%
Dyslipidemia	32	38,1%
Steatosis	18	21,4%
Other Comorbidities*	3	3,6%

Table 1. Sample characteristics. \* Other comorbidities: sleep apnea n = 2; Altered basal glycemia n = 1.

### Results on weight and BMI

Table 2 and Figures 3 and 4 show the results on weight, the main objective of the study. A progressive decrease in weight and BMI was recorded from the initial visit in patients who remained on treatment. Thus, from an average (SD) initial weight of 101 (17.5) kg, averages (SD) of 88.2 (14.1), 83.1 (12.8), 78.8 (11.8) were recorded. , 73.4 (9.25) and 72.7 (9.3) in steps 2, 3, 4, 5 and 6 respectively. Table 2 indicates the statistical significance of each step vs the initial weight ( $p < 0.0001$  in all cases).

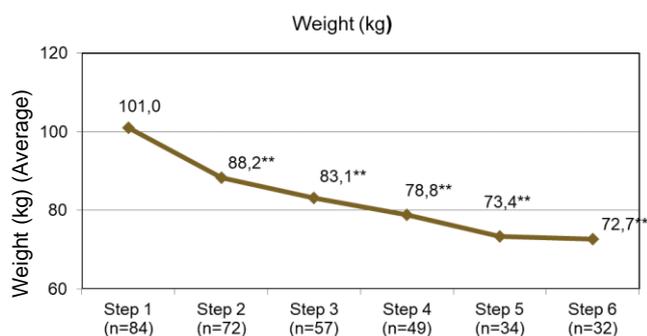


Figure 3. Weight evolution. \*\*  $p < 0.001$  in reference to Step 1

	n	Average (SD)*	p value vs step 1**	Median*	P25; P75*	Min; Max*
Step 1	84	101,0 (17,5)	-	99,8	84,6; 115,0	71,5; 147,7
Step 2	72	88,2 (14,1)	<0,0001	87,4	75,0; 98,0	65,5; 124,0
Step 3	57	83,1 (12,8)	<0,0001	82,0	72,0; 92,0	63,0; 112,0
Step 4	49	78,8 (11,8)	<0,0001	77,2	70,0; 85,2	62,0; 123,0
Step 5	34	73,4 (9,25)	<0,0001	71,5	66,5; 78,0	60,0; 94,0
Step 6	32	72,7 (9,3)	<0,0001	70,9	65,3; 78,4	58,0; 91,5

Table 2. Weight evolution. SD: standard desviation. \* Values in Kg. \*\* p value of difference of weight means through Student's T test for paired data.

The BMI also decreased significantly ( $p < 0.0001$ ), going from an initial average of 35.87 (4.61) kg / m<sup>2</sup> to an average of 29.49 (2.78) kg / m<sup>2</sup> at the end of the ketogenic diet (final step 3) and at 26.0 (1.85) kg / m<sup>2</sup> at the end of step 5 and beginning of the maintenance period (Figure 4).

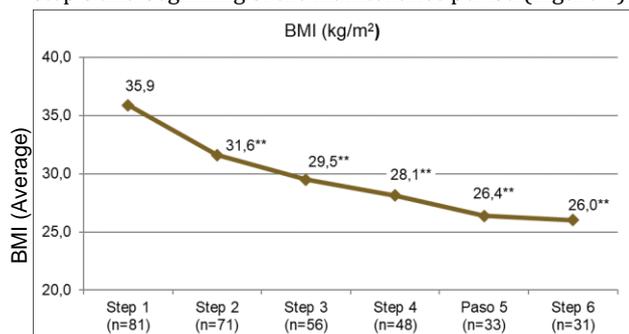


Figure 4. BMI evolution. \*\*  $p < 0,001$  in reference to Step 1.

Table 2 also shows the number of individuals from whom data are available in each step, which decreased progressively from 84 in step 1 to 32 in step 6. The reasons for discontinuation are shown in Table 3.

	PRE-START	STEP 1	STEP 2	STEP 3	STEP 4	STEP 5
	Average (SD)	Average (SD)	Average (SD)	Average (SD)	Average (SD)	Average (SD)
Fasting blood sugar (mg/dL)	104,58 (26,60)	82,93 (23,12)	82,87 (16,30)	82,47 (14,98)	88,35 (21,28)	85,00 (17,36)
HbA1c (%)	5,27 (2,10)	6,04 (0,92)	5,40 (1,08)	5,08 (1,24)*	6,00 (0,79)	6,3 (6,3; 6,3)
Total cholesterol (mg/dL)	205,53 (41,52)	190,34 (48,05)	174,82 (37,25)**	186,35 (41,33)	189,22 (46,27)	149,20 (31,12)
Triglycerides (mg/dL)	143,11 (84,78)	108,74 (44,31)	99,44 (34,41)*	94,92 (40,41)*	110,29 (84,45)	75,33 (16,77)
LDL (mg/dL)	48,00 (53,70)	125,10 (38,29)	109,60 (27,33)**	120,03 (33,03)	122,61 (45,12)	74,67 (21,77)
HDL (mg/dL)	49,68 (10,32)	42,85 (8,53)	43,97 (7,87)	45,99 (6,41)*	47,64 (6,57)**	43,77 (0,93)**
GOT (U/L)	33,33 (21,85)	38,33 (21,16)	25,71 (10,77)**	20,51 (6,68)**	20,79 (14,25)**	17,00 (1,41)*
GPT (U/L)	38,48 (33,06)	41,31 (30,81)	24,61 (12,61)**	19,71 (8,75)**	22,61 (14,25)**	16,40 (6,19)*
GGT (U/L)	41,62 (27,93)	30,49 (17,85)	20,32 (9,64)**	16,48 (6,36)**	21,95 (16,37)*	18,40 (8,29)

Table 3. Evolution of analytical parameters \*\*  $p < 0.001$ ; \*  $p < 0.05$ ; comparisons with respect to step 1. Student's T test for paired data.

### Blood pressure and metabolic parameters

Along with weight loss, the patients presented a significant decrease in blood pressure levels, both systolic (131.19 (9.86) mmHg vs. 111.25 (12.46) mmHg;  $p = 0.0010$ ) and diastolic (84.16 (8.71) mmHg vs 65.75 (11.54) mmHg;  $p < 0.0001$ ). Glycemia did not show changes but a significant decrease in HbA1c and triglyceride levels was observed in step 3, as well as a significant improvement in liver enzymes GOT, GPT and GGT (Table 4).

	n (%)
Refuse to start treatment	12 (18)
Intercurrent illness	6 (9,3)
Transgressions /non-compliances	5 (7,8)
Economic reasons	3 (4,6)
Treatment intolerances	1 (1,5)
Lack of monitoring	1 (1,5)
Not registered	36 (56,2)
Total	64 (100)

Table 4. Reasons for discontinuation of treatment.

### Modifications in pharmacological procedures during treatment

Out of the 5 patients under an oral anti-diabetic procedures at the time of starting the weight loss treatment, three patients withdrew (60%), one patient underwent a change in medication and the other remained on it. Out of the 18 patients under anti-hypertensive treatment before undergoing the weight loss program,

83.3% (n = 15) were able to discontinue the medication, and only 3 patients continued to require anti-hypertensive drugs. Regarding statin treatments, they were withdrawn in 4 cases (30.8%) , they were withdrawn and subsequently reintroduced in 5 cases (38.5%) , in 1 case (7.7%) they were reintroduced and were maintained in 3 cases (23.1%) .

### Tolerability safety

Treatment tolerability was good and only mild and transient adverse events were reported in 8/84 treated patients, consisting of constipation (n = 5), diarrhea (n = 2), and dizziness (n = 1). No serious adverse events were reported

### Discussion

The study results show that the program was accepted by 87.5% of the patients to whom it was proposed and the average weight loss in the patients who remained in the study at the end of step 3 was 21.4 kg and 24.1 kg at step 6, both statistically significant results. The weight loss appears remarkable and similar to that of other published studies using the same method. Thus, Moreno et al [16] recorded a weight loss of  $13.6 \pm 3.9$  kg after two months of treatment and of  $19.9 \pm 12.3$  kg after 12 months. Gómez Arbeláez et al [19] observed a loss of  $20.2 \pm 4.5$  kg after four months and De Luis et al [17]  $19.74 \pm 5.10$  kg. in a recent study, reported that an average weight loss of 12.5 kg persisted after two years [18].

Despite not having a cost-benefit analysis, the fact that almost 9 out of 10 patients agreed to start treatment, indicates that for certain obese patients, the intensive multidisciplinary treatment may be a feasible option despite the difficulty posed by the economic cost. In other settings, such as smoking, unfunded methods have been used and integrated into the primary care consultations.

The goals usually set in the initial treatment of obesity are to achieve a moderate weight reduction (generally a 10% loss) to reduce the incidence of type 2 diabetes, improve cardiovascular risk factors, and persist over time [11]. In this context, the average loss recorded, 24 kg in step 6, which seems much higher than the indicated objectives, and this is an important fact because a powerful weight loss is a real predictor of long-term maintenance. The available evidence on this issue seems powerful [23-26].

Another relevant aspect of this study is that the results come from actual data obtained from the daily clinical practice. While randomized clinical trials remain the gold standard for evaluating therapeutic methods, other designs can contribute to obtaining information on effectiveness in much larger and heterogeneous populations. Outside the rigid pattern of a clinical trial, different age groups, ethnicities, concomitants with other drugs, as well as other general patients' conditions not studied in clinical trials are included. Additionally, the therapeutic compliance of a clinical trial is not comparable to that of the daily consultation.

The main limitation of the study refers to the fact that it deals with a retrospective registry without a comparator group. Likewise, there's a lack of information on the history of treatments and previous failures to lose weight and reasons for rejecting or not choosing other treatment

proposals. However, the purpose of this pilot study was not to evaluate the population or the profile of patients with excess weight for whom this multidisciplinary treatment could be more appropriate, but rather the previous step, that is, to evaluate the effectiveness of the treatment and the Obesity functional unit. Another remarkable limitation is the number of patients who dropped out prematurely for reasons that are listed in Table 3.

67.8% of the patients reached step three, that is, the end of the point of ketosis and 38% reached step 6 in other words, the end of the maintenance stage. It should be considered that the available meta-analyses show that adherence to a dietary treatment is usually very poor [27] and that this is precisely a study of data in real clinical practice.

Almost 40% of the individuals completed the treatment reaching the maintenance phase, which supports the feasibility of the treatment in Primary Care. This initiative has been successful for a considerable number of obese subjects, who, in addition to establishing a diet and physical exercise, have been given emotional support, essential to keep motivation and acquire new lifestyle habits. There is no consensus on what the best diet for weight loss is. The main differences between diets are the distribution of calories between the various types of macro-nutrients, the ease of monitoring and the greater or lesser short-term weight loss [28]. Although classically the most widely used diets to lose weight had been low-fat diets, in recent years it has been shown that the increase in caloric intake in the diet is mainly due to the increase in the intake of carbohydrates (CH) and not fat [29]. For this reason, the use of diets that are based on reducing the amount of CH is increasingly popular.

Depending on the greater or lesser CH restriction, the diets can be classified into "low CH diets" and "ketogenic diets". In the latter, the contribution of CH is less than 50 g / day, which reduces insulin and glucagon levels and stimulates lipolysis and the formation of ketone bodies to obtain energy. This induced ketosis reduces adipose tissue and ketone bodies reduce hunger, which usually results in rapid weight loss, as shown in our study. In addition, this type of diet has a special incidence in the loss of abdominal fat, the most metabolically active and most related to the risk of development of comorbidities [19], resulting safe if always performed under medical supervision. The accumulated experience with the ketogenic diet of the studied method shows that it is safe, without serious adverse events but only some mild and transient side effects [16, 17].

### Conclusions

The implementation of the multidisciplinary program to lose weight has shown to be a feasible alternative in the Primary Care consultation for the treatment of patients with obesity, showing efficacy in actual conditions despite the fact that this therapeutic option is not funded by the public health system.

### Conflicts of interest

I. Sajoux and G. Guzmán are the Pronokal Group employees . They have contributed to this work in training Dr. A. Altés for the application of the methodology of the

multidisciplinary weight loss program, as well as the revision of the manuscript.

### Financing

The PronoKal Group has financed the statistical analysis of the data recorded in the study by the independent company Crossdata (a division of Punta Alta Comunicación, S.L.).

### Bibliografía

1. World Health Organization (WHO). 10 datos sobre la obesidad. Mayo 2017. Disponible en: <http://www.who.int/features/factfiles/obesity/es/>
2. Rubio MA, Salas-Salvadó J, Barbany M, Moreno B, Aranceta J, Bellido D et al. Consenso SEEDO 2007 para la evaluación del sobrepeso y la obesidad y el establecimiento de criterios de intervención terapéutica. *Rev Esp Obes* 2007; 7-48. DOI: 10.1016/S0025-7753(07)72531-9
3. Adams KF, Schatzkin A, Harris TB, Kipnis V, Mouw T, Ballard-Barbash R et al. Overweight, obesity, and mortality in a large prospective cohort of persons 50 to 71 years old. *N Engl J Med*. 2006; 355:763-78.4. DOI: 10.1056/NEJMoa055643.
4. Basterra-Gortari FJ, Bes-Rastrullo M, Ruiz-Canela M, Gea A, Martínez-González MÁ. Tendencia de la prevalencia de obesidad y diabetes en adultos españoles, 1987-2012. *Med Clin (Barc)*. 2017; 148(6):250-256. DOI: 10.1016/j.medcli.2016.11.022.
5. Izaola O, de Luis D, Sajoux I, Domingo JC, Vidal M. Inflamación y obesidad (lipoinflamación). *Nutr Hosp*. 2015; 31(6):2352-8. DOI: 10.3305/nh.2015.31.6.8829.
6. Consejería de Sanidad y Consumo. Comunidad de Madrid. Guía de Actuación en situaciones de sobrepeso y obesidad. Edición. 2009.
7. Conselleria de Sanitat. Generalitat Valenciana. Guía de Actuación clínica. Atención Primaria de la Comunitat Valenciana. Disponible en: <http://publicaciones.san.gva.es/publicaciones/documentos/V.4006-2002%20bis.pdf>
8. Consejería de Sanidad y Consumo. Junta de Extremadura. Prevención de la Obesidad y de la Diabetes Mellitus tipo 2. Documento de apoyo a las actividades de Educación para la Salud. Disponible en: <https://saludextremadura.ses.es/web/detalle-contenido-estructurado&content=7426>
9. Osakidetza. Gobierno de Euskadi. Manejo de la obesidad en atención primaria. *Boletín INFAC* 2008; 16(6):29-34.
10. R. Herrero Lozano, J.A. Ibáñez Estella. El sobrepeso y la obesidad en la consulta de Atención Primaria. *Semergen* 2004; 30(2):60-7.
11. M. Maté Del Tío, M.D. Cano, R. Álvarez-Sala Walther, J. Bilbao Garay. Manejo de la obesidad en Atención Primaria. *Medifam* 2001; 11: 4-10.
12. Escobar C, Divisón JA. Pérdida de peso y diabetes. *Semergen*. 2016; 42(1):52-3.
13. Buchanan K, Sheffield J, Tan WH. Predictors of diet failure: A multifactorial cognitive and behavioural model. *J Health Psychol*. 2017 Jan 1:1359105316689605.
14. J.J. Arrizabalaga, A. Calañas-Continente, J. Vidal, L. Masmiquel, M.J. Díaz-Fernández, P.P. García-Luna et al. *Guía de práctica clínica para el manejo del sobrepeso y la obesidad en personas adultas. Grupo de Trabajo sobre la Obesidad de la Sociedad Española de Endocrinología y Nutrición. Endocrinol Nutr* 2003; 50(Supl 4):1-38.
15. <http://www.metodopnk.com/esp/>
16. Moreno B, Bellido D, Sajoux I, Goday A, Saavedra D, Crujeiras AB et al. Comparison of a very low-calorie-ketogenic diet with a standard low-calorie diet in the treatment of obesity. *Endocrine*. 2014; 47(3):793-805. DOI: 10.1007/s12020-014-0192-3.
17. de Luis D, Domingo JC, Izaola O, Casanueva FF, Bellido D, Sajoux I. Effect of DHA supplementation in a very low-calorie ketogenic diet in the treatment of obesity: a randomized clinical trial. *Endocrine*. 2016;54(1):111-122. DOI: 10.1007/s12020-016-0964-z.
18. Moreno B, Crujeiras AB, Bellido D, Sajoux I, Casanueva FF. Obesity treatment by very low-calorie-ketogenic diet at two years: reduction in visceral fat and on the burden of disease. *Endocrine*. 2016;54(3):681-690. doi: 10.1007/s12020-016-1050-2.
19. Gomez-Arbelaez D, Bellido D, Castro AI, Ordoñez-Mayan L, Carreira J, Galban C et al. Body Composition Changes After Very-Low-Calorie Ketogenic Diet in Obesity Evaluated by 3 Standardized Methods. *J Clin Endocrinol Metab*. 2017; 102(2):488-498. doi: 10.1210/jc.2016-2385.
20. EFSA Panel on Dietetic Products, Nutrition and Allergies (NDA). Scientific Opinion on the Tolerable Upper Intake Level of eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA) and docosapentaenoic acid (DPA). *EFSA Journal* 2012; 10(7):2815.
21. SCOOP-VLCD task 7.3. Reports on tasks for scientific cooperation. Collection of data on products intended for use in very-low-calorie-diets. Report. Brussels. European Commission, September 2002.
22. <http://pronokalgroup.com/>
23. Astrup A, Rössner S. Lessons from obesity management programmes: greater initial weight loss improves long-term maintenance. *Obes Rev*. 2000; 1(1):17-9.
24. Handjieva-Darlenska T, Handjiev S, Larsen TM, van Baak MA, Lindroos A, Papadaki A et al. Predictors of weight loss maintenance and attrition during a 6-month dietary intervention period: results from the DiOGenes study. *Clin Obes*. 2011; 1(2-3):62-8.
25. Anderson JW1, Konz EC, Frederich RC, Wood CL. Long-term weight-loss maintenance: a meta-analysis of US studies. *Am J Clin Nutr*. 2001; 74(5):579-84.
26. Nackers LM, Ross KM, Perri MG. The association between rate of initial weight loss and long-term success in obesity treatment: does slow and steady win the race? *Int J Behav Med*. 2010; 17(3):161-7
27. Lemstra M, Bird Y, Nwankwo C, Rogers M, Moraros J. Weight loss intervention adherence and factors promoting adherence: a meta-analysis. *Patient Prefer Adherence*. 2016; 10:1547-59.
28. Seguí Díaz M. Existen diferencias entre las dietas en el peso corporal. *Semergen*. 2016; 42(7):485-487. DOI: 10.1016/j.semerg.2016.01.007.
29. Austin GL, Ogden LG, Hill JO. Trends in carbohydrate, fat, and protein intakes and association with energy intake in normal-weight, overweight, and obese individuals: 1971-

---

2006. *Am J Clin Nutr.* 2011; 93(4):836-43. doi:  
10.3945/ajcn.110.000141.

© 2020 seco- seedo. Published by bmi-journal. All rights reserved.

