

Revisiones

Behavioural therapy in the treatment of obesity (II): role of the Mediterranean diet

M. Garaulet¹ and F. Pérez de Heredia^{1,2}

¹Department of Physiology. Faculty of Biology. University of Murcia. Spain. ²Obesity Biology Research Unit. School of Clinical Sciences. University of Liverpool. UK.

Abstract

Objectives: Obesity is the consequence of an imbalance between energy intake and expenditure, food intake being affected by multiple factors —psychological, social, work-related, etc. This revision discusses the role of diet in the behavioural treatment (BT) of obesity, which faces multiple approaches and focuses on patients' behaviour rather than their mere energy intake.

Setting: Recent literature has been revised that deals with the health benefits of Mediterranean diet in order to assess its suitability for obesity treatment based on BT.

Results: BT helps patients to develop skills and techniques in order to adopt proper habits and attain their healthiest weight. Patients learn to establish realistic goals, both as regards weight and behaviour, and to evaluate their progress in modifying eating and exercising habits.

The application of the Mediterranean diet in obesity treatment presents various advantages which are based on the principles of this diet —wide variety of food, high carbohydrate content, or high satiating capacity, which prevents specific hunger and ketogenesis—, and has been demonstrated to be effective in reducing body weight.

Conclusions: BT based on the Mediterranean diet is a useful tool for obesity treatment. The Mediterranean diet provides the patients with a diet established on widely recognised nutritional benefits, suitable to their social and daily life, and that can be easily followed in the long term, according to the objectives of BT. For these reasons, Mediterranean diet-based BT helps to prolong both the treatment and maintenance periods and therefore contributes to a more stable weight loss.

(Nutr Hosp. 2010;25:9-17)

DOI:10.3305/nh.2010.25.1.4265

Key words: *Mediterranean diet. Obesity treatment. Cognitive behavioural therapy. Group therapy.*

Correspondence: Marta Garaulet.
Department of Physiology. Faculty of Biology.
University of Murcia.
Campus de Espinardo, s/n.
30100 Murcia. España.
E-mail: garaulet@um.es

Recibido: 27-II-2009.
Aceptado: 21-V-2009.

LA TERAPIA DE COMPORTAMIENTO EN EL TRATAMIENTO DE LA OBESIDAD (II): PAPEL DE LA DIETA MEDITERRÁNEA

Resumen

Objetivos: La obesidad es consecuencia del desequilibrio entre gasto energético e ingesta, y la ingesta está influida por múltiples factores (psicosociales, laborales, etc.) Esta revisión analiza el papel de la Dieta Mediterránea en la terapia de comportamiento (TC) para la obesidad, una terapia multidisciplinar que prioriza los hábitos del paciente sobre la mera ingesta energética.

Ambito: Se ha revisado la literatura reciente relacionada con las propiedades saludables de la Dieta Mediterránea, para determinar la idoneidad de su uso en el contexto de la TC.

Resultados: La TC ayuda a desarrollar habilidades y técnicas para adquirir hábitos apropiados y conseguir un peso saludable. El paciente aprende a establecer metas realistas en relación a su peso y comportamiento, y a evaluar su progreso con respecto a los cambios de hábitos alimentarios.

El empleo de la Dieta Mediterránea en el tratamiento de la obesidad presenta varias ventajas derivadas de los principios de esta dieta —variedad, alto contenido en carbohidratos, o alta capacidad saciante, previniendo hambres específicas y cetogénesis—, demostrándose efectiva en la pérdida de peso.

Conclusiones: La TC basada en la Dieta Mediterránea es una herramienta útil en el tratamiento de la obesidad. Esta dieta proporciona beneficios nutricionales ampliamente reconocidos, es compatible con la vida social, y se puede seguir a largo plazo, cumpliendo así los objetivos de la TC. Por ello, las terapias basadas en la Dieta Mediterránea ayudan a prolongar los periodos de tratamiento y mantenimiento, contribuyendo a una pérdida de peso más estable.

(Nutr Hosp. 2010;25:9-17)

DOI:10.3305/nh.2010.25.1.4265

Palabras clave: *Dieta mediterránea. Tratamiento de la obesidad. Terapia cognitiva. Terapia de grupo.*

Introduction

Obesity represents a major health threat nowadays. In 1997, the World Health Organization recognised its global character,¹ and in 2000, for the first time in history, the number of overweight/obese adults was greater than that of underweight.² The current prevalence of obesity is estimated in approximately 400 million people worldwide.³

What is the reason for this epidemic? If we consider that the rise in obesity prevalence has been steepest in the last 20-30 years, genetic or endocrine explanations are not sufficiently satisfactory, since there is no evidence of such a considerable switch in the genetic or metabolic profile of the world population. So the origin must be environmental: urban living has led to a dramatic decrease in physical activity, while the development of the food industry and marketing provides us with an enormous offer of tasty, energy-dense food, available 24/7.² The facilities of modern life interact with our physiological and genetic mechanisms, acting synergistically on food intake and body weight gain (fig. 1).⁴

To confront this obesity-inducing environment, we need to re-adapt our lifestyle habits to these new conditions. Besides, we should take into account that obesity is regarded as a chronic disease, so any modification of habits orientated to prevent and/or treat obesity must be suitable to last a lifetime.

Since 1960s-1970s, behavioural techniques have been proposed for obesity treatment, and several studies and programs, such as the Diabetes Prevention Program and the Look AHEAD (Action for Health in Diabetes) trial, provide solid data on the long-term results of intensive behavioural management interventions.^{5,6}

Evidence points towards a role of the Mediterranean diet in preventing obesity.⁷⁻¹² It covers most nutritional recommendations, like low content of refined carbohydrates, high fiber content, moderate fat content -mostly unsaturated-, and moderate-to-high content of vegetable proteins (fig. 2), but also appears as a safe strategy to treat metabolic syndrome and to reduce associated cardiovascular risk.⁷⁻¹² Moreover, results suggest that promoting eating habits consistent with Mediterranean diet patterns maybe a useful part of efforts to combat obesity.⁷⁻¹²

In this review we focus on the role of diet in behavioural therapy for obesity treatment. Despite the many widely attested benefits associated with weight loss, dietetic treatment is questioned by some sectors of the scientific and medical world, since some studies have shown that as many as 80% patients who start dietetic treatments abandon before achieving their goal, and that a good part of the weight lost will be regained in few years.^{13,14} Mediterranean diet, due to its special characteristics and healthy properties, widely proved in scientific research, constitutes a very interesting and effective tool for behavioural therapy in the treatment of obesity —not in vain it is regarded, more than a way of eating, as a way of living.

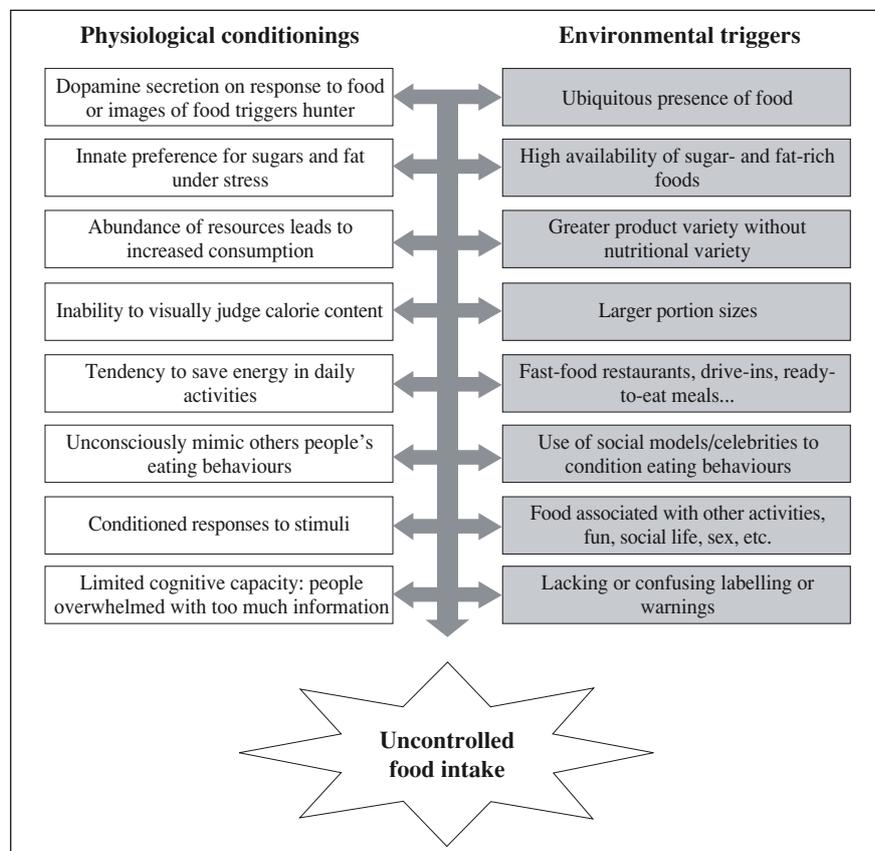


Fig. 1.—Interaction between physiological conditionings and environmental triggers that lead to excess food intake. (Adapted from Cohen D, Diabetes 2008).⁴

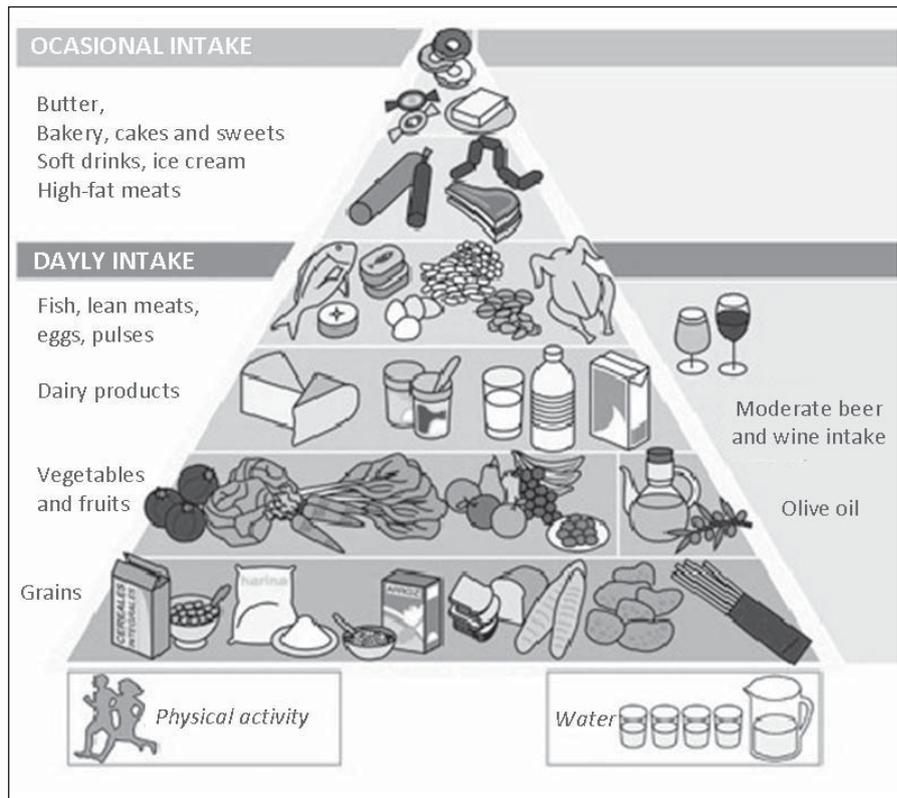


Fig. 2.—The food pyramid of the Mediterranean diet. (Adapted from <http://www.murciasalud.es/pagina.php?id=1208&id-sec=87>).

The use of behavioural therapy in obesity treatment

Principal characteristics of behavioural therapy

Behavioural therapy (BT) in relation to body weight management is based on the principles of “conditioning”, which indicate that eating is frequently associated with external events closely linked to ingestion.¹⁵ The use of BT is intended to help the patient to identify those signals that trigger inappropriate behaviour both as regards eating and physical activity, and to learn afterwards to develop new responses in the face of these signals. Rather than help to decide “what” to change, it consists in identifying “how” to change. Patients must understand that the proper control of body weight will not depend on willpower, but on the development of skills that will lead them to “normalise” their relation with food.

Three features define BT: first, it is directed at attaining *objectives*; goals must be clear and easily measurable. Secondly, the treatment is orientated towards a *process*; patients are encouraged to study the factors that will enable the objective to be reached. Thirdly, BT looks for *small changes* that can be easily made, rather than dramatic changes that will almost certainly be short lived.

Different techniques are used in BT, such as stimulus control, self-monitoring, positive reinforcement, or cognitive restructuring (table I).

In addition, a particular characteristic of our BT is that it is based on the Mediterranean diet, which has

been proved effective in promoting weight loss and improving obesity-related pathologies.¹⁶⁻¹⁹

The effectiveness of behavioural treatment

In recent years, treatments have tended to become more effective as a result of increased length combined with the gradual incorporation of new behavioural techniques.

Table I
Techniques used in behavioural therapy for obesity treatment

<i>Technique</i>	<i>Applications</i>
Stimulus control	Restricting the number of places where eating is permitted, eating slowly, not skipping meals, keeping palatable food in opaque containers, etc.
Self-monitoring	Daily log of food consumed and exercise taken.
Positive reinforcement	New clothes, or small gifts, or prizes when the aimed weight is reached.
Cognitive restructuring	Substituting negative and self-destructive thoughts by positive and stimulating ones.
Prevent relapses	Identifying “slips” and how to avoid them.

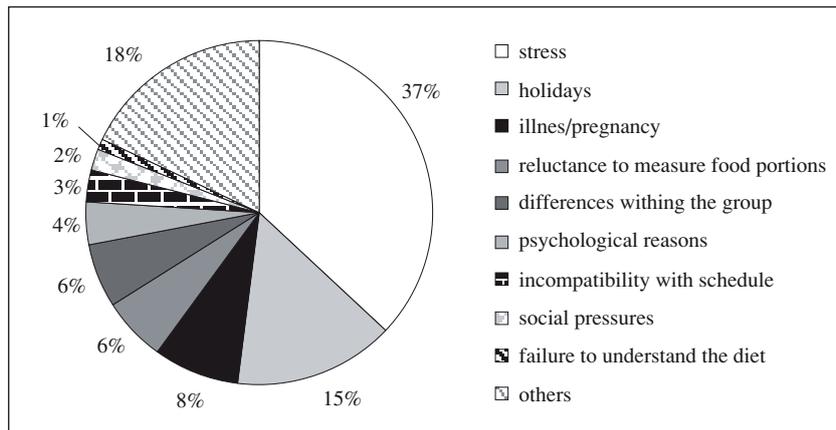


Fig. 3.—Reasons for dropping out a weight loss programme.

Most studies on BT, however, have been university-based. Despite their importance, they tell us little about the efficacy of BT in clinical practice. A bibliographical revision of commercial studies found that weight loss reported here was lower than that recorded in university-based studies.²⁰

Patients will be faced with different obstacles in their way to controlling body weight, sometimes resulting in the treatment to be abandoned. The main causes for abandoning treatment have been reported to be holidays –implying change in eating habits and loss of daily routine; the search for quick results; and social reasons –active social life or work that involves eating out frequently¹⁶ (fig. 3).

Strategies for increasing the success of treatments

The general perception for many years was that almost no behavioural treatment was successful in maintaining long-term weight loss. Some studies showed that during the year following treatment, patients recovered 30-50% weight lost. Follow-up studies four years after treatment showed a stabilisation of weight loss at 4% below initial weight.^{13,14}

However, success in maintaining weight loss has been now redefined, and a loss of 10% initial weight for at least one year is now considered successful. Recent studies have suggested that 20% individuals achieve this figure, and in this respect data from “The National Weight Control Registry” are encouraging;²¹ its members have shown an average weight loss of 33 kg maintained for more than 5 years. To achieve this, members speak of exercising approximately one hour/day, following low-fat hypocaloric diets, taking breakfast regularly, and maintaining eating habits during the weekend. They also point out that maintaining weight becomes easier with time, and that if weight loss can be maintained for two years long-term success rates increase. The usefulness of strategies for controlling stimuli and the need for constant exercise is emphasised, as is the need to control depression. Such

information shows that long-term weight loss is possible, and helps us to identify key techniques towards this end. Indeed, recent studies have tried to identify strategies that make the maintenance process easier, including:

1. *Food provision*: weight loss is greater when two or three meals per week are substituted by dietetic foods (milkshakes, biscuits, etc.) or by meals packed in controlled portion sizes along with standard BT, compared with hypocaloric diets plus BT.^{22,23}

2. *Changed expectations*: it is important to set realistic goals as regards weight loss; it has been suggested that new treatments should propose more modest goals than have been previously set.²⁴

3. *Maintenance programmes*: the key to success for maintaining weight loss lies in the ability to keep the healthy habits acquired through BT, which is a difficult task; a healthy lifestyle needs planning, skill in the choice of alternatives and in estimating portion sizes, and diligence in recording food intake and energy expenditure. All this needs time to be learnt and maintained. Many of the techniques used during maintenance will differ from those used to lose weight. Motivation is the main problem during this time, since patients do not have the previous objective of losing weight. Some of these techniques are:²⁵

– Increasing the length of maintenance: new BT programmes aim to keep subjects involved in the treatment for longer, and it has even been argued that obesity should be treated as a chronic illness with life-long follow up.²⁶

– Using Internet: the use of Internet has been proposed to prevent patients from tiring of attending clinics.²⁷

– Exercise and/or diet: maintenance programmes based on changes in eating habits seem to be more effective at maintaining weight loss —especially when they involve reduced fat intake— than exercise-based ones. Even so, the importance of exercise is borne out by several studies.²⁸

4. *New cognitive therapy treatment*: Cooper and Fairburn considered two most important reasons for

abandoning maintenance: first, patients may consider that they have not achieved the set goal yet and give up trying; second, in these circumstances they do not realise the importance of maintaining weight, so they return to old habits and therefore put on weight.²⁴

Based on cognitive therapy, the researchers developed a new approach to help the patient to acquire effective long-term behavioural patterns, in order to reduce the regaining of lost weight and thus to overcome psychological problems thereby derived. The authors proposed three key points:

- 1) Treatment must help patients to appreciate any weight loss achieved.
- 2) Patients must be encouraged to adopt as a goal weight stability and not further loss.
- 3) Patients should be taught behavioural and cognitive skills to achieve adequate control of their weight.

The maintenance programme is divided into two phases, the first lasting 24-30 weeks and the second 14 weeks. In each phase several modules are proposed, in which different behavioural techniques are applied.^{24,29}

The role of diet in behavioural therapy

Theoretically, losing weight through the diet should be easy, since it consists of producing an energy deficit in which energy intake is less than energy expenditure. However, dietitians know how difficult it is to instill correct eating habits in modern-day society, where it is so easy to obtain tasty, high-calorie food, and where any celebration is an excuse for overeating.

The American National Institute of Health (NIH) concluded the following in its guidelines for treating obesity:³⁰

– Reductions in calorie intake are accompanied by weight loss. Low-calorie diets have produced weight losses of approximately 10% initial weight.

– Changes in diet composition based on reductions in fat level produce weight loss. Diets in which fat represents less than 30% total calorie intake help to lose weight.

Selecting the most appropriate diet for behavioural therapy

From a BT point of view, it is important to remember the principle behind this type of therapy—changing a patient's habits with the aim to long-term change. Therefore, not all diets are useful for BT, even if they have demonstrated their usefulness for reducing body weight.

Most dietetic approaches are based on the reduction of a group of food or a certain macronutrient, mainly fat and carbohydrates. Low-fat diets (15-20% total

energy as fat) have proved to be effective in reducing weight loss in the short term (6-12 months), while no significant effects have been observed in the long term.³¹

Cutting down on carbohydrates has been the base of many popular diets, re-emerging in such diets as the Atkins' diet and the Zone diet.³⁰ The principle behind these diets is that too many carbohydrates render serum insulin levels higher, promoting fat storage. However, like low-fat diets, this type of diet seems to be useful only in the short term. Low-carbohydrate diets inevitably have high concentrations of proteins and fat, and rapidly deplete the glycogen stored in the liver and activate the ketosis system as a result of fat oxidation. Therefore, short-term weight loss is largely a consequence of water loss due to glycogen depletion—especially during the initial phase of the diet, when hydrated glycogen is catabolised to maintain plasma glucose values³⁰ and excretion of ketone bodies.

Although some comparisons regard low-carbohydrate diets as more effective than low-fat ones for short-term weight loss,³¹ others showed that weight loss does not distinguish between carbohydrate-rich and carbohydrate-poor diets,³² suggesting that it is the reduction in total energy intake what determines weight loss, regardless of the proportion of nutrients. This hypothesis, along with those studies in which individuals given high-fat diets do not show higher cholesterol values (provided that fat is mainly of the unsaturated type), have revived the controversy as to whether low-carbohydrate diets should be recommended for treating obesity. But even when they lead to short-term weight loss, low-carbohydrate high-fat diets may exert undesirable side effects in the long term, making their use unsuitable for BT.

BT should also reject very low-calorie diets (VLCD), since they have proved of little use in long-term weight loss.¹ Moreover, this type of diet does not permit patients to acquire new eating habits gradually, which is essential for long-term success.

Diets that do not ensure recommended nutrient intake, *i.e.* 10-15% protein, 30-35% fat and 50-60% carbohydrates³³ are not suitable for BT. The idea is to educate the patient to assume correct eating habits that will last a lifetime. Health professionals have the obligation to keep abreast of all the myths and errors that different diets give rise to, and to transmit to the patient recommendations based on established nutritional knowledge.³⁴

In general, diets used in BT are hypocaloric, with energy contents of at least 1,000 kcal, in which the recommended nutrient proportions are maintained, with ≥ 0.8 g protein/kg body weight/day and ≥ 100 g carbohydrates/day to avoid ketogenesis.¹⁶ Moreover, healthy habits such as adequate breakfast, not missing meals (3-5/day), eating slowly, moderate portions size, etc., are all part of the therapy.

Portion size has to be controlled in BT, especially for meat products and added fat. This might be unattrac-

tive to patients, who will frequently be reluctant to this step. Therefore, it is necessary to apply methods that facilitate the control of portion size without unnecessary efforts. Recently, BT has been using diets permitting *ad libitum* ingestion of carbohydrates, while the portion size and quantities of high-fat and high-protein foods are controlled. Toubro and Astrup³⁵ found that, during maintenance, patients following this type of diets regained less weight than those prescribed a low-calorie diet (the difference was 0.3 kg vs. 4.1 kg of weight gain). Other studies, on the contrary, found no difference in this respect (36,37).

Although these diets usually cover recommendations, care must be taken that they contain at least the minimum quantity of proteins and fat necessary to supply essential amino acids, fatty acids, and liposoluble vitamins.

It is also important that restrictions should not be too rigid; flexibility in the diet is associated with less craving and binge-eating, and greater success in maintaining weight loss.^{38,39} A controlled diet is recommended, but one which includes the occasional treat, such as cakes, alcohol, sweets, etc., which should be enjoyed without feeling guilty.

It should be remembered that no diet is any good if it is not followed over the long term and if it does not establish lifelong habits. Therefore, the diet in BT should be compatible with patients' social lives, tastes, or daily activity, and also permit the odd treat. In short, BT tries not so much to impose a diet but to design a way of life jointly with and for the patient.

The Mediterranean Diet in behavioural therapy

Epidemiological studies in Mediterranean countries show that the population is slowly moving away from their traditional diet. The growing preoccupation with body weight and the innumerable slimming diets that have proliferated are partly responsible for people's growing rejection of the Mediterranean diet. For instance, in Spain, a high percentage of women (47%) are constantly on a diet but do not reach or maintain their desired weight.⁴⁰ Most such diets are insufficient in carbohydrates, monotonous and incompatible with the individual's social life; they take the pleasure away from eating and are generally based on wrong nutritional concepts. By contrary, the advantages of the Mediterranean diet are well known, including protection against metabolic alterations associated with obesity, such as high blood pressure, hypercholesterolemia, hypertriglyceridemia, and higher cardiovascular risk.^{8,9,41} Spain, although traditionally known to have a Mediterranean style of life, is currently one of the European countries with the highest prevalence of obesity,⁴² and efforts are being made by the governments to emphasize the importance of the Mediterranean food habits.⁴³

Different Mediterranean lifestyle programmes performed in Mediterranean^{8,10} and non-Mediterranean

countries^{11,12} have shown that BT accompanied by food habit control, caloric reduction and a balanced nutrient distribution based on the Mediterranean diet is useful for losing weight and for improving obesity-associated alterations. An interesting finding from a randomized controlled clinical trial⁴⁴ was that a moderate fat, energy-controlled Mediterranean-style diet offered an alternative to a low-fat diet, with higher adherence and consequently improvement in weight loss.

Indeed, a greater adherence to the Mediterranean diet has been associated with lower prevalence of abdominal obesity,⁴⁵ and it has been also proposed that the Mediterranean Diet is particularly effective on glycaemia control.⁴⁶

Characteristics of the Mediterranean diet

The principles of the Mediterranean diet are summarized in figure 4.¹⁹

The application of the Mediterranean diet for weight loss purposes must be accompanied by reduced energy intake (reductions of 500-1,000 kcal/day); fat must not exceed 30% energy, and oleic acid must constitute at least 55% total fat at the expense of saturated fats –this can be attained by using olive oil as culinary fat. It is important to bear in mind that the ingestion of fat has been shown to be a main factor in obesity.⁴⁷ In this regard, recent nutritional recommendations from Greece based on the Mediterranean pyramid were criticised, because fat intake has been increasing in this country since the 1950's due to the ingestion of olive oil, leading to a substantial overall weight gain.⁴⁸

Another important consideration is that a hypocaloric diet (1,200-1,800 kcal) with a considerable contribution of vegetal products (lentils, chickpeas, beans) to total proteins must be varied, and care must be taken to provide sufficient consumption of haemo iron. Doing so, iron-related haematological parameters will be maintained within normal values.⁴⁹

Advantages of the Mediterranean diet in behavioural treatment of obesity

The application of the Mediterranean diet in BT has been demonstrated to be effective in reducing obesity.^{9,16} The main advantages of the Mediterranean diet in the treatment of obesity are consequence of its characteristics:

- It is highly satiating, due to high fiber intake.
- It is composed of high-volume foods with low-calorie density.
- Given its high carbohydrate content, it does not trigger specific hunger and therefore binge-eating.
- For the same reason, it is not ketogenic.
- Even though it can be hypocaloric, it keeps adequate nutrient proportions.

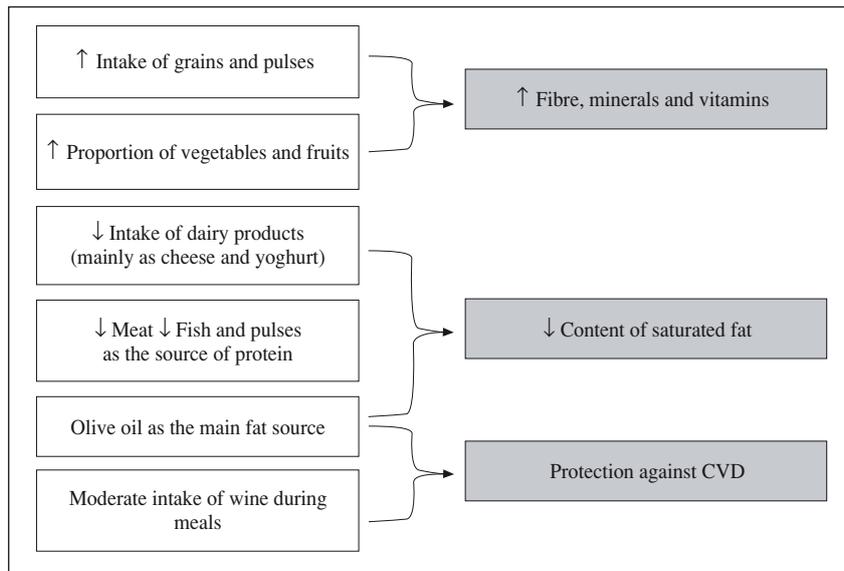


Fig. 4.—Main features of the Mediterranean diet.

- It is healthy.
- It can be followed over the long term (important for maintenance purposes).
- It is tastier than other low-fat regimens. Olive oil enhances the flavour of certain foods and contributes to increase vegetable intake.⁴⁴

Flynn and Colquhoun⁵⁰ suggested that the Mediterranean diet is as effective as any other diet in patients seeking to follow a weight loss programme. Furthermore, Fernandez de la Puebla and co-workers⁵¹ found that isocaloric substitution of a diet rich in saturated fatty acids by another with the properties of the Mediterranean diet reduced body fat proportion. In a recent study from our group on 1,500 patients, we found an average weight loss of 9.8% and a significant improvement in blood-related parameters, such as glucose, cholesterol and uric acid.⁴⁹

Mechanisms proposed for the benefits of the Mediterranean diet

Vegetable and fruit content: The high proportion of vegetables and fruits in the Mediterranean diet helps to increase both satiation (the signal to stop eating during the course of a meal) and satiety (the sensation that determines the length of the period between meals), since it has been suggested that it is volume rather than energy density which influences short-term intake.⁹ The high fiber content of vegetables, fruits and legumes contributes to this increased satiety.

Olive oil as the main fat source: Olive oil seems to be a key element in the effects of the Mediterranean diet on body weight control. Our research group has shown that monounsaturated fatty acids, especially oleic, are associated with lower adipocyte number in adipose tissue,

suggesting that they may limit hyperplasia in obese populations,⁵² and other authors propose that oleic acid can induce fatty acid oxidation more actively than other fatty acids.⁹ It has been also argued that exogenous oleic acid (for instance, in olive oil) would reduce the activity of the stearoyl-CoA-desaturase,⁵³ the enzyme that synthesizes oleic acid from saturated fatty acids and a key element in body fat accumulation.⁵⁴

Adherence to the treatment: Dropping out is reduced in obesity treatments based on the Mediterranean diet. Results from our group show attrition rates of was 6-9%, much lower than those found in other clinical studies with different diets.^{14,16,54,55} These good results could be related to the Mediterranean-style diet approach, as above mentioned and previously described.⁴⁴ Subjects find this diet tastier than the low-fat regimens tried before.

In conclusion, BT is a useful tool for the treatment of obesity, aiming to acquire long-life habits that help to lose weight and to maintain a stable body weight afterwards. In this context, the Mediterranean diet provides the therapists with a tastier satiating diet, established on widely recognised nutritional benefits and that can be followed over the long term. For these reasons, Mediterranean diet helps to prolong both the treatment and maintenance periods and therefore contribute to a more stable weight loss.

Acknowledgements

We are grateful to the Obesity Research Group of the University of Murcia for their help, especially Juan José Hernandez-Morante and Ana Espallardo. Also to the personnel of the “Centros de Nutrición Garaulet”, who put into practice the ideas gained from scientific research.

References

- World Health Organization 2000. Obesity: preventing and managing the global epidemic. Report of a WHO consultation. Geneva, Switzerland: World Health Organization (WHO technical report series 894).
- Caballero B. The global epidemic of obesity: an overview. *Epidemiol Rev* 2007; 29: 1-5.
- World Health Organization 2006. Obesity and overweight. Fact sheet n. 311. <http://www.who.int/mediacentre/factsheets/fs311/en/print/html>.
- Cohen DA. Neurophysiological pathways to obesity: below awareness and beyond individual control. *Diabetes* 2008; 57: 1768-1773.
- Márquez-Ibáñez B, Armendáriz-Anguiano AL, Bacardí-Gascón M, Jiménez-Cruz A. Review of controlled clinical trials of behavioural treatment for obesity. *Nutr Hosp* 2008; 23 (1): 1-5.
- Johnston CA, Tyler C, Foreyt JP. Behavioral management of obesity. *Curr Atheroscler Rep* 2007; 9 (6): 448-453.
- Buckland G, Bach A, Serra-Majem L. Obesity and the Mediterranean diet: A systematic review of observational and intervention studies. *Obes Rev* 2008; 9 (6): 582-593.
- Giugliano D, Esposito K. Mediterranean diet and metabolic diseases. *Curr Opin Lipidol* 2008; 19: 63-68.
- Schröder H. Protective mechanisms of the Mediterranean diet in obesity and type 2 diabetes. *J Nutr Biochem* 2007; 18: 149-160.
- Mendez MA, Popkin BM, Jakszyn P, Berenguer A, Tormo MJ, Sánchez MJ *et al*. Adherence to a Mediterranean diet is associated with reduced 3-year incidence of obesity. *J Nutr* 2006; 136 (11): 2934-2938.
- Toobert DJ, Glasgow RE, Strycker LA, Barrera M Jr, Ritzwoller DP, Weidner G. Long-term effects of the Mediterranean lifestyle program: a randomized clinical trial for postmenopausal women with type 2 diabetes. *Int J Behav Nutr Phys Act* 2007; 4: 1.
- Goulet J, Lapointe A, Lamarche B, Lemieux S. Effect of a nutritional intervention promoting the Mediterranean food pattern on anthropometric profile in healthy women from the Québec city metropolitan area. *Eur J Clin Nutr* 2007; 61 (11): 1293-1300.
- Kramer FM, Jeffery RW, Forster JL, Snell MK. Long-term follow-up behavioral treatment for obesity: patterns of weight regain among men and women. *Int J Obes Relat Metab Disord* 1989; 13: 123-136.
- Jeffery RW, Drewnowski A, Epstein LH, Stunkard AJ, Wilson GT, Wing RR *et al*. Long-term maintenance of weight loss: current status. *Health Psychol* 2000; 19: 5-16.
- Dell'Osso B, Altamura AC, Mundo E, Marazziti D, Hollander E. Diagnosis and treatment of obsessive-compulsive disorder and related disorders. *Int J Clin Pract* 2007; 61: 98-104.
- Garaulet M, Pérez-Llamas F, Zamora S, Tebar FJ. Weight loss and possible reasons for dropping out of a dietary/behavioural programme in the treatment of overweight patients. *J Human Nutr Diet* 1999; 12: 219-227.
- Garaulet M, Pérez-Llamas F, De Juarez ML, Tebar FJ, Zamora S. Evaluación del consumo alimentario en mujeres con sobrepeso que van a ser sometidas a un programa de adelgazamiento voluntario. *Nutr Hosp* 1997; 6: 257-261.
- Garaulet M, Torralba M, Alba P, Navarro M. Adelgazar sin milagros: el Método Garaulet. Madrid, Spain: Luna ed.; 2000.
- Garaulet M. Pierde peso sin perder la cabeza. Madrid, Spain: Editec; 2004.
- Womble LG, Wang SS, Wadden TA. Commercial and self-help weight loss programs. In: Wadden TA, Stunkard AJ, eds. Handbook of obesity treatment. New York: Guildford Press. 2002, pp. 395-415.
- Freeman J. Keeping off lost weight. For more than a decade, the National Weight Control Registry has been tracking people who have lost weight and kept it off. *Diabetes Forecast* 2005; 58: 58-61.
- Jeffery RW, Wing RR, Thorson C, Burton LR. Strengthening behavioral interventions for weight loss: a randomized trial of food provision and monetary incentives. *J Consult Clin Psychol* 1993; 6: 1038-1045.
- Wing RR, Jeffery RW, Burton LR, Thorson C, Nissinoff KS, Baxter JE. Food provision vs. structured meal plans in the behavioral treatment of obesity. *Int J Obes Relat Metab Disord* 1996; 20: 56-62.
- Cooper Z, Fairburn CG. A new cognitive behavioral approach to the treatment of obesity. *Behav Res Ther* 2001; 39: 499-511.
- Leibbrand R, Fitcher M. Maintenance of weight loss after obesity treatment: is continuous support necessary? *Behav Res Ther* 2002; 40: 1275-1289.
- Perri MG, Nezu AM, Viegner BJ. Improving the long-term management of obesity: theory, research and clinical guidelines. New York: Wiley Press; 1992.
- Harvey-Berino J, Pintauro S, Buzzell P, DiGiulio M, Casey-Gold B, Moldovan C *et al*. Does using the Internet facilitate the maintenance of weight loss? *Int J Obes Relat Metab Disord* 2002; 26: 1254-1260.
- Wing RR, Phelan S. Long-term weight loss maintenance. *Am J Clin Nutr* 2005; 82 (1 Supl.): 222S-225S.
- Cooper Z, Fairburn CG, Hawker DM. Cognitive-Behavioral treatment of obesity. A clinician's guide. New York: The Guilford Press; 2003.
- National Institutes of Health. The Practical Guide: Identification, Evaluation, and Treatment of Overweight and Obesity in Adults. Bethesda, MD: National Institutes of Health Publications; 2000.
- Malik VS, Hu FB. Popular weight-loss diets: from evidence to practice. *Nat Clin Pract Cardiovasc Med* 2007; 4 (1): 34-41.
- Nordmann AJ, Nordman A, Briel M, Keller U, Yancy WS, Brehm BJ *et al*. Effects of low-carbohydrate vs. low-fat diets on weight loss and cardiovascular risk factors. A meta-analysis of randomized controlled trials. *Arch Intern Med* 2006; 166: 285-293.
- Departamento de Nutrición. Tablas de ingestas recomendadas de energía y nutrientes para la población española. Madrid, Spain: Departamento de Nutrición; 2001.
- Freedman MR, Kennedy E. Popular diets: a scientific review. *Obes Res* 2001; 9 (Supl.): 1S-40S.
- Toubro S, Astrup A. Randomised comparison of diets for maintaining obese subjects' weight after major weight loss: ad lib, low fat, high carbohydrate diet vs. fixed energy intake. *Br Med J* 1997; 314: 29-34.
- Schlundt DG, Hill JO, Pope-Cordle J, Arnold D, Virts KL, Katahn M. Randomized evaluation of a low fat "ad libitum" carbohydrate diet for weight reduction. *Int J Obes Relat Metab Disord* 1993; 17: 623-629.
- Jeffery RW, Hellerstedt WL, French SA, Baxter JE. A randomized trial of counselling for fat restriction versus calorie restriction in the treatment of obesity. *Int J Obes Relat Metab Disord* 1995; 19: 132-137.
- Smith CF, Williamson DA, Bray GA, Ryan DH. Flexible vs. rigid dieting strategies: relationships with adverse behavioural outcomes. *Appetite* 1999; 32: 295-305.
- Westenhoefer J, Stunkard AJ, Pudel V. Validation of the flexible and rigid control dimensions of dietary restraint. *Int J Eating Disord* 1999; 26: 53-64.
- Technology Assessment Conference Panel. Methods for voluntary weight loss control: Technology Assessment Conference Statement. *Ann Intern Med* 1993; 119: 764-70.
- Garaulet M, Marin C, Pérez-Llamas F, Canteras M, Tebar FJ, Zamora S. Adiposity and dietary intake in cardiovascular risk in an obese population from a Mediterranean area. *J Physiol Biochem* 2004; 60: 39-49.
- Berghöfer A, Pischon T, Reinhold T, Apovian CM, Sharma AM, Willich SN. Obesity prevalence from a European perspective: a systematic review. *BMC Public Health* 2008; 8: 200.
- Ballesteros Arribas JM, Dal-Re Saavedra M, Pérez-Farinós N, Villar Villalba C. The Spanish strategy for nutrition, physical activity and the prevention of obesity (NAOS Strategy). *Rev Esp Salud Publica* 2007; 81 (5): 443-449.
- McManus K, Antinoro L, Sacks F. A randomized controlled trial of a moderate-fat, low-energy diet compared with a low

- fat, low-energy diet for weight loss in overweight adults. *Int J Obes Relat Metab Disord* 2001; 25 (10): 1503-1511.
45. Panagiotakos DB, Chrysohoou C, Pitsavos C, Stefanadis C. Association between prevalence of obesity and adherence to the Mediterranean diet: the Attica study. *Nutrition* 2006; 22 (5): 449-456.
 46. Shai I, Schwarzfuchs D, Henkin Y, Shahar DR, Witkow S, Greenberg I, *et al.* Weight loss with a low-carbohydrate, Mediterranean, or low-fat diet. *NEJM* 2008; 359 (3): 229-241.
 47. Garaulet M, Pérez-Llamas F, Canteras M, Tebar FJ, Zamora S. Endocrine, metabolic and nutritional factors in obesity and their relative significance as studied by factor analysis. *Int J Obes Relat Metab Disord* 2001; 25: 243-251.
 48. Ferro-Luzzi A, James WPT, Kafatos A. The high-fat Greek diet. A recipe for all? *Eur J Clin Nutr* 2003; 57: S2-S7.
 49. Hernández T, Hernández-Morante JJ, Esteban A, Garaulet M. Efectividad de un método conductual y de educación nutricional en la pérdida de peso. Posibles factores predictivos. *Rev Esp Obes* 2005; 3: 250-272.
 50. Flynn G, Colquhoun D. Successful long-term weight loss with a Mediterranean style diet in a primary care medical centre. *Asia Pac J Clin Nutr* 2004; 13: S139.
 51. Fernández de la Puebla RA, Fuentes F, Pérez-Martínez P, Sánchez E, Paniagua JA, Lopez-Miranda J, Pérez-Jiménez F. A reduction in dietary saturated fat decreases body fat content in overweight, hypercholesterolemic males. *Nutr Metab Cardiovasc Dis* 2003; 13: 273-277.
 52. Garaulet M, Hernández-Morante JJ, Luján J, Tébar FJ, Zamora S. Relationship between fat cell size and number and fatty acid composition in adipose tissue from different fat depots in overweight/obese humans. *Int J Obes* 2006; 30 (6): 899-905.
 53. Soriguer F, Rojo-Martínez G, Rodríguez de Fonseca F, García-Escobar E, García Fuentes E, Olveira G. Obesity and the metabolic syndrome in Mediterranean countries: A hypothesis related to olive oil. *Mol Nutr Food Res* 2007; 51: 1260-1267.
 54. Ntambi JM, Miyazaki M, Stoehr JP, Lan H, Kendziorski CM, Yandell BS *et al.* Loss of stearoyl-CoA desaturase-1 function protects mice against adiposity. *Proc Natl Acad Sci USA* 2002; 99: 11482-11486.
 55. Bautista-Castaño I, Molina-Cabrillana J, Montoya-Alonso JA, Serra-Majem L. Variables predictive of adherence to diet and physical activity recommendations in the treatment of obesity and overweight, in a group of Spanish subjects. *Int J Obes Relat Metab Disord* 2004; 28 (5): 697-705.
 56. Giri M. Medical management of obesity. *Acta Clin Belg* 2006; 6: 286-294.