Nutrición Hospitalaria
ISSN: 0212-1611
info@nutriciónhospitalaria.com
Grupo Aula Médica
España

Marqués, M.ª; Moleres, A.; Rendo-Urteaga, T.; Gómez-Martínez, S.; Zapatera, B.; Romero, P.; de Miguel-Etayo, P.; Campoy, C.; Martínez, J. Alfredo; Azcona-San Julián, C.; Marcos, A.; Marti, A.; Warnberg, J.; group, EVASYON

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Nutrición Hospitalaria, vol. 27, núm. 1, enero-febrero, 2012, pp. 165-176
Grupo Aula Médica
Madrid, España

Nutrición Hospitalaria

Nutr Hosp. 2012;27(1):165-176
ISSN 0212-1611 • CODEN NUHOEQ
S.V.R. 318

Original

Design of the nutritional therapy for overweight and obese Spanish adolescents conducted by registered dieticians; the EVASYON study

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Abstract

Background: **Dietary treatment for obese adolescents should aim to ensure adequate growth and development, by reducing excessive fat mass accumulation, avoiding loss of lean body mass, improving well-being and self-esteem and preventing cyclical weight regain. The aim of this article is to describe the dietary intervention design and the methods used to evaluate nutritional knowledge and behavior in the EVASYON study (Development, implementation and evaluation of the efficacy of a therapeutic programme for overweight/obese adolescents).**

Methods/design: **EVASYON is a multi-centre study conducted in 5 Spanish hospital settings (Granada, Madrid, Pamplona, Santander and Zaragoza), where 204 overweight/obese Spanish adolescents were treated in groups of 9 to 11 subjects over 20 visits. The study was implemented in two stages: an intensive, calorie-restricted period for the first 9 weeks, and an extensive body-weight follow-up period for the last 11 months. A moderate energy intake restriction was applied in the intensive period according to the degree of obesity, on the basis of a balanced diet supplying 50-55% of daily energy as carbohydrates; 30-35% as fats and 10-15% as proteins. In the intensive period, adolescents were prescribed both a fixed full-day meal plan for the first three weeks and a full day meal plan with different food-choices for 6 weeks. Later, adolescents received a flexible meal plan based on food exchanges for the follow-up period until the end of the trial.**

Data on food intake, dietary and meal-related habits and behavior were collected by means of dietary questionnaires. To analyse nutritional knowledge, adolescents were examined regarding nutrient concepts and food

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Recibido: 14-VIII-2011.
Aceptado: 17-VIII-2011.

DISEÑO DE TERAPIA NUTRICIONAL PARA ADOLESCENTES ESPAÑOLES CON SOBREPESO Y OBESIDAD REALIZADO POR DIETISTAS TITULADOS; EL ESTUDIO EVASYON

Resumen

Antecedentes: **El tratamiento dietético para los adolescentes obesos debería asegurar el crecimiento y desarrollo adecuados al reducir la acumulación excesiva de masa grasa, evitar la pérdida de masa magra corporal, mejorar el bienestar y la autoestima y prevenir la ganancia cíclica de peso. El objetivo de este artículo es el de describir el diseño de la intervención dietética y los métodos empleados para evaluar el conocimiento y la conducta nutricionales del estudio EVASYON (Desarrollo, implantación y evaluación de la eficacia de un programa terapéutico para adolescentes con sobrepeso/obesidad).**

Métodos/diseño: **EVASYON es un estudio multicéntrico realizado en 5 hospitales españoles (Granada, Madrid, Pamplona, Santander y Zaragoza), en el que se trató a 204 adolescentes españoles con sobrepeso/obesidad en grupos de 9 a 11 individuos a lo largo de 20 visitas. El estudio se implantó en dos etapas: un período intensivo de restricción calórica durante las 9 primeras visitas y un período extensivo de seguimiento del peso corporal durante los últimos 11 meses. Se aplicó una restricción moderada de consumo de energía durante el período intensivo en función del grado de obesidad, sobre la base de una dieta equilibrada que aporta el 50-55% de la energía diaria en forma de carbohidratos; 30-35% como grasas y 10-15% como proteínas. En el período intensivo, se prescribió a los adolescentes un régimen de comidas fijo para todo el día durante las 3 primeras semanas y un plan de comidas para todo el día con diferentes opciones durante 6 semanas. Posteriormente, los adolescentes recibieron un régimen de comidas flexible sobre la base de los intercambios de alimentos durante el período de seguimiento hasta el final del ensayo.**

Se recogieron los datos de consumo de alimentos, dietéticos y hábitos relacionados con las comidas mediante cuestionarios de dieta. Para analizar el conocimiento nutricional, se examinó a los adolescentes con respecto a conceptos

items for a healthy diet with the appropriate tools. Participants were given nutritional information with complementary teaching material, which was available on the EVASYON website (www.estudioevasyon.com).

***Discussion:* The dietary intervention of the EVASYON programme with a moderate calorie restriction for a limited period of time could be a good strategy in treating overweight and obese adolescents and that will be tested further. Moreover, combining fixed plan with free-choice menus may help adolescents and their families to make right decisions for every day meals.**

(*Nutr Hosp.* 2012;27:165-176)

DOI:10.3305/nh.2012.27.1.5452

Key words: *Adolescence. Multidisciplinary intervention. Nutritional education. EVASYON.*

de nutrición y alimentos concretos para una dieta sana con las herramientas adecuadas. Se proporcionó a los participantes información nutricional con material educativo complementario que estaba disponible en la página web del estudio (www.estudioevasyon.com).

***Discusión:* La intervención dietética del programa EVASYON con una restricción calórica moderada durante un período de tiempo limitado podría ser una buena estrategia para el tratamiento de los adolescentes con sobrepeso y obesidad y se probará más adelante. Además, el combinar el plan fijo con menús de elección libre podría ayudar a los adolescentes y sus familias a tomar las decisiones correctas para las comidas de todos los días.**

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Palabras clave: *Obesidad. Adolescencia. Intervención multidisciplinar. Educación nutricional. EVASYON.*

Background

Adolescence is a period of the life cycle characterized by important changes in body size and composition as well as in lifestyle habits.[1,2] The prevalence of overweight and obesity among adolescents is dramatically increasing all over the world[3,4,5]. This alarming trend is seen as a burden by public health professionals and government agencies and there is now a clear need to develop well founded standardized interventions to treat overweight/obese adolescents, following evidence-based practice criteria.

The risk of obesity depends on the interaction of genetic predisposition and exposure to obesogenic (environmental) risk factors such as inappropriate eating habits and food choice, poor nutritional knowledge, sedentary behavior and low physical activity, all of which are becoming major social problems in many countries.[6,7,8,9] These etiological factors are associated with clinically important co-morbidities (cardiovascular disease, hypertension, type 2 diabetes mellitus, eating disorders, cancer…) in adult life.[10] It is unlikely that a single-sided intervention can be targeted against all these multi-causal agents. Indeed, lifestyle changes require a high degree of commitment and active participation from adolescents and their relatives. Therefore, parents are central agents for change in the promotion of healthy eating and activity habits and their involvement in the programme is essential for an intervention to be successful.[11,12] A multi-disciplinary approach is necessary with the participation of dieticians, doctors, psychologists and physical activity experts among other professionals as a single team.[13-14]

Interventions that combined behavioral therapy with dietary and physical activity changes are widely used, and appear to be the most successful strategies for improving long-term weight maintenance and health status.[14,15,16] Ideally, dietary treatment for obese children and adolescents should aim to ensure adequate growth and development, by reducing excessive fat mass accumulation, avoiding loss of lean body mass, improving well-being and self-esteem and preventing cyclical weight regain.[13]

Balanced food patterns constitute a model for healthy living, based on foods to eat rather than foods to avoid, and an understanding of suitable weight-control measures.[17] Promoting weekly menus with food variety is also the best defense for avoiding nutritional deficiencies and excess, as well as meeting micronutrient requirements.[1,18] Moreover, meal plans with food exchanges represent a useful tool to encourage adolescents to keep to balanced diets.

The timetable for different meals throughout the day and their calorie distribution are also important issues as ways to improve nutritional education and food behavior in this population. Adolescents tend to have high energy density meals and snacks, therefore an important goal is to reduce calorie content.[19] This practice involves a wide range of fresh and seasonal food, with a high proportion of vegetables, grains, fresh fruit and pulses, principal sources of vitamins, minerals, carbohydrates and fiber, which could play an important role in weight control and in decreasing dietary energy-density.[13,20-21]

The aims of the EVASYON study were: 1) to develop a treatment programme including education on nutrition and physical activity patterns, 2) to implement this programme during one year in overweight/obese Spanish adolescents and 3) to evaluate the efficacy and limitations of the programme. For dissemination and comparative purposes with previous and future studies, detailed information concerning the design, development and evaluation of the dietary intervention of the EVASYON study is provided here.

Methods/design

Experimental design

The EVASYON programme is an interventional study implemented in a cohort of overweight/obese ado-

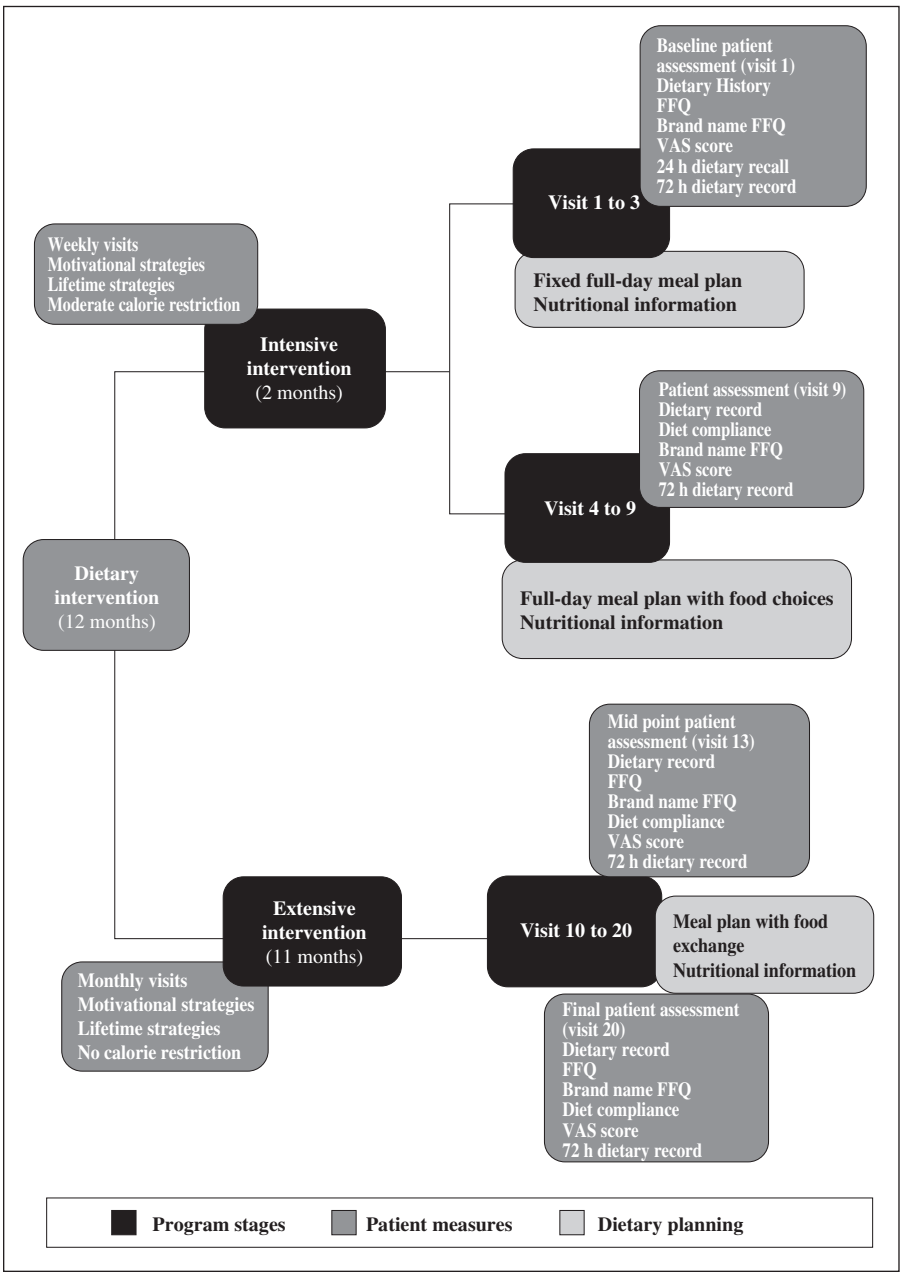

Fig. 1.—EVASYON study design and dietary intervention in the treatment programme. The dietary intervention was carried out over approximately one year including twenty visits within two specific stages: the intensive period (9 visits) with moderate calorie restriction, and the extensive period (11 visits) with no calorie restriction. The dietary planning was different is each stage, and dietary questionnaires were administered at baseline, and in visits 9, 13 and 20, to complete patient assessments.

lescents aged 13 to 16 years as described by Martínez-Gómez et al.[7] The initial treatment programme was conducted in 5 Paediatric hospitals from different cities in Spain (Granada, Madrid, Pamplona, Santander and Zaragoza) in small groups of nine to eleven patients. During the programme period, adolescents made twenty visits over approximately one year, within two specific stages (fig. 1): an intensive intervention period including 9 weekly visits for two months, and the extensive body weight maintenance intervention period including 11 monthly visits. Information on inclusion criteria is given in the work of Martínez-Gómez et al.[7] Written consent to participate was obtained from both parents and adolescents. The complete study protocol was conducted in accordance with the ethical standards of the Helsinki Declaration (revised in Hong-Kong in 1989, in Edinburgh in 2000 and in Korea in 2008), following the European Community's guidelines for Good Clinical Practice (document EEC 111/3976/88 of July 1990) and current Spanish law regulating clinical research in humans (RD 561/1993 regarding clinical trials). The study was approved by the Ethics Committee of each hospital participating in this project and by the Ethics Committee of the Spanish National Research Council (CSIC). Data obtained during the intervention was confidential and restricted to the participating investigators. Health authorities had full access rights to the database for inspection purposes.

Nutritional therapy and an educational programme on diet and food knowledge, psychological and eating

NAME: DATE: NUMBER:

Date of birth:
Age:
Sex:
Year/School:
Name of father or mother:
Address:
Town /City:
Province:
Postcode:
Telephone:
E-mail:
Weight at birth:

Recent changes in weight:

- How many people live with you?
- Do you usually eat lunch at home or at school?
- If you eat at home, do you eat with your parents or with other adults?
- Who does the cooking?
- Who does the shopping?
- Do you have a microwave, oven or grill?
- Do you eat out at the weekend? And during the week?
- Do you go to fast food restaurants? How often?
- Do your eating habits change at the weekends? YES, NO, Which day?
- Do you have any special daily eating habits?
- What's the first thing you have when you get up?
- Has anything special happened over the last 3 months that's changed your eating habits?
- What do you usually drink during meals?
- Do you usually have second helpings?
- What do you usually eat between meals?
- How frequently do you buy sweets, confectionary or salty snacks?

HABITS

How many meals do you have every day and at what time?
Do you watch TV when you eat?
Do they make you eat food that you don't like?
How long do you take to eat your meals?
When do you feel really hungry?
Do you think you eat healthily?
Do you like cooking for your family?
Do you think you have good healthy eating habits at home?
What do they think in your house about eating? Is getting a healthy diet important or not?
Do you prefer eating on your own or accompanied? Why?
Do you eat on your own in secret? Yes, No. Do you feel bad when you do that?

Additional file 1.—Dietary history model.

Visual scale hungry/full

Date: Time: *Name:* *Number:*

The line for each question must be exactly 10 cm (100 mm) long from 0 to 10. From 0 to more patients should draw in how they feel. The dietician should then measure the score in mm with a ruler.

This test can be done referring to the nearest main meal, lunch or supper from the previous day.

Do you feel hungry? How hungry?

Not at all hungry — Very hungry
0 —————————— 100 mm

Do you feel full? How full?

Not at all full — Absolutely full
0 —————————— 100 mm

Are you satisfied? How satisfied?

Absolutely empty — I couldn't eat a thing
0 —————————— 100 mm

Would you like to eat more? How much more?

Nothing — A lot
0 —————————— 100 mm

Are you thirsty? How thirsty?

Not at all thirsty — I've never been so thirsty
0 —————————— 100 mm

Additional file 2.—Visual Analogue Scale (VAS score).

behavior assessment, physical activity and family involvement, were covered throughout the programme. Nine measurement categories were established: Diet and food habits; physical activity and health-related physical fitness; psychological profile; anthropometry; body composition; haematological profile; biochemistry and metabolic profiles; mineral and vitamin profile; immunological profile and genetic profile. All the parameters in each measurement category, excluding genetic profile, were assessed at least at four points: baseline (visit 1), at the end of the intensive intervention (visit 9), at mid point of the overall intervention (visit 13), and at the end of the EVASYON treatment programme (visit 20).[7]

Measurement of food intake

The EVASYON food and nutrition programme involved trained registered dietitians (RD), professionals who were directly responsible for the dietary and nutrition education programme.

At baseline, participants were personally interviewed by an EVASYON Registered Dietician (RD) to evaluate their meal patterns, appetite, food choices and snacking, with specific dietary questionnaires. A detailed dietary history collected information about the family food-shop organization, usual location for meals during the week and week-ends, meal-related habits before starting the therapy or the personal beliefs about the role of food in the family, among others (Additional file 1). It was important for clinicians and RDs to inquire about specific disordered eating attitudes to assess whether they were likely to increase the risk of further eating disorders or weight gain.[22,23]

Moreover, a semi-quantitative food frequency questionnaire (FFQ), previously validated in Spain**,** was administered at the beginning, at six months and at the end of the programme. This tool was used to record usual food frequency consumption according to the standard portion size, energy and nutrient intake, and to detect possible nutritional risks and misbehaviors.[24]

Additionally, a visual analogue scale (VAS score) was used for the measurement of appetite and anxiety-related eating habits[25] (Additional file 2).

After personal interview at visit 1, adolescents and their families received a group session where the RD explained how to complete a 24 h-dietary recall. Pictures of food portion sizes and tables of equivalences

1. Do you usually eat slowly chewing your food properly?
   YES NO
   Do you watch TV when you're eating?
   YES NO
2. Have you eaten out (in a restaurant, pizzeria or fast-food place) one day this week?
   YES NO
3. Have you had breakfast before leaving the house every day this week?
   YES NO
4. Have you had a mid-morning snack every day this week?
   YES NO
   Have you eaten fruit in your mid-morning snack?
   YES NO
5. Have you eaten lunch or dinner on your own one day this week?
   YES NO
6. Have you watched television when you were eating something?
   YES NO
   Can you remember what it was?
7. Have you bought something to eat when you were with friends?
   YES NO
   Can you remember what it was?
8. Do you usually have second helpings when you eat?
   YES NO
   What type of food do you usually have for a second helping?
9. How many times a week do you eat nuts and dried fruit?
   a) Never d) Three times
   b) Once e) Four times
   c) Twice f) More than four times
10. Do you eat at set times? YES NO
    How many times do you eat a day?
    a) Two d) Five
    b) Three e) Six
    c) Four f) More than six
11. Do you usually eat everything that is served on your plate?
    YES NO
    Does it sometimes seem to be a lot of food?
    YES NO

At which meal? a) Breakfast; b) Mid-morning break; c) Lunch; d) Mid-afternoon break; e) Dinner.

Additional file 3.—Dietary record model.

were used to illustrate the size of usual servings. This information helped the participants to fill in the 72 h dietary record. The data were transformed into grams or milliliters and were processed with an "ad hoc" computer programme, using validated food composition tables from Spain.[26,27]

In different patient assessments (visits 1, 9, 13 and 20) other dietary questionnaires were used to survey information on the adherence and challenges to the programme. A specific dietary record explored food habits that could be modified during the therapy (Additional file 3). Also, the survey for compliance with the diet contained two sections. The first part collected information on the food frequency intake of the main food groups, and favorite foods (but supposedly not healthy items) for adolescents such as sweet drinks, alcohol, cakes and fast food. The second part gathered information on meal-related habits and psychological aspects [Additional file 4]. A brand name FFQ and

Part A:

1. Do you have olive oil? Do you know how much you have every day? (including oil used for cooking, meals out, salads, etc)
2. How many portions of vegetables and greens do you have every day?
3. How many pieces of fruit (including fresh fruit juice) do you have every day?
4. How many portions of red meat, hamburgers, sausages and spicy cold meats do you have every day?
5. Do you sometimes eat between meals? What sort of food do you eat then?
6. How many carbonated and/or sugary drinks (soft drinks, sodas, colas, pop, lemonade, etc.) do you have every day?
7. Do you drink any alcohol? How many alcoholic drinks do you have during the weekend?
8. How many portions of legumes do you have a week?
9. How many portions of fish or seafood do you have a week?
10. How many times a week do you eat bought shop cakes (not homemade) and similar sweet products like biscuits, caramel custards, cakes, confectionary etc?
11. Do you prefer to have food like chicken, turkey or rabbit rather than red meat, pork, hamburgers or sausages?

Part B

1. Do you usually eat slowly taking time to chew your food properly? Do you watch TV when you eat?
2. Have you eaten out (in a restaurant, pizzeria or McDonalds) one day this week?
3. Have you had breakfast before leaving the house every day this week?
4. Have you had a mid-morning break every day of the week? Have you had fruit for your mid morning break?
5. Have you eaten lunch or dinner on your own any day this week?
6. Have you watched TV when you were eating? Can you remember what it was?
7. Have you bought something to eat when you were with friends? Can you remember what it was?
8. Do you usually have second helpings? What sort of food do you have second helpings of?
9. How many times have you eaten nuts and dried fruit this week?
10. Do you eat your meals at set times? How many times do you eat a day?
11. Do you usually eat everything that is served onto your plate? Does it sometimes seem too much?

Additional file 4.—Survey for compliance with the diet.

also, the VAS score and the 72 h dietary record were completed in each assessment.

Assessing energy, nutritional requirements and calorie restriction

The International Obesity Task Force (IOTF) body mass index (BMI) cut-off values were used for the diagnosis of overweight and obesity in the adolescents.[28] To determine basal metabolism rate (BMR), Schofield's et al. (1985) equation was used,[29] where the value of 1.3 was assumed as the activity factor to obtain

the total daily energy expenditure (TEE) for most subjects.

The BMI value was normalised to the standard deviation score. The restriction percentage was calculated as follows: If Z = 2-3, the TEE was reduced by 20%; if Z = 3-4, it was reduced by 30%; and if Z > 4, TEE was reduced by 40% and on this basis, a daily calorie restriction range was established. In no case were the diets lower than 1,300 kcal or higher than 2,200 kcal. Furthermore, energy restriction acted as a method to correct the excessive food portions consumed with reference to age, sex and physical activity level. At the end of each dietary period, it was necessary to adjust the equations according to the current body weight and the basal metabolism rate was measured to identify possible shifts in energy consumption/expenditure.[30]

Dietary intervention strategy and exchange list guidelines

The intensive treatment programme with a moderate calorie restriction was divided into two subphases: three weeks (visits1 to 3) consisting of fixed full-day meal plan according to the criteria described above, and the next six weeks (visits 4 to 9) consisting of fixed full-day meal plan with food choices. During the extensive intervention period (visits 10 to 20), the adolescents were assigned to a flexible meal plan with food exchanges, maintaining a balanced diet according to sex and age. Daily energy distribution was based on the school period promoting breakfast and avoiding multiple snack consumption along the day. Therefore, dietary patterns maintained a typical distribution of 3 main meals (breakfast providing 20% of daily calories, lunch with 30-35%, and dinner with 20-25% of daily calories) and 2 snacks (mid-morning 5-10%, and afternoon 10-15% of daily calories).[20,31] The diets were designed in accordance with the proportions of macronutrients recommended by the Food and Nutrition Board of the National Research Council: carbohydrates 50-55% of total daily energy intake (EI) (sugars < 10%); fats 30-35% of EI (10-20% monounsaturated, <10% saturated, 7-10% polyunsaturated); cholesterol < 300 mg /day, and proteins 10-15% of EI.[32]

The initial objective of the intervention was to join both adolescents and their families in the nutritional treatment; therefore, they received an energy-adjusted full-day menu for three weeks, to achieve the established calorie and nutrient objectives. The meal plan specified all daily meals, the type of foods to include with serving sizes (expressed in grams or individual portions), the garnishes, tips for healthy cooking, and daily bread and oil servings (table I).

The second meal plan used in EVASYON programme consisted of full-day menus with food choices structured similarly to the diets used before, but specifying the main food group and the serving size, and with the possibility to choose from a list of specific foods. In this context, the meal plans became an easy tool for the family to acquire a degree of self-sufficiency selecting healthy foods and to develop healthy habits for making good decisions for the family's well-being (table II).

Table I
Example of one-day detailed meal plan (1,700 kcal) in the first three weeks of the intensive intervention

	Day 1
Breakfast	1 bowl semi-skimmed milk 2 small slices bread with natural tomato + 15 g ham 125 g kiwi
Mid-morning snack	150 g pear 30 g cereal bar
Lunch	200 g courgette purée (150 g courgette + 50 g onion + 80 g potato) 90 g grilled turkey + 100 g grilled green asparagus 30 g bread Low-fat yoghurt
Afternoon snack	175 g orange 3 pieces Melba toast + 30 g low fat cheese
Dinner	200 g mixed salad Plain omelette (1 egg) + 30g tin natural tuna 30 g bread 100 g banana
Others	Oil: 30 g/day (3 tbsp.)

The next step in the extensive body-weight maintenance programme was the full-day meal plan with exchanges. The exchange lists system used in the EVASYON study was based on the unification of nutrients (carbohydrates, proteins and lipids) and calories taking into account normal Spanish foods and serving sizes.[33] The serving sizes of listed food items corresponded to an average of the amount of calories, carbohydrates, proteins and fats supplied, thus, any selection within a food group covered the same energy and macronutrient content.[34] Based on the daily established energy requirements per person, the number of exchanges for each food group was quantified, following the dietary guidelines of food consumption in Spain.[35] This method helped professionals generate uniformity in exchange conversions for recipes and food labels, in order to adapt family and personal food habits. On this basis, meals described the main food groups to be included, and each group was broken down into a list of foods with appropriately exchangeable food-portions (servings expressed in grams and home measures). This system gave flexibility and diversity to the diet and the family became responsible for programming the weekly menu by applying the acquired knowledge[36] (table III).

Table II
Example of one-day meal plan (1,700 kcal) with food choices during weeks 4 to 9 of intensive intervention

	Day 1	*Food groups*		
Breakfast	Milk Cereal + 15 g Ham Fruit	Cereal	Breakfast and mid-morning snack	30 g cereals 2 slices bread 45 g bread (normal or whole-grain) 4 pieces Melba toast 4 Marie biscuits
Mid-morning snack	Fruit Cereal		Afternoon snack	20 g cereals/1 cereal bar 1 sliced bread 30 g bread (normal or whole-grain) 3 pieces Melba toast 3 Marie biscuits
Lunch	200 g vegetable purée (with 80 g potato) 90 g white meat + 100 g vegetables 30 g bread yoghurt	Dairy products	1 glass of semi-skimmed milk 1 low-fat yoghurt (natural, flavoured, with fruit…)	
		Vegetables	Cooked vegetables: borage, artichoke, green beans, vegetable stew, chards, spinach, courgettes, auberginies, mushrooms, peppers (grilled or sautéed). Raw vegetables: lettuce, chicory, escarole, asparagus, natural tomato, carrot, beetroot, celery….	
Afternoon snack	Fruit Cereal + 30 g low-fat cheese	White fish	Hake, grouper, sole, young hake, halibut, gilthead, bream, sea bass, trout, codfish, conger, cuttlefish, prawns.	
Dinner	200 g varied salad 1 egg + 30 g tin natural tuna 30 g bread Fruit	Pulses and starches	Lentils, beans, chickpeas, peas, broad beans, soya beans. Baked, boiled or micro-waved potato.	
		Egg	Omelette, hard-boiled egg, scrambled eggs, poached egg	
		White meat	Chicken, turkey, rabbit , partridge, quail	
Others: Oil	Oil: 30 g/day (3 tbsp)	Cold meat	Boiled ham, turkey breast or lean cured ham.	

Assessing nutritional knowledge

The understanding of the environmental influences, parents' habits, health concerns and the association within nutritional knowledge and food choices, is relevant to develop effective youth obesity prevention strategies.[36,37,38] At baseline, the EVASYON adolescents were requested to complete information about basic nutrition concepts, healthy eating and the relationship between several foods items and the corresponding food group to analyse their nutritional knowledge and food preferences (Additional file 5).

Nutritional assessment and educational materials

The intensive programme included weekly in-person visits with the RD to control the understanding and the fulfillment of the dietetic patterns and lifestyles, to answer possible doubts and to motivate the participants with the previously one-week established objectives. After this, group sessions took place, where the RD emphasized dietary knowledge, teaching of behavioural-change techniques and motivational, life and time management strategies, as well as the importance of the compliance with healthy habits and family support.

Educational materials were developed for EVASYON study to support the dietary treatment targets, such as the childhood food guide pyramid, pictures of portion-sizes, cooking techniques, basic concepts for planning healthy menus, etc., which were available on the EVASYON webpage.[39] Similarly, all the incidences and changes related to lifestyle were recorded in a notebook of guidance to be reviewed by the RD in the next interview. A practical guide with recommendations for controlling body weight was handed out to families.

During the extensive body-weight maintenance period, adolescents attended monthly in person follow-up visits with the RD. They and their families received group sessions on different aspects such as diet, physical activity, healthy habits and weight maintenance skills, how to engage in healthy weight control behaviors and relapse prevention. Objectives were planned to be accomplished on a one-month basis. Other studies have reported successful results following these strategies.[40]

Table III
Example of a meal plan (1,700 kcal) with food exchanges for the extensive intervention

	Food	*Quantity*	*Portion*
Breakfast	*Dairy products*	*Choose one among:* 240 g semi-skimmed milk 250 g low-fat Yoghurt	 1 bowl 2 units
	Cereals	*Choose one between:* 45 g bread (normal/sliced) 37 g Melba toast 22 g Marie biscuits 30 g cereals/cereal bar	 1 big slice bread or 2 small 4 units 3-4 units 3 tbsp
	Fruit	*Choose one among:* 175 g orange, peach, strawberries 150 g apricot, tangerine, pear 125 g kiwi, apple, pineapple. 75 g banana	 1 small unit/medium-sized
Mid-mornink snack	*Fruit*	*Choose one among:* 175 g orange, peach, strawberries 150 g apricot, tangerine, pear 125 g kiwi, apple, pineapple 75 g banana	 1 small unit/medium-sized
	Cereals	*Choose one among:* 45 g bread (normal/slice) 37 g Melba toast 22 g Marie biscuits 30 g cereals/cereal bar	 1 big slice 4 units 3-4 units
	Protein	*Choose one among:* 15 g boiled or cured ham 15 g semi-fat cheese or 30 g low-fat white cheese	 1 slice 1 small portion
Afternoon snack	*Cereals*	*Choose one among:* 30 g bread (normal/slice) 25 g Melba toast 15 g Marie biscuits 20 g cereals/cereal bar	 1 medium-sized slice 3 units 2-3 units 2 tbsp
	Dairy products	*Choose one among:* 125 g low-fat yoghurt 120 g semi-skimmed milk	 1 unit 1 small glass
	Protein	*Choose one among:* 15 g boiled or cured ham 15 g semi-fat cheese or 30 g low-fat white cheese	 1 slice 1 small portion

Table III *(cont.)*
Example of a meal plan (1,700 kcal) with food exchanges for the extensive intervention

Food	*Quantity*	*Portion*
First course: *choose one among*		
Vegetables	200 g raw or 240 g boiled (green beans, cauliflower, leeks, natural tomato, courgettes, lettuce, pepper, chard, thistle…) + 80 g raw or 90 g boiled potato	1 medium-sized plate (the potato reduces by 30 g the total amount of bread)
Cereals	*Choose one among:* 50 g uncooked or 175 g boiled pasta 50 g uncooked or 140 g boiled rice 200 g raw or 225 g boiled potato	1 medium-sized plate
Second course: *choose one among:*		
Protein	**Lunch** *Choose one among:* 120 g raw or 105 g cooked white or oily fish. 90 g raw or 70 g cooked lean meat (chicken, turkey, veal, rabbit, pork loin)	
	Dinner *Choose one among:* 80 g raw or 70 g cooked white or oily fish 60 g raw or 45 g cooked lean meat 60 g egg + 30 g ham or 40 g tin natural tuna 120 g low-fat fresh cheese or 60 g reduced-fat cheese (Cottage cheese, fromage frais, Quark, Spanish Burgos and Manchego, cheese triangles, Roquefort…) 60 g boiled or cured ham 30 g ham + 30 g reduced-fat cheese or 60 g fresh cheese + 30 g ham	1 unit + 1 ½ slices 2 medium-sized slices 2 small portions 3 fine slices
*Pulses** (Choose 1 dish of vegetable for first dish)	90 g uncooked or 225 g boiled: beans, chickpeas, lentils or 60 g uncooked legumes + 30 g ham 300 g uncooked or 360 g boiled fresh peas or 200 g raw + 30 g ham	1 big plate
*Garnish** (when the first course is cereal)	100 g raw or 120 g boiled vegetables	1 small plate
Others		
Bread (Distribute between lunch and dinner)	60 g bread or 30 g (when vegetable + potato are eaten)	2 medium-sized slices
Olive oil	Total day: 30 g	3 tbsp
Dessert: *Choose one among:*		
Dairy products	*Choose one among:* 125 g low-fat yoghurt 120 g semi-skimmed milk	1 unit 1 small glass
Fruit	*Choose one among:* 175 g orange, peach, strawberries 150 g apricot, tangerine, pear 125 g kiwi, apple, pineapple 75 g banana	1 small unit or medium-sized

Discussion

The EVASYON study is a multidisciplinary and multicentre programme for overweight/obese adolescents that involved the management of dietary habits, physical activity and psychological profiles, in order to lower adiposity and prevent the development of chronic adult disease related to obesity such as diabetes, hypertension, and metabolic syndrome.

The EVASYON nutritional programme was monitored by RDs as practitioners qualified to implement and evaluate nutritional assistance programmes targeted at improving the nutritional status of the population.[41] These professionals were previously trained

Classify the following foods into main food groups (cereals, vegetables, fruits, dairy products, meat, fish, pulses, dry fruits, cold meats, fats, pastries, sweets):

Lentils	Rice	Chard	Carrots
Banana	Green beans	Sardine	Leek
Chickpeas	Sole	Kiwi	Cauliflower
Sponge cake	Cookies	Chicken	Cabbage
Olive oil	Veal	Lettuce and tomato	Macaroni
French Omelette	Pork loin	Beef liver	Yogurt
Rabbit	Orange	Noodle soup	Pear
Sirloin steak	Milk	Apple	Beans
Boiled ham	Courgette	Grapefruit	Pineapple juice
Nuts	Cured ham	Sliced bread	Strawberries
Marmalade	Butter	Sugar	Borage
Cheese	Croissant	White bread	Hazelnuts
Peanuts	Lemon	Salmon	Potatoes
Hake	Spinach	Crème caramel	Cardoon

Which three do you like best?

Which three do you like least?

Do you know what the following are: *Proteins, Carbohydrates, Lipids, Vitamins and Minerals?* (Explain them briefly).

How would you define the term *Balanced Diet?*

Additional file 5.—Nutritional Knowledge survey.

according to the work plan of the project with specific workshops and seminars, in order to reduce inter-individual (inter-centre) variations. Moreover, the teaching material and protocols for the different worksheets of the project were available for all centers through a continuously updated website.[39]

Many different approaches and therapies have been proposed for weight loss treatment in obese and overweight children.[15,42,43,44] Unbalanced hypocaloric diets or very low calorie diets probably lack essential vitamins and minerals and should not be recommended during the period of growth.

Programmes including moderate calorie restriction and physical exercise have achieved better results than diet only, showing decreases in total body fat mass, and cardiovascular risk factors, maintaining total body fat-free mass, as well as improving insulin sensitivity and lipid profile, such as an increase of high density lipoprotein cholesterol fraction (HDL-c) levels.[16,43,45,46,47,48] The magnitude of the energy restriction together with the duration of the trial are always a challenge, but more especially in this population group. In adolescents, energy requirement and micronutrient intake are critical issues for appropriate growth and development.[33] Our strategy consisted of a moderate calorie restriction for a limited period of time (9 weeks) followed by a maintenance period with a balanced non calorie-restricted diet. In the literature, trials with obese adolescents used different calorie restriction ranges varying from 600 kcal/day to 1,800 kcal/day.[15,43,49,50] In the current study, a supply of total energy between 1,300 kcal/day and 2,200 kcal/day for participants was indicated according to the degree of obesity.

It is important to mention that breakfast apparently provides considerable protection for future obesity in adulthood.[51] We strongly recommended three food groups (dairy products, cereals and fruit) to be included in menus.[33,52] Semi-skimmed milk, low fat yoghurts and fresh cheese were also recommended as healthy choices to cover the daily needs of calcium, and contribute to the protein content of the diet.[20]

Moreover, over the last few years, the type of dietary fat has been receiving more attention regarding its association with obesity and its co-morbidities. Participants were advised by RDs to remove meat fat before cooking, reduce cold meats, and margarines, shortenings, pastries and industrial cakes which contain saturated and hydrogenated fats.[20,33]

Due to the large evidence on the protective effect of olive oil on body weight and lipid control,[53,54] olive oil was recommended as the principal fat source for cooking and dressing meals. To complete the daily nutrient requirements with healthy foods, common choices presented in menus for dinner were vegetables and salads, soups, cereals, eggs, fish and lean meats while for dessert fresh fruit or yoghurt were encouraged.

Furthermore, observational data support that consuming large portions of energy-dense foods could play a role in the etiology of obesity.[6,55] A reduction in the consumption of canned juices and soft drinks containing excess sugar and additives, meat servings, eating away from home, and portion size[33,56] should be

encouraged together with increased consumption of moisture-rich foods such as fruits and vegetables, legumes, fish and cereals. These messages seem to be effective in preventing weight gain and promoting weight loss.[6,44,55,57]

In conclusion, the dietary intervention of the EVASYON programme was developed to improve nutritional education in order to achieve food behavior modification. A moderate calorie restriction for a limited period of time seems to be a good strategy in treating overweight/obese adolescent since it is crucial to maintain their appropriate growth and development. Moreover, combining fixed plan with free-choice menus helps adolescent and their families make the right decisions for every day meals.

Competing interests

The author(s) declare that they have no competing interests'.

Authors' contributions

MM and AdM contributed equally to this work. AsM, AmM and CC designed the study and obtained funding. The RDs MM, TR, BZ, PR and PM intensively participated in the dietary intervention study. All authors provided insight into the study design and contributed to the drafts and approved the final version.

Acknowledgements and Funding

The work was completed with the funding from Spanish Ministry of Health and Consumption (Carlos III Institute of Health. FIS. Grant PI 051080, PI 051579). AdM was supported by a grant from the Departamento de Educación del Gobierno de Navarra.

Our research work received the award from AESAN (Spanish Agency for Food Security and Nutrition) from the Spanish Ministry of Health and Consumption for the best applied research project in 2009.

We gratefully acknowledge all adolescent participants and their families who participated in the study. The careful reading of the final English version of the manuscript by Edwards M. (University of Malaga) is sincerely appreciated.

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