

Public health and the prevention of obesity: Failure or success?

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Abstract

In recent decades, obesity has become a major public health problem in developed societies and economies in transition. Rapid social changes that have occurred since the mid 20th century prompted major changes in eating habits and lifestyles, with the gradual abandonment of traditional dietary patterns and culinary techniques, significant decrease in physical activity and increased sedentary time, giving as result in an imbalance in the energy balance. Obesity is a risk factor for many chronic diseases. There is evidence that childhood obesity influences adult health condition. Additionally, obesity in children affects their physical, emotional and social wellbeing. According to some estimates the cost of obesity may represent up to 12% of health cost in some countries. Many actions have been developed since around the year 2000 WHO alerted about the problem. The analysis of the factors involved in the origin of the problem have led to recognize the importance of creating supportive environments for healthier food choices and physical activity to be the easiest and accessible options in common everyday environments, such as schools, workplace or community environment. Evidence is long available that the most effective interventions to prevent childhood obesity should consider multiple strategies and last longer. Today it is also recognized the importance of implementing policies that encourage supportive friendly environments for physical activity and help decisions to opt for healthy eating habits.

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Key words: *Obesity. Children. Prevention. Food habits. Physical activity. Policy.*

SALUD PÚBLICA Y PREVENCIÓN DE LA OBESIDAD: ¿ÉXITO O FRACASO?

Resumen

En las últimas décadas la obesidad se ha convertido en un importante problema de salud pública en las sociedades desarrolladas y economías en transición. Los rápidos cambios sociales acontecidos desde mediados del siglo 20 impulsaron importantes transformaciones en los hábitos alimentarios y estilos de vida, con el progresivo abandono de los modelos alimentarios y técnicas culinarias tradicionales, importante disminución de la actividad física y aumento del tiempo de sedentarismo, dando como resultado un desequilibrio en el balance energético. La obesidad es un factor de riesgo asociado para muchas enfermedades crónicas. En los niños además de condicionar su salud como adultos, afecta su salud física, emocional y social durante la niñez. Según algunas estimaciones el coste de la obesidad puede representar hasta el 12% del gasto sanitario en algunos países. Se han desarrollado muchas acciones desde que en torno al año 2000 la OMS alertara sobre el problema. El análisis de los factores implicados en el origen del problema han llevado a reconocer la importancia de crear ambientes favorables para que las opciones alimentarias y de actividad física más saludables sean las más fáciles y asequibles en las actividades y entornos cotidianos más habituales, como colegios, medio laboral, entorno comunitario. Desde hace tiempo se dispone de evidencia de que las intervenciones más efectivas para la prevención de la obesidad infantil deben contemplar múltiples estrategias y prolongarse en el tiempo. Hoy además reconocemos la importancia de poner en marcha políticas que favorezcan entornos amables que estimulen la práctica de actividad física, favorezcan decisiones que permitan configurar hábitos alimentarios más saludables.

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Palabras clave: *Obesidad. Niños. Prevención. Alimentación. Actividad física. Políticas.*

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Introduction

According to WHO, overweight and obesity is the fifth risk factor for mortality in the world. About 2.8 million deaths yearly are associated to obesity in the world. Furthermore, 44% of the burden for diabetes, 23% for ischemic heart disease and between 7% and 41% for certain types of cancer are attributable to excess body weight.

In Spain the prevalence of overweight and obesity has steadily increased in the last decades. Data from studies based on individually measured body weight and body height on random population samples from different age groups show that the prevalence of obesity around the year 2000 was higher in boys than girls in childhood and adolescence up to 25 years. From this age onwards, particularly from 45 years the prevalence of obesity rises with age in women and rates are clearly above those in men. The prevalence of obesity rises with age in men from 45 years as well, although more slowly.¹

Among the school age population, data estimated in the PERSEO project in 2009 in the Autonomous Regions involved show a significant increase in the prevalence of obesity between 6 and 12 years in Andalusia, Murcia, Extremadura and Galicia compared to previous data measured between 1998 and 2000, regions which already showed high rates then. However, the prevalence of obesity has considerably increased in the same age group in regions such as Castilla-Leon with moderate-low prevalence rates in 2000. The Canary Islands showed the highest rate in 2000 and the prevalence is still high, but has not increased. These figures are consistent with estimates in the Aladino study in a national sample of the same age group in 2010.

In the international context, the prevalence of obesity in Spain in adults is slightly below average estimates for OECD countries. Prevalence of excess body weight in Spanish children and adolescents, however, is clearly above the average estimates for OECD countries for this age group, 22.9% for girls and 32% for boys aged 5-17 years, according to data published by IASO.²

In Western Australia body mass index is the leading risk factor for disease, above tobacco. If estimated projections become true most, adults in the world will be overweight or obese by the year 2030. A systematic review including studies from 25 countries analysed obesity trends since 1999. Results show a steady increase in the problem. This trend can be observed both in European and in Asian countries. In America, evolution trends of obesity rates is associated with race and ethnicity; thus obesity has increased in non-Hispanic American blacks and Mexican women, while the trend is changing in other population groups.⁴ Figure 1 shows standardized rates of overweight (including obesity) and projected trends according as estimated by the OECD.

Despite the prevalence of obesity in adults is increasing in most countries in the world,⁵ some studies suggest decline is starting in children, as shown in a review including data from 9 European countries, North America, Asia and Oceania⁶ maybe a result of Public Health interventions.

Body Mass Index (BMI), health indicators and health costs

Different analyses on the impact of low BMI and high BMI on disease and survival have been conducted.

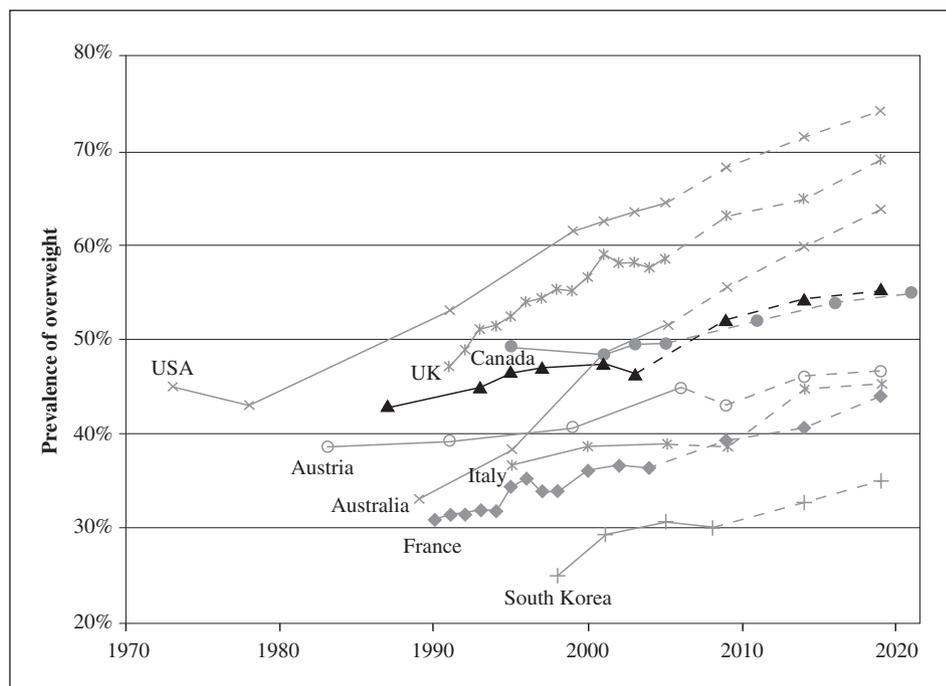


Fig. 1.—Standardized rates of overweight (including obesity) and projected trends. Source: OECD, 2012.

According to the analysis based on the “Prospective Studies Collaboration”,⁷ including data from 57 studies from Western Europe and USA (n = 894.576), mean age: 46 years; 61% males and BMI: 25 kg/m², BMI is a strong predictor of overall mortality. In this study each 5 kg/m² higher BMI was on average associated with about 30% higher overall mortality, 40% for vascular mortality, 60-120% for diabetic, renal, and hepatic mortality, 10% for neoplastic mortality and 20% for respiratory. The authors concluded that mortality was lowest at BMI about 22.5-25 kg/m². The progressive excess mortality above this range is due mainly to vascular disease. At 30-35 kg/m², median survival is reduced by 2-4 years; at 40-45 kg/m², it is reduced by 8-10 years, comparable with the effects of smoking. The excess mortality below 22.5 kg/m² is due mainly to smoking-related diseases, but is not fully explained⁷.

A recent meta-analysis of reported hazard ratios of all-cause mortality for overweight and obesity relative to normal weight in the general population included 97 studies providing a combined sample size of more than 2.88 million individuals and more than 270 000 deaths. Relative to normal weight, both obesity (all grades) and

grades 2 and 3 obesity were associated with significantly higher all-cause mortality. Grade 1 obesity overall was not associated with higher mortality, and overweight was associated with significantly lower all-cause mortality, suggesting that the main contribution to excess mortality in obesity comes from higher levels of BMI, equal or above 35.⁸

Regarding health care costs attributable to overweight and obesity, the Bernard Krief Institute published a report in 1999 about the cost of obesity in Spain and estimated the health expenditure associated to obesity to account up to 7% of total health care costs in the country. These estimates could likely add up to 9% to date considering pharmaceutical treatments used without a prescription, herbal remedies, especial dietetic products and private consultants and clinics. Table I summarizes the impact of childhood obesity on physical, emotional and social health.

Obesity and overweight have been shown to increase the rate of several common adverse medical conditions, resulting in economic costs of \$300 billion per year in the United States and Canada. These costs result from an increased need for medical care and the loss of

Table I
Impact of childhood obesity on health

<i>Physical Health</i>	
Impaired glucose tolerance	Hyperinsulinemia: OR: 12.1
Type 2 diabetes	In the USA, ↑ 10 times diabetes prevalence in children (1982-1994)
Metabolic syndrome	Present in 30% of obese children (USA)
Hypertension	Almost 60% of children with hypertension are obese TAS: OR 4.5; TAD: OR 2.4
Dyslipemia	↑ LDL: OR 3.0; ↓ HDL: OR 3.4; ↑ TGC: OR 7.1 58% of obese children has 1 cardiovascular risk factor; 25% ≥ 2 RF
Hepatic steatosis	>10% of obese children
Cholelithiasis	Approx. 50% of cases are associated with adolescent obesity. ↑ 75% (1979-1999)
Sleep Apnea	↑ 175% (1979-1999)
Asthma	40% of hospital admissions are associated with obesity
Menstrual disorders	30% of women with polycystic ovary syndrome are obese
Orthopedic disorders	Flat feet, genu valgum, Blount disease, (two thirds of cases occur in obese),...
Emotional Health	low self-esteem
	Negative body image
	Depression
Social Health	Stigmatization
	Negative stereotypes
	Bullying
	Marginalization and isolation

Sources: Dietz WH. *Pediatrics*, 1998; Reilly JJ et al. *Arch Dis Child*, 2003; NAS. *Preventing childhood obesity*, 2005; Wang G; Dietz WH. *Pediatrics*, 2002.

economic productivity resulting from excess mortality and disability. It has been reported that more than one quarter of America's health care costs are related to obesity and that health care costs of obese workers are up to 21 percent higher than non-obese workers.⁹ A systematic review of costs associated with obesity or intervention programs in Canada between 1990 and 2011 referred that direct costs accounted for 37.2% to 54.5% of total annual costs and between 2.2% and 12.0% of Canada's total health expenditures were attributable to obesity.

The costs of obesity in American children has been estimated to account for 9% of health care costs, and a considerable increase has been reported compared to estimates a decade ago (1-6%). Preventive interventions for childhood obesity are estimated to account for 5% of health care costs.¹⁰⁻¹² In addition to that, disturbances related to emotional and social health caused by obesity in children and adolescents should be considered as well.

Actions to control obesity

Awareness about the obesity situation has improved, at least in terms of the number of policy programs, guidelines and strategic plans. Since the WHO published the obesity report in 2000, defined obesity as an epidemic and one of the more relevant public health problems, a lot of efforts have been invested in the design of effective strategies to combat excess body weight and reverse trends.

In 2004 WHO published the Global Strategy on Diet and physical activity for health after a long development process. The initiative engaged all member states to take action and adopt national strategic plans and local actions in line with the agreed strategy.¹³

Additional documents in the same direction have been prepared by expert committees and agreed by member states from different international organizations. Some examples to mention include the European Charter on counteracting obesity published in the context of the WHO European Ministerial Conference on counteracting obesity, diet and physical activity for health, held in Istanbul (Turkey), 15-17 November 2006; the Commission of the European Communities White Paper on a Strategy for Europe on Nutrition, Overweight and Obesity related health issues, 2007¹⁴ or the report Obesity and the economics of prevention: fit not fat, carried out jointly by the OECD and the World Health Organization and discussed by Health Ministers at a meeting held in Paris in October 2010.¹⁵

In September 2011 the United Nations general Assembly held a high-level meeting on non-communicable disease prevention and control in New York. The General Assembly adopted by consensus the resolution titled "Political Declaration of the High-level Meeting of the General Assembly on the Prevention and Control of Non-communicable Diseases". The Action Plan for

implementation of the European Strategy for the Prevention and Control of Non-communicable Diseases 2012-2016 consider priority interventions the reduction of trans fatty acids and salt intake as well as the promotion of healthier food habits by means of fiscal policies,¹⁶ and the WHO Action Plan 2008-2013 for the implementation of the world strategy for the prevention and control of non-communicable diseases.

The Ecological Model: Policies, environments and behaviours

To design strategies to counteract obesity it is important to consider the origins of the problem. Since the middle of the 20th century and particularly in the last third of the last century rapid sociological changes took place with great impact in life styles and the organization of everyday life in many countries: urbanization processes and progressively abandonment of rural areas, women incorporation into the work force which brought changes in family life with an impact in family meals, the time devoted to the acquisition of food, food preparation and consumption or even the way foods and beverages are consumed; changes in the systems of food production and distribution with a huge growth in the industries related to this sector; transformation in the marketing and publicity strategies as well as the means used; improvements in wellbeing and welfare society, among other considerations.

All these modifications influenced life styles of children, adolescents and adults driving to changes in food habits, a considerable reduction in usual physical activity in a high proportion of the population and an increase in the time devoted to sedentary activities. At the same time, traditional food patterns, cooking styles and traditional recipes have been gradually replaced by food preparations requiring short time to be ready and increasing consumption of either in part or just ready to eat foods and beverages as well as more frequent consumption of foods away from home, in commercial restaurants, canteens, school meals, workplaces or institutions.¹⁷

This analysis of the current situation implies the recognition that food consumption patterns and individual physical activity are significantly influenced by the environment in which we live, by the supply of food and drinks available in the environments in which we develop daily activities —study, work, leisure—, by the possibility of access to safe and friendly environments to practice physical activity, walking, etc.. In this context we are also influenced by the social groups with which we interact, closer groups which are more relevant such as the family, the school or the group of friends; other social influences are more distal as fashions, trends or the community in which we live.

From this point of view, the Ecological Model of behavior change has been accepted. The model recognizes the interaction between the environment and the

different behaviors as a theoretical model of reference for planning strategies for the prevention of obesity. In fact, the WHO recognizes that to support people in the process of making choices, so that in relation to eating and physical activity the healthier option is also easy to access and simple, it is essential to create favorable environments in the areas in which normal daily activities are performed, the community where we live, where we study, where we work or where we enjoy leisure time and rest. Policies, norms, regulations and social agreements at different levels are essential to create healthier environments. In this framework the different social groups interact and finally, individuals make choices and take decisions based on their personal motivations, attitudes, information and beliefs.¹⁸

Initiatives to improve nutrition and prevent obesity and its complications in different countries

With this approach different strategies have been tested in different countries. Incentives to encourage healthy behaviors, such as reducing taxes for families participating in sports (Canada) and use of financial disincentives to discourage unhealthy behaviors, such as quotas for each employee that exceeds the acceptable limit of waist circumference (Japan). Initiatives to increase the variety and quality of food supply have also been launched, such as fruits and vegetables in socioeconomically disadvantaged environments or in isolated and distant areas (UK, USA), regulation of access to food and beverages high in fat, sugar or salt in schools (France, Spain, USA, etc.), regulations to influence consumers purchasing decisions of food and drink, such as changes in food labeling as the multiple traffic light (UK), or the Healthy Choices symbol (The Netherlands), control and regulation of food and beverage advertising by self-regulatory codes and other measures (Spain, UK, etc.), creating communities that support healthy eating and physical activity, with initiatives such as the EPODE program in France and other countries; Shape-UP Sommerville in the U.S. and other community interventions implemented in the U.S. and in Australia.¹⁹⁻²¹

In other cases, as some U.S. states have been proposed regulations governing minimal time devoted to physical activity at school. Other interventions have regulated care to people with overweight or eating behavior disorders, or even regulating the systematic collection of information on weight and height in certain conditions for surveillance purposes, for example in France aimed at school population. Table II shows policy approaches for obesity prevention implemented in different countries.

Overall policies are aimed at promoting changes in the environment so as to generate spaces (time and place), safe and friendly routes to encourage the practice of physical activity and facilitate the provision of food and beverages that enable the practice of healthy

eating habits as the most easy and accessible option. Some of these interventions have promoted changes in the menus offered in school canteens or in the repertoire of foods and beverages offered at the outlets inside school buildings or sports or leisure centers for children and youth. Other initiatives have regulated the nutrition information on food labels so that it is easier to understand to consumers and help them to make informed choices of food and beverages in line with healthy eating patterns, for example quantitative advice and graphics as the multiple traffic light or symbols like the healthy choices logo or the green lock²² In some countries fiscal policies have suggested either to add taxes to certain foods and drinks high in energy density or reducing others, such as fruits and vegetables to encourage their consumption.²³

Moreover, policies should also be directed at promoting individual behavior change towards the adoption and practice of healthier eating habits and physical activity from local environments.^{17,19,21}

In this sense, both the Global Strategy on Diet, Physical Activity and Health (DPAS) and PAHO include the following among the key interventions to reduce the burden of obesity and chronic diseases through dietary changes: promoting and protecting exclusive breastfeeding until six months of age, increasing the availability, accessibility and consumption of plain water, reduce the consumption of sugar and fat in drinks, reduce consumption and the amount of added sugar in foods, reduce saturated fat intake and eliminate the consumption and production of industrial trans fats, increase the consumption of vegetables and fruits, increase consumption of whole grains and fiber in the diet, reducing sodium intake, reduce portion sizes in restaurants and outlets selling prepared foods and processed foods, increase nutrition for health literacy and increase the capacity of responsible decision-making about a healthy diet in the population.

Strategy for Nutrition, Physical Activity and Obesity Prevention (EsNAOS)

Following the commitments made with the approval of the DPAS, in 2005 Spain adopted the Strategy for Nutrition, Physical Activity and Obesity Prevention (EsNAOS),²⁴ an ambitious strategic plan that marked the lines of action in subsequent years, which considered the implementation of measures such as nutrition education programs, improving the food supply in school canteens; limiting the availability of energy-dense products in vending machines located in the school environment, promotion of school sport activities, control of food and beverage advertising aimed at children; adequacy of the nutritional composition of products mainly in the content of salt and trans fats and the development of protocols for primary care. All these lines of action focus on actions in three main areas. In the family and community environment through infor-

Table II
Policy approaches for obesity prevention implemented in different countries

<i>Policy</i>	<i>Description</i>	<i>Country</i>
Incentives to motivate healthy behaviours; Financial disincentives to discourage certain less healthy behaviours	Tax reduction for families participating in sports	Canada
	Added fees in companies contribution to national insurance for each employee exceeding the acceptable limit for waist circumference	Japan
Requirements to improve food quality, food diversity and availability	An initiative was issued in New York city to increase permits for sale of fruit on sidewalks in neighbourhoods with high rates of poverty	USA
Restricting access to unhealthy foods	Elimination of sugary drinks in schools	France, USA
Regulations focused on influencing consumer choice	The voluntary traffic light system in highly visible image on the front of food packages	UK, Australia
Regulation of marketing and advertising	NAOS Strategy. Self-regulation of advertising codes. Development of dietary guidelines for families, schools and businesses	Spain
Creating communities that support healthy lifestyles	EPODE. Community intervention to prevent childhood obesity, based on 4 pillars: 1) Political support at the highest level, 2) a solid scientific basis, 3) social marketing and 4) multi-stakeholder participation. Program "Shape-Up Somerville". Initiative by Tufts University and the City of Somerville in Massachusetts to promote physical activity and healthy eating	France European Unión USA
Stipulation of minimum requirement of physical activity (work places) and physical education (school setting)	Norms in Connecticut and Kentucky in the US to regulate a minimum daily physical activity in school children	USA
Mandates for health care coverage of overweight and obesity by insurance companies	Law requiring social work and health insurance companies to provide coverage for eating disorders such as obesity, bulimia and anorexia. Anti-discrimination Act of obesity in Georgia, requires insurers to cover treatment for morbid obesity in their insured	Argentina USA
Mandates to generate resources for government use	Law determining the measurement and reporting of body weight and height in schools	France

mation campaigns, creation of working groups at regional and municipal levels and collaboration with entertainment companies and toy manufacturers and advertisers.

At school level the NAOS Strategy includes three main lines of action: nutrition education through the school curriculum, specific workshops and promoting teacher training in this area; regulation and supervision of food supply and operation of school canteens and regulation of the supply of food and beverages through vending machines located in schools. It also focuses on physical activity in schools.

In all lines of action specifically the strategy considers participation, meeting spaces and negotiation with key stakeholders: federation of parents associations, business associations of affected sectors: food and beverage manufacturers, catering, vending, commercial distribution, as well as the scientific and professional associations concerned.

NAOS strategy considers especially the industrial sectors involved through the establishment of agreements with the Spanish Federation of Food and Drink Industries (FIAB) and commercial distribution companies: ANGED or ASEDAS. Results of these collaboration agreements was the adoption and implementation

of the code of self-regulation of food and beverage advertising aimed at children PAOS, supporting the design and implementation of dissemination of the Strategy; Trade policies in the products of "own brand" or Development of advertising and promotion of food under the NAOS Strategy. In July 2011, the Parliament approved Law 17/2011, of 5 July, Food Security and Nutrition and a few months later was published a consensus document on food in schools.

Intervention studies conducted in Spain

Apart from PERSEO Project,²⁵ statewide, different intervention proposals have emerged aimed at the prevention of obesity. The study of Cuenca and the Four Provinces study investigated the association of adiposity on cardiovascular risk factors in childhood and youth. These studies were used as starting point for the implementation of a research project aimed at evaluating the effectiveness of an intervention to promote leisure-time physical activity in order to prevent overweight/ obesity and other cardiovascular risk factors in schoolchildren. The results after two years of implementation of the

project in 10 schools in Cuenca were encouraging with a 6% reduction in the prevalence of obesity in girls and 2% in boys and a substantial improvement in the lipid profile.

Thao-Salud is inspired EPODE, a program started in France in 2004. This initiative was launched based on the experience carried out in two northern cities of France, Fleurbaix and Laventie in 1992. These experiences revealed that the actions in schools and in the city have a positive impact and may slow the progression of the prevalence of obesity and overweight in children. EPODE Program (“Ensemble Prévenons l’Obésité Des Enfants”) started in 10 pilot French cities lead by the French communication agency. Thao-Child Health began in 2007 in five pilot municipalities. This is a program to promote healthy habits at the municipal level. The program is targeted to school children of 3-12 years involving all local actors in contact with the children. Since 2010, it has begun to develop a specific program for children 0-3 years.²⁶

The project strategy includes a first step of information and awareness campaigns aimed at local stakeholders through communication strategies. In a second phase begins intervention in schools. It provides a component for secondary prevention aimed at health professionals and families with overweight children.

“Kids in Motion” is a structured program aimed at modifying eating habits, lifestyles and emotional aspects in obese children (6-12 years) and their families. The results show a decrease in BMI, an increase in the quality of the Mediterranean diet, and less anxiety. Ability was observed for long-term follow-up in 59% of the population.

Almost all the Autonomous Communities are developing activities or projects of nutritional epidemiology and prevention of obesity.

PERSEO project

The PERSEO project has been based on the development of a community intervention program focused on the school environment with involvement of students, teachers, families and community environment, with the overall objective to promote better eating habits and adequate physical activity in the school population. PERSEO seeks to achieve a school and family environment conducive to the practice of healthier eating habits and physical activity in Primary school children, promoting increased consumption of fruits and vegetables, reducing fat intake, increasing levels of physical activity and reduce sedentary time both at school and in the home environment.²⁵

The proposed intervention in the project consists of 10 teaching units with classroom activities (change knowledge, attitudes, habits, skills, preferences), creates occasions at school that favor increased availability and access to a healthy food supply, limited access to high caloric and low nutrient density food and drink (cafeteria, recess fruit, alternative parties). PERSEO promotes phy-

sical activity by suggestions for more active recess. It includes working with families and involvement of Parents Associations (AMPAs) in the project. Specific educational materials including teachers guides, activity books for students, educational materials for families, educational materials for persons responsible for school meals and includes collaboration of health centers next to participating schools.

Aspects such as sustainability, intergenerational and intercultural dialogue, and recognition to local products, culture and culinary tradition were taken into account in the design of the contents and promoted. Dynamics were proposed based in active learning experiences. This is a proposal for continued and progressive intervention in the 6 years of Primary school, with a required minimum intensity of 20 activities per school year.

In relation to the financial budget available it was decided that the first phase of the project would be developed in the Autonomous Communities with higher prevalence of obesity, with reference to the study enKid. In this PERSEO area were included Andalucía, Canarias, Castilla-Leon, Extremadura, Galicia, Murcia and the autonomous cities of Ceuta and Melilla.

A prospective study was designed for evaluation of the project, with an intervention group (34 schools) and a control group (33 schools), with assessments at baseline, after the first year and after two years of intervention. The participating schools delivered Primary education (First to 4th grade primary school at the beginning) from six autonomous regions, Ceuta and Melilla.

The study protocol contemplated individual anthropometric measurements, a validated assessment questionnaire of dietary habits and physical activity of schoolchildren and others about the habits of the families, and determinants of these behaviors. Information was also collected on the school environment, school policies, nutrition education and physical activity at school and in particular, on food intake in the cafeteria. Information was collected using the same protocol at all sites at the beginning of the project, at the end of the first school year of intervention and after two years.

We recruited 13,767 children aged between 6 and 11 years, enrolled between 1st and 4th year of primary education in 67 schools, with the active collaboration of 640 teachers. The average rate of permits for students: 95% and the response rate in the first phase of the project PERSEO: 88.35% (n= 11,677) completed both phases the 80.37% (n= 10,623). Between 2000 and 2010 the prevalence of obesity in the Perseo region has increased an average of 2%.

It has been observed a protective effect of the intervention on the risk of obesity, the greater the higher the degree of implementation and program fidelity. The results of the intervention show significant progress in improving lifestyles in students/participants in the project belonging to the intervention group in relation to the control schools.

Evidence of the PERSEO project’s positive results in all aspects suggest the need to maintain over time the dynamic

and content of the intervention in the school setting, facing the challenge of engaging families in helping to develop healthier eating habits and physical activity behaviors in school and exploring teaching methods that achieve maximum efficiency in collaboration with all professionals and workers involved in the school community and health professionals in the area of reference.

Estimating the potential impact of reducing obesity in the medium term

García Goñi,²⁷ expert in health economics has analyzed in depth the estimation of the potential impact on the prevalence of obesity in the medium term according to three levels of action: 1) A first level that would trigger

health information programs, food safety, prevention strategies and promotion of physical activity. A potential reduction level of 10-15% is estimated for this section. 2) A second level with coercive measures, regulation and intervention on the food industry and stakeholders. Expected impact: 15:33%; 3) Economic measures to change consumer behavior in particular reducing the price of healthy food items, ban of XXL portions or commissioning additional special taxes to certain products as have been launched in Denmark, France, Hungary and some cities USA. Potential reduction: 30-55%.

Cost effectiveness of interventions

Some authors have conducted the cost-effectiveness analysis of different interventions for the prevention of

Table III
Cost-effectiveness for selected interventions to prevent obesity

<i>Intervention</i>	<i>Target population</i>	<i>Cost-effectiveness</i>
Unhealthy food and beverage tax (10%)	Adults	Cost-saving
Front-of-pack traffic light nutrition labelling	Adults	Cost-saving
Reduction of advertising of junk food and beverages to children	Children (0-14 years)	Cost-saving
School-based education programme to reduce television viewing	Primary schoolchildren (8-10 years)	Cost-saving
Multi-faceted school-based programme including nutrition and physical activity	Primary schoolchildren (6 years)	Cost-saving
School-based education programme to reduce sugar-sweetened drink consumption	Primary schoolchildren (7-11 years)	Cost-saving
MOVI, After school physical activity intervention	Primary schoolchildren (10-11 years)	Intervention cost: 125,469,75 € Cost per child 269,83 €
PERSEO Multi-faceted school-based programme including nutrition and physical activity	Primary schoolchildren (6-11 years)	Cost per child 16 €
Family-based targeted programme for obese children	Obese children (10-11 years)	Cost-saving
Multi-faceted targeted school-based programme	Overweight/obese primary schoolchildren (7-10 years)	Cost-saving
Gastric banding-adolescents	Severely obese adolescents (14-19 years)	Intervention cost: 101,644,702 € Net cost per DALY saved: 3,440 €
Family-based GP-mediated programme	Overweight/moderately obese children (5-9 years)	Intervention cost: 4,926,000 € Net cost per DALY saved: 3,675 €
Multi-faceted school-based programme without an active physical activity component	Primary schoolchildren (6 years)	Intervention cost: 40,036,500 € Net cost per DALY saved: 16,650 €
Active After Schools Communities Program	Primary schoolchildren (5-11 years)	Intervention cost: 31,507,800 € Net cost per DALY saved: 64,100 €
TravelSMART schools	Primary schoolchildren (10-11 years)	Intervention cost: 10,242,380 € Net cost per DALY saved: 91,475 €
Walking School Bus	Primary schoolchildren (5-7 years)	Intervention cost: 31,501,600 € Net cost per DALY saved: 594,168 €

Source: Modified from Gortmaker et al. *Lancet* 2011; 378: 838-47.

obesity and have also taken into account the available evidence on the effectiveness of each intervention. Vost et al. in Australia concluded in their study that it is possible to get great impacts on the health of the population (>100,000 DALYs) only with some interventions that reach large proportions of the population as taxes or legislative measures to restrict the content of salt in staples like bread; Evidence for these interventions is classified as “probable”.²⁸

In relation to obesity in particular have been identified as cost-effective interventions in addition to the tax measures, reduction of television advertising and the use of nutritional labeling graphical information such as the multiple traffic light. Also some community interventions to change eating habits and physical activity, but its effects depend on maintaining their public funding over time.²⁹ Table III shows information related to cost-effectiveness for selected interventions to prevent obesity.

According to an OECD report² the implementation of a universal strategy for the prevention of obesity each year would prevent 155,000 deaths from chronic diseases in the countries involved in this organization. These measures would have an annual per capita cost very acceptable: USD 12 per capita in Mexico; 19 USD per capita in Japan and England or 32 USD in Canada. In Spain the Perseo study estimated a cost of 21 USD per capita. This cost does not account for the indirect impact on families, teachers and other professionals in the education community and the health system (2008-2011).

Measuring the effectiveness of such interventions can be difficult because they cannot always be measured by controlled trials and it is necessary to use other approaches. Moreover, when assessing the effectiveness of interventions on the prevalence of obesity in the population is important to note that although perhaps not capable of achieving the target prevalence raised, slowing the projected trend may be an indicator of success and can have a major impact on the health system.³⁰

Conclusions

Despite the implementation of various initiatives of community intervention the prevalence of obesity continues to rise in Spain in all age groups except in the female group belonging to high socioeconomic status.

The initiatives with the school population target group obtained significant improvements or in some cases modest changes in obesity indicators. These programs (including those with modest results) should be continued in time as part of the teaching, demanding greater involvement of the school community.

The improvement in eating habits should be accompanied by an increase in physical activity energy expenditure.

Children with overweight and obesity require distinct patterns of physical activity... Even with regard to the subject area of physical education.

We need to continue encouraging preventive strategies and self-management by means of programs and initiatives with families, food companies, health administration, public administration, education sector, and mass media, local and regional governments.

Treatment of obesity requires multidisciplinary teams in place in all levels of health care, in both the public and private sectors.

References

1. Aranceta J, Serra-Majem LI, Foz-Sala M, Moreno B. Prevalencia de obesidad en Espana. *Med Clin* 2005; 125: 460-6.
2. OECD. OBESITY UPDATE 2012 www.oecd.org/health/fitnotfat
3. Rokholm B, Baker J, Sorensen T. The levelling off of the obesity epidemic since the year 1999 - a review of evidence and perspectives. *Obes Rev* 2010; 11: 835-46.
4. Flegal K, Carroll M, Ogden C, Curtin L. Prevalence and trends in obesity among US adults, 1999-2008. *JAMA* 2010; 303: 235-41.
5. Finucane MM, Stevens GA, Cowan MJ, Danaei G, Lin JK, Paciorek CJ et al. National, regional, and global trends in body-mass index since 1980: systematic analysis of health examination surveys and epidemiological studies with 960 country-years and 9-1 million participants. *Lancet* 2011; 377: 557-67.
6. Olds T, Maher C, Zumin S, Peneau S, Lioret S, Castetbon K et al. Evidence that the prevalence of childhood overweight is plateauing: data from nine countries. *Int J Pediatr Obes* 2011; 6: 342-60.
7. Prospective Studies Collaboration, Whitlock G, Lewington S, Sherliker P, Clarke R, Emberson J, Halsey J et al. Body-mass index and cause-specific mortality in 900 000 adults: collaborative analyses of 57 prospective studies. *Lancet* 2009 Mar 28; 373 (9669): 1083-96.
8. Flegal KM, Kit BK, Orpana H, Graubard BI. Association of all-cause mortality with overweight and obesity using standard body mass index categories: A systematic review and meta-analysis. *JAMA* 2013; 309: 71-82.
9. Behan DF, Cox SH, Lin Y, Pai J, Pedersen HW, Yi M. Obesity and its Relation to Mortality and Morbidity Costs November 30, 2010. Disponible en URL: [<http://www.soa.org/research/research-projects/life-insurance/research-obesity-relation-mortality.aspx>]
10. Han JC, Lawlor DA, Kimm SY. Childhood obesity. *Lancet* May 15 2010; 375 (9727): 1737-48.
11. Koplan J, Liverman C, Kraak V, eds. Preventing childhood obesity: health in the balance. Washington, DC: Institute of Medicine of the National Academies, The National Academies Press, 2005.
12. Wang YC, McPherson K, Marsh T, Gortmaker SL, Brown M. Health and economic burden of the projected obesity trends in the USA and the UK. *Lancet* 2011; 378: 815-25.
13. WHO. Global strategy on diet, physical activity and health. Geneva: World Health Organization, 2004. <http://www.who.int/dietphysicalactivity/en/> (accessed June 23, 2012).
14. Commission of the European Communities. White Paper on a Strategy for Europe on Nutrition, Overweight and Obesity related health issues Brussels, 30.5.2007 COM (2007) 279 final [http://ec.europa.eu/health/archive/ph_determinants/life_style/nutrition/documents/nutrition_wp_en.pdf]
15. Sassi F. La obesidad y la economía de la prevención. París: OCDE, 2010.
16. WHO Regional Office for Europe. Action Plan for implementation of the European Strategy for the Prevention and Control of Noncommunicable Diseases 2012-2016. Copenhagen: World Health Organization 2012.
17. Swinburn BA, Sacks G, Hall KD, McPherson K, Finegood DT, Moodie ML et al. The global obesity pandemic: shaped by global drivers and local environments. *Lancet* 2011; 378: 804-14.

18. Gortmaker SL, Swinburn BA, Levy D, et al. Changing the future of obesity: science, policy, and action. *Lancet* 2011; 378: 838-47.
19. Simmons A, Mavoia HM, Bell AC, De Courten M, Schaaf D, Schultz J et al. Creating community action plans for obesity prevention using the ANGELO (Analysis Grid for Elements Linked to Obesity) Framework. *Health Promotion Int* 2009; 24 (4): 311-24.
20. Summerbell CD, Waters E, Edmunds LD, Kelly S, Brown T, Campbell KJ. Intervenciones para prevenir la obesidad infantil (Revisión Cochrane traducida). En: La Biblioteca Cochrane Plus, 2008 Número 2. Oxford: Update Software Ltd. Disponible en: <http://www.update-software.com>.
21. Khan LK, Sobush K, Keener D, Goodman K, Lowry A, Kakietek J et al. Recommended Community Strategies and Measurements to Prevent Obesity in the United States. *MMWR* 2009; 58 (July 24)/No. RR-7.
22. Borgmeier I, Westenhoefer J. Impact of different food label formats on healthiness evaluation and food choice of consumers: a randomized controlled study. *BMC Public Health* 2009; 9: 184.
23. Eyles H, Mhurchu CN, Nghiem N, Blakely T. Food Pricing Strategies, Population Diets, and Non-Communicable Disease: A Systematic Review of Simulation Studies. *PLoS Med* 2012; 9(12): e1001353.
24. Neira M, de Onis M. The Spanish strategy for nutrition, physical activity and the prevention of besity. *Br J Nutr* 2006; 96 (Suppl. 1): S8-11.
25. Aranceta J. El programa PERSEO como modelo de prevención de la obesidad en la edad escolar. *Nutr Hospitalaria* 2008; S1: 50-5.
26. Borys JM, Le Bodo Y, Jebb SA, Seidell JC, Summerbell C, Richard D. EPODE approach for childhood obesity prevention: methods, progress and international development obesity reviews (2012) 13, 299-315.
27. García-Goñi M, Hernández-Quevedo C. El reto de la obesidad infantil en España y su legislación. *Economía y salud: boletín informativo* 2011; 71: 9-13.
28. Vos T, Carter R, Barendregt J, Mihalopoulos C, Veerman JL, Magnus A, et al, ACE-Prevention Team. Assessing Cost-Effectiveness in Prevention (ACE-Prevention): Final Report. University of Queensland, Brisbane and Deakin University, Melbourne, 2010.
29. Carter R, Moodie M, Markwick A, Magnus A, Vos T, Swinburn B et al. Assessing Cost-Effectiveness in Obesity (ACE-Obesity): an overview of the ACE approach, economic methods and cost results. *BMC Public Health* 2009; 9: 419.
30. Backholer K, Walls HL, Magliano DJ, Peeters A. Setting Population Targets for Measuring Successful Obesity Prevention. *Am J Public Health* 2010; 100: 2033-7.