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Martínez Vizcaíno, Vicente; Cañete García-Prieto, Jorge; Notario-Pacheco, Blanca; Sánchez-López, Mairena

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# Successful intervention models for obesity prevention: The role of healthy life styles

Vicente Martínez Vizcaíno<sup>1,\*</sup>, Jorge Cañete García-Prieto<sup>1</sup>, Blanca Notario-Pacheco<sup>1</sup>  
and Mairena Sánchez-López<sup>1,2</sup>

<sup>1</sup> Social and Health Care Research Center. Universidad de Castilla-La Mancha. Cuenca. Spain. <sup>2</sup> School of Education. Universidad de Castilla-La Mancha. Ciudad Real. Spain.

## Abstract

Children obesity is considered a serious public health problem around the world. In Spain, the prevalence of overweight/obesity is reaching alarming figures, exceeding 35% of the children. Several hypotheses suggest that the energy balance model does not fit very well when analyzing the causes of the current obesity epidemic and, although genetics seems to explain up to 30% of the likelihood to become obese in infancy, has been suggested that genetics might be influenced by environment factors including vigorous physical activity (PA). Some recent systematic reviews indicate that there is enough evidence about the effectiveness of interventions to prevent obesity in children 6-12 years old; however, the heterogeneity of the effect, and the potential selection, information and publication biases that undermine the validity of these studies, thus their results should be interpreted with caution. In Spain, an extracurricular PA program of leisure-time (MOVI) has evidenced some effectiveness on reducing the adiposity and on improving the lipid profile in schoolchildren. To overcome some weakness of MOVI program, a second edition of this study was designed. The objectives of this review are twofold: 1) to analyze latest data of the obesity epidemic in Spain; and 2) to describe the main features of MOVI-2 program, and overall of the successful interventions to prevent children obesity.

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Key words: *Obesity. Interventions. Children. School. MOVI program.*

## MODELOS EXITOSOS DE INTERVENCIÓN PARA LA PREVENCIÓN DE LA OBESIDAD: EL PAPEL DE LOS ESTILOS DE VIDA SALUDABLES

## Resumen

La obesidad infantil continúa siendo un serio problema de salud pública en todo el mundo. Las cifras actuales en España son alarmantes, y se sitúan en torno al 35,4%. Hay varias hipótesis que apuntan a que el modelo de balance energético como causa de la obesidad infantil no se sostiene. Y aunque las razones genéticas parecen explicar hasta el 30% de la probabilidad de llegar a ser obeso, se ha sugerido que esta herencia podría ser influenciada por factores ambientales entre los que se encuentra la actividad física (AF) vigorosa. Aunque las últimas revisiones señalan que existe evidencia suficiente sobre la efectividad de las intervenciones para prevenir la obesidad en niños de 6-12 años, la heterogeneidad del efecto encontrado en los resultados y la posibilidad de sesgos de diseño y de publicación de los estudios hacen que los resultados deban interpretarse con cautela. En España la intervención MOVI, un programa extraescolar de AF de carácter recreativo, ha conseguido disminuir la adiposidad, y mejorar el perfil lipídico. Para superar potenciales limitaciones de la primera intervención, se diseñó una segunda edición. Los objetivos de esta revisión fueron: 1) analizar los últimos datos de la epidemia de la obesidad infantil en España; y 2) describir las principales características del programa MOVI-2, y en general de las intervenciones que han sido efectivas para prevenir la obesidad en niños.

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Palabras clave: *Obesidad. Intervenciones. Niños. Escuela. Programa MOVI.*

## Introduction

Children obesity remains a serious public health problem around the world<sup>1</sup>. In Spain, current prevalence

rates range from 35% to 42%.<sup>2,3</sup> Although recent studies have shown a leveling-off or even a decline in the prevalence of overweight/obesity in children in different countries of the world,<sup>4,5</sup> in the period 2004-2010 prevalence of overweight in boys aged 8-11 years from Cuenca, Spain, increased from 21.6% to 28.0% and the percentage of body fat from 22.6% to 24.0%. In girls, however, the trend seems to have stabilized.<sup>2</sup>

In parallel to the growing trend in the overweight prevalence, during the last decade of the 20<sup>th</sup> century underweight prevalence was increasing in Spain, from

**Correspondence:** Vicente Martínez Vizcaíno.  
Centro de Estudios Sociosanitarios.  
Universidad de Castilla-La Mancha.  
Santa Teresa Jornet, s/n.  
16071 Cuenca.  
E-mail: Vicente.Martinez@uclm.es

2.7% in 1992 to 9.2% in 2004 in children 9-10 years,<sup>6</sup> and in other European countries<sup>7</sup>. Fortunately, latest estimations reported in Spanish children show that from 2004 to 2010 the underweight prevalence has not increased, and stands at around 8.5%.<sup>2</sup>

Therefore, the population approach for addressing the prevention of overweight, as in other public health problems, we should take into account the classic good practice Latin axiom *primum non nocere*, so that it might be that interventions whose effectiveness on reducing overweight is controversial have also an undesirable effect increasing the proportion of underweight children.

### *Determinants of the obesity epidemic in Spanish children*

At the individual level, body fat accumulation results from an imbalance between energy intake and energy expenditure. If intake exceeds expenditure the excess of energy will be stored as fat. On the other hand, it has been estimated that genetics susceptibility explains about the 30% of the likelihood of child will develop obesity,<sup>8</sup> although this is a polygenic inheritance strongly influenced by the interaction genes, environment and lifestyle.<sup>9</sup>

However, at the population level non-genetic factors are the responsible for the frequency of obesity, including epigenetic,<sup>10</sup> eating behavior patterns at an early age, activity/inactivity patterns, and other psychological, social and environmental factors.<sup>9</sup> Nowadays, the relative importance of energy expenditure and intake in the development of the current obesity epidemic is a debatable issue. A recent review of studies addressing this question in different regions of the world<sup>11</sup> concluded that in view of the great variability in the study designs, in the exposure and outcome measures used, and the wide population range in which the studies were based, the estimation of the importance of each one of these two factors, intake and energy expenditure, was not possible in children and teens.

In Spanish children, however, there are some considerations that worth to examine, and that leading us to suspect a greater importance of the decreasing of energy expenditure as determinant of the current obesity epidemic. First, data from both the AVENA study<sup>12</sup> and the enKid study<sup>13</sup> support the association between overweight and TV hours in Spanish children and adolescents. Furthermore, baseline measurement of an intervention study not yet published by our group,<sup>14</sup> show that children who are overweight or obese consume on average less calories/day than children with normal weight, and these normal weight children less than thinness children. After a first view of these data might be argued that children with overweight/obesity do less daily physical activity than less normal weight children, but when we controlled in multivariate models for cardiorespiratory fitness levels, a variable closely related to physical activity levels, these differences in

energy intake by weight categories remain unchanged. These results are in accordance with that reported from other studies,<sup>15,16</sup> and support the new hypothesis proposed by Gutin suggesting that vigorous physical activity at early ages would have a pivotal role in the of stem cells differentiation in bone and muscle tissues through stimulation by mechanical influences such as physical activity<sup>17</sup>. If this theory were consolidated would have important implications in determine which is the best age range for implement preventive interventions, and which is the most appropriate type of activity for it.

There are several hypotheses that do not support the energy balance model for explaining the childhood obesity epidemic, and even though no one doubt of the importance of genetics on predicting obesity, it has been suggested that genetics could be very strongly influenced by environmental factors including vigorous physical activity.<sup>18,19</sup>

### *Efectividad de las intervenciones preventivas sobre obesidad infantil*

A Cochrane systematic review aimed to evaluate the effectiveness of interventions for preventing obesity in children and adolescent concluded that there is enough evidence on the effectiveness of interventions to prevent obesity in children aged 6-12 years, although should be considered that the heterogeneity of the effect found in the studies, as well as the risk of design and publication biases, and therefore this results should be interpreted with caution. Furthermore this review concludes by recommending for future studies: 1) analyze the long-term results, 2) assess how those interventions that are effective can be maintained over time in a sustainable manner, 3) include economic evaluations, 4) potential damage reporting (i.e. eight reduction in thinner children, reduction of essential nutrients, etc.), 5) subgroup analysis by gender, location, race or socioeconomic status, 6) describe in detail the activities carried out in the intervention (to facilitate their applicability and transferability to other populations), and finally, 7) to focus on children 0-5 years.<sup>20</sup>

A recent meta-analysis whose objective was to assess the efficacy of intervention programs on the body mass index (BMI) of children and adolescents, as well as explore the possible differences between the school and after-school intervention programs showed school or after school interventions had a similar effect.<sup>21</sup> Considering that in Spanish context seems very complicated to propose legislative changes aimed to include interventions to tackle children obesity in the schools curricula, the implementation of interventions at recess or after school seems to be more feasible.

The conclusions of a review that examines the systematic reviews and meta-analysis aimed to evaluate the effectiveness of programs addressing the prevention and control of childhood obesity indicates that information about the barriers and challenges encountered

when designing and implementing interventions in real life situations will provide important information on feasibility and sustainability, and identify if failure or modest success of the intervention was due to a problem with the intervention's development, content or implementation.<sup>22</sup>

Most of the systematic reviews emphasize on the importance of taking into account the theoretical models of behavior's changes in which the intervention is based.<sup>23</sup> The usefulness of these models in the development of intervention strategies that affect multiple areas has been proven in several studies.<sup>24,25</sup> One of the most commonly used is the socio-ecological model.<sup>26,27</sup> This model distinguishes several levels on influence on behavior usually depicted as a graph with concentric circles (fig. 1). At the central level are represented the biological/genetic, physiological and sociocultural influences that make-up the individual's identity. In the second circle are placed personal relationships, the environment close to the children; this micro-system consisted of relationships with parents, teachers, sibling, and friends. A third level of influence it's known as exo-system, and includes physical and social environments that influence children's behavior, but without interacting (neighborhood and its built environment, media, location of the school, working conditions of parents, etc.). Finally, the macro-system (fourth level) influ-

ences the child's behavior; this macro-system includes traditions, social, culture, laws, history, etc., of the country where the child grows.

This paper review the characteristics of the most promising interventions.

## Results

Table I shows characteristics of 12 effective school-based interventions on prevention obesity in children (6-12 years). All studies were randomized controlled trials, implemented in school area, and included as outcome BMI or prevalence of overweight/obesity.

Six studies were conducted in the United States, one in South America, one in Australia and four in different countries of the European Union (Spain, Switzerland, Germany and Sweden). Most of the studies were done in school (with modifications into curriculum),<sup>28-36</sup> two studies were done in after school schedule (FitKid and MOVI),<sup>37-40</sup> and one was done jointly in school and after school (STOPP).<sup>41</sup> The duration of follow-up ranged from 3 months to four years; of these 12 studies, 2 studies had a follow-up period of 3 months, 5 studies between 8 months and one and a half year, and 6 studies more than one and a half year (two, three o four years). Seven of the interventions included increase in phys-

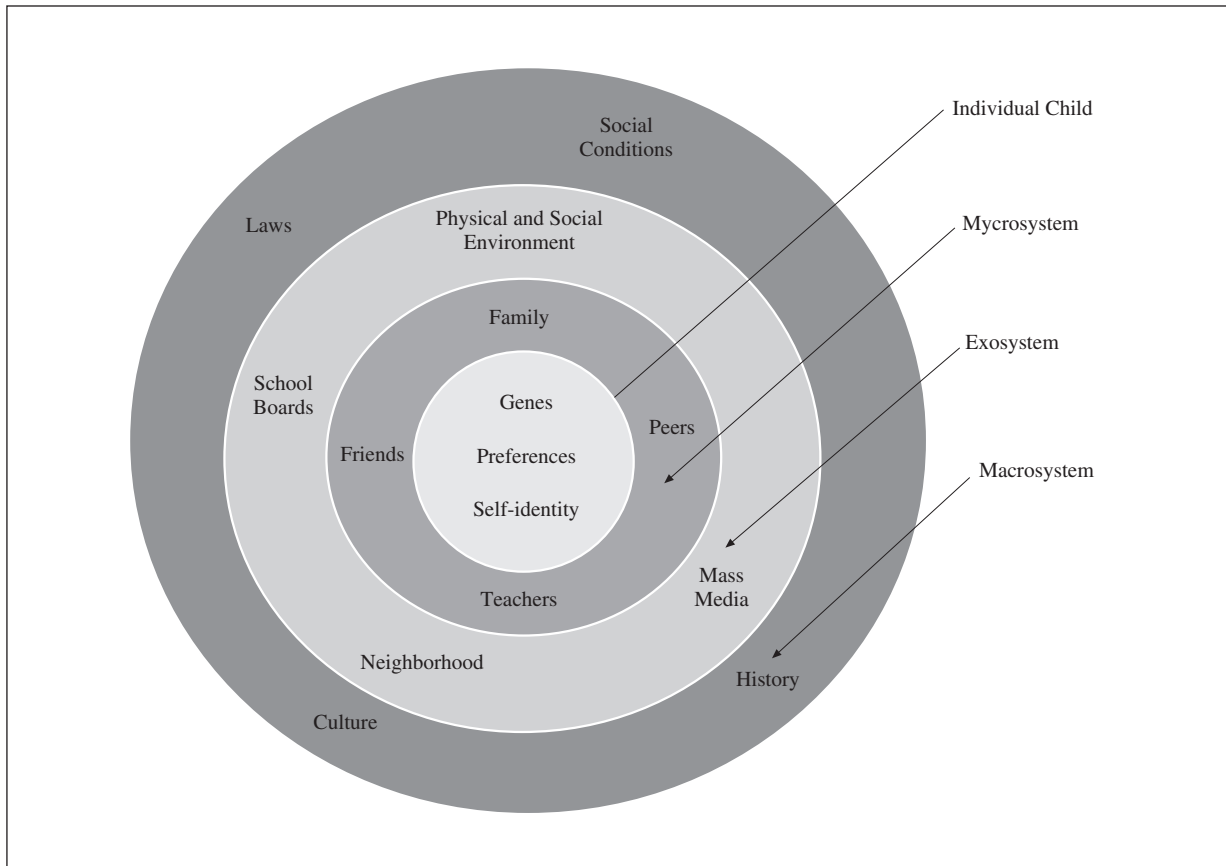


Fig. 1.—Ecological Model. Adapted from Bronfenbrenner's Ecological Model describing the environmental influences on a child.<sup>27</sup>

**Table 1 (Cont.)**  
*Characteristics of effective school-based interventions on prevention obesity in children (6-12 years)*

<i>Authors/year/ country/ name of program</i>	<i>Setting/ Duration (month or years)</i>	<i>Sample sizes/ age (years)/ gender</i>	<i>Theory/Intervention</i>	<i>Outcome measures</i>	<i>Results</i>
<b>Interventions based on increase PA and reduce sedentary time</b>					
Flores R, 1995 <i>California, USA</i> <b>Dance for Health</b> <sup>28</sup>	School 3 months	At baseline: 81 At follow up: 49 10-13 Only girls	NA School based aerobic dance replaced usual PE class and education in health	– BMI – Attitude to PA	– Reduction BMI – No changes in the attitude to PA
Robinson TN, 1999 <i>California, USA</i> <sup>29</sup>	School 3 months	At baseline: 192 At follow up: 192 8-9 Boys and girls	NA Reducing time TV, videotape and video game. The intervention consisted of 18 lessons lasting 30' into the-standard curriculum	– BMI – TST – WC – TV time	– Reductions BMI and all other measures of body fat – Reductions reported TV time
Yin, Z. et al, 2005; Gutin B, et al, 2008 <i>Georgia, USA</i> <b>The Medical College of Georgia Fitkid Project</b> <sup>37,38</sup>	After-School 3 years	At baseline: 601 At 3 years follow up: 316 8-9 Boys and girls	<i>Environmental change</i> 2 hour after-school sessions, 5 days/week on school days. The programme included: • 40 min of academic enrichment activities, during which healthy snacks were provided. • 80 min of moderate-to-vigorous PA (40 min vigorous) including activities to improve sports skills, aerobic fitness, strength, and flexibility.	– % body fat – Bone density – Fat mass – Fat-free mass – BMI – WC – Fitness – CV risk factors	<b>1<sup>st</sup> year:</b> – Reduction % body fat – Increasing bone density – No differences fat mass and fat-free soft tissue between groups post-intervention – Increasing fitness <b>3 year:</b> – Reduction body fat during school months – Significant group by time interaction in favour of intervention participants in bone density and fat-free soft tissue – No differences between groups post intervention in fat mass – Increasing fitness – No difference in BMI, WC and CV risk factors
Salmon J, et al, 2008 <i>Melbourne, Australia</i> <b>Switch-play</b> <sup>30</sup>	School 1 year	At baseline: 295 At follow up: 268 10-11 Boys and girls	<i>Social cognitive theory and behavioral choice theory</i> Three intervention groups: • Behaviour Modification (BM) group: In addition to the usual PE and sports classes, 19 lessons (40-50 min each) were delivered in classroom by one qualified PE teacher for 1 school year • Fundamental Motor Skills (FMS) group: In addition to the usual PE and sports classes, 19 lessons (40-50 min each) were delivered either in the indoor or outdoor PA facilities at each school for 1 school year • BM/FMS group: children in this group received both BM and FMS lessons	– BMI – Overweight/ Obesity – Objectively assessed PA	– Reduction in BMI post-intervention in the BM/FMS – On average, those in the BM/FMS group were over 60% less likely to be overweight or obese – Compared with controls, FMS group children recorded higher levels and greater enjoyment of PA; and BM children recorded higher levels of PA across all four time points