Obesity Prevention in Children

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Abstract
The prevalence of childhood overweight and obesity continues to be unacceptably high and of public health concern in Europe. During childhood and adolescence, environmental factors are the main drivers of obesity development. Obesity is caused by a chronic energy imbalance involving both dietary intake and physical activity patterns. Several risk factors are influencing obesity development, even starting in the prenatal period. From birth, along life, mainly diet and physical activity/inactivity are the most important drivers on top of genetic susceptibility. The first years of life can therefore be crucial to start preventive interventions that can have an impact on lifestyle and on later overweight and obesity. Schools are an attractive and popular setting for implementing interventions for children. Interventions including a community component are considered to be the most effective. Obesity control will require policy interventions to improve the environments that promote poor dietary intake and physical inactivity rather than individually focused interventions. More solid institutional and health policies are needed together with more effective interventions to obtain evident changes for the prevention of excess adiposity among children.

The prevalence of childhood overweight and obesity continues to be unacceptably high and of public health concern in Europe [1]. This epidemic is all the more concerning given the clear association between excess adiposity and adverse health consequences such as cardiovascular diseases and type 2 diabetes mellitus [2] among the most prevalent examples of obesity-related morbidity.

During childhood and adolescence, environmental factors are the main drivers of obesity development. Regular physical activity participation positively influences almost every human physiologic system. Physical activity promotion interventions could have a considerable impact on population health given the inordinately low levels of physical activity observed when data are gathered through objective monitoring versus self-report [3].
Recently, it has been emphasized that obesity control will require policy interventions to improve the environments that promote poor dietary intake and physical inactivity rather than individually focused interventions, pointing out that the necessary policy changes are fraught with political challenges not associated with clinical interventions that focus on individuals [4]. The integration of actions within existing systems into both health and non-health sectors (trade, agriculture, transport, urban planning, and development) could also greatly increase the influence and sustainability of policies [5]. Ecological models stress the influence of family and the home environment on the modifiable risk factors for child obesity.

**Energy Gap Analysis**

Obesity is caused by a chronic energy imbalance involving both dietary intake and physical activity patterns. However, the results concerning energy and macronutrient intakes are not conclusive [6]. Energy balance homeostasis is regulated by a complex network of neurohormonal and metabolic processes, which maintain the individual body composition status with a strong inertia. Overweight appears when persistent positive energy imbalances occur for long periods of time. Based on weight gains and estimated energy storage from dual-energy X-ray absorptiometry, it can be estimated that this imbalance in children could be around 100–200 kcal/day [7]; but these approximated values are only mean estimations with a relative wide range of possibilities depending on predisposition to maintain an individual body composition.

With this same concern, longitudinal data of normal-weight children (1,029 girls and 1,028 boys; Kiel Obesity Prevention Study, KOPS) were used to calculate energy gain (i.e. increase in fat mass and fat-free mass) in normal-weight children staying normal weight (persistent children) or becoming overweight (incident children). The 90th percentiles of energy gap (kcal/day) in incident children were 58.1 (6–10 years) and 72.0 (10–14 years) in girls and 46.0 (6–10 years) and 53.2 (10–14 years) in boys. Therefore, from these results, it was suggested that energy gap should not exceed 46–72 kcal/day to prevent overweight in children [8]. Therefore, the amount of daily energy imbalance that may increase fat mass in children seems to be smaller.

**Risk Factors for Obesity Development**

Several risk factors are influencing obesity development, even starting in the prenatal period. From birth, along life, mainly diet and physical activity/inactivity are the most important drivers on top of genetic susceptibility (fig. 1). During the postnatal period, both excessive energy and protein intake have been related to later adiposity [9].

Dietary patterns seem also to be associated with obesity development. Those factors cumulating more scientific evidence are a low meal frequency, skipping breakfast
Fig. 1. Percentage of body fat development and adiposity influencing factors from birth to adulthood for boys and girls.
and a high consumption of sugar sweetened beverages [9]. Diet composition and food energy density in children feeding have shown controversial results and findings are not conclusive in relation to long-term adiposity development.

Studies using objective measures of physical activity support that a high level of physical activity, particularly vigorous physical activity, is associated with a lower total and central body fat in children and adolescents [10]. However, physical activity and sedentary behaviors are different constructs and have particular correlates. There is evidence that excessive television watching promotes obesity in children and adolescents, but this does not occur for video games and computer use [11].

Although previous research has focused on single behaviors, recent literature contends that obesogenic behaviors tend to cluster under sociocultural habit influences [12]. Dietary factors and physical activity and sedentary behaviors could cluster in the same children and this could increase the risk independently related with every factor.

**Community-Based Interventions**

Interventions including a community component are considered to be the most effective; however, there is no much experience with this type of interventions in Europe. The Identification and prevention of Dietary- and lifestyle induced health EFfects In Children and infantS (IDEFICS) study, is a prospective cohort study with an embedded community and school base intervention [13]. This study started with a baseline survey in eight countries in 2007–2008. Baseline participants of the prospective cohort study were 16,224 children aged 2–9 years. Parents reported sociodemographic, behavioral, medical, nutritional and other lifestyle data for their children and families. Examinations of children included anthropometry, blood pressure, physical fitness, accelerometry, DNA from saliva and physiological markers in blood and urine. The built environment, sensory taste perception and other mechanisms of children's food choices and consumer behaviors were studied in subgroups. Between 1,507 and 2,567 children from both sexes with a mean age of 6.0 years were recruited from each country. A second survey reassessed the children 2 years later to determine the etiological associations between baseline predictors and selected follow-up end points, and also for assessing short-term effects of the intervention, comparing children from control and intervention areas.

The IDEFICS intervention strategy was embedded within the general concept of health as an ecologically determined phenomenon. The ecological environment of a child includes the family and the school, which are in turn embedded in larger social and societal spheres influenced by the community at large and also by events and changes at the global scale. Changing the health behavior in a context of complex interactions cannot be achieved by putting in place simple manipulations at any of these levels, but necessitates intervening at all levels in a way that is consistent towards its targets [14].
The objectives of the IDEFICS study were as follows: (1) to develop culturally acceptable and integrated, sustainable, multicomponent community-oriented intervention program, targeting lifestyle and behavior determinants at the community, school, household and individual level for the primary prevention of overweight and obesity in children (aged 2–9 years) in different European countries; (2) to implement such a community-oriented intervention program in a standardized way, yet allowing for local adaptations, across eight areas in Europe, and (3) to evaluate different aspects of such a multicomponent intervention program (its effect, sustainability, acceptability and so on) both at the level of the recipients (children and their parents) and at the level of involved actors in the field (school boards and personnel, school medical staff, mass media, local authorities and so on). Evaluation comprised development evaluation, process evaluation and outcome evaluation.

The overall elaboration of the IDEFICS community-oriented intervention program predominantly followed the framework of the ‘intervention mapping protocol’. Relevant behaviors and their determinants were thereby carefully dissected and integrated into matrices for operational interventional actions, chosen on the basis of existing evidence and/or supporting theoretical models for behavior change. The behaviors targeted most emphatically through the intervention efforts were diet, physical activity and ability to cope with stress, further decomposed into six so-called key messages (table 1). These key messages constituted measurable outcome variables that were integrated in the IDEFICS field-survey battery.

Under the umbrella of a module devoted to ‘lobbying for community environmental and policy interventions’, a perspective for long-term community-based obesity prevention has been created through a listing of potential policy initiatives that can be initiated by the community platform at any point in time. Examples of this are political decisions aimed at influencing safe mobility of children within the area, creating green areas and restricting publicity for unhealthy lifestyles.

Apart from the IDEFICS study, there are other initiatives in Europe, like EPODE and other similar programs developed in some countries like Belgium, Greece or Spain, among others [15]. In this context, social marketing is an increasingly used approach to address social problems. Social marketing can be defined as the design,
implementation and control of programs calculated to influence the acceptability of social ideas, and involving considerations of product, planning, pricing, communication, distribution and marketing research. Social marketing thinking and strategies are now located at the top of health improvement strategies in several countries. To maximize the effectiveness of social marketing focusing on childhood obesity, it needs to bring about a change in the social determinants of health and safety. Further research is required in this field. At the moment, studies aimed at preventing obesity in children and adolescents have not included social marketing aspects in their interventions in a comprehensive manner [16].

**Evidence of Effective Interventions**

Schools are an attractive and popular setting for implementing interventions for children. There are at least eight reviews, three meta-analyses and five systematic reviews [17]. All of the reviews recognized that studies were heterogeneous in design, participants, intervention and outcomes. Intervention components in the school setting associated with a significant reduction of weight in children included long-term interventions with combined diet and physical activity and a family component. Several reviews also found gender differences in response to interventions. As no single intervention will fit all schools and populations, further high-quality research needs to focus on identifying specific program characteristics predictive of success.

The first years of life can therefore be crucial to start preventive interventions that can have an impact on lifestyle and on later overweight and obesity [18]. This systematic review included seven randomized controlled trials, from which four trials were carried out in preschool settings, one with an exclusive educational component, two with an exclusive physical activity component and one with both. Two trials were family based, with education and counseling for parents and children. The remaining trial was carried out in maternity hospitals, with a training intervention on breastfeeding. None of the interventions had an effect in preventing overweight and obesity. The failure to show an effect may be due to the choice of outcomes, the quality of the randomized controlled trials, the suboptimal implementation of the interventions, the lack of focus on social and environmental determinants.

Twenty-four studies in which children and/or adolescents interacted with electronic interventions delivered as adjunct or sole interventions for the prevention or treatment of obesity and/or obesity-related behaviors were included in a recent review [5]. Fifteen focused on obesity prevention. Most studies demonstrated some form of significant outcome (e.g. reported changes in dietary and/or physical activity behaviors) in participants receiving interactive electronic interventions, with 11 of 15 studies leading to positive changes in measured or reported adiposity outcomes. In 87% of studies, the effects of interactive electronic interventions were not separately
evaluated from other intervention components. Studies were mostly conducted in the USA, largely in minority populations, and the direct transferability of interventions to other populations is unclear.

Obesity prevention requires effective interventions targeting the so-called energy balance-related behaviors (i.e. physical activity, sedentary and dietary behaviors) [19]. To improve the (cost-) effectiveness of these interventions, one needs to know the working mechanisms underlying behavioral change [20]. Mediation analyses evaluates whether an intervention works via hypothesized working mechanisms. Identifying mediators can prompt intervention developers to strengthen effective intervention components and remove/adapt ineffective components. Despite its importance, few studies published results of mediation analysis. On the basis of the limited number of published studies, self-efficacy and intention appear to be relevant mediators for physical activity interventions.

**Final Comments**

The high obesity prevalence over the world is influenced by factors related to diet and energy expenditure within an obesogenic environment, turning out in a positive energy balance (energy gap) in predisposed individuals in which an increase of body adiposity may result when energy mismatch is extended through long periods of time. Many obesity-related factors can appear during the prenatal and/or the early postnatal period, which are mainly related to diet composition and total energy intake. So far, longitudinal studies have failed in identifying which risk factors may increase body adiposity in later periods of life; however, researchers agree with considering dietary aspects, physical activity and sedentary behaviors as major determinants when designing intervention programmes aimed to overweight prevention. Community-, school- and family-based approaches are needed with a special interest in sociocultural aspects to obtain behavioral changes and changes in their relevant determinants. Current findings derived from intervention-based studies at family and school levels are not consistent. More solid institutional and health policies are needed together with more effective interventions to obtain evident changes for the prevention of excess adiposity among children.

**References**


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