

# Integrated Approaches to Combatting Childhood Obesity

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## Key Messages

- Integrated obesity prevention, involving both child and parent at multicomponent levels (individual, within the family, school, community, and socioeconomic), is needed. Community-based strategies and socioeconomic factors are important influencers in achieving effective preventive approaches.
- Breastfeeding promotion and adequate timing and composition of complementary feeding, together with good parenting style, are the strategies to prevent later childhood obesity risk.
- After the first 2 years of life, healthy dietary patterns should be promoted. Eating behavior, portion size control, eating frequencies, and family meals are critical elements in obesity prevention. Combining an increase in physical activity with the reduction of sedentary habits is another key strategy to modulate the energy balance of children.

## Keywords

Childhood obesity · Prevention · Dietary pattern · Healthy lifestyle · Integrated approach

## Abstract

**Background:** The global prevalence of childhood obesity has grown sharply in recent decades. Obesity is considered a public health problem which directly affects the health status

of children in numerous ways. To combat this trend, integrated approaches are necessary to prevent childhood obesity. Strategies require a comprehensive perspective at individual and parental level alongside the adoption of measures to engage the community and environment. **Summary:** Prevention is addressed as crucial in limiting the pediatric obesity epidemic in the long term. Breastfeeding and appropriate complementary feeding are recognized as early dietary factors that affect the future risk of obesity development during the first 2 years of life. During childhood and adolescence, dietary patterns, eating habits, portion size, eating frequencies, and family meals are important dietary factors to target for preventive strategies, as well as parenting style which is influenced by parents' education. Physical activity promotion and the reduction of sedentary behavior are also recommended. The adherence of children and families to obesity prevention programs is highly dependent on socioeconomic factors. Moreover, setting food quality standards and public policies to promote healthy lifestyle habits is strongly advocated. The implementation of cost-effective preventive strategies is of high priority and requires an integrated approach by healthcare services. All stakeholders involved should take an active role in supporting and empowering children and families in order to cope with this multifactorial and complex disease.

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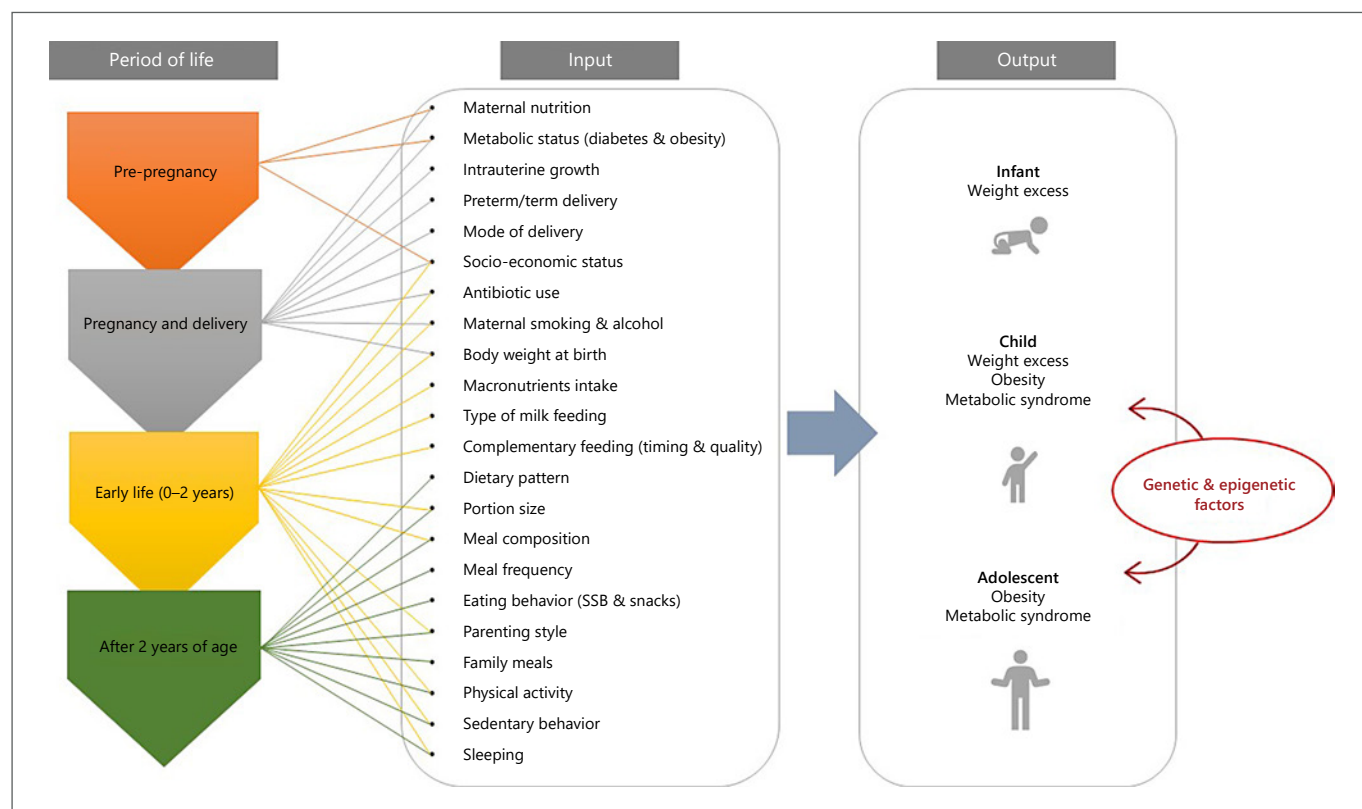
## Introduction

Globally, the number of children with obesity has increased tenfold: from 5 and 6 million in 1975 to 50 and 74 million in 2016 for boys and girls, respectively [1]. If post-2000 trends continue, obesity is predicted to affect 25% of all children under 16 years by the end of 2050 [2]. Obesity is therefore a global public health problem which directly affects the health status of children, being responsible for several adverse consequences both in the short and long term [3].

Obesity itself is a direct cause of morbidities in childhood, including gastrointestinal, musculoskeletal, and orthopedic complications, sleep apnea, and the accelerated onset of cardiovascular disease and type 2 diabetes, as well as the comorbidities of the latter two noncommunicable diseases (NCDs) [4]. Consequently, there is an urgent call for action across health systems to face the problem [3]. Unquestionably, obesity is an important risk factor for the NCDs that can lead to lifelong morbidity. However, obesity development is a complex and multifactorial process that dates to before birth (Fig. 1). According to the Developmental Origins of Health and Disease (DoHAD) hy-

pothesis, there is a relationship between unfavorable fetal conditions and the development of NCDs in future life [5, 6]. The first 1,000 days of life from conception to early childhood, usually recognized as a “window of susceptibility”, represent a period in which maternal diet and early nutrition might modulate gene expression of newborns, and those changes are usually referred to as epigenetic changes [7, 8]. This linkage between maternal nutrition and its influence on future health and prevention of NCDs in children is fundamental since nutrition has transgenerational epigenetic effects [6]. Thus, the importance of identifying and promoting integrated life-cycle prevention interventions is crucial (Fig. 1), as we will discuss later on.

Parents naturally want to provide for the best growth and development of their children [9]. However, by adopting unhealthy eating habits and lifestyles, families have a role in increasing the risk of developing childhood obesity [10, 11]. Consequently, family involvement represents an element in the fight against childhood obesity (Fig. 2). To guarantee adherence of families and children to obesity prevention and intervention programs, a suitable environment is required [12]. Socioeconomic factors, financial resources, and community



**Fig. 1.** “Multifactorial development of childhood obesity,” modified from [5]. Distinct period of life in which lifestyle factors have an impact on the future risk of developing pediatric obesity.

engagement are part of the sustainability framework necessary for obesity prevention and require the attention of policy makers (shown in Fig. 2) [13].

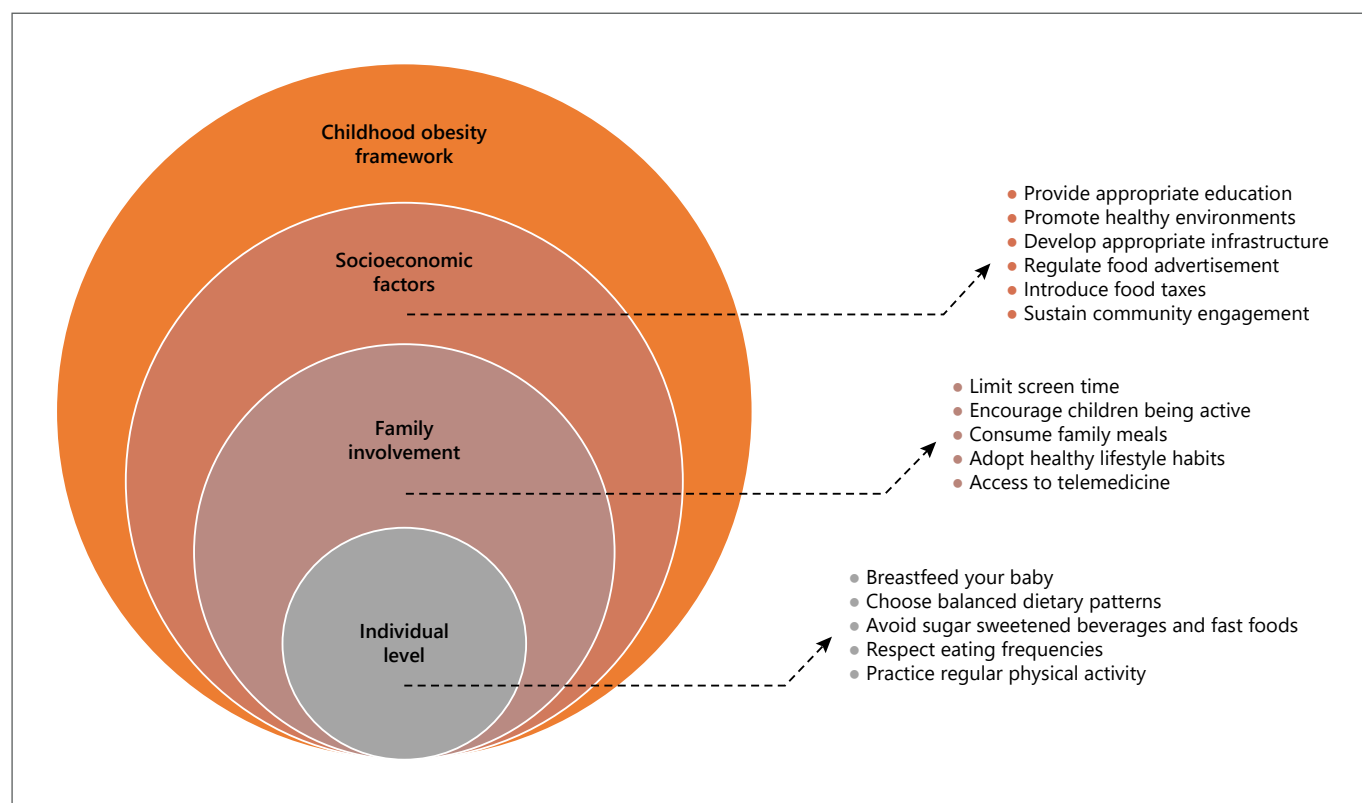
Prevention and treatment are two imperative determinants to be evaluated in the context of childhood obesity. Unfortunately, our ability to treat childhood obesity is less than satisfactory with moderate-to-low efficacy of interventions in ameliorating overweight [14, 15]. At present, the development, implementation, and evaluation of cost-effective prevention strategies are therefore of high priority [12]. Early childhood preventive interventions are successful in establishing healthy eating patterns and physical activity habits [12, 16].

Evidence on the lifetime cost of childhood obesity is scarce compared with that on the economic burden of adult obesity. Without focusing solely on healthcare expenditure, pediatric obesity has the risk to turn into adult obesity and related comorbidities, with broader impacts against the labor market and society as a whole. Prevention of childhood obesity will result in significant economic and intergenerational benefits that currently cannot be accurately estimated or quantified [17]. There are a number of current World Health Organization

(WHO) strategies and implementation plans related to optimizing maternal, infant, and child nutrition and adolescent health that are highly relevant when considering a comprehensive and integrated approach to obesity prevention [17].

The successful prevention of childhood and adolescent obesity cannot be achieved by single interventions but requires an integrated multicomponent approach [3, 12, 18]. This multicomponent approach is an active strategy, involving both child and parents at several levels, targeting physical activity, dietary habits, and lifestyle behavior [12]. The efficacy of this multicomponent intervention has been reported, demonstrating larger effects compared to single interventions [19].

An integrated community-based approach is composed of a cluster of strategies performed in a community, consisting of changes in the political, physical, sociocultural, or economic environment, designed for individual behavioral change towards a healthier lifestyle [20]. The integration of these components is likely to have complementary effects on children's health. Therefore, given this complex framework, the role of an integrated multicomponent approach will be discussed in regard to childhood obesity prevention.



**Fig. 2.** "Childhood obesity framework and stakeholders," modified from [4]. Components of the multilevel childhood obesity prevention scenario, from individual to community and socioeconomic strategies.

## Modulating Factors in the First Two Years of Life on Later Obesity Risk

Obesity prevention is an ongoing process, which starts even before birth, during prenatal life [12]. In fact, early lifestyle and nutritional choices before and during pregnancy have important long-term effects on later health of the offspring, usually known as “early metabolic programming” [6, 21]. Body mass index (BMI) at the time of conception, diet, and lifestyle together with weight gain of the mother are currently recognized as metabolic modulators of obesity in the newborn [21]. This developmental plasticity during early life continues during the first 2 years of life [21, 22].

During this age, both breastfeeding and complementary feeding are highly recognized as factors affecting the risk of obesity development [16]. Breastfeeding is associated with a 13% reduction in overweight or obesity [23]. The preventive effect on later obesity risk depends also on the duration of breastfeeding and, if exclusive, it is associated with slower growth rates during infancy. Conversely, there is evidence, particularly in high-income country settings, that shorter breastfeeding duration causes higher weight gain during infancy [24].

An additional modulating factor is the macronutrient composition of infant formula [12]. In the past decades, infant formulae used to have a higher amount of protein compared to human milk [25]. Nowadays, this excessive protein content has been recognized as a negative factor, altering the growth trajectory pattern in childhood [12] and doubling the risk of becoming obese compared to infants with low-protein formula [26]. Thus, breastfeeding should be promoted as long as possible during infancy in order to favor obesity prevention [16], and when not feasible, infants should receive lower-protein infant formula [27].

Complementary feeding is an important factor affecting metabolic development, as timing of introduction and type of solid food consumed have been identified as important risk factors for later obesity risk [12, 28]. According to the European Society for Paediatric Gastroenterology, Hepatology, and Nutrition (ESPGHAN) position paper, complementary food should not be introduced before 4 months but should not be delayed beyond 6 months [29]. Several studies confirm that a higher protein intake in infancy and early childhood is convincingly associated with increased growth and higher BMI in childhood [29, 30]. Thus, 15% is recognized as the up-

per limit of recommended intake of protein during complementary feeding, as a higher consumption may contribute to an increased risk for later obesity [29]. Regarding cow's milk consumption after 1 year of age and adiposity, there is no evidence to recommend reduced-fat cow's milk consumption to prevent childhood overweight or obesity [16].

Lastly, children who received parental advice on behavioral states, namely, hunger, sleep, interactive play, and emotional regulation, showed a modest reduction of  $-0.28$  in BMI z-score at 3 years [31]. Thus, parental responsiveness might be associated with a better development of a child's self-regulation [16].

## Key Factors after Two Years of Life Related to Obesity Risk

### *Diet-Related Factors*

#### Healthy Dietary Patterns

During childhood, dietary habits, the choice of portion size, and dietary patterns seem to be predictive of subsequent overweight and obesity rather than single dietary nutrients alone. After infancy, no single dietary nutrient alone has been consistently associated with the development of overweight and obesity; rather, dietary habits and the choice of portion sizes and dietary patterns appear to be predictive [12].

Recently, it has been shown that dietary patterns acquired early in life can influence eating behavior and affect health later in childhood. It seems that eating habits acquired in the first 2 years of life are unchanged at 8 years of age. Thus, the adoption of healthy eating habits in pre-school and school-aged children should be promoted as early as possible [32].

The Mediterranean diet (MD) is a dietary pattern characterized by low-refined fiber-rich vegetal products (vegetables, fruits, whole grains, pulses, nuts, and seeds) accompanied by moderate-to-high fish, seafood products, poultry, eggs, and dairy product consumption and reduced consumption of red meat. The most distinctive aspect of the MD is using olive oil as the main source of lipids in the diet. To evaluate children's and adolescent's adherence to MD, several questionnaires have been validated (KIDMED, MDS, fMDS, or MediLIFE). Based upon such questionnaires, the protective role of the MD against NCDs is now widely recognized [33]. Thus, adopting an MD might be protective against obesity during childhood,

**A higher protein intake in infancy and early childhood is convincingly associated with increased growth and higher BMI in childhood**

even though more studies are required. Based on expert opinion, this dietary pattern can be used as preferable recommendation during the pediatric age.

Moreover, also the Nordic diet has been recognized to have a high percentage of plant-based foods (such as berries, cabbage, root vegetables, legumes, fresh herbs, mushrooms, nuts, and whole grain) and to be rich in fatty fish and rapeseed oil and low in high-fat dairy products. Among plant-based dietary patterns, there is lacto-ovo-vegetarianism, which excludes meat and fish. Subcategories are lacto-vegetarianism, which excludes eggs, and ovo-vegetarianism, which excludes dairy products, and lastly, veganism, which excludes meat, fish, dairy products, eggs, and honey. Data on the effect of vegetarian diets and the Nordic diet on children and the prevention or treatment of overweight and obesity is scanty [34–37]. In conclusion, to better assess childhood obesity prevention, according to different dietary patterns and populations, further high-quality intervention studies should be implemented.

#### Eating and Drinking Behavior

**Sugar-Sweetened Beverages.** Sugar-sweetened beverages (SSBs) are drinks rich in sugars (sucrose, high-fructose corn syrup, fruit juice concentrates). Recently, the Childhood Obesity Surveillance Initiative (COSI) released the latest report about eating habits of children in 23 European countries. Among primary school-aged children, 30–80% did not consume fresh fruit daily, 30–90% did not eat vegetables daily, and up to 45% consumed soft drinks on more than 3 days a week [38]. Moreover, in children and adolescents living in low-income communities, SSB consumption seems higher among Hispanic and black ethnic groups having also high fast food consumption. Conversely, having a parent with higher education level and routinely consuming breakfast was associated with lower SSB consumption [39]. SSB consumption among female adolescents was higher in low- to middle-income countries (LMICs), especially in Africa and Latin America and the Caribbean [40].

The ESPGHAN Committee on Nutrition position paper about outcomes related to the intake of sugar in infants, children, and adolescents stated that a higher intake of free sugars is associated with an increased risk of excess weight gain [41]. Evidence shows a positive association between the consumption of SSBs and obesity, in particular, SSBs can negatively impact BMI z-score [42]. In this regard, targeted interventions on SSB intake decrease SSB consumption among children aged 0–5 years [43]. Currently, several countries are adopting taxation on these products in order to limit their spread, and the removal of SSB-vending machines, particularly in schools, is a desirable goal for obesity prevention.

**Skipping Breakfast.** Skipping breakfast has been considered a risk factor for obesity as it is believed to have a critical role in energy balance and dietary regulation, due to later hunger and consumption of more obesogenic foods. Many studies reported that at least 10–30% of children and adolescents never eat breakfast, and there is an increasing trend in skipping breakfast from childhood to adolescence, a habit more common in girls than in boys, both in high-income countries than in LMICs [38]. Overall, studies representing around 94% of all subjects report a positive association between skipping breakfast with overweight and obesity [16]. Interestingly, when adopting nutritional education interventions at multilevel (school, promotion campaign, home environment), the prevalence of breakfast skipping is reduced among children and adolescents from high-income countries [44].

**Consumption of Snacks and Fast Foods.** Snacking is usually referred to as the consumption of foods rich in energy

## Skipping breakfast has been considered a risk factor for obesity

density, salt, saturated fats, and refined sugars but poor in nutrients [45, 46]. All these characteristics, which can negatively influence taste, contribute to children's increasing choice of processed foods and consuming larger portions than they need for their age. The frequency of consumption of snacks is heterogeneous between countries and regions of Europe, with lower values of daily consumption of snacks observed in the northern European countries and higher values among the southern European and Asian countries [38]. Additionally, a recent systematic review states that 40% of adolescent girls in Latin America and the Caribbean consume fast/convenient foods daily, while snacking (eating/drinking between meals) is common and takes place during school hours [40]. Also, fast food consumption is increasingly considered a contributing factor to obesity prevalence in childhood. Unfortunately, as children age, the higher availability of fast food restaurants has been associated with the risk of obesity [47].

**Portion Size and Eating Frequencies.** A variety of factors are likely to be involved in determining how children learn about portion size, such as media, observational learning, parents' feeding practices, and postprandial feelings [39]. Testing the responsiveness to increasing portion size, evidence shows that in 5-year-old children, food consumption is more likely to be influenced by portion size than in 3-year-old children



[48]. Moreover, 4-year-old children taught to focus on self-regulatory satiety cues (such as the fullness of their stomachs) showed better self-regulation of energy intake than those who were rewarded for completing their plates [48]. Energy intake in children seems affected by the served portions [49], and findings suggested that “liking” or palatability may play a role in determining whether increasing portion size increases children’s food intake.

Eating frequencies are important determinants in obesity prevention; in fact, consuming 5 meals per day was associated with lower childhood obesity risk in several studies [50–52], whereas consuming fewer than 3 meals a day showed higher anthropometric and obesity indices in children, perhaps due to a worse modulation of hunger [51]. Thus, children up to 12 years of age are encouraged to eat at least 5 meals per day, including a mid-morning and a mid-afternoon snack [16].

#### *Promotion of Regular Physical Activity and Reduction of Sedentary Habits*

Physical activity is recognized as the main modifiable component in the total energy expenditure balance [12]. Children and adolescents who practice moderate to vigorous physical activity have been reported to have lower adiposity [53, 54]. The WHO physical activity guidelines have proven successful in preventing excessive weight gain in 419 eleven-year-old European children [55]. In the same cohort, BMI was monitored during a 5-year period and a higher BMI was found in children who spent longer time in sedentary behaviors, even in those who had moderate to vigorous physical activity [56].

Promotion of regular physical activity in schools and communities appears a promising approach for lowering the obesity risk and should be considered as part of an integrated strategy for childhood obesity prevention [57]. According to the WHO recommendations, children 3–17 years old should spend at least 60 min a day in a moderate to vigorous intensity physical activity [58, 59]. However, the promotion of physical activity per se is not sufficient [60], and combining regular physical activity with decreased sedentary time is necessary in order to have preventive effects [16]. Electronic device use and screen time at mealtimes and during the day should be strictly limited during pediatric age. Interventions for the reduction of sedentary behaviors are important in preventing obesity [61]. For the future, high-quality studies that evaluate the most beneficial types of physical activity to prevent obesity are required [16, 62].

#### *Home and Family Environment*

During infancy, parents are usually well-intentioned and through the example of what they themselves eat can influ-

ence the child. Parents have control until the age of about 10 years over their children’s nutritional choices, exercise, and screen time, but during adolescence, the biggest influencers are peer groups and social media. Thus, several studies have investigated the role of family meals [10, 11].

Frequent family meals have been associated with a healthier and more varied dietary pattern [10]. Moreover, there might be an inverse association between frequent family meals and being overweight, and this effect is more consistent among children than adolescents [10].

In northern Europe, children who had family breakfast or dinner less than once weekly and TV viewing during the dinner were more likely to be overweight, while there was no association between family breakfast or dinner and adiposity status (according to BMI) in southern and eastern European countries [11]. Thus, sharing regular family meals represents an opportunity to establish healthy habits with positive outcome on health and on weight-excess prevention [16]. In LMICs (studies from urban and rural area of Brazil, China, India, South Africa, and Tonga), the prevalence of adolescent girls (10–19 years) who eat lunch outside home is 60.2%. The most frequently reported place of consumption was the school cafeteria or tuck shop [40]. In preschool-aged children, parents or carers are the first target for intervention to acquire lifestyle modification (improve dietary quality, increase physical activity, and reduce sedentary behavior), often using behavior changes techniques [63, 64].

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## **Sharing regular family meals represents an opportunity to establish healthy habits**

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Parents play an important role as a suitable model for their child’s healthy and unhealthy behavior [65]. Moreover, the role of parenting both in the development of childhood overweight and in obesity prevention has increasingly been reported [66, 67]. Therefore, current approaches are moving towards a greater parental involvement to modify the shared family environment and to support and implement child behavior changes [3, 68].

Taveras et al. [69] found that an intervention that included both decision support for clinicians and outreach to parents appeared to be effective in improving healthcare quality measures for child obesity. These findings highlight the value of informed, activated families and prepared, proactive practice teams. Thus, the strategy to include a family component has

been revealed as an important issue in the effectiveness of long-term childhood weight control interventions [70, 71]. Overall, parent outreach has the potential to provide sustainable, low-cost, high-reach approaches for improving quality of childhood obesity prevention [69].

#### *School and Community Strategies*

It is the primary responsibility of governments to ensure that policies and actions address the obesogenic environment and to provide guidance and support for optimal development at each stage of the life-course [17]. Considering the benefits of breastfeeding for mother and child, policies should support mothers to breastfeed, through regulatory measures such as maternity leave, facilities, and time for breastfeeding in the work place [17]. During the first 2 years of life, food exposure influences the establishment of healthy dietary habits. Complementary feeding, for example, is an opportunity to ensure good nutrition at an early age but can be undermined by inappropriate marketing of commercial products [72]. In this regard, the WHO has published guidance on ending the inappropriate promotion of foods for infants and young children implementation manual [73]. Many countries' legislations on complementary foods, particularly in low-income countries, may need to be strengthened in line with WHO recommendations.

It is important to identify active players in obesity prevention throughout childhood. Compulsory schools and child-care settings provide an easy entry point to engage children and adolescents and embed healthy eating and physical activity habits. For example, food education and physical activity have to be included into the daily routine and curriculum of such institutions [17, 72]. However, such education can be integrated effectively into mainstream topics when teachers are appropriately engaged and informed. Moreover, collaboration and exchange of information between the education sector and health ministries will help move this agenda forward. The government, which has the control over educational sectors, has the ability to endorse appropriate programs to support the preventive strategies. Since high energy-dense food and SSBs are important drivers in the development of obesity, greater control should be exercised in relation to this issue.

First of all, schools should not allow inappropriate foods and beverages to be sold or marketed within the school environment (e.g., a ban of vending machines), while providing

education about healthy eating patterns [17, 74]. Examples of such integrated prevention strategies are in place in different countries. A 2016 survey of school policies in 153 countries found 53 (24%) regulated food and beverage marketing in schools and 28 (18%) have some form of ban on food- and beverage-vending machines in schools [75]. Since 2015, Uruguay has prohibited any kind of marketing of foods and non-alcoholic beverages in schools that do not meet the Ministry of Health's school nutrition recommendations, including sponsorship, use of logos or brands on school supplies, or distributing prizes or free samples [72]. In France, the ministry has adopted in 2005 a ban on vending machines in both primary and secondary schools. In the latter, the ban decreased the frequency of morning snacks and reduced sugar intake from these snacks by 10 g per person per day [76].

Secondly, community strategies to reduce access to unhealthy foods and to limit the obesogenic environment should be addressed by governments and institutions. Screen watching and television advertising can affect pediatric food preferences and consumption [12]. Interestingly, the effect of a hypothetical Australian law that restricts until 9.30 p.m. advertising of food and beverages high in fat, sugar, and salt was evaluated. According to the estimations, the most disadvantaged socioeconomic class was likely to benefit more compared to the least disadvantaged economic group, reaching 1.5 times higher health benefits [77]. Similarly, the long-term impact on BMI of a food tax model, which implemented SSB taxes of 1 peso per liter, was studied in Mexico. The estimated average BMI reduction with the tax was 0.15 kg/m<sup>2</sup> which translates into 2.54% change in the prevalence of obesity. Moreover, the tax would prevent 86–134 thousand cases of diabetes [78]. Interestingly, taxation has the potential to modify consumer behavior and consumers might benefit from food taxes, by limiting consumption of foods that exert negative health outcomes, in particular for children who live in LMICs [79].

Lastly, it may be possible to establish areas around schools where the sale of unhealthy foods and beverages is restricted; however, this may not be feasible in a number of settings [17]. For example, a study conducted in Arkansas has suggested that the closeness within 1 mile and the number of fast food restaurants can negatively impact the school-level obesity rate [80]. However, other factors need to be taken into account concerning the food environment (large supermarkets, convenience stores, fast food outlets), and longitudinal stud-

## **Schools should not allow inappropriate foods and beverages to be sold or marketed within the school environment**

ies are required to evaluate its impact in school neighborhoods.

Overall, integrated care models are usually developed in multiple sectors addressing not only the role of professionals of primary care but also the importance of communities and school settings on child health outcomes [81]. A recent meta-analysis evaluated the effectiveness of childhood obesity prevention programs conducted and implemented in various settings [82]. A greater proportion of multi-setting studies demonstrated significant and beneficial results compared with single-setting interventions. Interestingly, the strength of evidence for diet-physical activity combined interventions in child-care or home setting to prevent obesity was low, whereas the evidence was high for combined interventions delivered in schools with both home and community components. In conclusion, at least moderately strong evidence supports the effectiveness of school-based interventions for preventing childhood obesity [82].

## Conclusion

An effective prevention of obesity in childhood and adolescents can be achieved by an integrated multicomponent approach, involving several stakeholders able to empower both children and families to change lifestyle and to reduce possible risk factors in their environment.

Nowadays, the role of parenting in childhood overweight and obesity has increasingly been recognized, as parents play an important role as a suitable model for their child's healthy and unhealthy behavior [66, 67]. Current approaches are moving into a greater parental involvement to modify the shared family environment and to support and implement child behavior changes [3, 68]. Therefore, families should be trained and educated on healthy dietary patterns and lifestyles through a multidisciplinary approach supported by healthcare professionals.

Substantial lifestyle modification is recommended in the prevention of obesity through an integrated approach of diet, exercise, and behavioral change strategies. National Institute for Health and Care Excellence (NICE) guidelines state that "multicomponent interventions are the treatment of choice for obesity, and these should include the behavioral component" [83].

A recent study also shows that behavioral change strategies are associated with a higher probability of long-term maintenance of the results achieved through calorie restriction and increased physical activity [84]. Family-level changes require integration with community and socioeconomic actions [81].

Research has addressed both the importance of setting food quality standards to promote healthy lifestyle habits and the development of appropriate infrastructure to encourage safe spaces where children can be active and can consume healthy foods [79]. Moreover, measures that can

be taken at the societal levels include availability and access to healthy but non-costly foods (e.g., water, fruits, and vegetables) and provision of food education in schools and communities [12, 79]. Societal standards to protect the health of children should be regarded as a part of prevention and intervention strategies to counteract

the childhood obesity trend. Community-based strategies instead should increase healthy options, reduce deterrents to healthy behaviors, build community capacity, and improve social and economic resources for individuals and families [12].

Educational institutions for children, from day care to secondary schools, should establish and implement standards that proactively promote healthy eating and drinking through education and the creation of healthy eating environments (e.g., standards for healthy school meals, elimination of unhealthy snacks, and sugar-containing drinks) [12]. Finally, actions should be taken to promote a better understanding of nutrition labeling, a specific taxation on unhealthy foods and/or a limitation of food advertising aimed at children. Multi-stakeholder collaboration to prevent childhood obesity in communities remains crucial. Pediatricians and health professionals should take an active role in sustaining and empowering families to implement measures that support the health of their children, and in promoting social measures that protect children's health. In order to achieve an effective childhood obesity reduction and to cope with the endemic nature of the problem, an integrated multi-component approach is necessary.

## Conflict of Interest Statement

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# Current approaches are moving into a greater parental involvement to modify the shared family environment



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## Author Contributions

Conceptualization: Elvira Verduci and Gianvincenzo Zuccotti; methodology: Elisabetta Di Profio and Giulia Fiore; writing – original draft preparation: Elisabetta Di Profio and Giulia Fiore; review and editing: Elvira Verduci; supervision: Gianvincenzo Zuccotti. All authors have read and agreed to the published version of the manuscript.

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