ENCYCLOPEDIA
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[Archived] Preventing Obesity in Young Children

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Introduction

Obesity and its comorbities are a leading world-health concern for which few effective treatments exist.[1,2,3] The recent increase in the number of overweight people in developed and developing countries results from significant changes in eating habits and physical activity behaviours of some populations. A large proportion of children growing up in these countries are at risk of becoming obese and developing associated comorbidities, such as metabolic syndrome and Type 2 diabetes early in life. Consequently, these chronically ill young people may well place substantial strains on both health care and social service systems.

The increasing prevalence of childhood obesity, ranked as a critical public-health problem in the 21st century, has led policy-makers in several countries to take preventive actions. The responsibility for obesity prevention among young children lies not only in the hands of parents and families but also in the hands of national governments, local governments, communities, non-profit organizations, the food industry, the media, and schools and local education authorities.

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Scientific knowledge about effective obesity prevention measures to be taken with young children is still insufficient. There is an urgent need to learn more about effective prevention in early childhood. These measures should aim to influence the eating and physical activity behaviours of young children and their families. More importantly, new rules have to be established in the field of consumer protection in order to protect young children from the influences of our modern living environment, which promotes the consumption of energy-dense foods and does not encourage physical activity.

Subject

The increase in the prevalence of obesity has been particularly striking since the late 70s in most industrialized countries. In some countries, the prevalence of obesity in children has doubled or even tripled over this period.[1,2] In fact, the body weights of obese children have dramatically increased.

Body weight increases are especially prevalent after three years of age (leading to an early adiposity rebound — a physiological increase in the percentage of body fat — at 5 or 6 years of age). In the U.S. the prevalence of obesity has doubled (jumping from 5% to 10.4%) between 1971–74 and 1999–2000 in pre-school children, aged 2 to 5 years.[4] Therefore, first years of life may well be the best period for intervention regarding primary or targeted obesity prevention.

Obesity is an acquired condition; nobody is born obese. Once an increased amount of body fat is acquired, the body strikes a new, stabilized energy balance.[3] So far, published data do not support the idea that this development is reversible. Therefore, a child's developmental influences are of central interest when searching for effective preventive measures and prevention should start as early as possible.

Problems

Childhood obesity is associated with a wide range of disorders that affect multiple organ systems. Increased body weights in children may lead, for instance, to insulin resistance, glucose intolerance, hypertension, and orthopaedic problems.[1] Some of these conditions produce clinical symptoms in the patient, while others do not. The physiologic and metabolic changes associated with obesity in children tend to follow them into adult life and increase the risks for disease, disability, and death.

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One of the most important consequences of childhood obesity is the early manifestation of Type 2 diabetes and metabolic syndrome. Type 2 diabetes in young people has grown in tandem with growth in body weights. According to data from NHANES III, the prevalence of metabolic syndrome is 0.1% and 16% in obese adolescents.[5] These adverse effects of obesity carry a high risk for secondary organ damage, including cardiovascular, liver and kidney disease. The comorbidities of childhood obesity are so great, they will most certainly increase national health-care costs.[6] Moreover, obesity in young people is associated with lower socio-economic status[7] and a higher proportion of psychiatric problems.[8] Indeed, treating obesity and its associated comorbidities has become a colossal challenge. Treatment programs based on changing physical activity and eating behaviours have only proved effective in a minority of patients and their families. But today, for the majority of children, there are simply no effective treatments.[1]

Research Context

In recent years, rates of obesity have increased over too short a time to indicate any significant genetic changes within populations. Thus, the primary cause of the rapid rise in obesity may lie in environmental and societal changes that are now affecting large proportions of the children in the world. The development of obesity results from an imbalance between energy intake and energy expenditure. This energy imbalance in children results mostly from physical inactivity (frequent television viewing), from eating high-fat high-energy foods (snacks, sugar-added beverages, fast-food products) and from taking large portions sizes.[2,3,9,10,11] Young children lack the ability to decide to control or to change their energy balance themselves by controlling the quality (energy content) and quantity (meal size) of food and by increasing physical activity. Even adults rarely succeed in controlling energy balance over longer periods of time. It has been demonstrated that environment and societal factors affect food intake and physical activity patterns and overwhelm the physiological regulatory processes (beyond our individual control) that operate to keep weight stable. The postnatal period and infancy are sensitive periods for the development of taste perception, eating behaviour, and possibly also physical activity behaviour. Eating behaviour is influenced by and influences both parental feeding strategies and child–parent interaction. Young children are also influenced in their physical activity behaviour by that of their parents.

More research is needed to understand the developmental effects related to the regulation of food intake and energy balance. In addition, efforts must be undertaken to identify relevant environmental and social factors that affect eating and physical activity patterns in families.

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Key Research Questions

There are several key research questions that should be addressed to gather knowledge about the factors responsible for increases in obesity among young children. With this knowledge, possible effective measures for childhood obesity prevention may better be formulated. More specifically, research must focus on the developmental factors involved in acquiring adverse eating and physical activity patterns and on possibilities for changing adverse environmental factors. We must ask:

1. Which developmental processes involved in regulating energy intake and expenditure are influenced by the living environment of young children?
2. Is it possible to alter these environmental factors and to prevent the development of adverse eating and physical activity patterns?
3. Is it possible to teach children to resist these factors without changing the environment?

- For example, concern has been expressed that the early introduction of sweetened beverages and high-fat, sweet-tasting snacks may be important contributing factors to childhood obesity since an early preference for such foods and beverages may develop.[12,13] We must therefore ask: To what extent does the early introduction of artificially flavoured, high energy density, high fat foods influence the development of taste perception and eating behaviour?

More data are required to support the theory that early eating patterns may be important contributing factors to childhood obesity, and subsequent intervention studies must prove this theory. Such intervention studies should either teach families to avoid these products or call for regulating sales and advertising for these products.

Recent Research Results

Recent research results have been reviewed extensively elsewhere[1,2,4,12] and are summarized in the paragraphs below.

Genetic and biological factors

Some data support the role of genetic factors.[2] There are high-risk ethnic groups of children who are disproportionately affected by the increasing prevalence of obesity when compared to the

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general population.[4] After age three, parental obesity is a stronger predictor of a child's future obesity as an adult than is the child's weight.[14] However, the genetic characteristics of humans have not changed in the last three years. Thus, recent body weight gains among the population are the result of an interaction of genotypes with behavioural and environmental factors. Genetic factors increase the susceptibility to gain weight in a modern living environment.

Other studies have shown that biological factors influence weight gain and have extended the hypothesis about 'metabolic priming'[15]: Several studies record a U-shaped relationship between birth weight and later BMI (with a higher prevalence of childhood obesity seen among infants with the lowest and highest birth weights).[16,17] Maternal diabetes during pregnancy results in offspring with higher birth weights and higher risk of obesity in childhood at five years of age.[18]

Studies also show that postnatal weight gain is important: A low birth weight followed by rapid catch up growth during early infancy seems to be a risk factor for the development of metabolic disturbances (insulin resistance, hyperinsulinemia) and obesity. It has also been shown that an early adiposity rebound results in a greater risk of subsequent obesity.[19]

Development of taste and hunger, satiety perception and eating behaviour

It has been known for some time that hormones extensively affect brain development. Recent evidence also suggests that perinatal and *in utero* nutrition may have long-term effects that continue into adulthood. Results obtained in animal studies suggest that there are critical periods in brain development early in life that may profoundly affect food intake and body weight.

Recently it has been shown that leptin can modulate both synapse numbers and synaptic activity in the NPY and POMC neurons in the hypothalamic arcuate nucleus.[20,21] These results suggest that leptin functions are essential to brain development, promoting formation of hypothalamic pathways that later convey leptin signals to brain regions, thereby regulating both food intake and energy consumption. These observations are consistent with the concept that under- and over-nutrition during critical periods of hypothalamic development may induce long-lasting and potentially irreversible effects into adulthood.

Studies in humans (the aforementioned studies having been performed on mice) suggest that the first years of life are a sensitive period for the development of eating and physical activity behaviour. Young children have a physiological sense of satiety that guides them to eat only until

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they are satisfied. It has been suggested that the food portion sizes consumed by children 1 to 2 years of age have been consistent over the past 20 years. It has shown that, early in life, infants are responsive to the energy density of food and are capable of controlling volume.[22] However, they become increasingly responsive to environmental cues such as portion size. By age five, larger proportions can lead to increased overall food intake.

It is also known that experience with flavours in breast milk from various foods promotes the acceptance of these foods when they are introduced into a solid diet later on. Infants prefer sweet and salty tastes.[23] Therefore, getting used to foods that are lacking in such tastes is a learning process that requires repeated positive experiences.[24,25]

Psychosocial factors

Risk factors for the development of obesity in early childhood include psychosocial and familial factors. Body mass index (BMI) in children and adults varies significantly according to the socio-economic status of the family.[26] Psychosocial factors that potentially increase the risk that a child will become obese include low socio-economic status, being an only child and living with a single parent. Parental feeding attitudes and child–parent interaction may also be influenced by cultural and psycho-social backgrounds.[27,28]

Breastfeeding

Epidemiological data suggest that breastfeeding affords a small but significant degree of protection against childhood obesity. A recent review of 11 studies with adequate sample size (all of which controlled for potential confounders) found that eight of the studies showed that breastfed children were at a lower risk of being overweight.[29] Breastfeeding is thought to promote an infant’s ability to regulate energy intake, allowing him or her to feed in response to internal hunger and satiety cues, thus resulting in a better control of meal size later in life.[30] Having analyzed longitudinal data from the Centers for Disease Control and Prevention Pediatric Nutrition and Surveillance System, Grummer-Strawn et al.[31] conclude that prolonged breastfeeding is associated with a reduced risk of overweight.

Food products

Halford et al.[32] showed that exposing school children to snack food advertisement promotes the over-consumption of snacks, affecting eating behaviours in distinctive ways, especially among

already obese children. This finding suggests that reducing snack food advertisement will help to prevent detrimental eating behaviour. Moreover, Ebbeling et al.[1] recently showed that obese adolescents, compared to their non-obese counterparts, are more likely to overindulge in fatty foods and are less able to compensate for this excess energy input under free-living conditions.[1] Pereira et al.[33] showed in a 15-year follow-up study that fast food habits among children have strong, positive, and independent associations with weight gain and insulin resistance in both young black and white adults in the U.S.

Soft drinks are a leading source of carbohydrates for American children as young as two years of age.[34] As sugar beverage intake rises, milk consumption drops. A prospective study has reported a positive association between the consumption of sugar-sweetened drinks and obesity.[35] Especially at younger ages, the consumption of readily available carbohydrate sources (food with a high glycemic index) may cause significant fluctuations in blood glucose and insulin levels, resulting in unfavourable metabolic effects. Such diets may program beta-cell functions, leading to increased insulin secretion, which could, in itself, fuel further weight gain.[36,37,38] It has also been suggested that caloric sweeteners, added to drinks and containing in particular fructose, are poor satiety inducers, leading to the over-consumption of calories, subsequent weight gain and, ultimately, to Type 2 diabetes.

There are new data supporting the hypothesis that fructose consumption has metabolic and hormonal consequences that may facilitate the development of insulin resistance and obesity.[39] In some countries soft drinks are sweetened with high-fructose corn syrup that contains up to 55% of the monosaccharide fructose. High-fructose corn syrup is also found in processed food ranging from candy bars, to crackers and ketchup sauces. Again, it seems that this ingredient fails in satisfying hunger, but generally succeeds in increasing the potential for overconsumption.

Physical activity

Wels et al.[40] have shown that lower levels of infant activity are associated with greater skinfold thickness in childhood. Another study suggests that low levels of physical activity in preschool children are associated with higher levels of body fat.[41] For younger children in particular, the family environment plays an important role in determining their level of physical activity.[2]

There is a positive association between the increased prevalence of obesity and the quantity of time spent watching television.[42] Television viewing may have a negative effect on energy balance

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by displacing active play and physical activity time while increasing caloric intake (during television viewing), a factor that may also result from the influence of food advertising.[42]

Role modelling of parents and caregivers

Parents play an important role in determining the weight development of their children: Insufficient knowledge about healthy nutrition, unhealthy eating behaviours and increased physical inactivity (parents as model) are the main factors influencing eating and physical activity behaviours of the children.

Research suggests that restricting palatable foods can lead to increased preferences for these foods. Moreover, parental feeding styles may promote overeating in children. Pressuring children to eat everything on their plates ("Clear your plate!") can encourage overeating. In a comprehensive literature review, most published studies reported at least one significant association between parental feeding styles and child outcome. Parental feeding restriction was associated with increased eating and weight status among children.[27,28] Weight gain among children appears to lead parents to impose restrictive feeding practises, which may, in turn, produce additional weight gain.[27,28] Therefore guidelines for overweight prevention that take child characteristics such as susceptibility to obesity and current weight status into consideration may be beneficial.

It should be remembered that it is normal for a child to reject new, unknown food. Five to 10 exposures to certain new food items may be needed before they are accepted. Repeated exposure is most critical during the first few years of life. Studies have shown, that parent-initiated exposure can increase children's acceptance of vegetables[13,43] and that child care pre-school settings are effective locations for promoting children's acceptance of new foods.[44]

Parents and caregivers are important role models and their food choices influence those made by their children. As children grow older, they make their own choices at school and their tastes tend to increasingly influence family decision-making in food choices.

A recent family-based intervention has focused on reducing sedentary behaviours (television viewing in particular) with the goal of influencing eating and activity behaviour and achieving weight loss. Early results from these studies are promising.[45]

Conclusion

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Overweight and obesity in children are ever-increasing worldwide health problems. Since the treatment and long-term reduction of excess body weight often prove to be insurmountable challenges, prevention appears to be the optimal solution. Several research studies support the use of preventive measures in early childhood. Certainly, parents and child-care providers should seek out knowledge about reasonable measures and should themselves be behavioural role models for healthy eating and physical activity. However, obesity prevention will likely fail if the child or the parents remain the sole focus, but the child's environment is not addressed. Obesity prevention (i.e., resisting weight gain) will require a broad-based public health program. Therefore, national governments, local governments, communities, non-profit organisations, the food industry, the media, and schools and local education authorities should all work together to improve children's living environments so that healthy eating and exercise habits are established early.

Implications

- In accordance with the American Academy of Pediatrics, exclusive breastfeeding is recommended for the first 4 to 6 months of life.[46]
- Reducing the amount of television viewing time and other sedentary behaviours to prevent obesity is recommended.[42,47] The American Academy of Pediatrics[48] recommends that no child should have a television in his or her bedroom. Television viewing time should be limited to no more than 1 to 2 hours of quality programming per day. Children younger than two years should not watch television.
- Parents and caregivers should be positive role models to have an impact on children's eating and physical activity behaviours. Initial rejection of new food is normal. Five to 10 exposures may be needed before certain new food items are accepted, and repeated experience is most critical during the first few years of life. Parents and caregivers should limit unhealthy snacks and beverages and avoid using food as a reward.
- Those working in public health and the food industry should be cognisant of the type of foods that are being advertised to all children. The production of new types of sweet carbohydrates that are slowly digestible, fibres-rich and low insulinemic may be helpful as well as the development of beverages and foods that are more satiating.
- The nutritional quality of foods and beverages served and sold in schools should be improved. School-based interventions to reduce children's television viewing time should

be implemented; such programs have shown to be efficient over the short term.[47,49] Gender and cultural needs should be considered.

- Parents should consider the weight of their children to be a critically important indicator of health. They should ensure that a trained professional routinely measures their child's height and weight (at least once a year).

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