Childhood obesity: are we missing the big picture?

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Summary

Childhood obesity is increasing worldwide, raising alarm about future trends of cardiovascular disease, diabetes and cancer. This article discusses what may underlie our failure to respond effectively to the obesity epidemic, and presents a wider perspective for future research and public health agendas. So far targeting individual-level determinants and clinical aspects of childhood obesity has produced limited success. There is growing interest in understanding the wider determinants of obesity such as the built environment (e.g. walkability), social interactions, food marketing and prices, but much needs to be learned. Particularly, we need to identify distal modifiable factors with multiple potential that would make them attractive for people and policymakers alike. For example, walking-biking-friendly cities can reduce obesity as well as energy consumption, air pollution and traffic delays. Such agenda needs to be driven by strong evidence from research involving multi-level influences on behaviour, as well as the study of wider politico-economic trends affecting people’s choices. This article highlights available evidence and arguments for research and policy needed to curb the obesity epidemic. The upstream approach underlying these arguments aims to make healthy choices not only the most rational, but also the most feasible and affordable.

Keywords: Childhood, environment, obesity, physical activity.

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Background

Obesity has become a leading cause of preventable morbidity and mortality worldwide (1). As a lifestyle risk resulting from an imbalance between energy intake and expenditure, obesity is rooted in aspects of modernity and is thus prone to escalation. Using international definitions, at least 10% of school-age children worldwide are overweight or obese, with the Americas leading at (32%), followed by Europe (20%) and then the Middle East (16%) (2). Currently, 17.1% of children and adolescents in the USA are overweight, about three times the rate of some 30 years ago (3).

The seriousness of childhood obesity stems from its association with major health risks such as diabetes and cardiovascular disease (4). Other than risks to health, obesity influences children’s quality of life, impacting their physical, social and psychological functioning (5,6). Children, after all, are not equipped to handle the prejudice and stereotyping associated with obesity which is shared even among health professionals (7). The economic costs of obesity are as troublesome; in the USA, estimated direct and indirect annual costs from obesity mount to $117 billion, while estimates of annual hospital costs associated with childhood obesity increased more than threefold (from $35 to 127 million) during 1997–1999 (8,9). In the UK, the annual cost of obesity (adults, children) is $6.4 billion (10). Obesity’s spread among the poor and minorities adds to their existing health disparities (11). Given the time course of many obesity-related health problems, the full health and economic brunt of obesity is yet to commence in most affected societies.

Although some genetic predispositions contribute to the development of childhood obesity, its rapid increase in
obesity requires a lifestyle approach. Food commercialism, technology, urban and socioeconomic development are contributing to the creation of what is termed ‘obesogenic environments’ that are nurturing over-eating and inactive lifestyles. Within these wider environmental influences, certain populations and communities can be more prone to obesogenic lifestyles. For example, Black girls and Hispanic boys in the USA stand out as being more affected by the obesity epidemic (3), which reflects mostly underlying behavioural susceptibility patterns (12). Understanding these complex interactions is important for the formulation of rational research and intervention strategies that will address the needs and circumstances of different groups of the society.

Childhood is a critical period for developing obesity as well as an opportune time to prevent or intervene on it, as eating and activity patterns develop during this period (13). Given the scale of the problem and what we already know about its root causes, it is surprising how little we have been able to alter its course. Recent systematic reviews of childhood obesity prevention and intervention programs indicate limited success at best (14,15). As a lifestyle risk, obesity requires a lifestyle approach.

Discussion

Energy intake

Simply put, obesity develops when unconsumed energy because of excess intake, reduced expenditure, or most likely both, accumulates gradually as fat tissue. Over the last few decades, there has been a radical change in how people obtain their food as well as in the composition of food itself. Supply, variety, price, manipulation of taste, packaging, fast food and aggressive marketing are leading to increasing numbers of people joining the consumption euphoria of various food products (16). Popular foods among children have shifted to those that are more energy-dense including fast foods, cereals, breads, potatoes and soft drinks (16). Preference for energy-dense foods (e.g. sweet, fatty) is likely to be an evolutionary-coined trait that conferred survival advantage when food supply was stochastic (17). Energy-dense food is not only associated with obesity and increased risk of cardiovascular disease and type 2 diabetes, but there is also evidence that such food can reduce satiety and increase appetite, leading to overeating in adolescents (18,19).

These changes in food supply and composition are mirrored in developing countries where per capita share of many essential food items increased by 50% in about 20 years, and where the transition towards more energy-dense diets and fast food is occurring across the whole socioeconomic continuum (20,21). The consolidation of many food-related industries into a handful of food giants has influenced nutrition patterns globally. China’s transition towards high-energy food and international brands (e.g. Coca Cola) occurred in record time, testament to the gigantic marketing efforts associated with the opening of the Chinese market to foreign businesses (22). In Mexico, three out of every 10 pesos Mexicans spend on food are spent at Wal-Mart (23).

Convenient, cheap and ‘tasty’ food products are hard to keep ashore, especially when backed by massive marketing campaigns. To put this into perspective, American children in the late 1970s ate 17% of their meals outside the home and fast food accounted for 2% of total energy intake. By mid-late 1990s, 30% of meals were eaten outside and fast food contributed to 10% of overall energy intake. In Australia, a third of the food dollar is spent on food purchased and consumed away from home (24). One large fast food meal can contain 2200 kcal, which would require a full marathon to burn off (25). Although the strength of evidence about the contribution of fast and manufactured food (e.g. soft drinks, junk food) to obesity in children varies, these food products typically incorporate many potentially adverse dietary factors, including high energy density, low price, appealing packaging and taste, and large portion size. Sweetened soft drinks represent a particularly worrisome product for children because of their widespread availability (60% of US middle schools sell soft drinks from vending machines) (26), appeal to youth and aggressive marketing to them. In a longitudinal study of 548 schoolchildren (mean age 11.7 years) in the Boston area, Ludwig et al. found that consumption of sugar-sweetened drinks was positively associated with likelihood of obesity among study participants (27).

To overcome an already oversaturated market, the food industry relies on boosting advertisement spending, currently totalling over $30 billion annually in the USA alone (more than any other industry) (28). As a result, children in the USA are exposed to about 40 000 food ads per year, 72% of which are for candy, cereal and fast food (29). Children are very receptive to marketing efforts based on children’s themes and channeled through child-oriented media. With the spread of satellite and e-media, children all over the world are increasingly subjected to the aggressive marketing of the food industry. Young children can be deprived of the ability to analyse claims made in such ads, which can lead to consumption by reinforcing and normalizing behaviour, prompting initial use, and rewarding continued use (29,30). For example, promotional spots on child-focused TV channels (e.g. Disney) equate food with fun and happiness in order to generate brand loyalty in very young children, even if it does not generate immediate sales (31,32). For schoolchildren in the Boston study previously mentioned, each increase of 1 h of television viewing was associated with an additional 167 kcal d⁻¹ as well as increases in the
consumption of foods commonly advertised on television (33). Similar evidence of food advertisement effects on children’s food selection and consumption is reported from other countries (34,35). Considering the totality of evidence, a recent report of the Institute of Medicine concludes that marketing strongly influences children’s food preferences, requests and consumption (36). Marketing to individuals whose judgement is not fully developed (that is why children are not able to drive or drink alcohol) is unethical and should become a prime concern of the public health community. Although no evidence yet supports this claim, the likelihood of advertisement of diet and healthy food being counterproductive cannot be ruled out especially given the history of the promotion of light cigarettes. This question is triggered further by the inconsistency surrounding the effect of dietary patterns on obesity in children (37–40). For example, fat consumption, frequently indicated in the obesity epidemic, has declined in the USA for both adults and adolescents at the time obesity was increasing (41,42). Much of the marketing of ‘healthy and diet food’ focuses on one aspect of the product (e.g. % fat reduced), which can create a sense of complacency and lead to over-consumption of these products regardless of their energy content. The recent packaging of food advertisements into charity projects of the advertiser (e.g. McDonald’s) aims at building brand recognition and loyalty among children. This is not to say that the industry should not be complimented for engaging in charity and community work, but there is a fine line between corporate social responsibility and subtle advertising strategies.

Energy expenditure

Activity patterns of children and adults have changed dramatically worldwide, as more people are driven by technology-based, comfort-oriented lifestyles. Reduced activity and factors contributing to inactive lifestyles such as TV/screen time, availability of playgrounds, school curricula and neighbourhood structure and safety have all been indicated in the obesity epidemic (43). In cross-sectional studies in the USA and Mexico, children who spend less time in moderate-to-vigorous physical activity (PA) were more likely to be obese than their active counterparts (44,45). Longitudinal evidence also supports the detrimental effect of reduced PA on children’s weight. In a study of more than 10 000 children aged 9–14 years in the USA, Berkey et al. found that the increase in body mass index (BMI) at 1-year follow-up was more pronounced among girls reporting higher caloric intake, less PA and more screen time (46). This finding was supported by data with longer follow-ups. Kimm et al. have shown during a 10-year follow-up of 2000 US girls (9–10 years old at baseline) that reduction in activity levels during adolescence was negatively related to participants’ BMI and adiposity (47).

TV viewing also has received research interest in the context of its potential to replace PA (48). Studying 312 10-year-olds, Harrison et al. showed that lower PA, self-efficacy for PA and aerobic fitness were associated with higher BMI and screen time (49). Using objective measurement of PA and TV viewing in a sample of 80 children 9–12 years of age, Hager found that the two measures were correlated only in the after-school period (50), indicating the complexity of possible interactions shaping children’s PA. This view is supported by a study of more than 1000 schoolchildren (5–6 years and 10–12 years) and their parents in Australia. This study showed that the relation between TV viewing and PA was moderated by family socioeconomic status (SES) and structure (presence of a sibling) (51). The potential interaction between TV viewing and PA can have long-term consequences, as has been shown by an elegant study of a birth cohort of 1000 individuals followed for 26 years. In this study, Hancox et al. demonstrated that TV viewing in childhood and adolescence was associated with overweight, poor fitness, smoking and raised cholesterol in adulthood (52). Interestingly, unstructured PA (street playing, biking) seems to be more protective against obesity compared with organized sports, according to a study of more than 3000 children (7–11 years) in Canada (53). Children’s ability to engage in unstructured PA outside the home is related to many factors: neighbourhood safety and structure, parental perceptions and time, weather, and social/community interactions (54,55). These factors, in turn, are related to urban planning, education, security, poverty, as well as larger policy and economic trends highlighting the multidimensional nature of the obesity problem and the importance of the need for wider environmental approaches (Fig. 1).

The built environment

Despite this emerging understanding of the complex nature of the obesity epidemic (56), the study of wider environmental influences and socioeconomic developmental trends on obesity has been modest at best. One of the emerging fields of research into obesity concerns the study of the effect of the built environment on PA and obesity. The premise of this research is simple; people drive less and walk more in more walkable communities (57). While such research in children is emerging, studies looking at the potential influence of elements of the built environment (land use, road connectivity, population density) on obesity in adults are providing novel insights about the contribution of larger developmental processes to the obesity epidemic. Much of this approach has focused on looking at how certain characteristics of the built environment encourage or discourage PA and whether this reflects on
Body weight. Obviously, establishing such connections has important implications for policies dealing with obesity. Initial evidence from this research shows that people who live in neighbourhoods with traditional or walkable design are more physically active than those who live in ‘suburban’ type neighbourhoods (58,59). Other studies examined the next step on this pathway; whether walkability of the built environment reflects on weight and PA. For example, Russ Lopez investigated the relation between urban sprawl and obesity by devising a scale from 1 to 100 to measure urban sprawl based on census data (area density and compactness). He then analysed the scale’s relation to BMI data from the Behavioural Risk Factor Surveillance System (BRFSS, 2000) controlling for important sociodemographic variables and found that the risk of being obese increased by 0.5% for each 1 point rise on the sprawl scale (60). Using similar methods on a wider scale, involving 448 counties and 83 metropolitan areas as well as individual data pooled from 1998, 1999 and 2000 BRFSS (n = 206,992), Ewing et al. showed that the county sprawl index had small but significant associations with minutes walked, obesity and hypertension (61). The influence of the built environment on health has multiple potential pathways involving PA, obesity, chronic disease, car-energy use, air pollution and respiratory exposure. Rigorous research conducted by Frank et al. in King’s county (Washington) incorporating the assessment of walkability, BMI, and NOx and VOC emissions showed that a 5% increase in walkability is associated with a 32.1% per capita increase in PA time, 0.2% reduction in BMI, 5.6% fewer vehicle miles and at least 5.5% fewer grams of emitted pollutants (62). Importantly, this study shows that the contribution of walkability to active transportation was more important than socioeconomic variables (education, income, etc.), indicating the potential positive effects of policies aimed at improving walkability across various socioeconomic levels. Although the magnitude of these influences is small, their widespread and multidimensional effect on the society as a whole makes their potential public health impact enormous.

Emerging studies about the relation between indices of the built environment and children’s PA show in general a positive relation between built environment features fostering activity and PA among children (63). For example, access to recreational facilities and schools, and the presence of sidewalks and controlled intersections were found to be positively associated with PA among children, while traffic density/speed, crime and area deprivation were negatively associated with PA among children (63).

By focusing mostly on suburban populations and not collecting comprehensive information about potential mediators within the built environment-individual behaviour relationship, this research has produced some inconsistencies. One such paradox lies in obesity being more prevalent in inner-city populations compared with suburban communities, whereby features of the built environment (e.g. walkability) would have predicted otherwise (64). Another lies in the inconsistency in research looking at the role of proximity to playgrounds for children’s PA (57). This highlights the need to expand this research agenda to the study of inner-city populations taking into account ethnicity, poverty, food insecurity, crime, access to destinations, social isolation and disparities in health services. Borrowing from the childhood asthma model, factors such as the presence of older siblings or pets (e.g. a dog) can be important determinants of children’s outdoors time...
and activity, especially in unsafe neighbourhoods (65). As such, the potential effect of such factors on children’s activity–weight relationship needs further exploration.

Future considerations

With rising trends reported in most parts of the world, childhood obesity has reached the stage of pandemic (25,66,67). Essentially, obesity has become rampant because we now tend to eat more and move less, and we are increasingly encouraged to do so by our environments. Obesity, in other words, is a sign of mismatch between our genes – still lingering at the hunter-gatherer epoch – and our current techno-commercial and comfort-oriented lifestyles. Wider lifestyle and environmental factors – obesogenic environment – are leading to fundamental changes in the society’s eating and activity patterns. Within this framework, individual factors (e.g. eating and activity preferences) and interpersonal factors (e.g. modelling from parents) (68), peer influences (69), and social norms (70) are shaped by socioeconomic, neighbourhood (e.g. crime level, walking-biking abilities), community (e.g. cultural attributes) and societal (laws-regulations, urban planning, economic, political) factors to set the course of the epidemic (Fig. 1).

This understanding still needs to be fully incorporated into research aimed at highlighting specific and shared features of the obesity epidemic both within and between societies. For example, food availability and accessibility, which have been suggested by studies in North America as important components of the obesogenic environment, do not seem to play such a role in Europe, even among lower socioeconomic groups (71). Our research in Syria, on the other hand, has shown that while women are more obese than men in general, advocating PA and healthy eating can be meaningless to many affected women unless major changes in education, gender role and power structure of the society occur (72,73). So there are obviously some universal characteristics of the global obesity epidemic, but responding to this health problem in each society requires proper understanding of the local environment and factors involved.

This response, moreover, should be guided by the nature of obesity’s potential risk factors (mostly widespread lifestyle changes), while obesity research is still dominated by the individual-level approach aiming at identifying behavioural components related to obesity and acting on them (74,75). The challenges of measuring individual behaviours (e.g. different eating and activity patterns), and the multiplicity of factors influencing them, make it hard to establish meaningful exposure gradients between individuals to be able to assess the role of these attributes in the obesity epidemic. From this perspective, TV viewing, changing patterns of eating (e.g. fast food), sedentary practices and even SES can be surrogates of susceptibility to wider environmental influences (e.g. food marketing, neighbourhood structure and safety, urban/economic/technological development) rather than key drives of the obesity epidemic (76). So, while much research has focused on TV viewing as an important determinant for obesity in children, population-level data on time of use for children in the USA show that sedentary activities like watching TV or passive leisure activities have decreased during the period of the obesity epidemic (77,78). Similarly, the potential for improving knowledge about the importance of fruit and vegetable consumption in obesity prevention (79) can be minimal given the relative inexpensiveness of nutritionally deficient foods (e.g. fast food) compared with fresh fruits and vegetables.

The clinical approach to obesity is also confusing the public health agenda, by placing the healthcare system as the first line of response to the obesity epidemic (80,81). The magnitude of obesity in most societies has already surpassed the ability of any healthcare system to cope with it from the clinical perspective (82). Also, current interventions to treat obesity have modest long-term success at best (83). Thus, prevention rather than treatment offers the best chance of altering the obesity course. In addition, lessons learned from the tobacco epidemic show that addiction as a disease and smoking as a public health problem respond to different tools and approaches. So, while nutrition and PA-based programs can be effective as treatments, affecting the population distribution of energy imbalance will require a different level of intervention targeting elements of the obesogenic environment rather than personal behaviours. In addition, a dynamic understanding of the epidemic’s course and the characteristics of each phase is still not fully recognized. Again, the tobacco epidemic provides a valid model: in the early stages, the most relevant approach was focused on providing evidence of the health and economic costs of the epidemic, but once this was established, policy approaches (taxation, regulation of packaging, sale, advertisement and smoking indoors) become more powerful tools (81).

Finally, solutions to the obesity epidemic should work within the unavoidable, mainly positive, aspects of modernity and be easily integrated within the ordinary life of people. As already mentioned, screen time has been repeatedly linked to obesity in children and interventions based on reducing screen time have been advocated as a solution (49,74,75,84). Understandably, excessive TV viewing can be deleterious to children in many ways, but one can argue that screen-based media will increasingly shape our children’s learning and experience development, i.e. solutions to the obesity problem should be compatible with this trend. By the same token, a free gym subscription or school-based PA program (85) will unlikely have a sustained effect on children in the absence of supportive
environments at home and beyond. Not only does emerging evidence indicate that unstructured exercise can be more relevant, but inducing long-term and sustainable change in PA level requires in addition to school-based diet-activity programs, more of a lifestyle integrated approach (e.g. ability to walk to school, shops, play outdoors).

Recognition of the importance of wider environmental influences on children’s diet and PA and of policy as a powerful tool to affect the obesogenic environments is emerging, with some recent initiatives setting the right course. For example, many states in the USA are enacting or considering legislations that limit sales of ‘competitive foods and beverages’, setting standards for nutrition and PA at school, or limiting vending machine selections in schools. Agreement has also been brokered recently by the William J. Clinton Foundation to limit vending machine sales of high-calorie beverages at schools. Canadian schools have implemented similar measures some 2 years earlier. In the UK moreover, a ban on junk food advertisement around all children’s programming and channels is coming into force, and similar bans are being considered in several developed countries. Developing countries, on the other hand, are expected to continue to be prey for the food industry because of failure to enact and enforce protective policies. Therefore, in order not to repeat the scenario with the tobacco epidemic, where success in the developed world was translated into the industry’s focus on developing countries (86), concerted international effort to regulate the food industry standards and marketing practices worldwide is required as early as possible.

Summary

In the absence of consensus about the causal pathways leading to the obesity epidemic, it is hard to devise a public health response that can affect its course. Research taking into consideration the various levels of influences related to eating/activity and leading to weight increase within each population can help single out important targets for prevention and intervention. Understanding the underlying roots of the global obesity pandemic, however, will also require comparing different populations for shared and distinctive features that can help explain different obesity rates and distributions. In addition, research can benefit from comparisons involving the same population at different time points (e.g. in relation to a policy or law that is likely to affect nutrition-activity). However, with the knowledge we already have and using the evidence from other lifestyle-related health problems, we can start moving in the right direction. Solutions to address the obesogenic environment can be more difficult and costly than intervening at the individual level (87), but are more likely to affect multiple junctions within the obesity pathway in a sustainable way. Given the multiple obvious benefits of the environmental approach in terms of reducing energy consumption, pollution, health costs, traffic obstruction, injuries and crime rates, it becomes hard to conceive why this is not happening in all major urban areas. Moreover, unlike targeted nutrition and PA programs, attending to the broader roots of obesity does not involve sacrificing any aspect of modernity or introducing rigid components to our lifestyles. The effects of such changes can be maximized by introducing regulations not only aimed at limiting the food industry’s ‘improper’ marketing strategies (food advertisement to kids, sponsorship of vending machines in schools), but also encouraging them to engage in society-responsible practices, such as giving them tax incentives for affordable healthy food, or for building accessible supermarkets and businesses in inner-city and poor residential areas.

Understandably, it is hard to pursue such an agenda among politicians and governments given the huge resources needed to produce results that may only be shown in the long run. But with increasing public awareness about the collective burden of obesity to everyone, as well as the burden of current environmentally blind lifestyles on the wellbeing of individuals and nations, this issue can become top priority on the agenda of politicians. Partnership with multiple stakeholders including the food and pharmaceutical industries together with urban planners and regulators will facilitate the transition towards more public and environmental friendly policies. Optimal solutions should not impinge on people’s freedoms but rather render unhealthy choices costly to individuals, corporations and government officials alike. Local regulations related to the food industry in developed countries should be backed by international coordination to avoid exporting problems of the developed world to poorer countries where policies are less likely to be enacted or enforced (88). Grim as the general picture of the obesity epidemic is today, it has perhaps never been clearer that rational solutions can alter its course leading the way to far-reaching benefits to people, the environment and the economy.

Conflict of Interest Statement

The authors declare that they have no competing interests, financial or non-financial.

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