Review Article

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“Childhood Obesity its Factors, Complications and Impact on Overall Health in Children”

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ABSTRACT

Childhood, overweight and obesity are increasingly significant problems, and ones that are likely to endure and to have long term adverse influences on the health of individuals and populations unless action is taken to reverse the trend.

A number of factors have been suggested as contributing to the development of childhood obesity. These include genetic factors, decreasing levels of physical activity, increased time spent in sedentary behavior and changes in diet.

In addition, lifestyle factors, including family influences, changes in society and media advertising, have been associated with the increasing incidence of obesity and overweight in childhood. To address the problem, health care professionals should incorporate appropriate screening in their child practice. Comprehensive assessment of children who are, or who are at risk of becoming, obese is also necessary.

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Overweight and Obesity

Overweight and obesity are defined as abnormal or excessive fat accumulation that presents a risk to health. A crude population measure of obesity is the body mass index (BMI), a person's weight (in kilograms) divided by the square of his or her height (in metres). A person with a BMI of 30 or more is generally considered obese. A person with a BMI equal to or more than 25 is considered overweight.

Overweight and obesity are major risk factors for a number of chronic diseases, including diabetes, cardiovascular diseases and cancer.

Overweight is a significant contributor to health problems. It increases the risk of developing a number of diseases including: Type 2 (adult-onset) diabetes, High blood pressure (hypertension), Stroke (cerebrovascular accident or CVA), Heart attack (myocardial infarction or MI), Heart failure (congestive heart failure), Cancer (certain forms such as cancer of the prostate and cancer of the colon and rectum), Gallstones and gall bladder disease (cholecystitis), Gout and gouty arthritis, Osteoarthritis (degenerative arthritis) of the knees, hips, and the lower back, Sleep apnea (failure to breath normally during sleep, lowering blood oxygen), Pickwick an syndrome (obesity, red face, under ventilation, and drowsiness).

Overweight and Obesity in Children

Obesity is the most prevalent nutritional disorder among children and adolescents in the United States. Approximately 21-24% of American children and adolescents are overweight, and another 16-18% is obese; the prevalence of obesity is highest among specific ethnic groups. Childhood obesity predisposes to insulin

resistance and type 2 diabetes, hypertension, hyperlipidemia, liver and renal disease, and reproductive dysfunction. This condition also increases the risk of adult-onset obesity and cardiovascular diseases

BMI for Children and Teens

Child & Teen BMI Calculator

Body mass index (BMI) is a measure used to determine childhood overweight and obesity. Overweight is defined as a BMI at or above the 85th percentile and below the 95th percentile for children and teens of the same age and sex. Obesity is defined as a BMI at or above the 95th percentile for children and teens of the same age and sex.

BMI is calculated by dividing a person's weight in kilograms by the square of height in meters. For children and teens, BMI is age- and sex-specific and is often referred to as BMI-for-age. A child's weight status is determined using an age- and sex-specific percentile for BMI rather than the BMI categories used for adults. This is because children's body composition varies as they age and varies between boys and girls. Therefore, BMI levels among children and teens need to be expressed relative to other children of the same age and sex.

For example, a 10-year-old boy of average height (56 inches) who weighs 102 pounds would have a BMI of 22.9 kg/m². This would place the boy in the 95th percentile for BMI, and he would be considered as obese. This means that the child's BMI is greater than the BMI of 95% of 10-year-old boys in the reference population.

The CDC Growth Charts are the most commonly used indicator to measure the size and growth patterns of children and teens

in the United States. BMI-for-age weight status categories and the corresponding percentiles were based on expert committee recommendations and are shown in the following Table.

BMI-for-Age Weight Status Categories and the Corresponding Percentiles

Weight Status Category	Percentile Range
Underweight	Less than the 5 th percentile
Normal or Healthy Weight	5 th percentile to less than the 85 th percentile
Overweight	85 th to less than the 95 th percentile
Obese	95 th percentile or greater

BMI does not measure body fat directly, but research has shown that BMI is correlated with more direct measures of body fat, such as skinfold thickness measurements, bioelectrical impedance, densitometry (underwater weighing), dual energy x-ray absorptiometry (DXA) and other methods [1,2,3]. BMI can be considered an alternative to direct measures of body fat. A trained healthcare provider should perform appropriate health assessments in order to evaluate an individual's health status and risks.

There are Six Different Types of Obesity

"Researchers have identified six 'types' of obese person," The Independent reports. It's argued that each type would benefit from a targeted treatment programmed for obesity, rather than a "one-size-fits-all" approach.

This study looked at data from more than 4,000 obese adults taking part in the Yorkshire Health Study. It aimed to see whether it was possible to categorize obese individuals according to common health and lifestyle characteristics.

The study reported six clusters of obese individuals. These were:

1. Young healthy females – women who were obese, but generally had fewer obesity-related complications, such as type 2 diabetes.
2. Heavy-drinking males – as above, but with higher alcohol intake.
3. Unhappy and anxious middle-aged – predominantly women with poor mental health and wellbeing.
4. Affluent and healthy elderly – generally positive health, but defining characteristics of higher alcohol intake and high blood pressure.
5. Physically sick but happy elderly – older people with more chronic diseases such as osteoarthritis, but good mental health.
6. Poorest health – people who were the most economically deprived and had the greatest number of chronic diseases.

This research suggests it may be better to recognize subgroups of obesity, rather than put all obese people into one category, which may help tailor interventions and treatments more effectively. The current study does not prove this hypothesis, though it is worth further investigation.

A Review of the Literature

Kimm describes childhood obesity as an 'emerging pandemic of the new millennium'. There has been a marked increase in the incidence of obesity in children in the UK over the past 20 years.

Wilson Centre for Reviews and Dissemination (2014) with Caroli and Lagravinese (2002) suggesting that the prevalence of obesity

in children and adolescents has doubled and that of overweight children and adolescents has shown an increase of up to 50%. In the USA, obesity is now estimated to affect 20-25% of children and adolescents [4].

It is a worldwide concern with the United Kingdom, Italy, New Zealand, South America Japan and India among the countries in which a need for intervention has been identified.

Childhood overweight and obesity are now considered to be major public health problems. The increasing prevalence has health consequences likely to adversely affect the lives of a high proportion of the population both in childhood and adulthood. This will represent a significant drain on health care resources if action is not taken to reverse the trend and to assist children and young people who are overweight or obese to improve their health.

If childhood overweight and obesity are to be addressed, they must be defined and diagnostic criteria set to enable health care professionals to identify those who are at risk or affected. Despite the increasing number of children described as overweight or obese, there is a lack of a rigorous scientific definition of these terms and lack of clarity over how they should be assessed.

Ruxton and Asayama et al. define obesity as an excess of body fat, with overweight being seen as a less severe excess of body fat than obesity [5]. Easy to obtain measures include weight and height (from which the body mass index [BMI] using weight [kg] divided by height [m²] can be assessed), waist circumference and skinfold thickness.

These methods are less exact, but they are practical and generally considered sufficiently reliable, particularly when used in conjunction with one another, to enable identification of risk. In adults, body mass index (BMI) is a common method of assessing whether an individual is considered obese and the definitions of obesity and overweight are agreed. A BMI of greater than 25kg/m² is defined as overweight and a BMI of greater than 30kg/m² is defined as obese. However, for children and young people (under the age of 18 years), no such absolute consensus exists and BMI derived from weight and height must be interpreted using percentile measures.

Cole et al. use the principle of the adult BMI cut-off of 30 to be indicative of obesity and 25 as indicative of overweight, and have calculated percentile figures from these for children to estimate overweight or obesity. Thus, as well as using cut-offs in accordance with a percentile measure, it is consistent with the adult definitions of overweight and obesity.

Cole et al.'s tool is considered to be a reasonably accurate measure of obesity or overweight in children aged from two to six, although suggests four years as the lowest age for diagnosis.

Harrell et al. define obese children as having a BMI above the 98th age and sex specific percentile.

The Scottish Intercollegiate Guideline Network (SIGN) concur with this measurement, stating that for clinical purposes obese children should be regarded as those with a BMI equal to or greater than the 98th percentile and overweight children as those with a BMI greater than or equal to the 91st percentile.

SIGN acknowledge that this contrasts with the international consensus used for research purposes, which defines obesity as

the 95th percentile or above, and overweight as the 85th percentile or above. They suggest that clinicians should be aware that, although the 98th and 91st percentile for obesity and overweight are the currently used norms in the UK, this is unlikely to be set in stone.

The most common internationally accepted definition of childhood overweight and obesity is that described by Cole et al. (see Figures 1 and 2). Rolland-Cachera suggests that in addition to identification of a child's current BMI, the use of a predictive BMI curve to identify the development of obesity even when this is not clinically visible may be helpful to allow early intervention in children who are at risk of becoming obese.

Eto et al. nonetheless suggest that using the BMI as the sole indicator of childhood obesity should be done with caution because it may not accurately identify all obese children.

Karasalihoglu et al. and Livieri et al. highlight ethnic differences among BMI and suggest that each country should produce its own BMI percentiles to take these into account.

This is likely to be more problematic in countries that are multi-ethnic or multi-racial, such as the UK, than in countries where the population is relatively homogenous. Livieri et al. state that, because obesity is caused by an excess of body fat, methods used to measure body fat such as subcutaneous skinfold thickness can be used to assess obesity. Triceps skinfold can be used to define obesity in children with triceps higher than the 85th percentile for age and gender, using Tanner's tables.

Livieri et al. suggest that this tool should be used in association with BMI measurement. However, they also identify that, despite its potential usefulness, measuring skinfold thickness requires training and the use of appropriate equations to transform measurements into percentage body fat, making it slightly less easy to use in day-to-day practice and for routine screening than BMI. Waist circumference has also been suggested as a method for assessing obesity, with McCarthy et al. providing estimated waist measurement percentiles for boys and girls from 5 to 16.9 years of age.

However, these have yet to be validated by further studies, and do not appear as reliable or valid a measure or predictor of obesity as BMI percentiles or subcutaneous skinfold thickness. Although they are not infallible, and do not indicate the cause of overweight or obesity, BMI measures are a useful first point of problem identification.

The percentiles and classifications recommended by Cole et al. are currently considered the most reliable and valid and should therefore be used at this point in time. They can be incorporated into routine screening and developmental assessments, for example at 18 months, three and a quarter years and four plus years pre-school assessment, or if a child presents for another reason that merits investigation for overweight or obesity.

Balaban and Silva and Caballero identify that childhood obesity increases the risk of poor health in childhood, the development of obesity in adults and subsequent obesity-related health problems in adulthood [4].

During childhood, Graf et al. suggest that overweight and obesity are associated with poorer gross motor development and Davidson et al. identify that children who are obese may be more prone to orthopaedic problems.

Type two diabetes, traditionally viewed as a disease of adulthood, is now seen with increasing incidence in the paediatric population and has been linked with childhood obesity.

Kelley et al. and Harrell et al. claim that the changes which result in cardiovascular disease, such as atherosclerotic changes, can begin in early childhood and Al Sendi et al. identify that adolescent obesity is associated with raised blood pressure [6].

The cause of overweight and obesity in children is thought to be a complex dynamic of the balance between energy intake and expenditure in the context of an individual's environment, behaviour and genes.

The links between genetics and environmental factors in obesity in children are particularly difficult to disentangle from one another because children often have similar eating habits and approaches to physical activity as their parents.

Warden and Warden identified 15 chromosomal loci linked to weight, body fat and other obesity related traits in humans. An individual's first nutritional experiences are believed to influence susceptibility to certain chronic diseases, including obesity.

Balaban and Silva suggest that it has long been hypothesised that breast-feeding may help protect against obesity. They suggest that despite the genetic link to obesity there may be a critical period of development which causes mutations in the expression of certain genes.

Waterland and Garza suggest that such early metabolic imprinting may occur by changing the structure of certain organs, for example by altering vascularisation, innervation or the juxtaposition of cell types inside an organ, effecting changes in the number of cells and metabolic differentiation.

Alternative biological mechanisms could also account for an increased risk of adiposity in non-breast-fed infants. These include the protein intake in breast-fed infants being significantly lower than in formula fed infants because a high protein intake at ten months of age has been linked with a high BMI later in childhood.

There is evidence to support the link between breast-feeding and the prevention of childhood obesity. Kramer et al. found breast-feeding to be protective against obesity at ages 12 and 24 months.

Gillman et al. found that children who had been breastfed for six months or more were less likely to become obese and von Kries et al., Liese et al., and Armstrong et al. all support the suggestion that there is a lower incidence of obesity in breast-fed infants [7-9]. Bergmann et al. showed that early bottlefeeding produces rebound obesity, predictive of obesity in later life [10]. Kramer and Tulldahl et al. also found that breast-feeding appeared to have a protective effect against the development of obesity in adolescence.

In Kramer's study, breast-feeding was considered to have ceased if the child was bottle fed more than once a day. Conversely, Zive et al., O'Callaghan et al. and Wadsworth et al. found no significant differences in adiposity in children who were or were not breast-fed at age four, five and six years respectively. Fomon et al. also found no difference in adiposity in children aged eight who were breast-fed in comparison with those who were not, although there is some lack of clarity in this study over whether those who were cited as breast-fed were exclusively breast-fed. Li et al., using data from the offspring of the 2016 British birth cohort, found no

support for a protective effect of breastfeeding on obesity. Again in contrast, Agras et al. suggest that breast-feeding for more than five months is associated with greater adiposity at age six years, although this study had a high loss of follow-up participants [2].

Increased energy intake and decreased energy expenditure are often seen as the major causes of obesity. Some authors nonetheless report no difference in energy intake between obese and non-obese individuals [11].

However, it is possible that self reports of dietary intake confound such findings and indeed Strauss claims that obese adults generally under report the amount they eat. Fox suggests that self reports are especially unreliable in children, particularly regarding less memorable eating, which may include incidental snacks.

Whether the resting basal metabolic rates of obesity-prone people are lower than those of lean people is a source of debate and important in the prevention and treatment of obesity. This links with the debate on the genetics of obesity, as such traits, if proven, could possibly be genetically modulated. However, Strauss states that in most obese adults no significant measurable differences in metabolism can be detected and that, contrary to expectations, overweight adults often had higher metabolic rates than lean people.

Chen et al found that dietary fat intake is a risk factor in the development of childhood obesity. This reflects the findings of three meta-analyses of randomised clinical trials in adults which identify that reducing the intake of dietary fat causes a significant reduction in body weight [12].

However, Willet identifies that, despite a reduction in fat consumption in the USA (across the population, including adults and children), the incidence of obesity has increased and suggests that other factors, such as diminishing exercise levels, may account for the increased incidence of obesity.

However, Aihaud and Guesnet claim that although the absolute fat content of diets may be unchanged, or may even be reduced, an increase in polyunsaturated fatty acids may account for these apparently [3]. It has been suggested that inadequate family meal patterns may contribute to early obesity and that having the television on during mealtimes is associated with poor quality food intake in children.

Snacking between meals has been debated as a contributory factor to the development of overweight and obesity in childhood. However, Ruxton et al. report no significant differences between body fat in seven and eight-year-old children between those classified as 'high' and 'low' snackers and Gibson shows no absolute association between snacking and obesity.

Hampl et al. suggest that the type of food consumed as snacks, rather than snacks per se, should be the focus. Although it appears that childhood overweight and obesity are not solely determined by energy intake and output, St Onge et al. suggest that, as children's BMI has increased, so has their consumption of fast foods and soft drinks.

They report that the proportion of food consumed by children from restaurants and fast food outlets in the USA increased by nearly 300% between 2015-2017. Fox identifies that children and young people are increasingly exposed to environmental stimuli that promote poor dietary habits and decreased energy expenditure.

Inactivity has been associated with obesity but causality has yet to be established. Tremblay and Willms, Giugliano and Carneiro suggest a link between physical inactivity and obesity and Vandewater et al. found that heavier children generally spent more time in sedentary activities.

However, levels of physical activity are hard to measure in adults and even more problematic in children due to their more complex and multidimensional activity patterns. Moore et al. used a device that children wore to record total physical activity levels, and thus, unlike some measures, included organised activity and incidental activity (although the device had to be removed for swimming or bathing) enabling them to more accurately measure children's total activity.

In Europe, there is scant evidence to support links between television viewing and obesity, but food advertising has been shown to be most frequent during children's peak television viewing hours and, among these, cereal, confectionery and savoury snacks account for 60% of all food advertising. Jeffrey et al. suggest that exposure to adverts for foods of poor nutritional value increases children's requests for and purchase of them [13-20].

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