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### BABY MASS INDEX

(“We must be the change that we want to see in the world.” Gandhi.)

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#### ABSTRACT

Childhood obesity has captured National headlines due to the astounding rates at which its prevalence rate is increasing. Obese children may experience immediate health consequences which can lead to weight-related health problems in adulthood. Public health authorities define childhood obesity as a score at or above the BMI of 30 [95th percentile] by age, while overweight is used to describe the BMI of 25 or higher [85th to 95th percentiles]. Body Mass Index [BMI] is measured by the formula: weight in kg divided by square of height in meters. Although the mechanism of obesity development is not fully understood, it is confirmed that obesity occurs when energy intake exceeds energy expenditure. Childhood obesity can be brought on by a range of factors which often act in combination. BMI is used as a screening tool to identify possible weight problems for children. CDC and the American Academy of Pediatrics [AAP] recommend the use of BMI to screen for overweight and obesity in children beginning at 2 years old. For children, BMI is used to screen for obesity, overweight, healthy weight, or underweight. However, BMI is not a diagnostic tool. The Body fat is estimated by Direct methods, Indirect method, Biochemical parameters and clinical parameters like Blood pressure etc. Although the mechanism of obesity development is not fully understood, it is confirmed that obesity occurs when energy intake exceeds energy expenditure. Childhood obesity can be brought on by a range of factors which often act in combination. Additionally, research is needed to test these issues. Looking into the future, 6 relevant levels may be involved in the prevention and treatment of pediatric obesity, and each of these needs investigation- family, schools, health care, government, industry, and media. Together, these 6 levels could promote childhood obesity as a high research priority and put it as the first point in the international public agenda.

**Key Words:** Corpulence, Obesity, Children, School.

#### INTRODUCTION

Childhood obesity has captured National headlines due to the astounding rates at which its prevalence rate is increasing. Obese children may experience immediate health consequences which can lead to weight-related health problems in adulthood. Obese children and teens have been found to have risk factors for cardiovascular disease [CVD], including high cholesterol levels, high blood pressure, and abnormal glucose tolerance[1][2]. In a sample of 5-to 17-year-olds, almost 60% of overweight children had at least one CVD risk

factor and 25% of overweight children had two or more CVD risk factors. In addition, studies have shown that obese children and teens are more likely to become obese as adults. In addition to suffering from poor physical health, overweight and obese children can often be targets of early social discrimination. The psychological stress of social stigmatization can cause low self-esteem which, in turn, can hinder academic and social functioning, and persist into adulthood.

#### DEFINITION OF OBESITY

In children and adolescents, BMI scores are not interpreted alone, but are considered in terms of percentiles by age and sex in order to better account for growth patterns. Some public health authorities define childhood obesity as a score at or above the BMI of 30

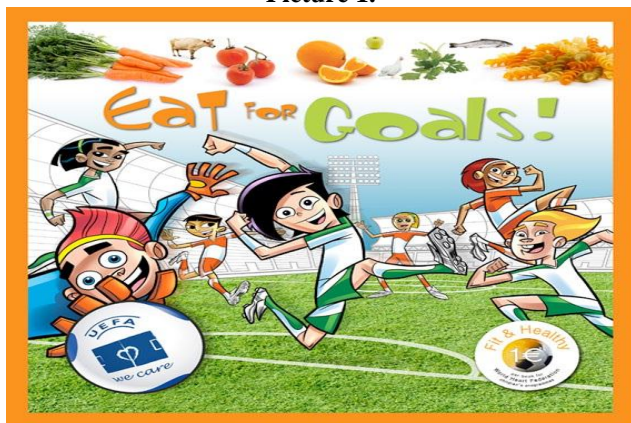
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Picture 1.



[95th percentile] by age, while overweight is used to describe the BMI of 25 or higher [85th to 95th percentiles].

### MEASURING AN OBESITY/OVERWEIGHT LEVEL OF CHILDREN

**What is BMI?** Body Mass Index [BMI] is a number calculated from a child's weight and height. BMI is a reliable indicator of body fatness for most children and teens. BMI can be considered an alternative for direct measures of body fat. Additionally, BMI is an inexpensive and easy-to-perform method of screening for weight categories that may lead to health problems.

**Body Mass Index [BMI] is measured by this formula: weight in kg divided by square of height in meters. The result of this calculation is then interpreted as:**  
 <br/>Below 18.5 = Underweight<br/>18.5 - 24.9 = Normal or ideal weight<br/>25 - 29.9 = Overweight<br/>Above 30 = Obese.

**BMI-for-age, weight status categories and the corresponding percentiles are shown in the following table:**

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

**How is BMI used with children and teens?** BMI is used as a screening tool to identify possible weight problems for children. CDC and the American Academy of Pediatrics [AAP] recommend the use of BMI to screen for overweight and obesity in children beginning at 2 years old [3].

For children, BMI is used to screen for obesity, overweight, healthy weight, or underweight. However, BMI is not a diagnostic tool. For example, a child may have a high BMI for age and sex, but to determine if excess fat is a problem, a health care provider would need to perform further assessments. These assessments might include skinfold thickness measurements, evaluations of diet, physical activity, family history, and other appropriate health screenings.

### Two children have the same BMI values, but one is considered obese and the other is not. Why is that?

The interpretation of BMI-for-age varies by age and sex so if the children are not exactly the same age and of the same sex, the BMI numbers have different meanings. Calculating BMI-for-age for children of different ages and sexes may yield the same numeric result, but that number will fall at a different percentile for each child for one or both of the following reasons [7].

- The normal BMI-related changes that take place as children age and as growth occurs.
- The normal BMI-related differences between sexes.

By seeing the above graphic for an example for a 10-year-old boy and a 15-year-old boy who both have a BMI-for-age of 23. [Note that two children of different ages are plotted on the same growth chart to illustrate a point. Normally the measurement for only one child is plotted on a growth chart.

### Body Fat Estimation and Risk Assessment

**a) Direct methods:** Dual-energy X-ray absorptiometry [DXA]. **b) Indirect methods:** Anthropometry [Weight, Height, BMI, Waist circumference, Waist-Hip ratio, Skin fold thickness], **c) Clinical parameters:** Blood pressure, **d) Biochemical parameters:** Lipid profile; Lipoprotein, Apo-lipoprotein; Blood glucose, Insulin levels; HbA1C [fasting samples] FFA levels, hepatic transaminases, etc

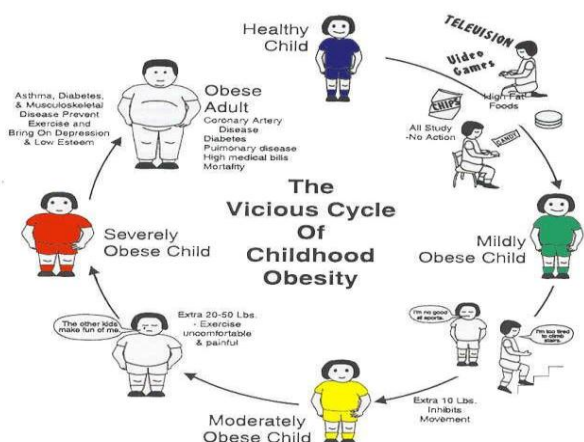
### CAUSES OF OBESITY

Although the mechanism of obesity development is not fully understood, it is confirmed that obesity occurs when energy intake exceeds energy expenditure. Childhood obesity can be brought on by a range of factors which often act in combination [4][5].

### Social and environmental factors

Changes in environmental and social factors are likely the main explanation for doubling of severe childhood obesity over the last 30 years. Obesity is encouraged by such "obesogenic environmental conditions that promote overeating". "Passive over consumption" due to changes taking place in food marketing, consumer behavior [e.g., increases in consumption of food and beverages] and targeted marketing of high calorie dense foods with low nutrients.

Picture 2.



### Diet

Over the last decades, food has become more affordable to larger numbers of people as the price of food has decreased substantially relative to income and the concept of 'food' has changed from a means of nourishment to a marker of lifestyle and a source of pleasure.

### Calorie & Fat intake

Total energy intake is difficult to measure accurately at a population level. However, a small caloric imbalance over a long period of time is sufficient to lead to obesity. Although fat eaten in excess leads to obesity. There is no strong enough evidence that fat intake is the chief reason for the ascending trend of childhood obesity.

### Physical activity

It has been hypothesized that a steady decline in physical activity among all age groups has heavily contributed to rising rates of obesity all around the world. Low participation rates in sports and physical education, particularly among adolescent girls, are also associated with increased obesity prevalence. In urban areas parents prefer having their children watch television at home rather than play outside unattended, "watching television and playing computer games are associated with increased prevalence of obesity.

### Genetics

Childhood obesity is often the result of interplay between many genetic and environmental factors. Polymorphisms in various genes controlling appetite and metabolism predispose individuals to obesity. Obesity is a major feature of a number of rare genetic conditions that often present in childhood. Prader-Willi syndrome is characterized by hyperphagia and food preoccupations which lead to rapid weight gain in those affected. Bardet-Biedl syndrome, MOMO syndrome, Leptin receptor

mutations, Congenital leptin deficiency, Melanocortin receptor mutations are other genetic disorders characterized by obesity.

### Home environment

Children's food choices are also influenced by content of family meals. Families with Sedentary life style and non-vegetarian, calorie dense, high fat foods are more likely to have obese children.

### Developmental factors

Various developmental factors may affect rates of obesity. Babies fed on formula feeds are likely to have higher BMI as children and adolescents. A child's body growth pattern may influence the tendency to gain weight. Fat babies at four months were 1.38 times more likely to be overweight at seven years old compared to normal weight babies.

### Medical/Endocrine diseases

Cushing's syndrome [condition in which body contains excess amounts of Cortisol], hyperinsulinism, Hypothyroidism and craniopharyngioma with hypothalamic involvement are the hormonal causes of obesity.

### Psychological factors

A positive correlation between obesity and low self esteem has been established. Researchers discovered that decreased self esteem led to 19% of obese children feeling sad, 48% of them feeling bored, and 21% of them feeling nervous. In comparison, 8% of normal weight children felt sad, 42% of them felt bored, and 12% of them felt nervous. Stress can influence a child's eating habits. Feelings of depression may cause a child to overeat.

### Adiposity rebound and Puberty

Adiposity rebound [AR] is the time at which children's adiposity or excess fat tissue declines to its lowest level and then begins to increase as the child, children who experience an early AR have elevated BMIs or are more likely to develop obesity at older ages.

### Mechanism of Obesity

During growth, fat cells increase in number and when energy intake exceeds expenditure, fat cells increase in size. When fat cells have reached their maximum size and energy intake continues to exceed energy expenditure, fat cells increase in number again. With fat loss, the size of the cells shrinks, but not the number. When fat loss occurs, none of the cells decrease in number they only decrease in size [6].

### Myths of Childhood Obesity

**Myth 1: Childhood obesity is parents' fault:** Maybe, sometimes. After all, parents are the ones who buy their

family's food and who set rules about TV time and who encourage [or don't] physical activity. But some kids may be genetically predisposed to obesity. Some parents may not understand good nutrition practices, or may not be able to afford or even find healthy foods in their neighborhood. And once kids are away at school for several hours a day, parents have less control over kids' choices.

**Myth 2: Childhood obesity is caused by fast food:** It's true that especially fast foods are plentiful, inexpensive, and unhealthy--loaded with way too many fat, salt, and empty calories. Even in more upscale restaurants, portion sizes are unnecessarily huge. But we all have the option to avoid fast food [packing our own lunches and snacks helps], or to make smarter choices when we do eat out, like selecting apples instead of French fries.

**Myth 3: Childhood obesity is caused by too much TV and video games:** We are a sedentary society, no doubt about it, and we do spend too much time staring at screens instead of moving our bodies. It's important for parents to set screen-time limits and provide alternative options for active play. But some video games actually do encourage exercise, and even a total ban on TV and other screens won't prevent obesity if kids eat a poor diet or have other complicating factors.

**Myth 4: Soda causes childhood obesity:** Soda alone doesn't cause obesity. A child who drinks a lot of soda and also has poor eating habits may be obese. If that same child is also living a sedentary life and eating additional processed foods then obesity may be the result. However, soda alone does not cause obesity.

**Myth 5: Obesity is inherited and you can't do anything about it:** It is true that tend to see obesity run in families. If a child is obese, chances are the parents are also obese or overweight. However, it is uncommon for genetics to cause obesity. Occasionally a child may be born with a hormonal imbalance that causes obesity, but that's not the norm. In most cases a parent has simply passed on their poor eating habits and inactive lifestyle to their children. Those two elements combine to cause obesity. Eat a healthy diet and get active and obesity can be reversed, even if the parents stay overweight. The best scenario, however, is that the entire family works together to change behaviors as a family.

**Myth 7: Obese children are just lazy:** Absolutely not. Obese children are the same as any other children. They love to play and be active. However, it is also very easy to be sedentary today. Video games, electronic devices and television all keep children indoors and on the couch. Children of all ages and sizes need to be motivated by the adults in their life to get outside and to move their bodies.

## MEDICAL MANAGEMENT

There are no medications currently approved for the treatment of obesity in children. Orlistat and sibutramine may however be helpful in managing moderate obesity in adolescence. Sibutramine is approved for adolescents older than 16. It works by altering the brain's chemistry and decreasing appetite. Orlistat is approved for adolescents older than 12. It works by preventing the absorption of fat in the intestines. Adolescents with BMI of more than 40 with associated complications are considered for bariatric surgery [3].

### Targets for Obesity Prevention Efforts

1. Reducing consumption of "energy dense" or high-calorie foods, especially foods of low nutritional value
2. Reducing consumption of sugar-sweetened beverages
3. Increasing consumption of fruits and vegetables
4. Increasing the initiation and duration of breastfeeding, with exclusive breastfeeding for the first 6 months.
5. Reducing sedentary leisure-time pursuits such as television, movies, computers, and video Games.
6. Increasing physical activity, promoting vigorous physical activity in children

### There are numerous ways the parents to get involved in preventing childhood obesity

- Model healthy eating yourself. Children are far more likely to eat what they see the adults in their lives eating.
- Limit extra foods such as confectionary and soft drink.
- Choose a variety of foods from the main food groups: vegetables and legumes, fruit, dairy food, lean protein from meat, poultry, fish, eggs and nuts, and wholegrain from breads, cereals, rice and pasta.
- Be physically active with your family. Go for walks, play outside, and turn off the TV.
- Practice regular exercising pattern. Playing outdoor games as well as Yoga. Parents need to be a model for their children.
- Limit your child's screen time. Don't allow your child to have a TV in his or her bedroom. Get children involved in the kitchen. Children are far more likely to eat what they have helped to prepare. Plus, by teaching them how to prepare food, you will give them the skills they will use for their whole lives.
- Provide an array of healthy snack options that are easily accessible to your children.
- Encourage your children to try new foods, including fruits and vegetables.
- Don't pressure your children to finish what is on their plates. Most children will stop when they are satisfied.
- Avoid using food as a reward for good behavior and restricting certain foods when giving punishment. This can develop feelings around food that can later cause unhealthy habits.



- Advocate to your local representative to fund programs that assist parents, schools and your community to create a healthy environment for children.
- Support organizations such as Healthy Kids Association that are doing something to help fight childhood obesity and diet-related diseases in children.
- Get involved in the canteen in your local school. Help to prepare healthy menu options for students. Contact your local council to encourage them to keep green spaces and limit development on them so that children have safe spaces to play [6][7].

**Picture 3.**



#### **There are some relatively easy things schools could do**

- Mandel: "Schools can create their own jingles, dances, and videos about healthy eating and exercise. A school can hold a competition. The PA system could offer a health tip of the day."
- Zied: "Some ideas include: taking kids to a garden or farm to see how food is made, teaching nutrition, home economics and cooking classes, or involving kids in creating healthy fundraisers [alternatives to bake sales]."
- Virgilio: "I think there should be cooking classes for parents after school, nutrition seminars, parent/child fitness classes and adult fitness classes in the p.m. ... all run through the school and coordinated by the wellness committee."
- Psychotherapist Pamela Garber, who has a practice in New York City: "Providing individual and small group counseling on premises and structuring that during recess time or health class time. This keeps the school in a supportive role, offering more services, but not altering the focus of the educational system."
- As for the cons, Prof. Virgilio mentions that "parents and the communities are depending too much on schools to address the obesity issue. Studies have demonstrated that the best approach for creating long-term positive health behaviors is the immediate home environment" [8].
- Zied: "Lack of funds is often cited as an excuse for not tackling the childhood obesity problem. While lack of funding cannot be argued, I do believe that a lack of concern for nutrition and fitness can be costly to kids in

terms of their academic performance. The better they eat ... the more nourished they are ... the better they tend to do on exams and homework."

- Garber: "The scope of responsibility within the school system is providing healthy snacks and meals, monitoring sugary drinks, and educating students within the school setting. Going beyond is taking on a parental role and is out of the scope of the school's place, outside of the boundary of what a school is designed to offer."

#### **HEALTHY SNACKS FOR KIDS**

##### **For children, snacks are an important part of a healthy diet.**

Children, particularly active ones and those going through growth spurts, may not get their energy requirements from only breakfast, lunch and dinner. When children get hungry between meals, it is important to make sure that there are good quality and wholesome snacks available to provide the extra energy and nutrients they need [8].

##### **Tips for healthy snacking**

- Think about the size of the snack. Snacks don't need to be too big. Give children just enough to keep going until the next meal.
- Think about the timing of snacks. Don't let kids get so hungry they want to eat anything in sight. Snacks should be offered at regular times of the day, preferably a couple of hours before the next meal to avoid spoiling their appetite for the main meal. If hungry before dinner is ready provide raw vegetables while they wait.
- Think about where snacks are consumed. At home, snacks should be consumed sitting down and not eaten while watching television or doing other things.
- Parents/care providers can be good role models for children by eating nutritious snacks themselves and by making these snacks readily available.
- Keep a selection of healthy snacks easily available in the fridge or pantry such as milk, yoghurt, chopped fruit, nuts, bread and breakfast cereal. Top up the fruit bowl with in season fruit.
- Teach kids how to use simple kitchen equipment to prepare healthy snacks such as milk shakes, toasted sandwiches and popcorn, wholemeal muffin or pita pizzas.
- Snacking at Home. It is easier to prepare healthy snacks at home where a variety of foods and equipment is available.

##### **Breads and Cereals**

- Toast, fruit toast, English muffins and crumpets – preferably wholegrain or whole meal.
- Home made pizza made using whole meal muffin or whole meal pita bread, reduced fat cheese and homemade tomato sauce that contains added vegetables.
- High fiber breakfast cereal with milk, sliced fruit or yoghurt

- Homemade popcorn [only add a drizzle of polyunsaturated margarine and a sprinkle of salt if at all]
- Whole meal pikelets.
- Cakes and muffins made with whole meal flour and with added fruit or grated vegetables
- Wholegrain crisp bread and crackers topped with tomato and avocado, peanut butter, reduced fat cheese.
- Sandwiches and wraps with salad and grated low fat cheese
- Toasted sandwiches made with reduced fat cheese and tomato, baked beans, tuna or creamed corn

#### ***Fruit, Vegetables, Nuts and Seeds***

- Use sliced tomato, cucumber, avocado or thinly spread unsalted peanut butter for topping biscuits, toast and in sandwiches
- Serve carrot, cucumber and celery sticks with low fat dips, reduced fat cream cheese or reduced fat cheese cubes
- Fresh or tinned fruit [packed in water or natural juice] with yoghurt or custard
- Homemade or commercial low sodium vegetable soup [with less than 250mg sodium /100mls]
- Dried fruit and nuts eg. almonds, pecans and walnuts

#### ***Dairy Products***

- Milkshakes made with reduced fat milk and a small amount of flavouring.
- Smoothies made with reduced fat milk, fruit and reduced fat yoghurt [frozen berries work well blended in smoothies].
- Reduced fat custard served with fruit.
- Small low fat ice confections containing extra calcium.
- Banana split made with sliced banana, yoghurt, custard or low fat ice cream and chopped peanut sprinkles.

**Picture 4.**



#### ***Snacking on the run***

Healthy snacking when out and about requires a bit more organization. Keep some of these ideas in the pantry or fridge to quickly grab when in a rush or heading out. On hot days pack snacks in a small, lightweight esky with a frozen water bottle. Send an extra container to school containing afternoon tea if kids are going straight to after school activities.

- Small packets of dried fruit and unsalted nuts and seeds.
- Small packets of plain popcorn.
- Tetra packs of plain or flavoured reduced fat milk or reduced fat custard.
- Small tetra packs or pop tops of 99% fruit juice.
- Portable fresh fruit such as mandarins, bananas and apples.
- Container of high fibre bites style breakfast cereals.
- Fruit tubs.
- Fruit straps 99% fruit.
- Small wholegrain or nut based snack bars with no added choc chips or chocolate or yoghurt coatings etc.
- Wholegrain crackers and tinned tuna.

#### ***Snacking at the Shops***

It can be a challenge to find healthy snacks when out and about. Snacks purchased when away from home tend to be served in large serve sizes so why not share one serve? Ask for drinks to be made with reduced fat milk and butter and cream to be served on the side or not at all.

- Hot chocolate or small serves of milk shakes made on reduced fat milk [just ask]. Supermarkets have single serves of cold reduced fat flavoured milk in their refrigerators.
- Raisin or cinnamon toast.
- Fresh or toasted sandwiches.
- Bread rolls from the bakery.
- Small finger buns or small date or sultana scones.
- Fruit with easy to peel skins from the fruit shop or supermarket.
- Small serves of reduced fat ice cream without chocolate coatings.
- Supermarkets have single serve yoghurt and frozen yoghurt available.

***Drinks:*** Water and reduced fat milk are the best choices. Keep fruit juice serve sizes small [<200mL]. Keep sugary drinks such as soft drink and cordial as occasional drinks.

***Sometimes snacks:*** Many popular snacks consumed by children such as biscuits, crisps, cakes, sausage rolls; chocolate bars, soft drinks etc are high in kilojoules, salt or sugar and are low in nutrients. These foods and drinks belong in the extras section of the Australian Guide to Healthy Eating. These can be included in a healthy diet but should not be eaten on a daily basis. Serve or purchase these foods only occasionally and don't let them take over the pantry or fridge as easy to access snacks.

## RECOMMENDATIONS

- Advocate for regulation of youth marketing.
- Strengthen consumers' ability to make informed food choices, gain access to accurate information, and
- take an active role in influencing food policy.
- Make communities more walk-able than bike-able.
- Increase access to healthy foods.
- Engage local governments and community groups, particularly those most affected by obesity, in community and policy initiatives.

## EFFECTS / COMPLICATIONS OF CORPULENCE ON HEALTH

The first problem to occur in obese children is usually emotional or psychological. Obese children often suffer from teasing by their peers. Some are harassed or discriminated against by their own family. Stereotypes abound and may lead to low self-esteem and depression. Childhood obesity however can also lead to life-threatening conditions including diabetes, high blood pressure, heart disease, sleep problems, cancer, and other disorders [7].

System	Condition	System	Condition
Endocrine	Impaired glucose tolerance Diabetes mellitus Metabolic syndrome Hyperandrogenism Effects on growth and puberty Nulliparity and nulligravidity	Cardiovascular	Hypertension Hyperlipidemia Increased risk of coronary heart disease as an adult
Gastrointestinal	Nonalcoholic fatty liver disease Cholelithiasis	Respiratory	Obstructive sleep apnea Obesity hypoventilation syndrome
Musculoskeletal	Slipped capital femoral epiphysis [SCFE] Tibia vara [Blount disease]	Neurological	Idiopathic intracranial hypertension
Psychosocial	Distorted peer relationships Poor self-esteem <sup>[16]</sup> Anxiety Depression	Skin	Furunculosis Intertrigo

## FUTURE CHALLENGES

Major concern related to childhood obesity is that obese children tend to become obese adults, with all the risks/ co morbidities associated [i.e., diabetes, cardiovascular diseases among many others]. The challenges of childhood obesity are not limited to one country but confront most nations around the world. Efforts to manage and to prevent childhood obesity involve education, research, and intervention. Research could drive new directions in prevention and could develop public policy that might help manage the problem. Additionally, research is needed to test these issues. Looking into the future, 6 relevant levels may be involved in the prevention and treatment of pediatric obesity, and each of these needs investigation: family, schools, health care, government, industry, and media. Together, these 6 levels could promote childhood obesity as a high research priority and put it as the first point in the international public agenda. Throughout most of human history, corpulence has been viewed positively - as a sign of prosperity or social status, good health, and a protective buffer against illness or injury. From a practical standpoint, there are only two avenues to weight control that an individual can influence-how much one consumes [i.e., food and drink] and how much physical activity one engages in. These are referred

to as the "Big Two." The environment, broadly defined to include the family, the community, schools, the marketplace, the built environment, and the entire cultural and socioeconomic context in which a child lives, can profoundly influence the Big Two.

## CONCLUSION

Obesity is a major health concern among Children worldwide. BMI is used as a screening tool to identify possible weight problems for children. CDC and the American Academy of Pediatrics [AAP] recommend the use of BMI to screen for overweight and obesity in children beginning at 2 years old. Although the mechanism of obesity development is not fully understood, it is confirmed that obesity occurs when energy intake exceeds energy expenditure. Childhood obesity can be brought on by a range of factors which often act in combination. The first problem to occur in obese children is usually emotional or psychological. Obese children often suffer from teasing by their peers. Some are harassed or discriminated against by their own family. The challenges of childhood obesity are not limited to one country but confront most nations around the world. Efforts to manage and to prevent childhood obesity involve education,

research, and intervention. Research could drive new directions in prevention and could develop public policy

that might help manage the problem. Additionally, research is needed to test these issues.

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