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### RESEARCH ARTICLE

#### THE PREVALENCE OF CHILDHOOD OBESITY WORLDWIDE

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#### Abstract

**Background:** Childhood obesity is an established worldwide health problem. Globally, 10% of school-aged children assessed to suffer from childhood obesity.

**Objectives:** To quantify the worldwide prevalence of overweight and obesity among children.

**Methods:** All previous articles collected from different resources like library, internet sources as Pub med, WHO, Medline, Cochrane library.

**Conclusion:** Prevalence of childhood obesity increases due to bad dietary habits, decrease physical activity, and to less extent genetic or as a manifestation of other morbid conditions. Childhood obesity has many psychosocial and medical health outcomes. Screening and effective health awareness programs are preliminary steps for its prevention. Reduced caloric intake and increased caloric expenditure through, lifestyle modifications and regular physical activity have an integral and interactive role to handle childhood obesity.

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#### Introduction:-

Historically, a heavy child meant a fit child, and the notion “bigger is better” was broadly believed. Nowadays, this view has significantly reformed based on evidence that childhood obesity is accompanying with many health problems.<sup>(1)</sup>

Obesity defined as having extra body fat. Overweight is defined as having extra body weight for a specific height from bone, water, muscle, fat, or a combination of these factors.<sup>(2)</sup> Both expressions mean that a child's weight is more than what is supposed to be healthy.

Body Mass Index (BMI) is defining as an individual's weight by kilograms divided by the square of height by meters. For children BMI is age- and sex-specific and referred to as BMI-for-age. Normal or healthy children weight percentile range from 5th percentile to less than the 85th percentile, Overweight percentile range from 85th to less than the 95th and obese greater than or equal to 95th percentile.<sup>(3)</sup>

Understanding the mechanism of obesity is unclear until now and it is promoted that obesity happens when the energy intake go beyond energy expenditure. Single etiology cannot explain this imbalance, so there are many etiologies can affect. Genetic factors affect the capability of a given child to an obesityconductive environment. On the other hand, lifestyle preferences, environmental factors, and cultural environment play the main roles in the rising worldwide prevalence of obesity. Genes can have hand in some cases, like, deficiency of leptin or medical roots such as growth hormone deficiency and hypothyroidism or side effects of drugs.<sup>(4)</sup>

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World Health Organization (WHO) listed the childhood obesity as a worldwide health problem. Globally, 10% of school-aged children are assessed to suffer from childhood obesity; where it is more run into industrialized and developed countries.<sup>(5)</sup>

In the US in the Bogalusa Heart Study, 70% of obese 5-17 year old have one risk factor at least for cardiovascular disease (CVD)<sup>(6)</sup> and in the UK surveillance program of children below 17 found that 83% of those with type 2 diabetes were obese and 95% overweight.<sup>(7)</sup>

Each year at least 2.6 million die from the consequence of being obese or overweight.<sup>(8)</sup>

In Arab countries, the nutrition change which happened through the past three decades plays a significant role in changing nutritional habits, socio-economic status and lifestyle in these countries with the consequence of developing a high percentage of childhood obesity.<sup>(9)</sup>

Obesity could be associated with various illnesses and health-related abnormalities like, musculoskeletal disorders, cardiovascular, and metabolic, etc.<sup>(10)</sup>

That prevention of childhood obesity is the most possible choice for that threat whose aim is to maintain the energy balance all over the individual's life span.<sup>(11)</sup>

Despite the huge risk caused by obesity and its affection of the person well-being immediately and will persist into adulthood, the causes are variable and can be controlled. This study is going to focus on the prevalence of childhood obesity worldwide especially Middle East countries, which indicate how serious this problem is.

### **Objective:-**

The objective of this study was to quantify the worldwide prevalence of overweight and obesity among children.

### **Methods:-**

Nowadays, childhood obesity is a growing problem all over the world. It has many health sequences in adult life. The prevalence and causes of childhood obesity have tackled in many previous researches. I found of literature searching for that topic.

All previous articles (reviews, research papers, expert opinion ...etc.) that were on childhood obesity were searched for and been collected as references. They were collected from different resources like library, internet sources as Pub med, WHO, Medline, Cochrane library; where The keywords used were childhood, obesity, overweight, prevalence, trend, middle east, developing countries.

### **Review of literature:**

#### **Definition:**

Overweight and obesity could be defined as "abnormal or excessive fat accumulation that may impair health".<sup>(12)</sup>

#### **Worldwide Prevalence of overweight and obesity:**

There is global increase in the prevalence of childhood overweight and obesity. It increased from 4.2% in 1990 to 6.7% in 2010 and expected to be 9.1% in 2020.<sup>(1, 13)</sup>

In Kuala Selangor 2006<sup>(5)</sup> prevalence of overweight and obesity was 14.6% and 7.2% respectively compared to India where overweight ranged from 3.0% to 25.2% and obesity from 1.4% to 11.7% .<sup>(5, 14, 15, 16)</sup> Meanwhile in Japan overweight accounted to 11.2% and obesity for 1.0%.<sup>(17)</sup>

One study that was carried out in South Africa concluded that childhood overweight accounted for 14.0% for boys and 17.9% for girls, while for obesity it was 3.2% for boys and 4.9% for girls<sup>(18)</sup> which was much higher than that in Sudan (was 10.8% and 9.7% for overweight and obesity respectively).<sup>(19)</sup>

Regarding European countries overall overweight and obesity ranged between 18.1%, 7.8, and 4.0 % up to 11.9% respectively.<sup>(20, 21, 22)</sup> In Brazil 2002 obesity was 8.4% with a sharp increase up to 10.6% in 2005.<sup>(23, 24)</sup>

In United States 2012, obesity was prevalent where it was 18.6% for boys and 15.0% for girls increasing up to 31.8% for overweight and 16.9% for obesity in 2014.<sup>(25,26,27)</sup> In Australia, childhood overweight and obesity accounts for 23.7% for boys and 24.8% for girls.<sup>(28)</sup> Look at a summary of overall prevalence of childhood overweight and obesity (table1).

#### **Prevalence of overweight and obesity in developing country:**

In 1995, 3.3% (about 17.5 million) of preschool children in developing countries had overweight; where Asia alone accounted for 60% (10.6 million). Within the UN sub regions, in North Africa the highest rate of overweight children was detected (8.1%); Algeria (9.2%), Egypt (8.6%), and Morocco (6.8%).<sup>(29)</sup>

Nowadays, there is increase in childhood obesity in developing countries where it accounts for 41.8% in Mexico, 22.0% in India, 22.1% in Brazil, and 19.3% in Argentina.<sup>(30)</sup>

#### **Prevalence of overweight and obesity in Middle East:**

In Port-Said, Egypt, prevalence of overweight and obesity was 18.4% for overweight boys and 17.1% for overweight girls, 13% for obese boys and 14% for obese girls. That was higher than that was obtained from Menoufya, Egypt where the prevalence of childhood overweight was 11% and the prevalence of obesity was 3.8%. Meanwhile in Alexandria, Egypt it was 16.8% for childhood overweight and 9% for obesity.<sup>(4, 31, 32)</sup> In Iraq the prevalence of childhood overweight was 6% and that of obesity is 1.3%<sup>(33)</sup> which was much lower than that of Kuwait where it was 30% for boys and 31.8% for girls for overweight and 14.7% for boys and 13.1% for girls for obesity.<sup>(34)</sup> In Yemen, childhood overweight was 12.7% and obesity 8.0%.<sup>(35)</sup> In Bahrain 15.7% of boys and 21.1% of girls had overweight.<sup>(9)</sup>

In Turkey, 9.8% of boys and 6.8% of girls were obese.<sup>(36)</sup> On study in Iran, Tehran the prevalence of obesity was 15.7% for boys and 21.1% for girls meanwhile another study showed that overweight was 21.1% and the prevalence of obesity is 7.8%. These values was lower than obtain from a study that was carried out in Brigand, Iran where overweight was 4.8% and obesity was 1.8%.<sup>(37, 38, 39)</sup>

#### **Prevalence of overweight and obesity in KSA:**

In National, Cross-sectional survey from Saudi Arabia (1994 to 1998) in five provinces of Saudi Arabia<sup>(26)</sup> showed that overweight accounts for 10.68% and 12.7% (for boys and girls, respectively) with average of 11.69%. Meanwhile obesity accounts for 5.9% and 6.7% (for boys and girls, respectively) with an average of 6.3%. Seven years later the prevalence of overweight became 23.1%, and obesity 9.3%. The prevalence of overweight was 15.7% among 0-5 year old children of  $\geq 1$  SD overweight, and 6% that of obesity ( $\geq 2$  SD).<sup>(10, 40, 41, 42, 43)</sup>

#### **Prevalence of overweight and obesity by sex:**

In the Middle East, obesity is more prevalent in boys than in girls.<sup>(40)</sup> This could attributed to cultural habits, social habits, attitude to food, food habits and physical activity pattern.<sup>(10)</sup> That could applied for Saudi Arabia, Iran Islamic Republic, Lebanon, Pakistan and Kuwait where higher prevalence of both overweight and obesity reported among boys than girls.<sup>(44)</sup> In addition, reports from Asia Qatar, Turkey and Greece showed higher rates among boys than in girls. In French and United states 2011- 2012, no gender difference encountered.<sup>(40, 26)</sup> On the other hand in Britain, more girls than boys classified as overweight or obese.<sup>(20)</sup>

#### **Prevalence of overweight and obesity by age:**

In KSA, the risk age group for overweight is the ages of 12 and 18 years. This age group could be because its association with sexual maturation for boys and girls.<sup>(10)</sup> Meanwhile obesity was more among 1-6 years age group and decreased among the 12-18 years age group among both boys and girls.<sup>(45)</sup>

When comparing overweight among different age groups in five European countries and four Asian it observed that the highest raw number of cases was among 10-year-old children while the accurate estimate age group at highest risk for overweight/obesity could not obtained.<sup>(44)</sup>

Moreover, in Costa Rican a higher prevalence of obesity obtained among children aged 7-9.<sup>(25)</sup>

**Prevalence of overweight and obesity by ethnicity:**

In Britain, one study proved that black girls (38.2%) were significantly more likely to be overweight or obese than were white (28.0%) or Asian girls (19.8%) although white girls were slightly more likely to be obese or overweight than were Asian one. <sup>(20)</sup>

In the US, non-Hispanic black and Mexican American children are at higher risk of being overweight than those who are white. <sup>(37)</sup>

In addition, a higher level of overweight and/or obesity has reported in Pakistani girls and boys, Indian and Afro-Caribbean than in British children from other ethnic backgrounds 27. <sup>(37)</sup>

**Prevalence of overweight and obesity by socioeconomic state:**

In UK, overweight and obesity were more prevalent in lower socioeconomic strata. <sup>(37)</sup> In Costa Rican, US, the prevalence of obesity was more prevalent among children whose mothers had 7–11 years of education and whose fathers had  $\geq 12$  years of education. <sup>(25)</sup>

**Body mass index:**

Body mass index (BMI) used to define obesity or increased adiposity, which measure the body fat in excellent way.

$BMI = \text{weight in kg} / (\text{height in meters})^2$

BMI classified according to international reference values and adopted by the International Obesity Task Force (IOTF). To determine the status of body mass, the age of child is pointed to the nearest half year and the individual child's status is classified (underweight or normal, overweight and obese) according to the cut-off BMI values for the corresponding age and sex (figure1, 2). <sup>(5)</sup>

In children, by using BMI percentiles obesity and overweight are defined as; children  $> 2$  year old with a BMI between the 85th and 95th percentiles fall in the overweight range and those with a BMI  $\geq 95$ th percentile meet the criterion for obesity. <sup>(46)</sup>

During infancy, there is high adiposity, which starts to decrease until a period, which called adiposity rebound, when body fat is at the lowest level after that it increases gradually until early adulthood. <sup>(46)</sup>

**Etiology:**

Humans can store energy in adipose tissue for survival in famine situation. In general, humans favor salty and sweet foods and reject bitter flavors. As several vegetables are bitter, this could explain their low consumption. However, repeated exposure to healthy foods as vegetables, can lead to accept it, especially if that happens in childhood.

Obesity result when there is imbalance between calorie intake and energy consumption. Individual adiposity is the result of interaction between genetically determined body habits, nutritional intake, appetite, energy expenditure, and physical activity. Environmental factors determine levels of physical activity, types of activities and levels of available food. <sup>(46)</sup>

**Environmental Changes:**

Over the last 4 decades, change in the food environment is happen. For example related to social changes the type of food industry is changed. Fewer families routinely prepare meals. Food industry often contains high levels of calories, fat, and simple carbohydrates. Relative to the family budget a drop in the price of numerous foods product happen because expansion of food industry. Increased between meals snacking, increased high-carbohydrate beverages consumption, including sport drinks sodas, juice, and fruit punch. Therefore, that One-third of U.S. children consumes fast food daily. <sup>(46)</sup>

A typical meal of fast food can contain 84 g and 2000 kcal of fat. Additional 560 kcal of low nutritional value from consuming high-carbohydrate about four serving's beverages per day. Sweetened drinks have related to increased risk for obesity. Use of high-fructose corn syrup to prepared foods and sweeten beverages is an additional important environmental alteration, leading to availability of inexpensive calories. <sup>(46)</sup>

Since World War II, children have lower levels of physical activities. They depends on cars with reduced walking together with parents' attention for academic performance leading to decrease time devoted in schools for physical

education. Poor safety of neighborhood is another factor lower the levels of physical activity because children are have to stay indoors. Computers, video games, and television have resulted in consumes less energy. <sup>(46)</sup>

Sleep pattern Changes may lead to development of obesity. In studies of healthy, lean, young men, decrease sleep hours were associated with increased ghrelin levels, and decreased leptin levels along with increased appetite and hunger. Sleep deprivation effects in insulin sensitivity and decreased level of glucose tolerance due to changes in sympathetic and glucocorticoids activity. Some effects of sleep deprivation can increase arousal, feeding, sympathetic activity, and/ or neuropeptide Y activity those could be relate to peptide, orexins synthesized in the lateral hypothalamus. <sup>(46)</sup>

#### **Genetics:**

Genetic determinants also can affect the susceptibility of the individual to be obese. For example, the FTO gene at 16q12 is associated with adiposity in childhood, probably clarified by increased energy consumption. <sup>(46)</sup>

In addition, MC4R deficiency associated with food-seeking behavior and early-onset obesity. <sup>(46)</sup>

In addition, there are genetic situations associated with obesity, such as Prader-Willi syndrome, which happen because absence of paternally expressed imprinted genes in the 15q11.2–q13 region (Prader-Willi syndrome is characterized by food seeking and insatiable appetite). <sup>(46)</sup>

During fetal and early life, epigenetic environmental modification of genes may have a role in developing obesity. <sup>(46)</sup>

#### **Endocrine and Neural Physiology:**

Through the gastrointestinal tract, neuroendocrine feedback loops linking adipose tissue, and the central nervous system can monitoring of short-term control of food intake (appetite and satiety) and “stored fuels” occurs. Gastrointestinal hormones, include peptide YY, glucagon-like peptide-1, cholecystokinin, and neuronal feedback stimulate satiety from vagal. Appetite stimulated by ghrelin. Adipose tissue release adiponectin and leptin hormones, which is, play a role in provide feedback to the brain about the energy storage level. These hormones act in the brainstem on the solitary tract nucleus and in the hypothalamus on the arcuate nucleus, and in turn, stimulate different neuronal networks. Adiponectin is secreted by adipocytes into the blood, in fasting its levels increased and in response to obesity its level reduced. Decreased adiponectin levels are linked with cardiovascular diseases and decrease insulin sensitivity. Satiety is directly affected by leptin, in animal models and in healthy human volunteers decrease leptin levels stimulate food consumption and increase leptin levels inhibit hunger. In the brain, there are numerous neuropeptides, including orexin; agouti related peptide, and peptide YY, affect stimulation of appetite, whereas  $\alpha$ -melanocortin–stimulating hormone and melanocortins are affect satiety. The neuroendocrine control of weight and appetite includes a negative-feedback mechanism, balanced between long-term control of adiposity (including leptin) and short-term control of appetite. Via the vagal–brainstem– hypothalamic pathway, Peptide YY decreases food consumption. <sup>(46)</sup>

In peptide YY, developmental changes are evident as school-age children and adults have lower level of peptide YY than in infants. Adults have higher fasting levels of peptide YY compared to obese children. Restore levels of peptide YY can happen with weight loss in children even though this does not happen in adults. In addition, patients homozygous for the FTO obesity risk allele establish poor postprandial appetite suppression and deprived regulation of the orexigenic hormone acyl-ghrelin. <sup>(46)</sup>

#### **Complications (co-morbidities):**

Complications of children obesity can start throughout childhood, adolescence and persist into adulthood.

A study of Harvard Growth found that overweight boys throughout adolescence were double as probable to die from disease of cardiovascular as those who had normal weight. Increase the possibility of such an immediate diseases include hypertension, type 2 diabetes, nonalcoholic fatty liver disease, and hyperlipidemia. The metabolic syndrome (hypertension, central obesity, hyperlipidemia, and glucose intolerance) increases risk for cardiovascular mortality and morbidity. In obese adolescents nonalcoholic fatty liver disease (NAFLD) occurs in 10-25% of them. In U.S NAFLD is nowadays the most common chronic liver disease. It can current with nonalcoholic steatohepatitis or

advanced fibrosis and may consequence to cirrhosis and hepatocellular carcinoma. Insulin resistance is usually associated. Furthermore, NAFLD related to increased possibility of cardiovascular disease.

In addition, obesity could be associated with chronic inflammation. Adiponectin, a peptide with anti-inflammatory characteristics, happens in low levels in obese patients as compared to lean persons, insulin-sensitive. Low adiponectin levels associate with elevated levels of plasma triglycerides and high adiponectin as well as free fatty acids levels correlate with peripheral insulin sensitivity, and an increase in BMI. Adipocytes secrete cytokines and peptides into the circulation, and pro-inflammatory peptides like tumor necrosis factor- $\alpha$  (TNF- $\alpha$ ) and interleukin (IL) -6 which is in obese patient occur in higher levels. Specifically, IL-6 in the liver stimulates production of C-reactive protein. C-reactive protein is an indicator of inflammation and might related to coronary disease, obesity, and subclinical inflammation.

Obesity complications can be mechanical, including orthopedic complications and obstructive sleep apnea. Orthopedic complications include slipped femoral capital epiphysis and Blount disease.

Mental health problems can exist with obesity, with the likelihood of bidirectional effects. These relations changed by ethnicity, gender, and socioeconomic status. In obese adolescent girls, self-esteem may lower compared to non-obese peers. The relation between obesity and adolescent depression studied and found that there is association between them. There is significant concern in the co-occurrence of obesity and eating disorders. <sup>(46)</sup>

#### **Evaluation:**

BMI trajectories, and growth chart for weight, height are the examination, which is begin with it to evaluate overweight or obese child.

To diagnose comorbid disorders a complete pediatric history should taken.

Family history should focus on the family history of obesity-associated disorders and the other family member's adiposity.

Laboratory testing for triglycerides, high-density lipoprotein, low-density lipoprotein, cholesterol, fasting plasma glucose, and liver function tests needed as part of the early evaluation for newly identified childhood obesity. <sup>(46)</sup>

#### **Prevention:**

##### **Primary prevention:**

For prevention of obesity, there are many levels due to difficulty of its development. Prevention efforts begin with Pediatrician with cautious monitoring of BMI percentiles and weight at constant checkup visits.

Family counseling about diet and healthy nutrition its importance for carried out their children health.

Prevention efforts should targeted to encourage mothers to breastfeeding for 6 month and entire breastfeeding for 24 month. At 6-month start to introduce food for infant should focus on vegetables, fruits, and cereals. Poultry, lean meats, and fish may presented later in the 1st year of life. Parents should counseled to avoid presenting highly sugared foods and drinks in the 1st year of life. As a substitute, they should give their young children and infants a rich variety of grains, vegetables, fruits, poultry, lean meats, and fish to help acceptance of a various and healthy diet. <sup>(46)</sup>

Promote physical activity throughout consistent healthcare child maintenance visits should be endorsed.

Because computer, television, and video game time can change health-promoting physical activity, parents have to limit the time consuming in front of the screen for their children. In addition, snacking during television time should prevented. Parents can convince their children to understand that commercials in television intend to sell a product. <sup>(46)</sup>

**Secondary prevention:****Diet:**

With obese child, the most important stating point is to calculate the appropriate caloric intake. Meals should be full of whole grains, vegetables, fruits, poultry, lean meat, and fish. Foods should carefully chosen for only their nutritional value, with great attention to fat and calories. <sup>(46)</sup>

**Physical activity:**

Weight loss does not happen without combination between increasing physical activity and decreasing caloric intake. However, increasing physical activity can reduced percent body fat and increase aerobic fitness even without weight loss. Therefore, being physical active can improve well-being, decrease possibility of cardiovascular disease, and contribute to weight loss. Physical activity could increased by engaging in physical activity through free time with friends and family, walking to school, or registering in organized sports.

If the parents are active, children are more likely to be active. <sup>(46)</sup>

**Drugs:**

There is no actual pharmacotherapy causes reversal of additional adiposity in children and adolescents. Available medications result in BMI improvement or modest weight loss even when combined with behavioral interventions. Different classes of drugs are of interest, including those that act centrally as anorexiant, or decrease energy intake those that affect the presence of nutrients through intestinal or reabsorption in the renal tubular, and those that affect metabolism.

Orlistat is the only U.S. Food and Drug Administration (FDA)-approved medication for childhood obesity <16 year old, which affect the absorption of fat by decrease it, resulting in modest weight loss. Complications include oily stools, spotting, and flatulence. <sup>(46)</sup>

**Surgery:**

Refer some cases of adolescents for evaluation for bariatric surgery is reasonable to happen. "The American Pediatric Surgical Association Guidelines" recommends that surgery could happen only for children with a BMI  $\geq 40$ , near-complete or complete skeletal maturity, and a medical complication resulting from obesity, after they try 6 month of a multidisciplinary weight management program and they fail. Surgical options include the adjustable gastric band and the Roux-en-Y. In obese adults, bariatric surgery helps in reduce the possibility of developing type 2 diabetes mellitus. <sup>(46)</sup>

**Tertiary prevention:**

It is helpful to be attention about eating patterns. Families have to be encouraged to make a plan for family meals, including breakfast. Make changes in eating patterns and nutritional intake it is almost impossible for a child if other family members do not undergo the same changes. <sup>(46)</sup>

**Conclusion:-**

Prevalence of childhood obesity increases due to bad dietary habits, decrease physical activity, and to less extent genetic or as a manifestation of other morbid conditions. Childhood obesity has many psychosocial and medical health outcomes.

Screening and effective health awareness programs are preliminary steps for its prevention. Reduced caloric intake and increased caloric expenditure through, lifestyle modifications and regular physical activity have an integral and interactive role to handle childhood obesity.

**Acknowledgment:-**

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**Annex:****Table 1:** summary of overall prevalence of childhood overweight and obesity.

Country	Year of publication	Overweight%	Obese %
Kuala Selangor(1)	2006	14.6%	7.2%
India			
Semi Urban(2)	2008	4.5%	1.4%
Indo-Asian(8)	2007	3.0%	
Urban Asian Indian(18)	2011	25.2%	11.7%
British(4)	2006	16.9% -19.3%	5.5-6.9%
Germany(5)	2015	7.8 %	4.0 %
Brazil(6)	2005	15.6%,	10.6%
(16)	2002		8.4%
United state			
Costa Rican(7)	2002	34.5%	26.2%
(19)	2014	31.8%	16.9%
(20)	2012		boy18.6% girl15.0%
Global(9)	2010	11.7%	
(12)	2015	47.1%	
South Africa(10)	2006	boy14.0% girl 17.9%	boy 3.2% girl 4.9%
Australia(14)	2010	Boy 23.7% in 2008 Girl 24.8% in 2008	
Switzerland(15)	2010	17.9%	11.9%,
Japan(17)	2003	11.2%	1.0%
Saudi Arabia(21)	2002	boy10.68% girl 12.7%	boy5.99% girl 6.74%
	2013	12.4%	20.2%
Makkah(24)	2002	Boy27.5% girl28%	
(29)	2008	14.2%	9.7%
Al-hsaa(34)	2010	23.1%	9.3%
(38)	2016	11.69%	6.3%
(39)			
Egypt			
Port Said(22)	2013	boy 18.4% girl 17.1%	boy13% girl14%
Menouf district(27)	2016	11%	3.8%
Alexandria(31)	2016	16.8%	9%
Iraq(23)	2005	6%	1.3%
Kuwait(25)	2004	boy30% girl 31.8%	boy14.7% girl 13.1%
Turkish Kütahya(26)	2014		boy9.8% girlr 6.8%
Sudan(28)	2011	10.8%	9.7%
Yemen(33)	2012	12.7%	8.0%
Bahrain(37)	2014	boy15.7% girl21.1%	boy28.9% girl30.7%
Iran			
Tehran(32)	2010	boy31.3% girl 41.9%	
Birjand(35)	2009	4.8%	1.8%
Tehran(40)	2003	21.1%	7.8%





Figure 1:- Body mass index (BMI)-for-age profiles for boys and men<sup>(47)</sup>.

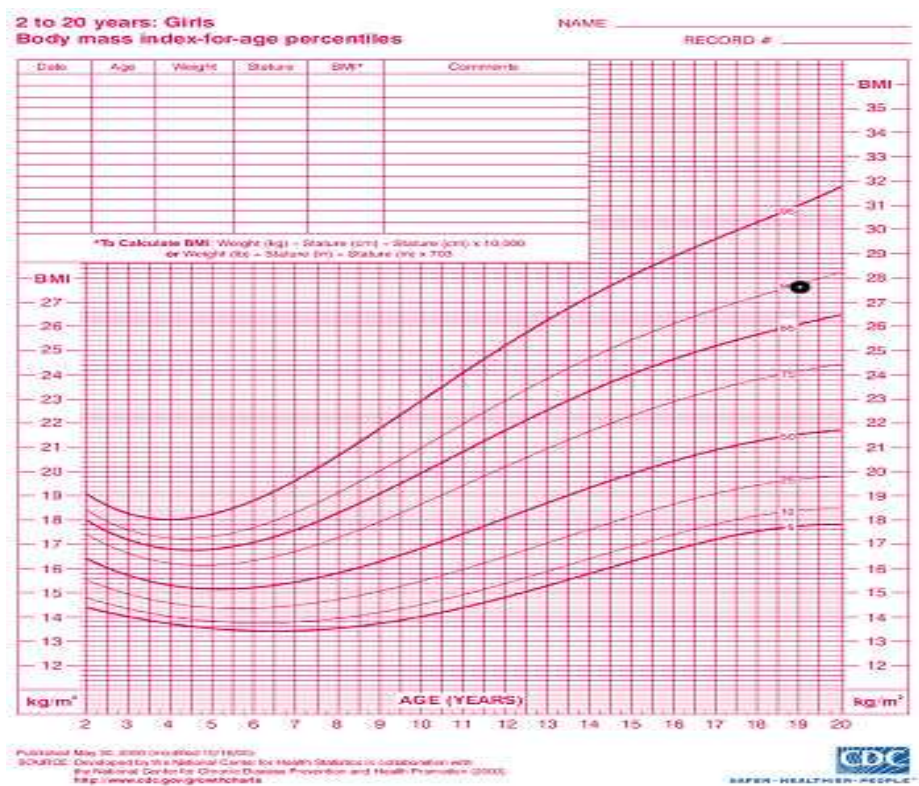


Figure 2:- Body mass index (BMI)-for-age profiles for girls and women.<sup>(47)</sup>

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