Health Consequences of Obesity in Children

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Introduction

- Obesity has become one of the **most important public health problems** in the many resource-rich countries and transitional economies.

- As the prevalence of obesity has increased, so has the prevalence of the comorbidities associated with obesity.

- It is imperative that health care providers identify overweight and obese children so that counseling and treatment can be provided.

Definitions

- **BMI** is the widely accepted standard measure of overweight and obesity for children **two years of age and older**.

- Other indices of childhood obesity, included: **weight-for-height** (particularly useful for the child **≤2 years**), measures of regional fat distribution (waist circumference and waist-to-hip ratio), and the growth standards developed by the WHO.
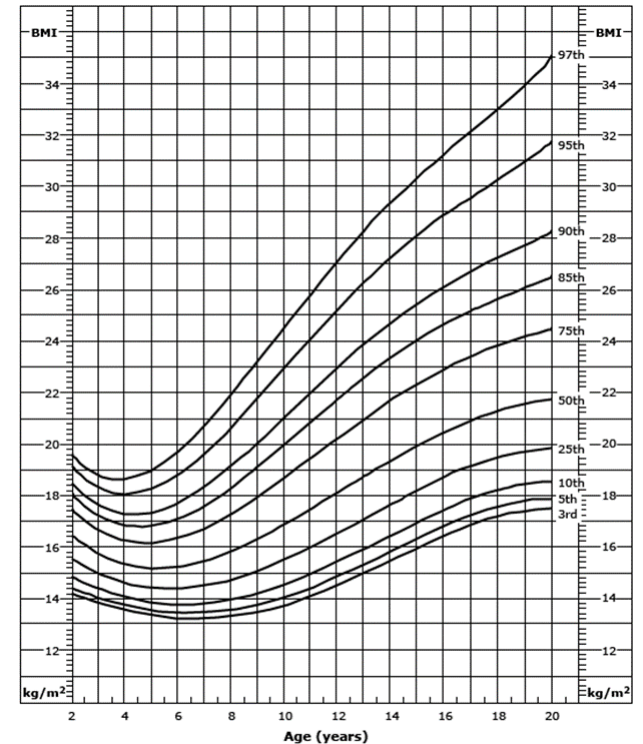
Definitions

- Because children grow in height as well as weight, the norms for BMI in children vary with **age** and **sex**.

- As children approach adulthood, the thresholds for defining overweight and obesity (**85th** and **95th** percentiles for BMI) are approximately **25 and 30 kg/m^2**, respectively, which represent the same thresholds for defining overweight and obesity in adults.

Classification of Obesity

| Category	Adults 18 years and older[1] (kg/m²)	Youth 2 to 18 years (CDC, AAP, IOM, ES, IOTF[2])
Underweight	BMI <18.5	BMI <5th percentile for age
Normal weight	BMI 18.5 to <25	BMI ≥5th to <85th percentile
Overweight	BMI 25 to <30	BMI ≥85th to <95th percentile
Obesity		
▪ Class I obesity	BMI ≥30 to <35	BMI ≥95th percentile to <120% of the 95th percentile or BMI ≥30 to <35 (whichever is lower)
▪ Class II obesity	BMI ≥35 to <40	BMI ≥120 to 140% of the 95th percentile or a BMI ≥35 to <40 (whichever is lower)*
▪ Class III obesity	BMI ≥40	BMI ≥140% of the 95th percentile or a BMI ≥40 (whichever is lower)
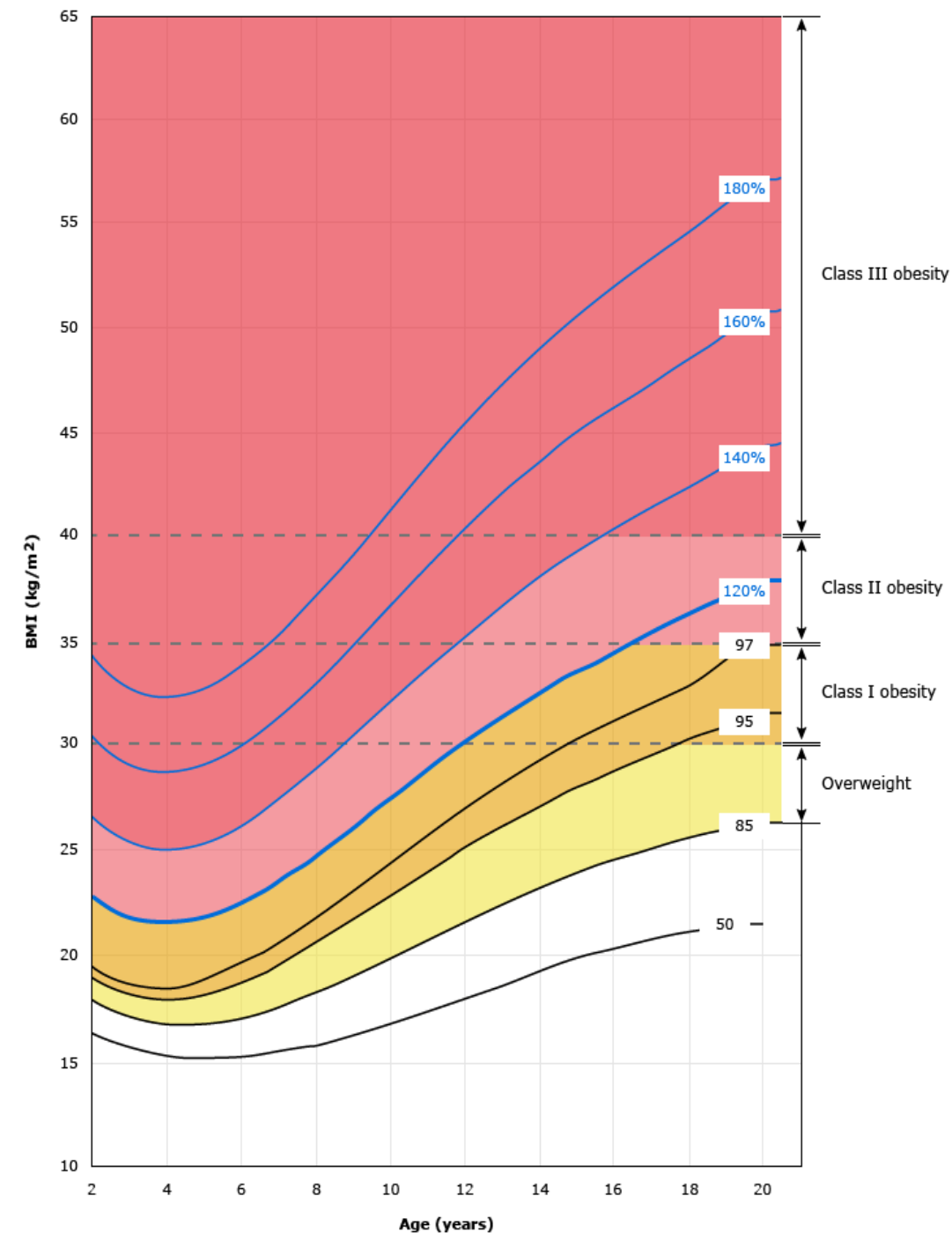
Prevalence of Childhood Obesity in the US

- For children and adolescents aged 2-19 years in 2017-2021: **19.7%** and affected about **14.7 million** children and adolescents.

- Obesity prevalence was **12.7% among 2-5 year**, **20.7% among 6-11 year**, and **22.2% among 12-19 year**.

- Obesity prevalence was **18.9%** among children and adolescents in the **lowest income** group, **19.9%** among those in the **middle-income** group, and **10.9%** among those in the **highest income** group.

Prevalence

- **Overweight:** 12.3% of preschool-aged children (2-5 years), 15.4% of school-aged children (6-11 years), 19.4% of adolescents (12-19 years)

- **Class I obesity:** 11.7% of preschool-aged children, 12.3% of school-aged children, 8.9% of adolescents

- **Class II or III obesity:** 2% of preschool-aged children, 6.4% of school-aged children, 10.1% of adolescent females and 13.2% of adolescent males
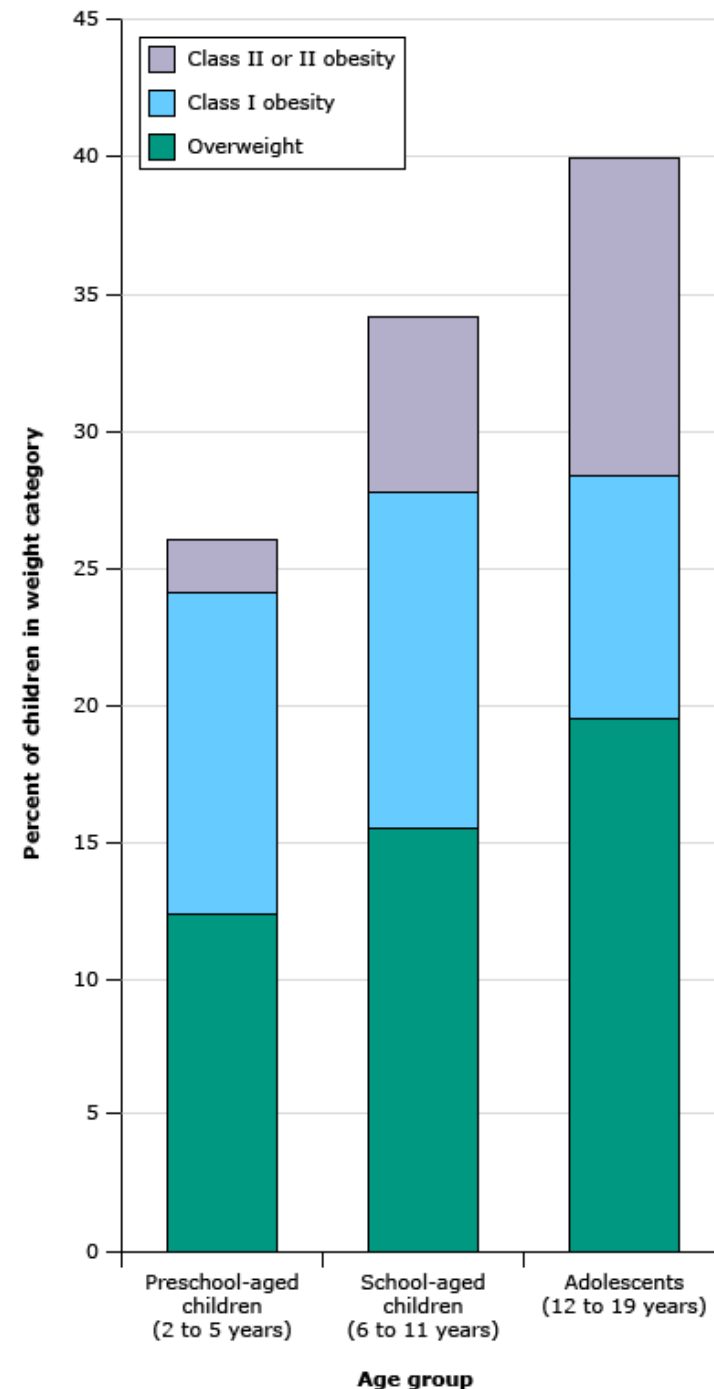
World Prevalence of Childhood Overweight after 2000
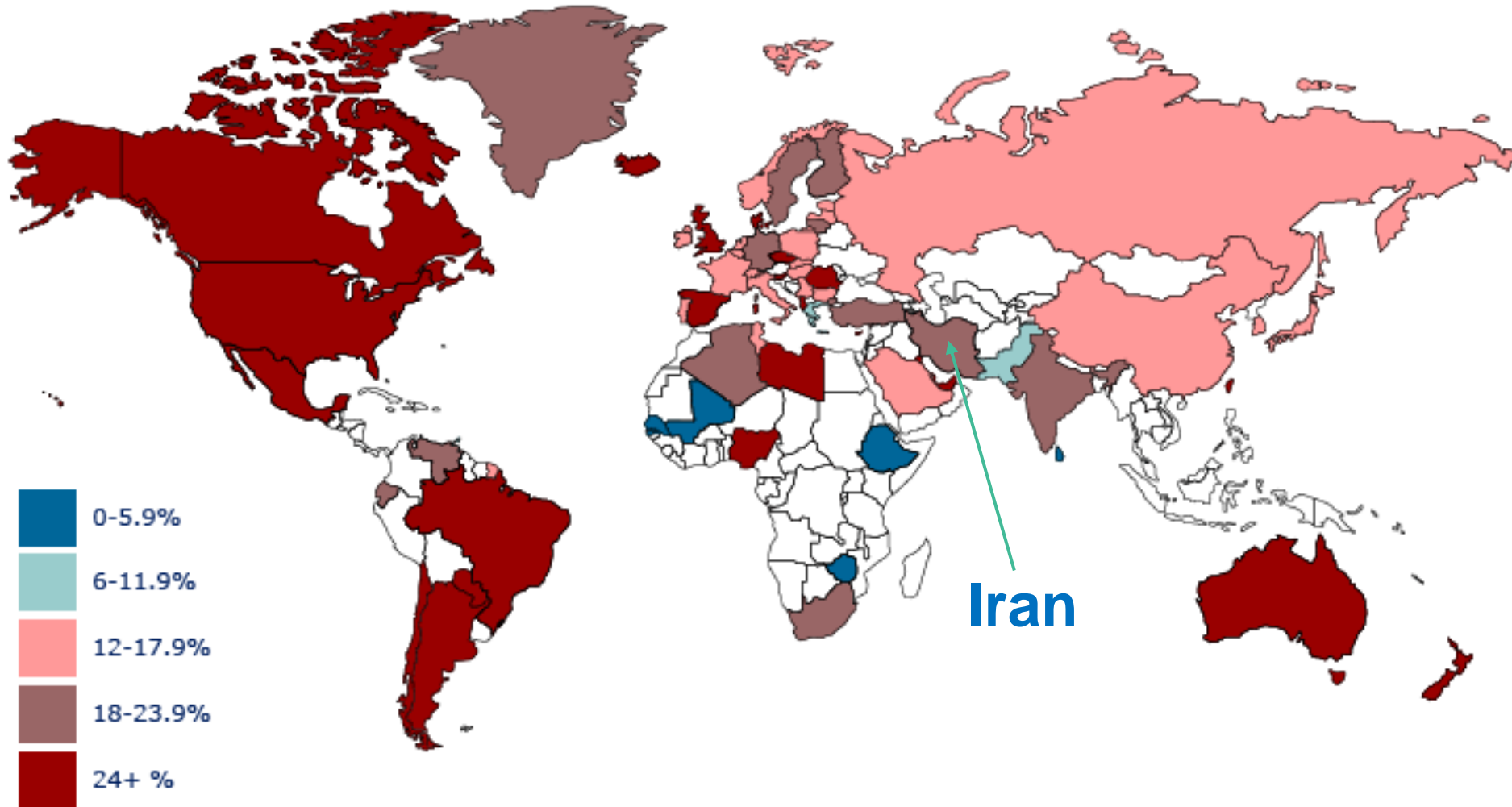
Iran

Legend:
- 0-5.9%
- 6-11.9%
- 12-17.9%
- 18-23.9%
- 24+ %

Prevalence of Childhood Obesity in Iran

Review Paper
The Prevalence of Obesity in Iranian Children: A Systematic Review and Meta-analysis

Hakimeh Akbari[1] ⊙, Masoud Mohammadi[1*] ⊙

1. Cellular and Molecular Research Center, Gerash University of Medical Sciences, Gerash, Iran.

The results of this study and in a study on 2637912 people aged 2-15 years, the overall prevalence of obesity in Iranian children was reported to be **11.4%** based on a meta-analysis.

Prevalence in less than 5 year

Prevalence of obesity and overweight in Iranian children aged less than 5 years: a systematic review and meta-analysis

Kamyar Mansori, PhD [1,2], Sorour Khateri, MD [3], Yousef Moradi, PhDc [4], Zaher Khazaei, MSc [5], Hossein Mirzaei, PhDc [6], Shiva Mansouri Hanis, MS [7], Mehran Asadi Aliabadi, PhDc [8], Mehdi Ranjbaran, PhDc [9], Fatemeh Varse, MSc [10], Serveh Parang, MSc [11]

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Purpose: The present study aimed to determine the prevalence of childhood obesity and overweight in Iranian children under 5 years of age using a systematic review and meta-analysis.

Methods: We searched MEDLINE (PubMed), Web of Science, Google Scholar, Scopus, CINHAL, and the Iranian databases, including Scientific Information Database (www.sid.ir), Iranian Research Institute for Information Science and Technology (Irandoc.ac.ir), Iranmedex (www.iranmedex.com), and Magiran (www.magiran.com), for all articles published between January 1989 and August 2017. Sources of heterogeneity were determined using subgroup analysis and meta-regression.

Results: Six articles were ultimately included in the meta-analysis to estimate the pooled prevalence, based on which the prevalence of obesity and overweight were estimated to be 8% (95% confidence interval [CI], 6%–10%) and 9% (95% CI, 7%–11%), respectively. The results of the subgroup analysis showed that the prevalence of obesity in boys and girls was 9% (95% CI, 6%–13%) and 7% (95% CI, 4–10%), respectively, and the prevalence of overweight in boys and girls was 10% (95% CI, 5%–15%) and 9% (95% CI, 5%–13%), respectively.
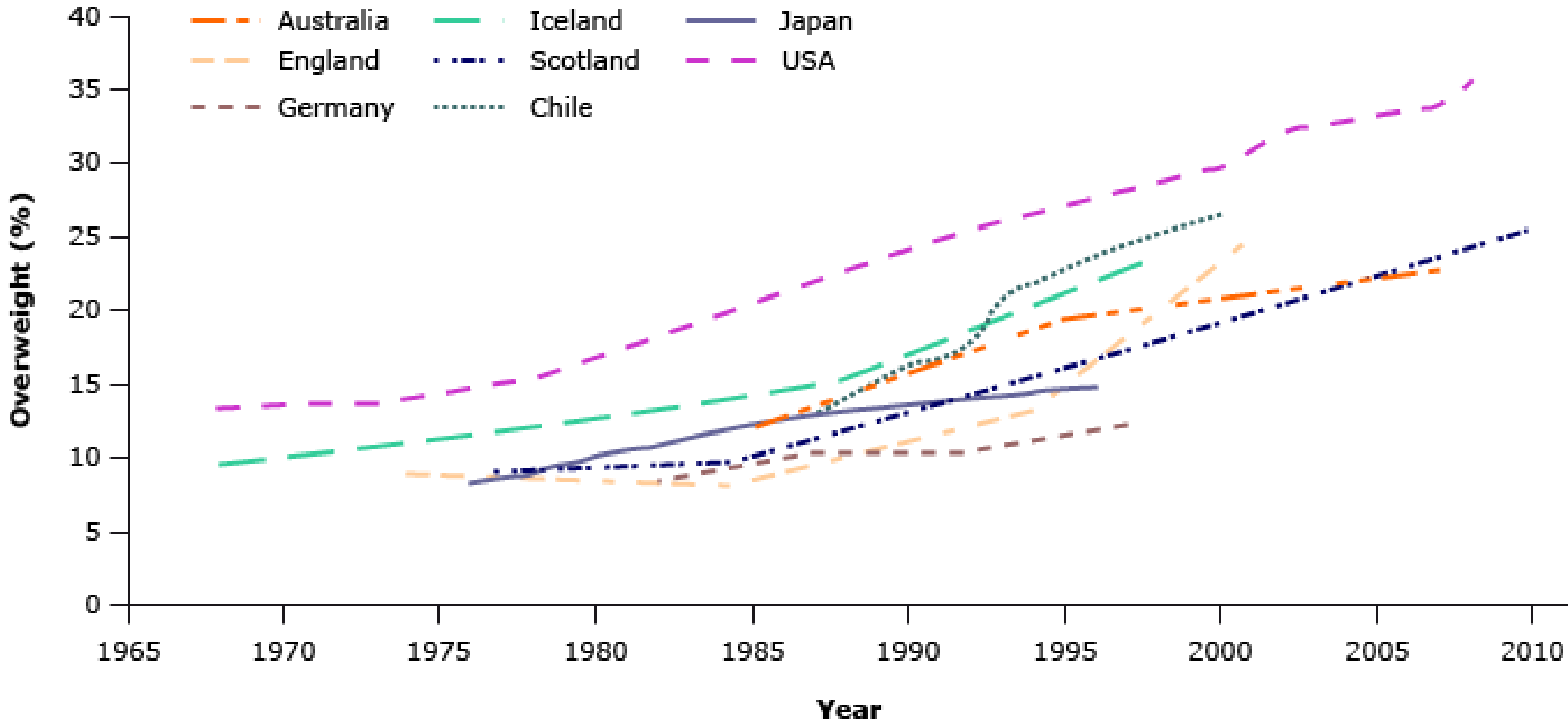
Conclusion: Despite high heterogeneity among the results of the articles included in the meta-analysis, the prevalence of obesity and overweight is higher in Iranian children under 5 years of age. Therefore, parents and the health system must pay more attention to the lifestyle, nutritional habits, and physical activity of these children.

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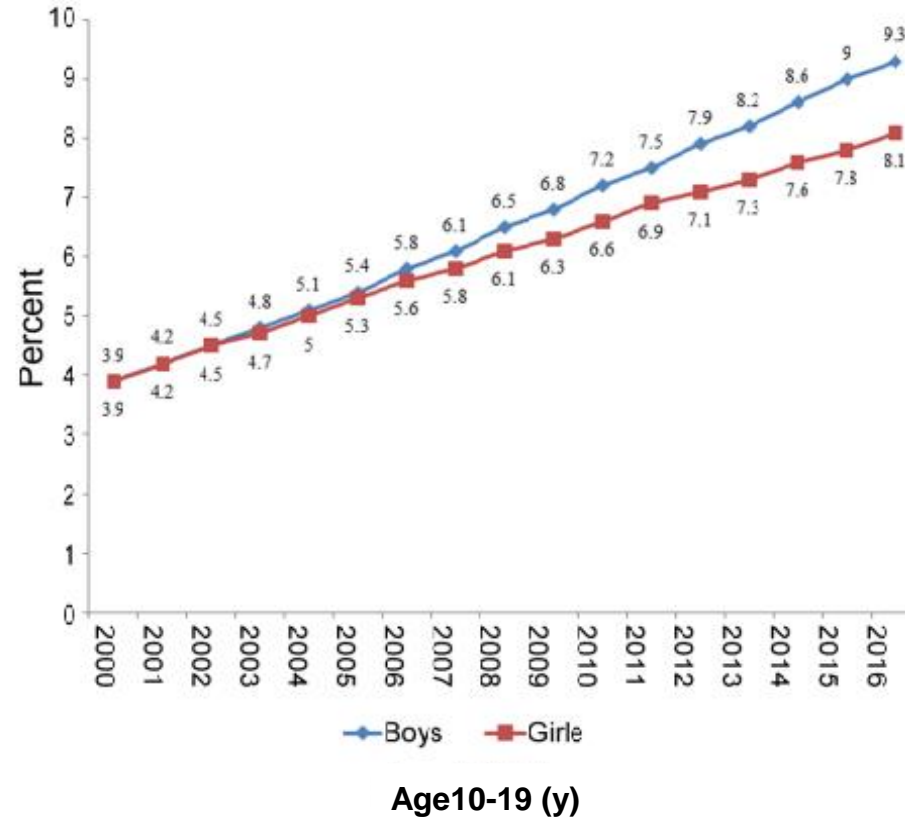Fax: +982186700000
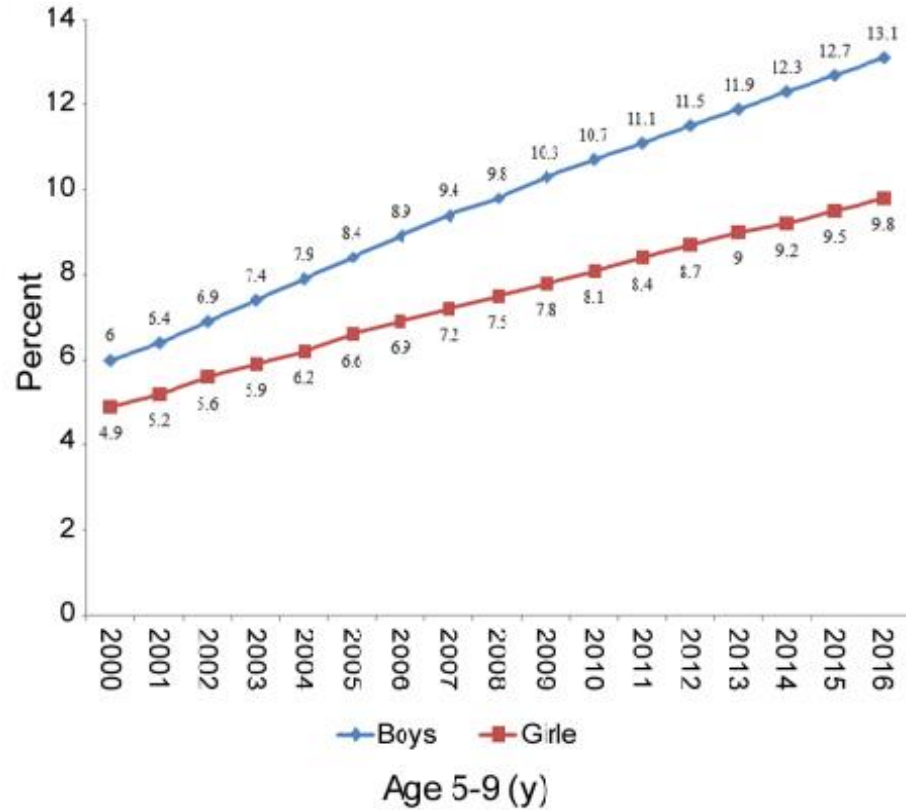E-mail: yousefmoradi211@yahoo.com
https://orcid.org/0000-0002-2936-5930

- Overweight 9%
- Obesity 8%
- Overweight in boys 10%
- Overweight in girls 9%
- Obesity in boys 9%
- Obesity in girls 7%

Changes in prevalence of childhood overweight over time

Trends in Obesity among Iranian Children and Adolescents

Age 5-9 (y)

Age10-19 (y)

Jenabi E, Khazaei S. Trends in Obesity among Iranian Children and Adolescents: 2000–2016. J Tehran Heart Cent 2020; 15 (1): 41-42.

COVID-19-related Changes

- The COVID-19 pandemic was associated with increases in childhood obesity in several countries.

- As an example, in a large health care system in California, the prevalence of obesity rose among all age groups during the first year of the pandemic; the **greatest change was among children 5-11 years old**, among whom the prevalence of obesity rose from 19-26%.

- Other studies report that the pandemic exacerbated risk factors for obesity, disproportionately impacting urban and low-income populations.

Persistence into Adulthood

- Many but not all obese children will become obese adults.

- The likelihood of persistence of childhood obesity into adulthood (sometimes called "tracking") is related to **age**, **parental obesity**, **severity of obesity**, and BMI trajectory during childhood.

- These observations provide support for the concept of **interventions early in life** to prevent and treat obesity.

- Among obese 6 year-old children with an obese parent, 50% remained obese as adults, and among obese 10-14 year-old children with an obese parent, 80% remained obese as adults.

- Most adolescents with obesity will continue to have obesity in adulthood.

Environmental Factors

- Almost all obesity in children is **strongly influenced** by environmental factors, either:

➢ **Sedentary lifestyle** or

➢ **Caloric intake** that is greater than needs

Environmental Factors

Decline in Physical Activity
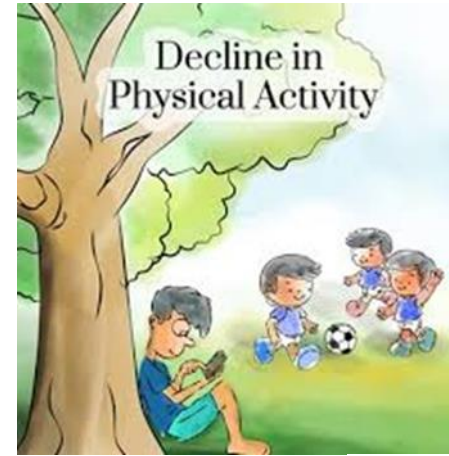
- Increasing trends in glycemic index of foods

- Sugar-containing beverages

- Fast food service

- Decreasing structured physical activity

- Increasing use of computer-, electronic-, and/or digital-oriented play activity
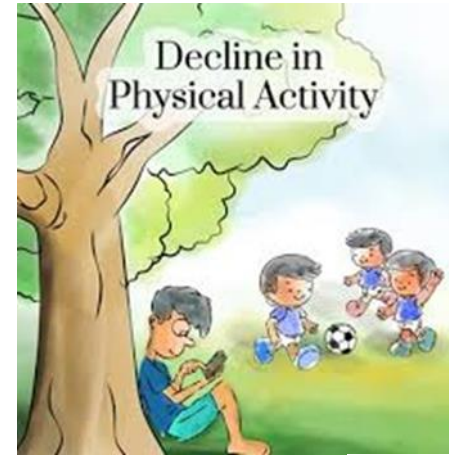
Sleep

- Mounting evidence suggests an association between **shortened sleep duration** or **irregular sleep** schedules and obesity.

- Sleep deprivation for one week was associated with increased food intake, weight gain, and higher leptin levels as compared with the child's usual sleep.

- Sleep may have an association with insulin resistance and cardiometabolic risk factors, independent of its association with obesity.

Others

- Certain psychoactive **drugs** (particularly olanzapine and risperidone), antiseizure medication, and glucocorticoids.

- **Endocrine causes** of weight gain are identified in less than 1% of children and adolescents with obesity (Cushing syndrome, Hypothyroidism, Growth hormone deficiency, ….)

- Influences of **gut microbiota**, **environmental toxins** (endocrine-disrupting chemicals, such as bisphenol A and dichlorodiphenyltrichloroethane), and **viruses** (few studies in animal models have proven that obesity can be triggered by infection with adenovirus).

Genetic Factors

- **Polygenic factors:** heritable factors are responsible for 40-85% of the variation in adiposity, but most of the genetic polymorphisms responsible have not yet been isolated.

- **Syndromic obesity:** specific syndromes in which obesity is a primary manifestation.

  ➢ Albright hereditary osteodystrophy (pseudohypoparathyroidism type 1a), Alström, Bardet-Biedl syndrome, Beckwith-Wiedemann, Carpenter, Cohen, Prader-Willi.

- **Monogenic obesity:** Single-gene defects in which obesity is the primary manifestation are even more rare. Several of these affect the melanocortin pathway in the central nervous system.

Health Consequences of Obesity
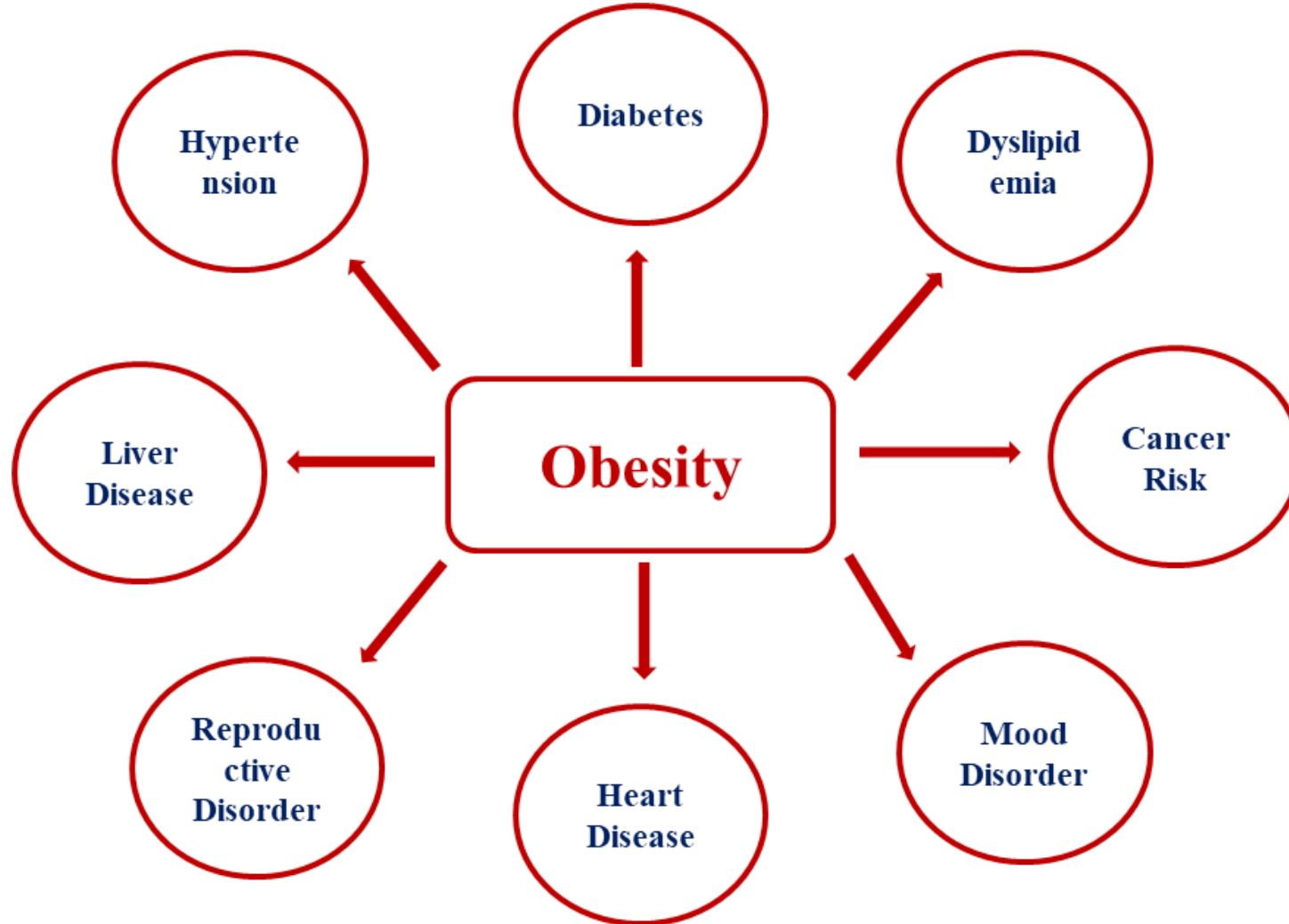
Hypertension

- Risk of hypertension is approximately **twofold higher in children with mild obesity** and **fourfold higher in those with severe obesity** compared with children with normal weight status.

- When hypertension is assessed using ambulatory blood pressure monitoring, approximately **50%** of children with obesity have hypertension.

Dyslipidemia

- Particularly in those with a **central fat distribution** and increased adiposity (as measured by triceps skinfold thickness ≥85th percentile).

- The typical pattern is one of elevated concentrations of serum LDL-cholesterol and triglycerides and a decreased concentration of HDL-cholesterol.

- The risk for these abnormalities **increases with the severity** of obesity.

Cardiac Structure and Function

- Cardiac structure and function

- Premature atherosclerotic cardiovascular disease

- Adult cardiovascular disease

Endocrine

- Impaired glucose tolerance

- Diabetes mellitus

- Hyperandrogenism in females

- Abnormalities in growth and puberty

Neurologic

- **Idiopathic Intracranial Hypertension**

➤ Idiopathic intracranial hypertension (**pseudotumor cerebri**) is uncommon in children and adolescents, but its prevalence is increased in those with obesity.

➤ The risk increases with the severity of obesity.

➤ Children and adolescents with idiopathic intracranial hypertension typically present with **headache**.

➤ Associated complaints may include nausea, vomiting, retroocular eye pain, transient visual obscurations, visual loss, and diplopia.

➤ **Papilledema** is the characteristic examination finding.
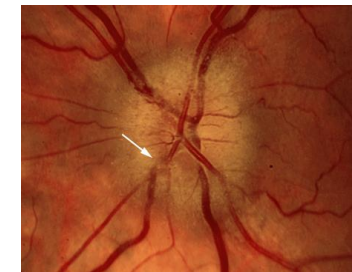
Pulmonary

- **Obstructive Sleep Apnea**

  ➢ Complete obstruction of the upper airway during sleep and cessation of air movement despite ongoing respiratory effort; partial airway obstruction is termed **obstructive hypoventilation**.

  ➢ Typically but not always associated with persistent snoring.

  ➢ The prevalence of OSA is markedly increased in children and adolescents with obesity.

- **Asthma**

Orthopedic

- **Slipped Capital Femoral Epiphysis**

- Displacement of the capital femoral epiphysis from the femoral neck through the physeal plate.

- It typically occurs in early adolescence.

- Obesity is a significant risk factor.

- The classic presentation is that of an adolescent with obesity who presents with non-radiating, dull, aching pain in the hip, groin, thigh, or knee and no history of preceding trauma.

- Diagnosis is confirmed by radiographs.

- **Genu Varus or Valgus**

Nutritional

- **Vitamin D Deficiency**

➤ More common among children and adolescents with obesity, although the prevalence varies among populations and regions.

➤ The utility of routine screening is controversial.

- **Iron Deficiency**

➤ ID and obesity are also seemingly associated, with a 1.3 higher odds of deficiency compared with normal-weight individuals.

➤ 40% of children with overweight or obesity were iron deficient compared with 4% of children of normal weight.

Gastrointestinal

- **Nonalcoholic Fatty Liver Disease**

➤ Obesity is associated with a clinical spectrum of liver abnormalities collectively known as nonalcoholic fatty liver disease (NAFLD), the most common cause of liver disease in children.

➤ NAFLD is subdivided into three categories, defined by histologic findings: **Nonalcoholic Fatty Liver** (NAFL), **Nonalcoholic Steatohepatitis** (NASH), and **NASH cirrhosis**.

➤ The prevalence of NAFLD is approximately 7% among children and adolescents in the general population and up to **34%** among children with obesity.

- **Cholelithiasis**

Treatment Options in Pediatric NAFLD

Lifestyle Changes

- Avoidance of sugar-sweetened beverages

- Consumption of healthy, well balanced diet

- Moderate- to high-intensity exercise daily

- Less than 2 hour/day of screen time

Medications for NAFLD

- No currently available medications have been proven to benefit the majority of patients with NAFLD

Other Interventions

- Bariatric surgery can be considered in select individuals with NAFLD and other comorbidities

Psychosocial

- Social isolation, distorted peer relationships, poor self-esteem, distorted body image, anxiety, and depression.

- The risk of psychosocial morbidity increases with increasing age and is greater among females than males.

- **Quality of Life:** decreased health-related quality of life (physical, emotional, social, and school functioning) compared with healthy, non-overweight children and adolescents.

- In the referral population, health-related quality of life among children and adolescents with severe obesity was similar to that reported by children and adolescents with cancer.

Long-term Consequences

- One major causative factor is **obesity-induced low-grade chronic inflammation**, which can be observed already in preschool children.

- This inflammation together with endocrine, paracrine, and metabolic effects of obesity increases the long-term risk for several severe diseases.

- **Type 2 diabetes** is increasingly prevalent in adolescents and young adults who have had obesity during childhood.

- When it is diagnosed in young individuals, the **morbidity and mortality rate is higher** than when it occurs later in life, and more dangerous than type 1 diabetes.

Marcus C, Danielsson P, Hagman E. Pediatric obesity-Long-term consequences and effect of weight loss. J Intern Med 2022; 292(6): 870-891.
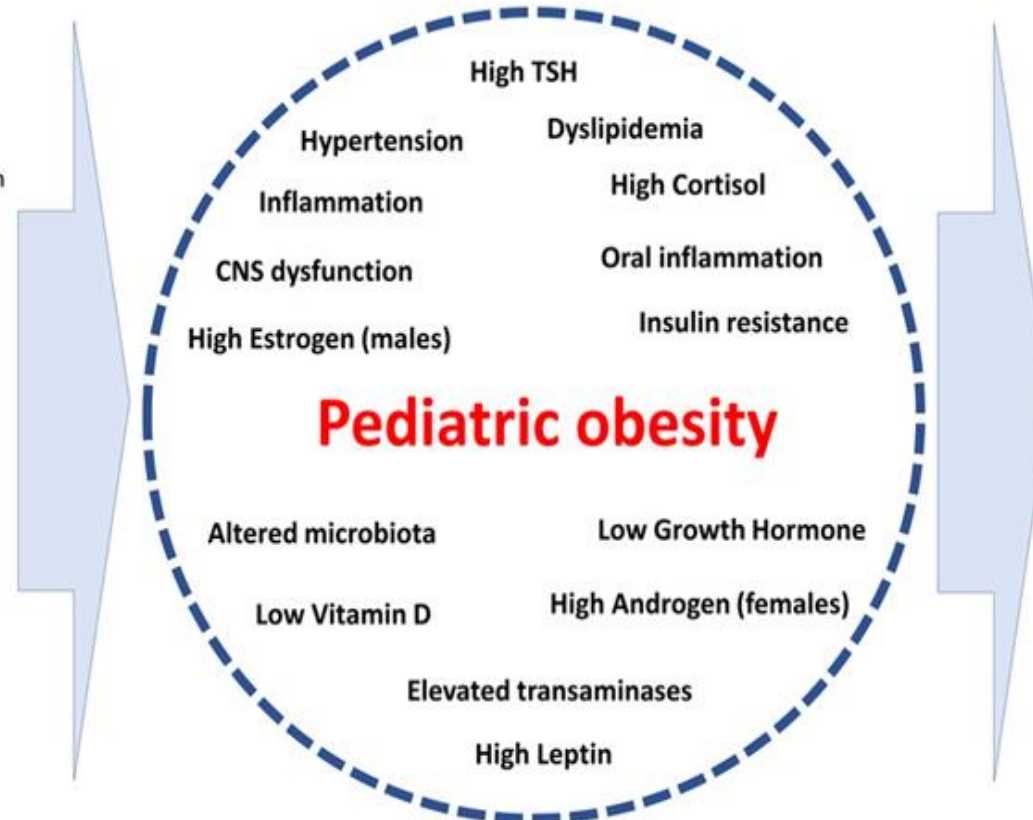
Long-term Consequences

- Childhood obesity also increases the risk for several autoimmune diseases such as **multiple sclerosis**, **Crohn's disease**, **arthritis**, and **type 1 diabetes** and it is well established that childhood obesity also increases the risk for **cardiovascular disease**.

- Consequently, childhood obesity increases the risk for **premature mortality**, and the mortality rate is **three times** higher already before 30 years of age compared with the normal population.

➤ The risks associated with childhood obesity are modified by weight loss.

➤ However, the risk reduction is affected by the age at which weight loss occurs.

➤ In general, early weight loss that is, before puberty is more beneficial, but there are marked disease-specific differences.

Long-term Consequences

Risk factors

- Genetics
- Epigenetics
- Obesogenetic environment
  - 24/7- food availability, affordability of energy-dense foods
  - Sedentary activities
  - Limited access to recreation areas
- Unhealthy eating habits
  - Large portion sizes
  - High intake of sugar-sweetened beverages
  - High glycemic foods
  - High intake of fast foods
  - Low fiber content
  - Low intake of fruits and vegetables
  - Irregular food intake
- Lifestyle factors
  - Low physical activity
  - Sedentary lifestyle
  - Insufficient sleep
  - Stress and depression

Mechanisms

High TSH

Hypertension   Dyslipidemia

Inflammation   High Cortisol

CNS dysfunction   Oral inflammation

High Estrogen (males)   Insulin resistance

Pediatric obesity

Altered microbiota   Low Growth Hormone

Low Vitamin D   High Androgen (females)

Elevated transaminases

High Leptin

Long-term consequences

- Type 2 diabetes
- Type 1 diabetes
- Cardiovascular disease
- Nonalcoholic fatty liver disease
- Cognition defects
- Multiple sclerosis
- Periodontitis and Caries
- Cancer – malignancies
- Mb Crohn
- PCO syndrome
- Gynecomastia
- Premature mortality
- Pseudotumor Cerebri
- Asthma
- Arthritis

Referrals

- **Severe obesity** (BMI ≥120% of the 95th percentile or BMI ≥35 kg/m^2, whichever is lower), especially if any comorbidities are present or if BMI ≥40 kg/m^2

- **Refractory obesity** progressive increase in BMI percentiles despite structured interventions in the primary care setting

- Severe obesity in a child **younger than two years**

- These children warrant special evaluation for the **underlying cause** of the obesity, as well as intensive support to optimize diet

- **Weight loss surgery** adolescents with severe obesity and especially those with major comorbidities

Thanks

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