

# **Metabolic syndrome among overweight & obese children**

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# Outline

- Introduction on metabolic syndrome, obesity, Hyperinsulinism & type 2 DM in children
- IDF definition of metabolic syndrome
- Escalating rates of pediatric obesity with increasing prevalence of type 2 DM
- Prevention of metabolic syndrome by prevention of obesity
- Therapeutic options

# Definition of Metabolic Syndrome

- IDF suggests that the metabolic syndrome should **not be diagnosed** in children younger than 10 years of age rather than only described as obesity
  - strong message for weight reduction should be delivered for those with abdominal obesity
- For children age 10 years or older, metabolic syndrome can be diagnosed with **abdominal obesity & the presence of two or more other clinical features** (i.e. elevated triglycerides, low HDL-cholesterol, high blood pressure, increased plasma glucose)
- For children older than 16 years, the IDF adult criteria can be used

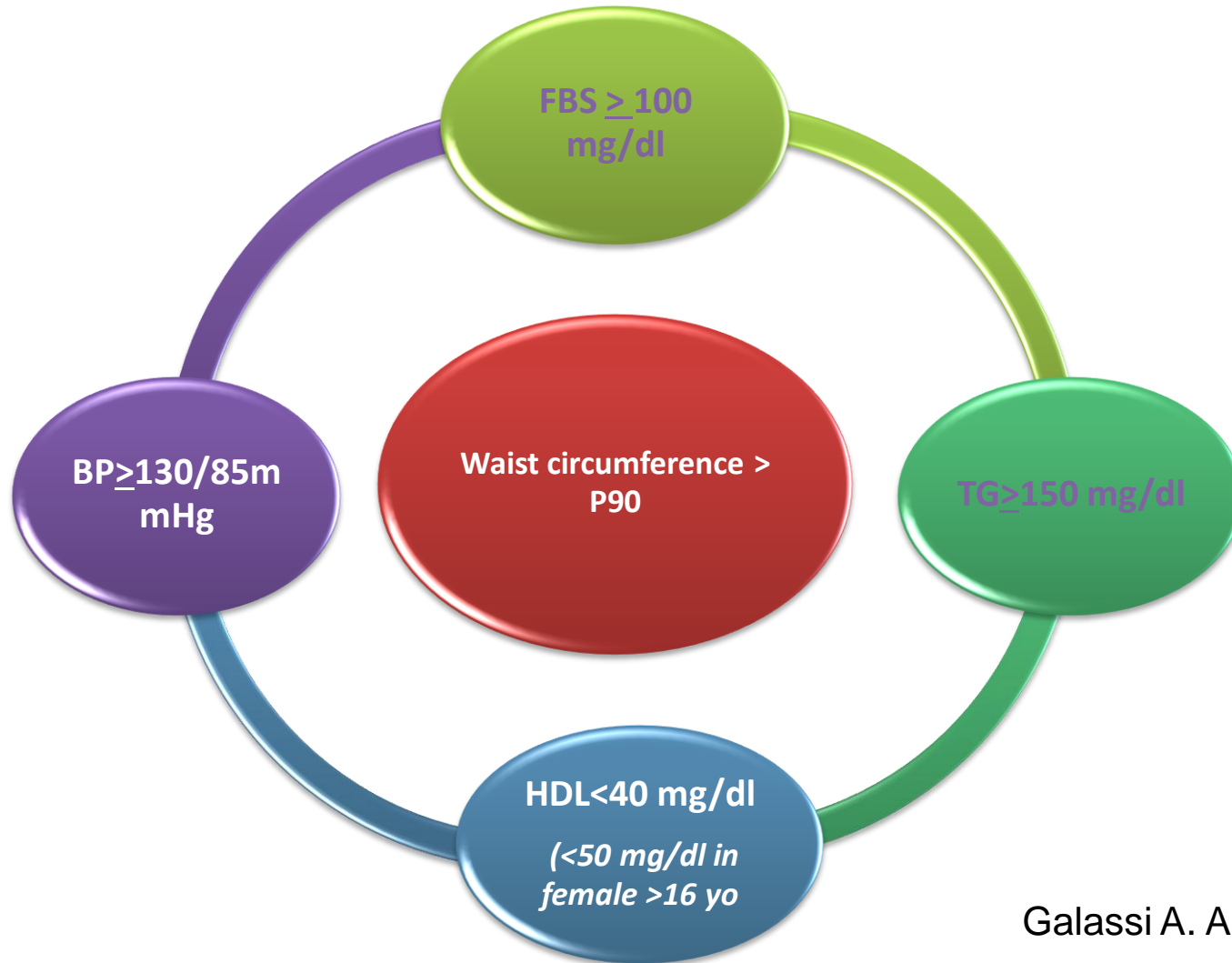
# Metabolic Syndrome

**A Combination of:**

- **Abdominal obesity**
- **Hyperinsulinism**
- **Hyperglycemia**
- **Increased triglyceride levels**
- **Decreased HDL-cholesterol levels**
- **Hypertension**

**A meta-analysis of the prospective studies has shown that the presence of metabolic syndrome increases the risk CVD**

# Metabolic Syndrome in children and adolescents: The clusters of metabolic risk factors (International Diabetes Federation)



**Presence of metabolic syndrome increases risk of**

- CVD (RR 1.53; 1.26-1.87)**
- CHD (RR 1.52; 1.37-1.69)**
- Stroke (RR 1.76; 1.37-2.25).**

# Prevalence of the Metabolic Syndrome

- Overall incidence
  - Age 12-19 years
    - 3-4%
  - Age 20-29 years
    - 6.7%
  - Adults  $\geq$  30 years
    - 23.7%
- National Health & Nutrition Examination Survey (NHANES)<sup>1</sup>(n=2400)
  - Adolescents age 12-19 years
    - BMI  $\geq$  95<sup>th</sup> percentile
      - 28.7%
    - BMI 85<sup>th</sup>-94<sup>th</sup> percentile
      - 6.1%
    - BMI  $\leq$  84<sup>th</sup> percentile
      - 0.1%

# Influencing Factors ?

- Intrauterine events for the unborn child & factors during early development years predispose a child to disorders such as obesity, prediabetes, and metabolic syndrome
  - The presence of **maternal gestational diabetes, low birth weight, and infant feeding practices** contribute to a child's future level of risk
- Other factors can be **genetic, socio-economic or environmental** (obesogenic environment)
  - Urbanization, unhealthy diet & increasingly sedentary lifestyle



**“ Abdominal Obesity ”** as measured by **waist circumference** is **more indicative of the Metabolic Syndrome** than **increased BMI**

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caglecartoons.com



CHILDHOOD OBESITY EPIDEMIC..

**Calories In**



**Calories Out**



# Super Sized Fast Food

1610 Calories  
63 gm fat







	Percentile for boys					Percentile for girls				
	10 <sup>th</sup>	25 <sup>th</sup>	50 <sup>th</sup>	75 <sup>th</sup>	90 <sup>th</sup>	10 <sup>th</sup>	25 <sup>th</sup>	50 <sup>th</sup>	75 <sup>th</sup>	90 <sup>th</sup>
Intercept	39.7	41.3	43.0	43.6	44.0	40.7	41.7	43.2	44.7	46.1
Slope	1.7	1.9	2.0	2.6	3.4	1.6	1.7	2.0	2.4	3.1
Age (y)										
2	43.2	45.0	47.1	48.8	50.8	43.8	45.0	47.1	49.5	52.2
3	44.9	46.9	49.1	51.3	54.2	45.4	46.7	49.1	51.9	55.3
4	46.6	48.7	51.1	53.9	57.6	46.9	48.4	51.1	54.3	58.3
5	48.4	50.6	53.2	56.4	61.0	48.5	50.1	53.0	56.7	61.4
6	50.1	52.4	55.2	59.0	64.4	50.1	51.8	55.0	59.1	64.4
7	51.8	54.3	57.2	61.5	67.8	51.6	53.5	56.9	61.5	67.5
8	53.5	56.1	59.3	64.1	71.2	53.2	55.2	58.9	63.9	70.5
9	55.3	58.0	61.3	66.6	74.6	54.8	56.9	60.8	66.3	73.6
10	57.0	59.8	63.3	69.2	78.0	56.3	58.6	62.8	68.7	76.6
11	58.7	61.7	65.4	71.7	81.4	57.9	60.3	64.8	71.1	79.7
12	60.5	63.5	67.4	74.3	84.8	59.5	62.0	66.7	73.5	82.7
13	62.2	65.4	69.5	76.8	88.2	61.0	63.7	68.7	75.9	85.8
14	63.9	67.2	71.5	79.4	91.6	62.6	65.4	70.6	78.3	88.8
15	65.6	69.1	73.5	81.9	95.0	64.2	67.1	72.6	80.7	91.9
16	67.4	70.9	75.6	84.5	98.4	65.7	68.8	74.6	83.1	94.9
17	69.1	72.8	77.6	87.0	101.8	67.3	70.5	76.5	85.5	98.0
18	70.8	74.6	79.6	89.6	105.2	68.9	72.2	78.5	87.9	101.0

Approximately 1 of every 4 children in the United States is considered overweight



**Farina**



**Mickey**



**Joe**

# Prevalence of overweight & obesity in Saudi children & adolescents

- Mohammad I. El Mouzan,<sup>a</sup> Peter J. Foster,<sup>b</sup> Abdullah S. Al Herbish,<sup>a</sup> Abdullah A. Al Salloum,<sup>a</sup> Ahmad A. Al Omer,<sup>c</sup> Mansour M. Qurachi,<sup>d</sup> and Tatjana Kecojevic<sup>b</sup>

- ***Ann Saudi Med.* 2010 May-Jun; 30(3):  
203-208**



- The national sample size, in Saudi reference was 19 317 healthy children & adolescents from 5 - 18 years of age
- The prevalence of **overweight 23.1%**, **obesity 9.3%** & **severe obesity 2%**, in all age groups

# Obesity-Related Co-morbidities

## ■ Cardiovascular Conditions

- Hyperlipidemia
- Hypertension (HTN)

## ■ Endocrine Conditions

- Dysmetabolic Syndrome
- Type 2 Diabetes
- Impaired Glucose Tolerance
- Menstrual Irregularities
- Polycystic Ovarian Syndrome
- Accelerated Growth

## ■ Gastrointestinal Conditions

- Non-Alcoholic Fatty Liver Disease (NAFLD)
- Gallstones

## ■ Orthopedic Conditions

- Blounts Disease
- Hip Disorders (SCFE)

## ■ Psychological Conditions

- Depression/Self-Esteem
- Substance Abuse
- Disordered Eating
- Discrimination

## ■ Pulmonary Conditions

- Asthma
- Sleep Apnea

# Obesity is a major factor for insulin resistance



Acanthosis nigricans

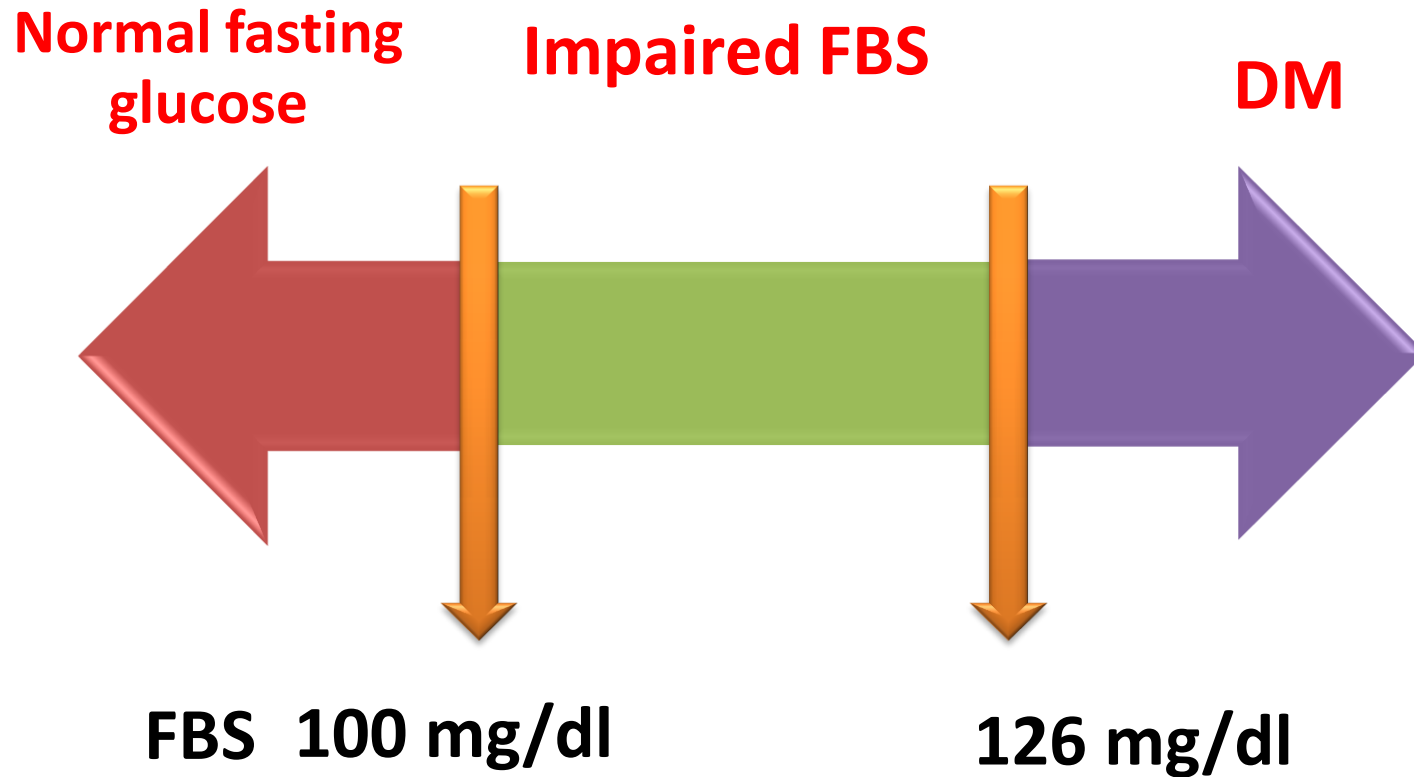


**Acanthosis  
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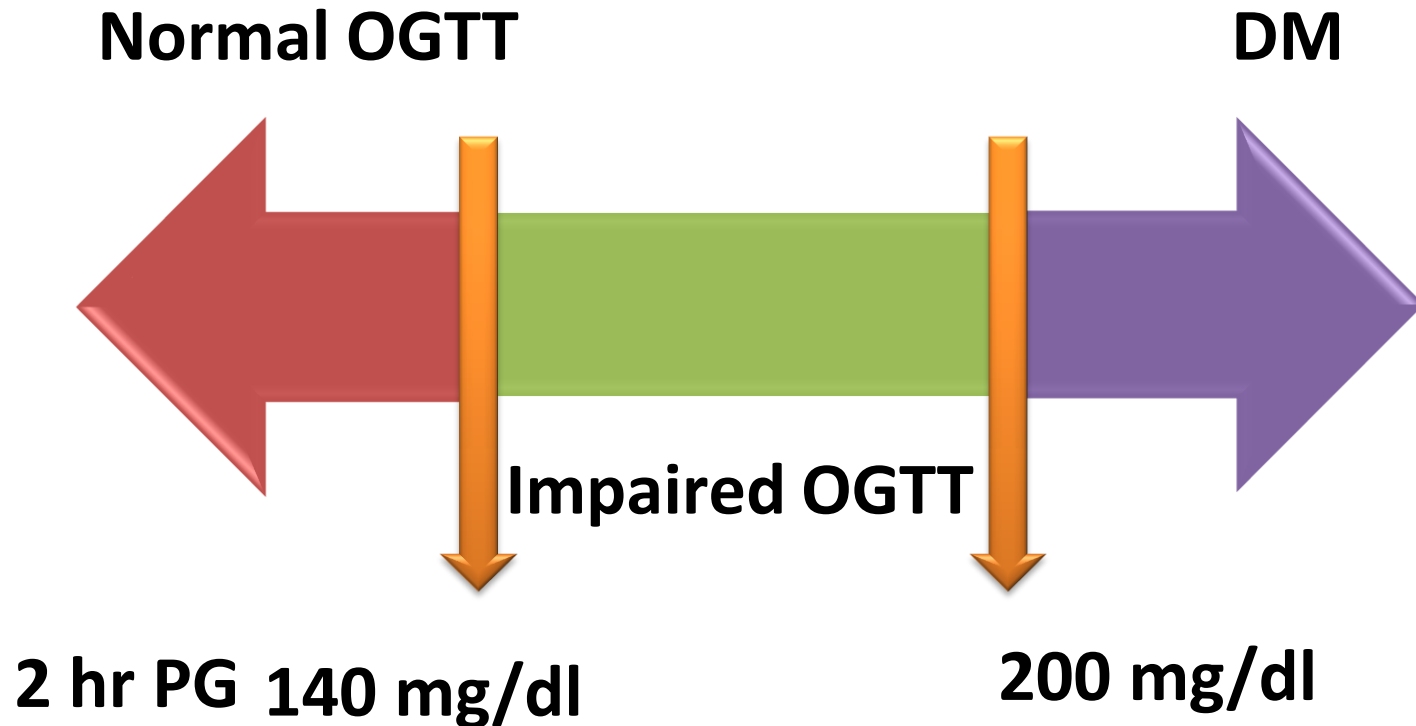




# Interpretation of Fasting Blood glucose



# Oral Glucose Challenge Test: Must be done in all cases of impaired fasting glucose





# 2005 NIH—National Heart Lung and Blood Institute BP Tables

TABLE 3

Blood Pressure Levels for Boys by Age and Height Percentile\*

Age (Year)	BP Percentile ↓	Systolic BP (mmHg)						Diastolic BP (mmHg)							
		← Percentile of Height →						← Percentile of Height →							
		5th	10th	25th	50th	75th	90th	95th	5th	10th	25th	50th	75th	90th	95th
1	50th	80	81	83	85	87	88	89	34	35	36	37	38	39	39
	90th	94	95	97	99	100	102	103	49	50	51	52	53	53	54
	95th	98	99	101	103	104	106	106	54	54	55	56	57	58	58
	99th	105	106	108	110	112	113	114	61	62	63	64	65	66	66
2	50th	84	85	87	88	90	92	92	39	40	41	42	43	44	44
	90th	97	99	100	102	104	105	106	54	55	56	57	58	58	59
	95th	101	102	104	106	108	109	110	59	59	60	61	62	63	63
	99th	109	110	111	113	115	117	117	66	67	68	69	70	71	71
3	50th	86	87	89	91	93	94	95	44	44	45	46	47	48	48
	90th	100	101	103	105	107	108	109	59	59	60	61	62	63	63
	95th	104	105	107	109	110	112	113	63	63	64	65	66	67	67
	99th	111	112	114	116	118	119	120	71	71	72	73	74	75	75
4	50th	88	89	91	93	95	96	97	47	48	49	50	51	51	52
	90th	102	103	105	107	109	110	111	62	63	64	65	66	66	67
	95th	106	107	109	111	112	114	115	66	67	68	69	70	71	71
	99th	113	114	116	118	120	121	122	74	75	76	77	78	78	79
5	50th	90	91	93	95	96	98	98	50	51	52	53	54	55	55
	90th	104	105	106	108	110	111	112	65	66	67	68	69	69	70
	95th	108	109	110	112	114	115	116	69	70	71	72	73	74	74
	99th	115	116	118	120	121	123	123	77	78	79	80	81	81	82
6	50th	91	92	94	96	98	99	100	53	53	54	55	56	57	57
	90th	105	106	108	110	111	113	113	68	68	69	70	71	72	72
	95th	109	110	112	114	115	117	117	72	72	73	74	75	76	76
	99th	116	117	119	121	123	124	125	80	80	81	82	83	84	84
7	50th	92	94	95	97	99	100	101	55	55	56	57	58	59	59
	90th	106	107	109	111	113	114	115	70	70	71	72	73	74	74
	95th	110	111	113	115	117	118	119	74	74	75	76	77	78	78
	99th	117	118	120	122	124	125	126	82	82	83	84	85	86	86
8	50th	94	95	97	99	100	102	102	56	57	58	59	60	60	61
	90th	107	109	110	112	114	115	116	71	72	72	73	74	75	76
	95th	111	112	114	116	118	119	120	75	76	77	78	79	79	80
	99th	119	120	122	123	125	127	127	83	84	85	86	87	87	88
9	50th	95	96	98	100	102	103	104	57	58	59	60	61	61	62
	90th	109	110	112	114	115	117	118	72	73	74	75	76	76	77
	95th	113	114	116	118	119	121	121	76	77	78	79	80	81	81
	99th	120	121	123	125	127	128	129	84	85	86	87	88	88	89
10	50th	97	98	100	102	103	105	106	58	59	60	61	61	62	63
	90th	111	112	114	115	117	119	119	73	73	74	75	76	77	78
	95th	115	116	117	119	121	122	123	77	78	79	80	81	81	82
	99th	122	123	125	127	128	130	130	85	86	86	88	88	89	90

- Pre-HTN
  - SBP and/or DBP
  - Between 90-94<sup>th</sup> percentile
  
- HTN
  - SBP and/or DBP
  - ≥ 95<sup>th</sup> percentile
  - On 3 or more occasions



**TABLE 2 Lipid and Lipoprotein Distributions in Subjects Aged 5 to 19 Years**

	Males			Females		
	5-9 y	10-14 y	15-19 y	5-9 y	10-14 y	15-19 y

**TABLE 1 Cut Points for Total Cholesterol and LDL Concentrations in Children and Adolescents**

Category	Percentile	Total Cholesterol, mg/dL	LDL, mg/dL
Acceptable	<75th	<170	<110
Borderline	75th-95th	170-199	110-129
Elevated	>95th	>200	>130

Adapted from NCEP guidelines for children and adolescents.<sup>22</sup>

HDL, mg/dL	5-9 y	10-14 y	15-19 y	5-9 y	10-14 y	15-19 y
5th percentile	38	37	30	36	37	35
10th percentile	43	40	34	38	40	38
25th percentile	49	46	39	48	45	43
50th percentile	55	55	46	52	52	51

Adapted from the Lipid Research Clinic Pediatric Prevalence Study.<sup>12</sup>

AAP. Pediatrics. 1992; 89: 525-584

Tamir I, et al. J Chronic Dis. 1981; 34(1): 27-39

# Prevalence of Hyperinsulinism, Type 2 Diabetes Mellitus & Metabolic Syndrome among Saudi Overweight & Obese Pediatric Patients

[Al-Agha A, Ocheltree A, Shata N,](#)  
[Minerva Pediatr.](#) 2012 Dec;  
64(6):623-31.

# Results

- Out of 387 Saudi children over 5 years study, **62.86%** of children and adolescents had BMI  $\geq$  85th percentile, **37.14%** had BMI  $\geq$  95th percentile
- The overall prevalence of Hyperinsulinism was **44.7%**
- The overall prevalence of T2DM was **9.04%**
- **Those with type 2 DM, 14.29%** had (MS), **34.29%** were hypertensive and **28.57%** had dyslipidemia

# Prevention of metabolic syndrome is by prevention of obesity



Strategies for Promoting Healthy  
Eating, Exercise and Parent  
Involvement

# Physical Activity

- Increased activity not only increases calorie use but also appears to decrease appetite
- In children younger than 2 yr of age ,AAP recommends avoiding TV watching & computers
- Children 2-18yr of age should have <2hr/day of “screen time” (TV, video games, computer) & TV should be removed from children bedrooms

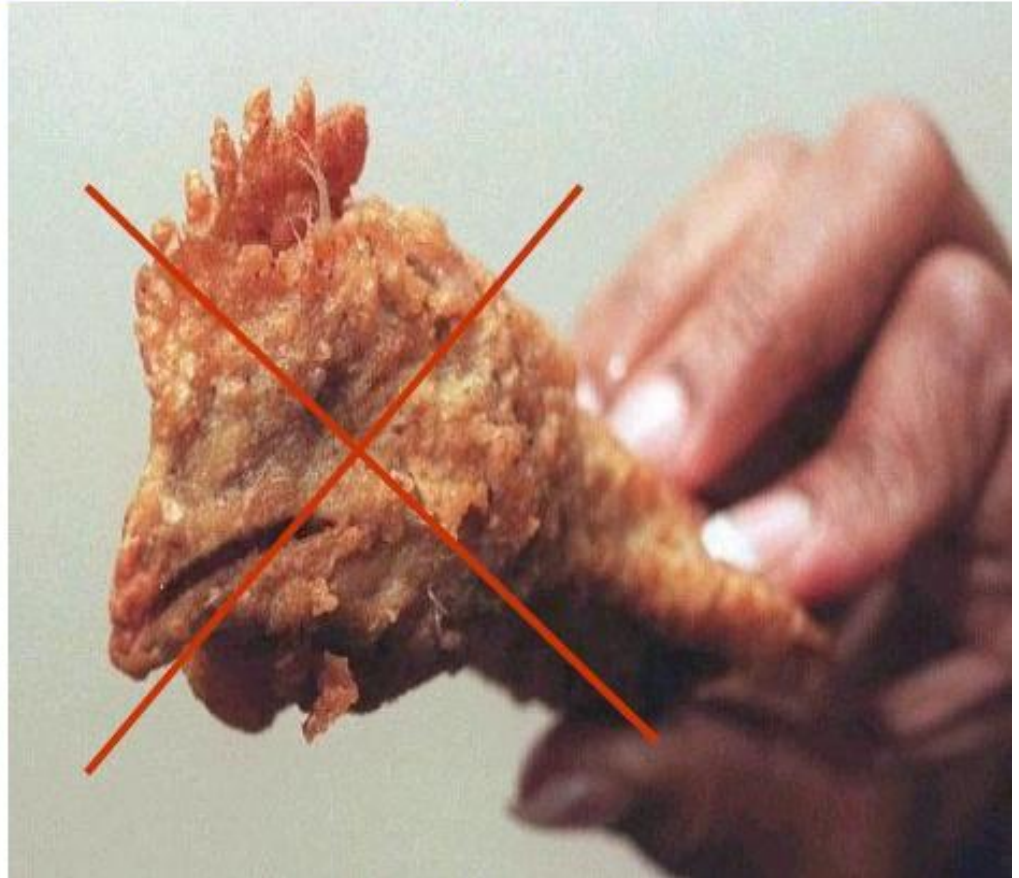
# Life Style Modifications





# Prevention of obesity

قال صلى الله عليه وسلم (ما ملأ آدمي وعاء شرا من بطنه، بحسب ابن آدم لقيمات يقمن صلبه، فان كان لا بد فاعلا فثلث لطعامه وثلث لشرابه وثلث لنفسه). رواه أحمد والترمذي



**B**

Breakfast Everyday



5 servings of  
fruits/veggies

3 structured meals  
daily

$\leq 2$  hrs daily of TV/video  
time

$\geq 1$  hr/day of moderate  
activity

**Almost None**

high sugar beverages



# Obesity: Pharmacotherapy

- Orlistat (Xenical )
  - FDA-approved for children  $\geq 12$ yr
  - Inhibits GI lipases
  - Dose: 120 mg TID
    - GI side effects common
- GLP-1 receptor agonist
  - Promising agent for both obesity & Type 2
  - Once weekly preparation
    - Trulicity
    - Not yet approved for adolescents only adults
- Metformin
  - Not FDA approved for obesity
  - Approved for T2DM/  
Hyperinsulinism
    - Approved in children  $\geq 10$ yr
    - $\downarrow$  hepatic gluconeogenesis
    - $\uparrow$  peripheral insulin sensitivity
  - Relatively no systemic side effects if normal liver and renal functions
  - GI side effects

# Therapeutic Goals in Metabolic syndrome

## Glycemic recommendations

- HbA1c <7%
- FBG: 70-130 mg/dL
- Fed glucose <180 mg/dl

## Weight/diet

- BMI < 25 kg/m<sup>2</sup>
- Exercise > 150 min/week
- Diet <7% saturated fat

*Adapted from ADA and EASD consensus 2009*

# Therapeutic Goals

## Dyslipidemia

- **LDL-C < 100 mg/dl**
- **HDL-C > 35 mg/dl**
- **TG < 150 mg/dl**

## Blood pressure

- **To lower less than: BP < 95th % for age, sex and height**

*Adapted from ADA and EASD consensus 2009, Libman IM. 2007*

# Conclusions

- Childhood obesity has reached epidemic proportions worldwide
- Mainstay of treatment is DIET/EXERCISE and changing “Obesogenic environment”
- The counseling should start in early childhood
- Important role of Pediatrician / Family practitioner

# Conclusions

- Early detection and treatment is likely to reduce morbidity and mortality in adulthood and help keep to a minimum the global burden of cardiovascular disease and type 2 diabetes mellitus

# Conclusions

- The prevalence of obesity was rather high in Saudi population (local study AlAgha,etal.), as was the prevalence of some of its related co-morbidities, mainly (T2DM) and hypertension.
- The endemic of unhealthy environment is sweeping across children and adolescents within our population, which is mainly due to behavioral and environmental factors
- **We all have** the responsibility of preventing excessive weight gain through **the promotion of a healthy lifestyle, family educational seminars and the reinforcement of indoor exercises**

**Thank you**