Medicine 439

MED439
KING SAUD UNIVERSITY

Revised & Approved
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Epidemiology of Diabetes Mellitus

Editing file

Lecture Objectives:

» To list the types of Diabetes Mellitus

» To describe the prevalence of Diabetes Mellitus

» To recognize the importance of diagnostic criteria for estimating the prevalence of diabetes mellitus

» To discuss the risk factors and complications of type II diabetes mellitus

- **Important**
- **Original content**
- **Boys Slides**
- **Girls Slides**
- **Doctor's notes**
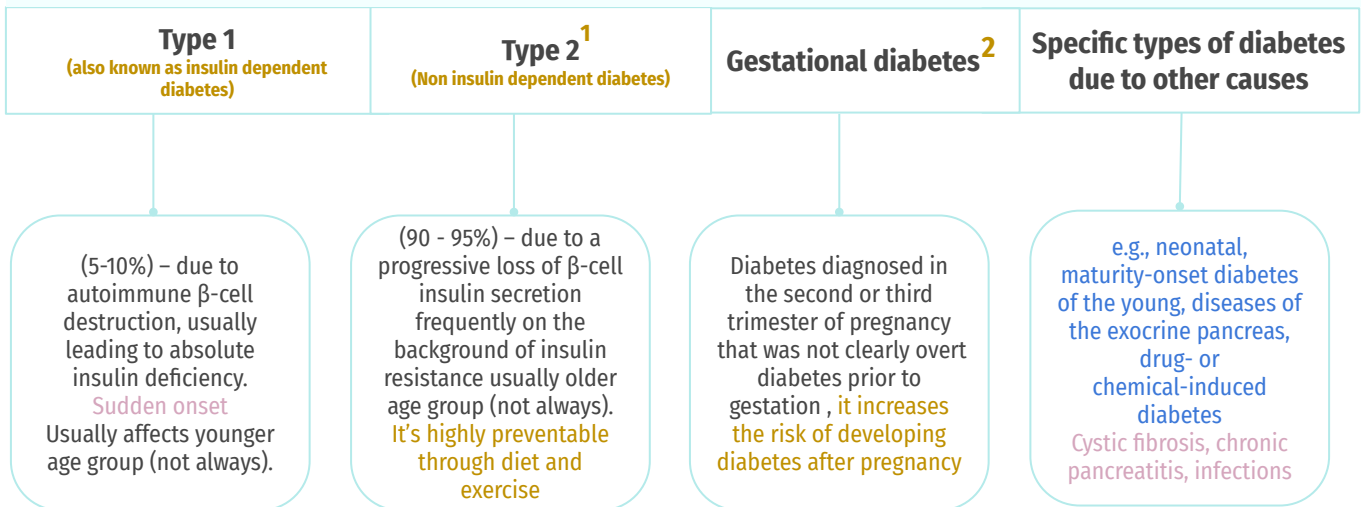- **Extra**

Diabetes Mellitus

Diabetes Mellitus

A metabolic disorder of **multiple aetiology** characterized by chronic hyperglycemia with disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action (body does not responding to insulin) or both.
It's a disease which is involving almost all systems of the body from the head to toe and at the same time it has a very very high prevalence.
Pre-diabetes: Impaired glucose tolerance A person with pre- diabetes has a blood sugar level higher than normal, but not high enough for a diagnosis of diabetes; & is at higher risk for developing type 2 diabetes. May remain undiagnosed for years; risk of complications same as for T2DM

Main types of diabetes

Type 1 (also known as insulin dependent diabetes)	Type 2 [1] (Non insulin dependent diabetes)	Gestational diabetes [2]	Specific types of diabetes due to other causes
(5-10%) – due to autoimmune β-cell destruction, usually leading to absolute insulin deficiency. Sudden onset Usually affects younger age group (not always).	(90 - 95%) – due to a progressive loss of β-cell insulin secretion frequently on the background of insulin resistance usually older age group (not always). It's highly preventable through diet and exercise	Diabetes diagnosed in the second or third trimester of pregnancy that was not clearly overt diabetes prior to gestation , it increases the risk of developing diabetes after pregnancy	e.g., neonatal, maturity-onset diabetes of the young, diseases of the exocrine pancreas, drug- or chemical-induced diabetes Cystic fibrosis, chronic pancreatitis, infections

Impaired glucose tolerance (IGT) and impaired fasting glycaemia (IFG) - intermediate conditions in the transition between normal blood glucose levels and diabetes (especially type 2)

Symptoms Boys slides

- Increase frequency of urine
- Increase appetite
- Easy fatigability
- Increase thirst
- Blurred vision
- Dry skin
- Weight loss
- Tingling hands and feet
- Slow healing wounds

1. Mostly occurs in older age group so it's not present in young adults, mostly when we are referring to diabetes mellitus we refer to type 2 diabetes mellitus and it has a huge huge prevalence.
2. It is mostly detected during pregnancy and it's either recognized during pregnancy or either it develops during pregnancy beca of the certain changes (physiological changes) which associated with pregnancy, the body is not able to control the blood sugar and you get hyperglycemia.

Diabetes Mellitus Boys slides

Diabetes	Fasting plasma glucose 2-h plasma glucose HbA1c	≥ 7.0 mmol/L (126 mg/dl) ≥ 11.1 mmol/L (200 mg/dl) ≥ 6.5%
Impaired glucose tolerance (IGT)	Fasting plasma glucose 2-h plasma glucose	<7.0 mmol/L (126 mg/dl) and ≥ 7.8 and <11.1 mmol/L (140 mg/dl and 200 mg/dl)
Impaired fasting glucose (IFG)	Fasting plasma glucose 2-h plasma glucose	6.1 to 6.9 mmol/L (110 mg/dl to 125 mg/dl) and (if measured) <7.8 mmol/L (140 mg/dl)
Gestational diabetes (GDM)	One or more of the following: Fasting plasma glucose 1-h plasma glucose[1] 2-h plasma glucose[2]	5.1–6.9 mmol/L (92–125 mg/dl) ≥ 10.0 mmol/L (180 mg/dl) 8.5–11.0 mmol/L (153–199 mg/dl)

1- Venous plasma glucose 2 hours after ingestion of 75 g oral glucose load
2- Venous plasma glucose 1 hour after ingestion of 75 g oral glucose load

Key facts

The number of people with diabetes has risen from 108 million in 1980 to 422 million in 2014.*

The global prevalence of diabetes among adults over 18 years of age has risen from 4.7% in 1980 to 8.5% in 2014.*

Diabetes prevalence has been rising more rapidly in middle- and low-income countries.*

Diabetes is a major cause of blindness, kidney failure, heart attacks, stroke and lower limb amputation.

In 2015, an estimated 1.6 million deaths were directly caused by diabetes. Another 2.2 million deaths were attributable to high blood glucose in 2012

Almost half of all deaths attributable to high blood glucose occur before the age of 70 years. WHO projects that diabetes will be the seventh leading cause of death in 2030.

Healthy diet, regular physical activity, maintaining a normal body weight and avoiding tobacco use are ways to prevent or delay the onset of type 2 diabetes.

Diabetes can be treated and its consequences avoided or delayed with diet, physical activity, medication and regular screening and treatment for complications.

Global Prevalence of Diabetes

1 — 2.8% in 2000;4.4% in 2030 worldwide (171 million in 2000; 366 million by 2030)
DM worldwide was already 366 million

2 — The prevalence increased to 382 millions (8.2%) by 2013 and current figures are >415 million
There is a large percentage of undiagnosed cases and a large percentage at high risk of developing DM

3 — A huge percentage of the reported diabetics are in the 40-59 age group, among whom 80% live in countries with low and middle-income economies

4 — In 2013, about half of all diabetes-related deaths in adults were in the age group below 60 years.
Every six seconds there is a diabetes-related death and more so in the poorly-developed regions

5 — 35 out of 219 countries (16%) show very high prevalence of diabetes, more than 12%, These countries fall mainly in the regions of the Middle-East, North Africa, South Asia and Western Pacific

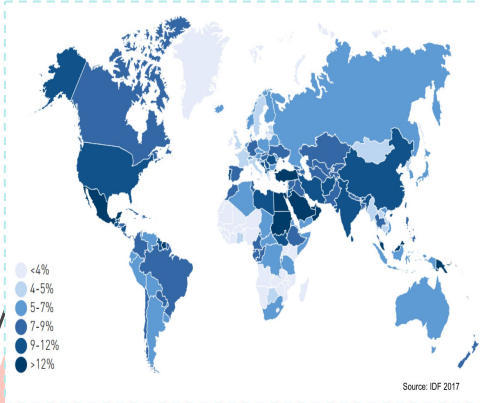# Regional and local prevalence

1- There are 20 Arab countries in which nearly 20.5 million people are living with diabetes and another 13.7 million are in the pre-diabetes stage, with Impaired Glucose Tolerance (IGT)

2- Six of the top ten countries having the highest prevalence rates of diabetes globally are found in the Gulf region, namely:
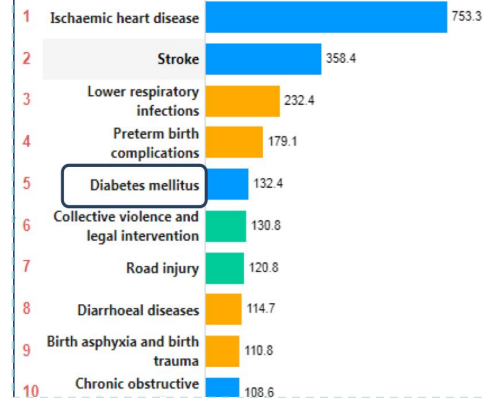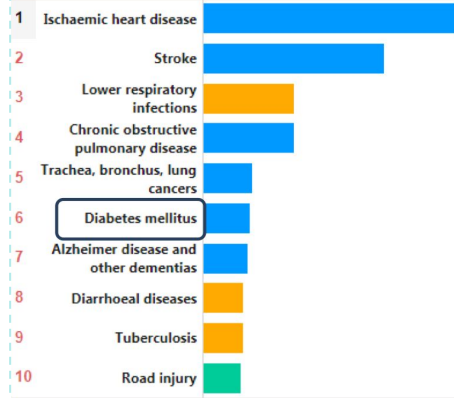Kuwait, Lebanon, Qatar, Bahrain, UAE and Saudi Arabia

3- Bahrain 15.4%; Kuwait 14.6%; UAE 18.7%; Qatar 15.4%
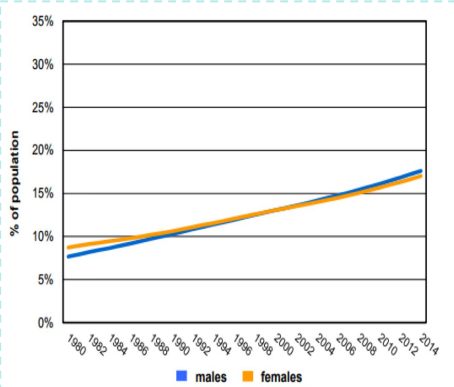
Regional and local prevalence

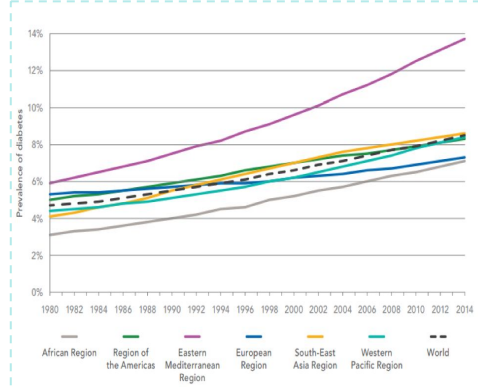## Estimated age-adjusted prevalence of diabetes in adults (20-79 years), 2017
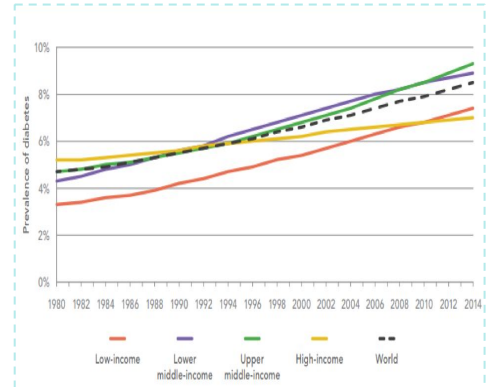

- <4%
- 4-5%
- 5-7%
- 7-9%
- 9-12%
- >12%

Source: IDF 2017

Top 10 causes of death

1	Ischaemic heart disease	
2	Stroke	
3	Lower respiratory infections	
4	Chronic obstructive pulmonary disease	
5	Trachea, bronchus, lung cancers	
6	Diabetes mellitus	
7	Alzheimer disease and other dementias	
8	Diarrhoeal diseases	
9	Tuberculosis	
10	Road injury	

1	Ischaemic heart disease	753.3
2	Stroke	358.4
3	Lower respiratory infections	232.4
4	Preterm birth complications	179.1
5	Diabetes mellitus	132.4
6	Collective violence and legal intervention	130.8
7	Road injury	120.8
8	Diarrhoeal diseases	114.7
9	Birth asphyxia and birth trauma	110.8
10	Chronic obstructive	108.6

Trends in age-standardized prevalence of diabetes in Saudi Arabia

- males
- females

Trends in prevalence of diabetes, 1980–2014, by WHO region

African Region, Region of the Americas, Eastern Mediterranean Region, European Region, South-East Asia Region, Western Pacific Region, World
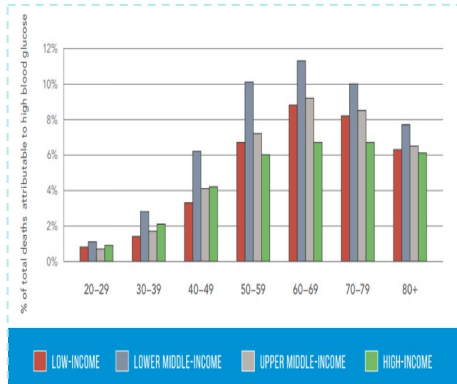
Trends in prevalence of diabetes, 1980–2014, by country income group

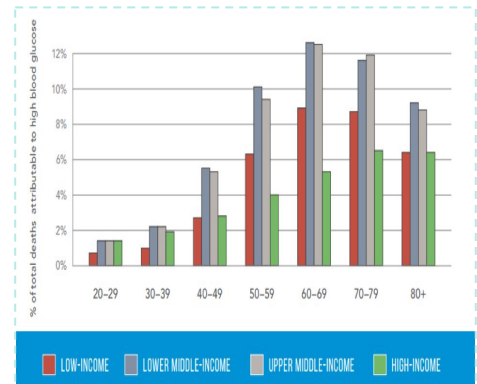Low-income, Lower middle-income, Upper middle-income, High-income, World

Percentage of all deaths attributable to high blood glucose for adults aged 20–69 years, by WHO region and sex, 2000 and 2012

MEN: 2000 2012 WOMEN: 2000 2012
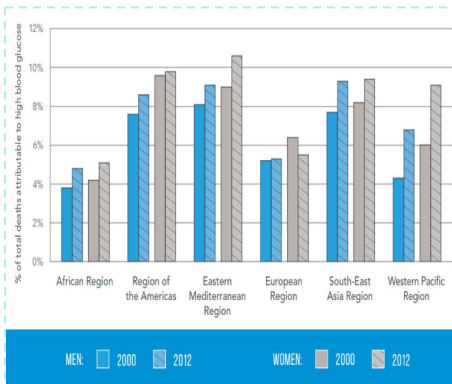
Percentage of all-cause deaths globally attributed to high blood glucose in men, 2012

LOW-INCOME, LOWER MIDDLE-INCOME, UPPER MIDDLE-INCOME, HIGH-INCOME

Percentage of all-cause deaths globally attributed to high blood glucose in women, 2012

LOW-INCOME, LOWER MIDDLE-INCOME, UPPER MIDDLE-INCOME, HIGH-INCOME

Regional and local prevalence

WHO region	Prevalence (%)		Numbers (millions)	
	1980	2014	1980	2014
African region	3.1%	7.1%	4	25
Region of the americas	5%	8.3%	18	62
Eastern Mediterranean region	5.9%	13.7%	6	43
European region	5.3%	7.3%	33	64
South-east Asia region	4.1%	8.6%	17	96
Western pacific region	4.4%	8.4%	29	131
Total	4.7%	8.5z	108	422

Estimated prevalence and number of people with diabetes (adults 18+ years)

WHO region	African region	Region of the americas	Eastern Mediterranean region	European region	South-east Asia region	Western pacific region
Both	111.3	72.6	139.7	55.7	115.3	67
Female	110.9	63.9	140.2	46.5	101.8	65.8
Male	111.1	82.8	138.3	64.5	129.1	67.8

High blood glucose age-standardized mortality rates per 100000 by WHO region, age 20+, 2012

Rank	Country	%	Years
1	Tuvalu	27.25	2017
2	Nauru	24.07	2017
3	New Caledonia	23.36	2017
4	Kiribati	22.66	2017
5	Mauritius	22.02	2017
6	Solomon Islands	18.68	2017
7	Saudi Arabia We can say that Saudi Arabia is actually the leading country if we exclude the small countries	17.72	2017
8	Papua New Guinea	17.65	2017
9	Egypt	17.31	2017
10	United Arab Emirates	17.26	2017

Diabetes prevalence (% of population ages 20 to 79)

Diabetes mellitus and KSA

Girls slides

- WHO ranks SA 2nd in the prevalence of diabetes in the Middle East region & 7th in the world: considered an epidemic
- A more recent study reported that the prevalence of diabetes had risen to 34.1% in males and 27.6% in females.
- The mean reported age for diabetes onset in males and females is 57.5 and 53.4 years
- The number of deaths attributed to diabetes in Saudi Arabia is about 170,000 adults, which is greater than 10% of all deaths in the country
- Saudi Arabia reported that 40.3% of diabetic patients are unaware of their having the disease
- Increasing age is a risk factor, recent studies showing different trend
- The incidence of T1DM is also on the increase over the last 30 years , with prevalence among the Saudi children and adolescents at 109.5 per 100,000
- Healthcare expenditures incurred by people with diabetes are increasing
- In 2010 on average, people diagnosed with diabetes spent ten times more towards medical healthcare expenditure
- Prevalence of DM in the central region (Riyadh), was 23.7% (age group 30-70 years), while another 14.1% had IFG
- The incidence of diabetes was significantly higher in the urban regions (25.5 vs 19.5 in the rural areas)
- The Northern (27.9%) and Eastern (26.4%) provinces showing greater rates of the prevalence of DM than the Southern region (18.2%), which supports a more rural lifestyle and a population with less tendency for obesity than those of the Northern and Eastern provinces

Trends in age-standardized
prevalence of diabetes
in Saudi Arabia
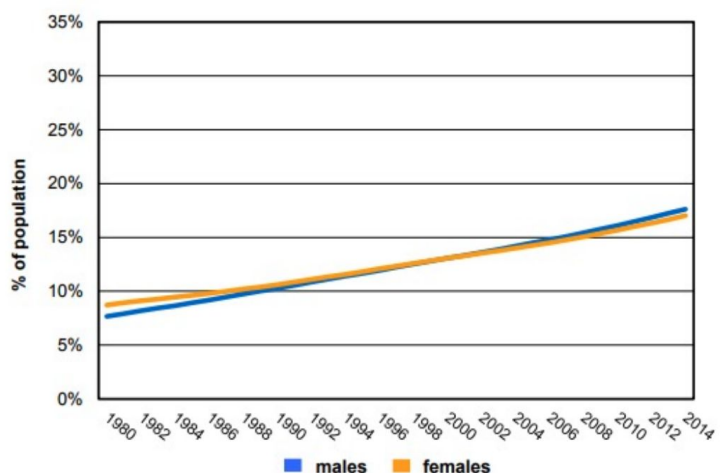
Diagnosis, signs & symptoms
Girls slides

- Thirst
- Passing lots of urine
- Fatigue
- Infections (thrush)
- Weight loss

1 Random plasma glucose

2 Fasting plasma glucose

3 Oral glucose Tolerance test (2h glucose)

The International committee on DM, recognized an intermediate group of subjects whose glucose levels, although not meeting criteria for diabetes, are nevertheless too high to be considered normal.

The categories of FPG values are as follows:

1
FPG <100 mg/dl (5.6 mmol/l) = normal fasting glucose

2
FPG 100–125 mg/dl (5.6–6.9mmol/l) = IFG (impaired fasting glucose)

3
FPG ≥126 mg/dl (7.0 mmol/l) = provisional diagnosis of diabetes (the diagnosis must be confirmed)

The corresponding categories when the OGTT is used are the following:

1
2-h postload glucose <140 mg/dl (7.8 mmol/l) = normal glucose tolerance

2
2-h postload glucose 140–199 mg/dl (7.8–11.1 mmol/l) = IGT (impaired glucose tolerance)

3
2-h postload glucose ≥200 mg/dl (11.1 mmol/l) = provisional diagnosis of diabetes (the diagnosis must be confirmed)

Diagnosis

1. Symptoms of diabetes plus casual plasma glucose concentration ≥200 mg/dl (11.1 mmol/l). Casual is defined as any time of day without regard to time since last meal. The classic symptoms of diabetes include polyuria, polydipsia, and unexplained weight loss. OR

2. FPG ≥126 mg/dl (7.0 mmol/l). Fasting is defined as no caloric intake for at least 8 h. OR

3. 2-h postload glucose ≥200 mg/dl (11.1 mmol/l) during an OGTT. The test should be performed as described by WHO, using a glucose load containing the equivalent of 75 gms glucose dissolved in water.

Ref: Diagnosis and Classification of Diabetes Mellitus American Diabetes Association Diabetes Care 2006 Jan; 29(suppl 1): s43-s48

Glycosylated Hemoglobin A1c

- In July 2009, the International Expert Committee recommended the use of the A1C test in the diagnosis of diabetes, with a threshold of 6.5%
- Internationally as marker to track the blood sugar control Limitations:
1. HbA1c may be increased falsely in certain medical conditions: kidney failure, chronic excessive alcohol intake, and hypertriglyceridemia.
2. Medical conditions that may falsely decrease HbA1c include acute or chronic blood loss, sickle cell disease or thalassemia.
3. Gestational diabetes may falsely increase or decrease HbA1c.

Why is diabetes so important?

Complications:
- Cardiovascular
- Eyes
- Renal - Hypertension, renal failure
- Feet and Skin infections,
- sexual, psycho-sexual, depression
- Quality of life
- Premature mortality
- Social Factors: The burden to patients and the family and to the health system

Common diabetes complications

Prevention is very very important to prevent complications.

| 1 | Loss of vision | 2 | End-stage renal disease | 3 | Cardiovascular events | 4 | Lower extremity amputations |

Loss of vision

- Diabetic retinopathy caused 1.9% of moderate or severe visual impairment globally and 2.6% of blindness in 2010.
- Studies suggest that prevalence of any retinopathy in persons with diabetes is 35% while proliferative (vision-threatening) is 7%.
- However, retinopathy rates are higher among people with type 1 diabetes, people with longer duration of diabetes, caucasian populations and possibly among people of lower socioeconomic status.

Cardiovascular events

- Adults with diabetes historically have 2-3 times higher rate of cardiovascular disease (CVD) than adults without diabetes.
- The risk of cardiovascular disease increases continuously with rising fasting plasma glucose levels, even before reaching levels sufficient for a diabetes diagnosis.
- Almost 7 in 10 people with diabetes over the age of 65 will die of some type of heart disease. About 1 in 6 will die of stroke.

End-stage renal disease

- Pooled data from 54 countries show that at least 80% of cases of end-stage renal disease (ESRD) are caused by diabetes, hypertension or a combination of the two.
- The proportion of ESRD attributable to diabetes alone ranges from 12-55%.
- The incidence of ESRD is up to 10 times as high in adults with diabetes as those without.

Lower extremity amputations

- Diabetes appears to dramatically increase the risk of lower extremity amputation because of infected, non-healing foot ulcer due to decreased blood circulation.
- Rates of amputation in populations with diagnosed diabetes are typically 10 to 20 times those of non-diabetic populations.
- Encouragingly several studies show a 40% to 60% reduction in rates of amputations among adults with diabetes during the past 10-15 years in western countries.

Complications Girls slides

- Diabetes accounts for more than 5% of the global deaths, which are mostly due to CVD.
- Study in one province of SA, found >70% patients having ≥ 1 complication.
- Diabetes is responsible for over one third of end-stage renal disease requiring dialysis (23% to 29%).
- Amputations are at least 10 times more common in people with diabetes (61% PAD, 31% neuropathy).
- A leading cause of blindness & visual impairment.
- Diabetics are 20 times more likely to develop blindness than non-diabetics.
- High risk for Diabetes nephropathy: Diabetes duration, retinopathy, neuropathy, hypertension, age >45 years, hyperlipidemia, male gender, smoking, and poor glycemic control.
- Number of diabetic patients seeking renal replacement therapy increased from 4% in the early 1980s to 14.8% in the mid-1990s, even higher to 40% in the late 1990s.
- Most of the deaths [60%] in dialysis patients are of those with DM.
- Nearly 37–41% of diabetic patients in Saudi Arabia develop a stroke while 61% of them develop peripheral artery disease.
- It is recommended that every Saudi above 30 years of age should undergo screening for both T2DM and T1DM and pre-diabetes.

Future Directions Girls slides

1 Tackling environmental factors and lifestyle

2 Appropriate use of screening tools to control diabetes mellitus

3 Therapeutic and management choices and updated criteria for treatment

4 Rehabilitation services for complications

5 The Saudi National Diabetes Registry (SNDR) was recently established with the primary goal of developing a database including all the diagnosed national diabetic patients

6 The objective of the SNDR is to act as an electronic medical file to provide the medical teams correct clinical, investigational, and management data.

7 It is a surveillance-monitoring tool for clinical and epidemiology practitioners by identifying the significant performance indicators linked to this disease in either acute or chronic cases.

8 The SNDR also provides data relating to the association of diabetes with hypertension, hyperlipidemia, and obesity

Genetic factors

- May play a part in development of all types
- Autoimmune disease and viral infections may be risk factors in Type I diabetes.
- Twin studies.

Family history

- Compared with individuals without a family history of type 2 diabetes, individuals with a family history in any first degree relative have a two to three-fold increased risk of developing diabetes.
- The risk of type 2 diabetes is higher (five to six fold) in those with both a maternal and paternal history of type 2 diabetes.
- The risk is likely mediated through genetic, anthropometric (body mass index, waist circumference), and lifestyle (diet,physical activity, smoking) factors.

Obesity

- Contributes to the resistance to endogenous insulin.
- The risk of impaired glucose tolerance (IGT) or type 2 diabetes rises with increasing body weight.
- The Nurses' Health Study demonstrated an approximately 100-fold increased risk of incident diabetes over 14 years in nurses whose baseline body mass index was >35 kg/m2 compared with those with BMI <22 .
- The risk of diabetes associated with body weight appears to be modified by age.
- Obesity acts at least in part by inducing resistance to insulin-mediated peripheral glucose uptake, which is an important component of type 2 diabetes.

Fat distribution

- The distribution of excess adipose tissue is another important determinant of the risk of insulin resistance and type 2 diabetes.
- The incidence of type 2 diabetes are highest in those subjects with central or abdominal obesity, as measured by waist circumference or waist-to-hip circumference ratio.
- Intra-abdominal (visceral) fat rather than subcutaneous or retroperitoneal fat appears to be of primary importance.

Risk factors

Physical inactivity

- Prolonged TV watching is associated with a significantly increased risk of type 2 diabetes. Men who watched TV more than 40 h per week had a nearly threefold increase in the risk of type 2 diabetes compared with those who spent less than 1 h per week watching TV.

Diet

- A number of dietary factors have been linked to an increased risk of type 1 diabetes, such as low vitamin D consumption; early exposure to cow's milk or cow's milk formula; or exposure to cereals before 4 months of age.However, none of these factors has been shown to cause type 1 diabetes.
- Consumption of red meat, processed meat, and sugar sweetened beverages is associated with an increased risk of diabetes.
- Fruits, vegetables, nuts, whole grains, and olive oil is associated with a reduced risk.
- It is important to recognize that most studies have used food frequency questionnaires to capture dietary patterns and that none of the food stuffs examined can be considered in isolation. For example, higher meat intake always means more saturated fat intake, relatively lower fruit and vegetable intake, and frequently, higher BMI (body mass index).
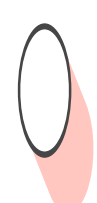
Smoking

- Several large prospective studies have raised the possibility that cigarette smoking increases the risk of type 2 diabetes. In a meta-analysis of 25 prospective cohort studies, current smokers had an increased risk of developing type 2 diabetes compared with nonsmokers (pooled adjusted RR 1.4, 95% CI 1.3-1.6).
- A definitive causal association has not been established, a relationship between cigarette smoking and diabetes mellitus is biologically possible based upon a number of observations:

  1-Smoking **increases the blood glucose concentration** after an oral glucose challenge.

  2-Smoking **may impair insulin sensitivity**.

  3-Cigarette smoking has been linked to **increased abdominal fat distribution** and greater waist-to-hip ratio that may have an impact upon glucose tolerance.

Infections

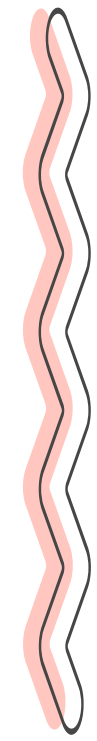- A range of relatively rare infections and illnesses can damage the pancreas and cause **type 1 diabetes**.

Pregnancy

- Pregnancy causes weight gain and increases levels of estrogen and placental hormones, **which antagonize insulin**.

Medications

- Drugs that are known to antagonize the effects of insulin:
1-Thiazide diuretics 2-Adrenal corticosteroids 3-Oral contraceptives.

Physiologic or emotional stress

- Causes prolonged elevation of stress hormone levels (cortisol, epinephrine, glucagon and growth hormone), which raises blood glucose levels, placing increased demands on the pancreas.

Quiz ❓
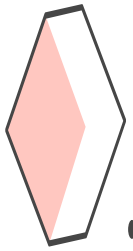
Q1- What is the most common form of diabetes worldwide?			
A.Type 1 diabetes	B.Type 2 diabetes	C.Gestational diabetes	D.Secondary diabetes
Q2- When a pregnant woman develops diabetes mellitus during the pregnancy it is called?			
A.Diabetes insipidus	B..Gestational diabetes	C..Type 1 diabetes mellitus	D.Type 2 diabetes mellitus
Q3- Which one of the following fasting blood glucose levels is considered to be normal?			
A.75 mg/dl	B.250 mg/dl	C.200 mg/dl	D. 120 mg/dl
Q4- Which one of the following is not a complication of diabetes?			
A.Nephropathy	B.Retinopathy	C-CVS disease	D.IBD
Q5- what type of diabetes is insulin dependant? And what age group does it affect?			
A.Type II, young	B.Type I, adults	C.Type I, young	D. Type II, adults

Answers

1.B 2.B 3.A 4.D 5.C

Leaders

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