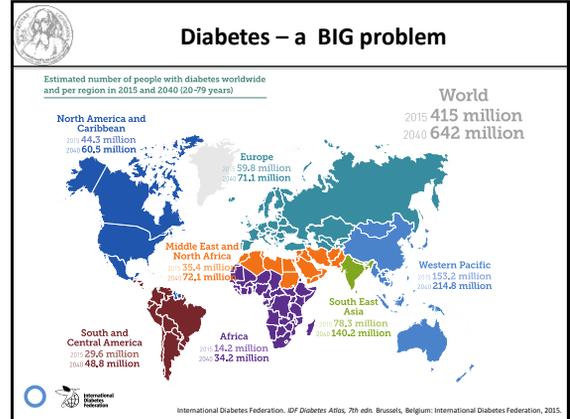


Internal propaedeutic – lecture for the 3rd class, general medicine
9.11.2016

Diabetology and metabolism

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Epidemiology

1 in 11 adults have diabetes (415 million)



46.5% of adults with diabetes are undiagnosed



By 2040, 1 adult in 10 (642 million) will have diabetes



International Diabetes Federation. IDF Diabetes Atlas, 7th edn. Brussels, Belgium: International Diabetes Federation, 2015.

Diabetes mellitus

- Diabetes mellitus is a chronic disease which has been described as a state of raised blood glucose (**hyperglycaemia**) associated with premature mortality.
- **Diabetes arises when:**
 - the beta cells in the pancreas fail to produce enough of the hormone insulin – **T1DM**
 - or when the body cannot effectively use the produced insulin – **T2DM**
- Hyperglycaemia seriously **damages many of the body's systems**, especially the blood vessels and nerves.

Classification of Diabetes

- **Type 1 diabetes**
 - β -cell destruction
- **Type 2 diabetes**
 - Progressive insulin secretory defect
- **Other specific types of diabetes**
 - Genetic defects in β -cell function, insulin action
 - Diseases of the exocrine pancreas
 - Drug- or chemical-induced
- **Gestational diabetes mellitus**

ADA. 1. Classification and Diagnosis. Diabetes Care 2012;35(suppl 1):S11.

Types of Diabetes

- **Type 1 (T1DM, DM1)**
 - onset in youth, destruction of beta cells and a requirement for insulin
- **Type 2 (T2DM, DM2)**
 - onset as adult or young adult, related to insulin resistance. May be treated with lifestyle modification, oral medications, and later may require insulin

T1DM versus T2DM

Diabetes Medications

Type 1 Diabetes	Type 2 Diabetes
 <p style="text-align: center;">Insulin is <i>always</i> needed</p>	 <p style="text-align: center;"><i>May</i> need Oral medication OR Oral medication plus insulin OR Insulin alone</p>

Main symptoms of diabetes

- feeling very thirsty
- going to the toilet a lot, especially at night
- extreme tiredness

Frequent urination
Excessive thirst
Unexplained weight loss
Extreme hunger
Sudden vision changes
Tingling or numbness in the hands or feet
Feeling very tired much of the time
Very dry skin
Sores that are slow to heal
More infections than usual

Diabetes – cardinal symptoms

CARDINAL SYMPTOMS

- POLYURIA
- POLYDIPSIA
- WEIGHT LOSS



OTHER COMMON SYMPTOMS

- LETHARGY AND WEAKNESS
- WHITE PATCHES IN THE MOUTH/ OROPHARYNX WITH DIFFICULTY IN DEGLUTITION (CANDIDIOSIS).
- WHITE VAGINAL DISCHARGE.
- RECURRENT SKIN INFECTIONS.
- DRY, SCALY SKIN
- DELAYED WOUND HEALING.
- PALPITATION & BREATHLESSNESS.
- CLAUDICATION.
- DIZZINESS ON STANDING.
- SUDDEN LOSS OF CONSCIOUSNESS.
- NUMBNESS/TINGLING/PAIN IN THE EXTREMITIES.
- CARPAL TUNNEL SYNDROME.
- RECURRENT NAUSEA AND VOMITING.
- DIARRHOEA/CONSTIPATION.
- URINARY INCONTINENCE.
- ERECTILE DYSFUNCTION.
- BLURRED VISION/FLOATERS/SUDDEN LOSS OF VISION AND DIPLOPIA.
- SORE AND BLEEDING GUMS.



CANDIDIOSIS



Normal vision Vision with diabetic retinopathy

Diabetic Ketoacidosis

B- Physical signs of DKA:

a-General signs: Ill appearance and disturbed consciousness.

b-Signs of dehydration:

- Skin: Dry, hot, flushed, and loss of skin turgor.
- Tongue: Dry (sometimes woody tongue).
- Eyes: Sunken eyes and dark circles under the eyes.

c-Vital signs:

- Tachycardia, hypotension and tachypnea.

d-Specific signs:

- Ketotic breath:** A strong, fruity breath odour (similar to nail polish remover or acetone).
- Acidotic breath** (Kussmaul's respiration): deep and rapid.
- Abdominal tenderness.

GENERAL ASSESSMENT

PATIENTS WITH ALTERED CONSCIOUSNESS

MUST CHECK FOR

- MENTAL STATE
- PULSE
- BLOOD PRESSURE
- RESPIRATION
- STATE OF HYDRATION (SKIN & MUCOUS MEMBRANE)



KUSSMAUL BREATHING



LOSS OF SKIN TURGOR—INDICATIVE OF DEHYDRATION

IN THE NON-ACUTE SETTING, IN ADDITION TO THE ABOVE PARAMETERS, MEASUREMENT OF BMI AND WAIST TO HIP RATIO IS OF GREAT IMPORTANCE. ORTHOSTATIC BP SHOULD ALSO BE MEASURED.

LOCOREGIONAL EXAMINATION

DIABETES CAN AFFECT ALMOST EVERY SYSTEM OF THE BODY. SO, A PATIENT SUSPECTED OF HAVING DIABETES SHOULD BE EXAMINED THOROUGHLY FROM HEAD TO TOE.

EXAMINATION OF HEAD AND NECK

- > XANTHELASMA
- > CRANIAL NERVE PALSY(III, IV, VI AND VII)
- > EYE MOVEMENTS
- > PTOSIS
- > HIRsutISM
- > CAROTID PULSE
- > CAROTID BRUIT
- > THYROID ENLARGEMENT



XANTHELASMA

EXAMINATION OF BUCCAL CAVITY

INSPECTION

ONE MUST LOOK FOR

- > PUFFY, RED GUMS.
- > A BUILD UP OF PLAQUE.
- > OBVIOUSLY DECAYED TEETH.
- > TYPICAL BAD BREATH OF PERIODONTITIS.

A COMPLETE DENTAL EXAMINATION, INCLUDING PERIODONTAL PROBING OF GUM POCKETS, IS NECESSARY TO DETERMINE THE PRESENCE AND SEVERITY OF PERIODONTAL INFECTION.



PERIODONTITIS AND GINGIVITIS

EXAMINATION OF SKIN AND NAIL



NECROBIOSIS LIPOIDICA DIABETICORUM (OVER SHIN)



GRANULOMA ANNULARE (OVER ELBOW)



ACANTHOSIS NIGRICANS (OVER AXILLA)



DIABETIC DERMOPATHY (OVER SHIN)



BULLOSIS DIABETICORUM (OVER FEET)



FUNGAL NAIL INFECTIONS (IN THUMB)

EXAMINATION OF INJECTION SITES

AREAS TO BE EXAMINED ARE

- > ANTERIOR ABDOMINAL WALL.
- > UPPER THIGH/BUTTOCKS.
- > UPPER OUTER ARM.

POSSIBLE FINDINGS

- > BRUISING
- > LIPODYSTROPHY
- > LIPOHYPERTROPHY
- > LIPOATROPHY



LIPOHYPERTROPHY



LIPOATROPHY

EXAMINATION OF ABDOMEN

POSSIBLE FINDINGS

- > HEPATOMEGALY(due to NON-ALCOHOLIC FATTY LIVER DISEASE).
- > ABDOMINAL TENDERNESS(in DKA).

EXAMINATION OF LEGS

POSSIBLE FINDINGS

- > CALF AND THIGH MUSCLE WASTING.
- > SENSORY ABNORMALITY.
- > DRY SKIN AND HAIR LOSS.
- > ABSENT/WEAK FEMORAL PULSE.
- > FEMORAL BRUIT.
- > LOSS OF KNEE/ANKLE JERKS.



ELICITATION OF ANKLE JERK

EXAMINATION OF FEET

INSPECTION

- > DEFORMITY LIKE CHARCOT NEUROARTHROPATHY/CLAW TOE.
- > CALLUS.
- > LOSS OF PLANTER ARCH.
- > DIABETIC FOOT ULCER.
- > DISCOLOURISATION OF SKIN(DUE TO ISCHAEMIA).
- > FUNGAL INFECTIONS.



CHARCOT NEUROARTHROPATHY



CLAW TOE



DIABETIC FOOT ULCER

EXAMINATION OF FEET(contd....)

PERIPHERAL PULSE

PALPATED AT

- POSTERIOR TIBIAL ARTERY
- ARTERIA DORSALIS PEDIS

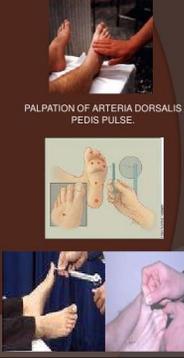
ALSO EXAMINE FOR NAILFOLD REFILLING.

MAY BE ABSENT.

TESTS FOR SENSATION

- LIGHT TOUCH(USING MONOFILAMENT).
- CRUDE TOUCH(USING BLUNT END OF PIN)
- PAIN(USING TIP OF PRICK).
- TEMPERATURE
- VIBRATION(USING 128 Hz TUNING FORK).
- PROPRIOCEPTION

MAY BE ABNORMAL.



Criteria for the Diagnosis of Diabetes

A1C ≥6.5%

OR

Fasting plasma glucose (FPG) ≥126 mg/dL (7.0 mmol/L)

OR

2-h plasma glucose ≥200 mg/dL (11.1 mmol/L) during an OGTT

OR

A random plasma glucose ≥200 mg/dL (11.1 mmol/L)

Prediabetes: IFG, IGT, Increased A1C

Categories of increased risk for diabetes (prediabetes)*

IMPAIRED FASTING GLUCOSE FPG 100–125 mg/dL (5.6–6.9 mmol/L)
IMPAIRED GLUCOSE TOLERANCE 2-h plasma glucose in the 75-g OGTT 140–199 mg/dL (7.8–11.0 mmol/L):
PREDIABETES A1C 5.7–6.4%

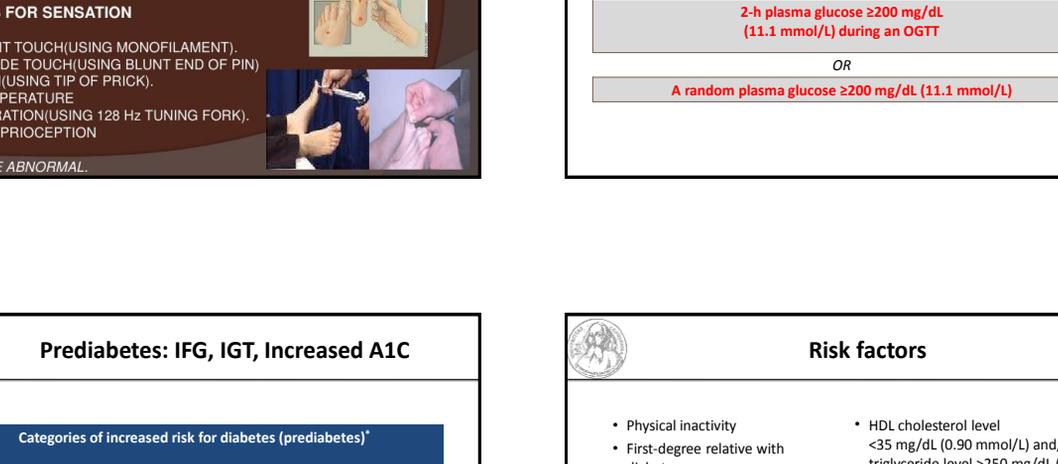
*For all three tests, risk is continuous, extending below the lower limit of a range and becoming disproportionately greater at higher ends of the range.

Risk factors

- Physical inactivity
- First-degree relative with diabetes
- High-risk race/ethnicity (e.g., African American, Latino, Native American, Asian American, Pacific Islander)
- Women who delivered a baby weighing >9 lb or were diagnosed with GDM
- Hypertension (≥140/90 mmHg or on therapy for hypertension)
- HDL cholesterol level <35 mg/dL (0.90 mmol/L) and/or a triglyceride level >250 mg/dL (2.82 mmol/L)
- Women with polycystic ovarian syndrome (PCOS)
- A1C ≥5.7%, IGT, or IFG on previous testing
- Other clinical conditions associated with insulin resistance (e.g., severe obesity, acanthosis nigricans)
- History of CVD

*At-risk BMI may be lower in some ethnic groups.
ADA. Testing for Diabetes in Asymptomatic Patients. Diabetes Care 2014;37(suppl 1):S17; Table 4

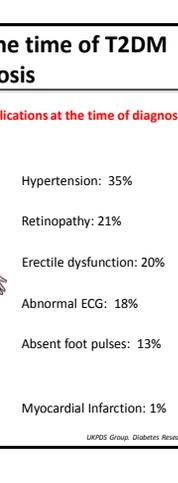
High blood sugar in not painfull but



- Stroke (cerebrovascular disease)
- Heart disease (cardiovascular disease)
- Bacterial and fungal infections of the skin
- Severe hardening of the arteries (atherosclerosis)
- Sexual dysfunction
- Poor blood supply to lower limbs (peripheral vascular disease)
- Necrobiosis lipoidica
- Gangrene
- Visual impairment: diabetic retinopathy, cataract and glaucoma
- Kidney disease (diabetic nephropathy)
- Autonomic neuropathy (including slow emptying of the stomach and diarrhea)
- Sensory impairment (peripheral neuropathy)
- Ulceration

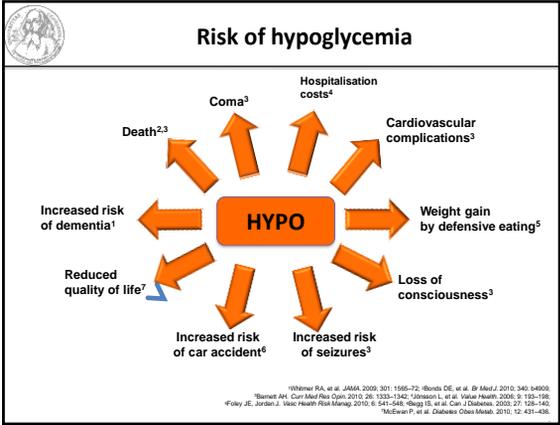
Complications at the time of T2DM diagnosis

50% patients have 1 or more diabetic complications at the time of diagnosis



- Ischaemic skin changes to feet: 6%
- Intermittent claudication: 3%
- Plasma creatinine >120µmol/l: 3%
- Stroke or TIA: 1%
- Hypertension: 35%
- Retinopathy: 21%
- Erectile dysfunction: 20%
- Abnormal ECG: 18%
- Absent foot pulses: 13%
- Myocardial infarction: 1%

UKPDS Group. Diabetes Research 1990;13:1-11.



Hypoglycaemia

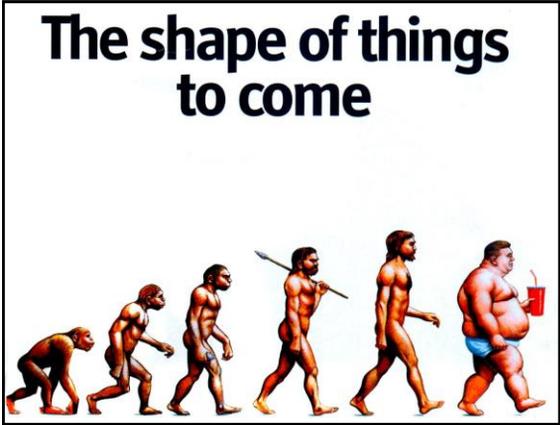
Low Blood Sugar Symptoms

SHAKING SWEATING ANXIOUS DIZZINESS HUNGER
 FAST HEARDBEAT IMPAIRED VISION WEAKNESS FATIGUE HEADACHE IRRITABLE

HYPO

Early adrenergic symptoms	Neuroglycopenic signs
Pallor	Confusion
Diaphoresis	Slurred speech
Shakiness	Irrational or uncontrolled behavior
Hunger	Disorientation
Anxiety	Loss of consciousness
Irritability	Seizures
Headache	Pupillary sluggishness
Dizziness	Decreased response to noxious stimuli

METABOLIC SYNDROME

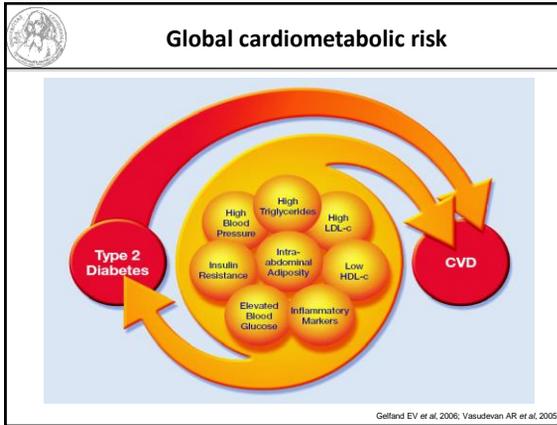


Definition

Constellation of metabolic abnormalities that confer increased risk of cardiovascular disease(CVD) and diabetes mellitus.

Alternative names:

- Metabolic syndrome
- Syndrome X
- Insulin resistance syndrome
- Deadly quartet
- Reaven's syndrome



- ### Features of metabolic syndrome
- The major features of metabolic syndrome include
- Central obesity
 - Hypertriglyceridemia
 - Low high density lipoprotein (HDL)
 - Hyperglycemia
 - Hypertension

- ### Epidemiology
- Prevalence increases with
 - Age
 - greater industrialization and urbanization
 - Increase in waist circumference is found predominantly **in women**.
 - Fasting TG>150 mg/dl and hypertension more likely in men.

- ### Risk factors
- **Overweight/ obesity** – central type (**key feature**)
 - **Sedentary lifestyle**
 - ✓ Predictor of Cvd events and associated mortality
 - ✓ Associated with central obesity, ↑ TG's, ↓ HDL, ↑ BP, ↑ glucose intolerance
 - **Aging** – prevalence increases with age
 - **Diabetes mellitus** – approx. 75% of T2DM or IGT have metabolic syndrome
 - **Coronary heart disease** – 50% of CHD patients have metabolic syndrome
 - **About 1/3rd of MS patients have premature CAD**
 - **Lipodystrophy** – both genetic or acquired have severe insulin resistance

- ### Clinical features
- Usually **asymptomatic** and a high index of suspicion is needed for diagnosis
 - **Examination**
 - ✓ Increased waist circumference
 - ✓ Increased Blood Pressure
 - ✓ Lipotrophy
 - ✓ Acanthosis nigricans / skin tags
- Should alert to search for other abnormalities

- ### Obesity
- Definition: excessive weight that may impair health
 - How do we measure If someone is obese?
 - Body Mass Index (BMI) = $\frac{kg}{m^2}$
 - BMI is calculated from your height and weight.
- | BMI | |
|----------------|-----------------|
| 18.5–24.9 | Normal weight |
| 25.0–29.9 | Overweight |
| 30.0–39.9 | Obese |
| 40.0 and above | Extreme obesity |

Cardiometabolic Risk

How to Measure Waist Circumference

- Locate upper hip bone and top of right iliac crest
- Place measuring tape in horizontal plane around abdomen at iliac crest
- Ensure tape is snug, but does not compress the skin
- Tape should be parallel to floor
- Record measurement at the end of a normal expiration

NIH, NHLBI, NHLBI Obesity Education Initiative, NAAO. NIH Publication Number 00-4084, October 2000. Kralia, et al. Nutrition, 2009;21:969-976.

Disease Risk* Relative to Normal Weight and Waist Circumference

	BMI (kg/m ²)	Obesity Class	Men 102cm (40 in) or less Women 88cm (35 in) or less	Men > 102cm (40 in) Women > 88cm (35 in)
Underweight	< 18.5			
Normal weight	18.5 - 24.9			
Overweight	25.0 - 29.9		Increased	High
Obesity	30.0 - 34.9	I	High	Very High
Obesity	35.0 - 39.9	II	Very High	Very High
Extreme Obesity	40.0 +	III	Extremely High	Extremely High

Cause of Obesity

- Simple equation...when you eat more than you use..it is stored in your body as "fat".
- Causes
 - Global shift in how we eat
 - Western diet of processed food
 - Higher sugar, fat and calories in what we eat
 - Less nutrients
 - Reduced intake of vitamins and minerals

What Are the Signs and Symptoms

- Weight gain usually **happens over time**. Most people know when they've gained weight. Some of the signs of overweight or obesity include:
 - Clothes feeling tight and needing a larger size.
 - The scale showing that you've gained weight.
 - Having extra fat around the waist.
 - A higher than normal body mass index and waist circumference.

How is body fat measured?

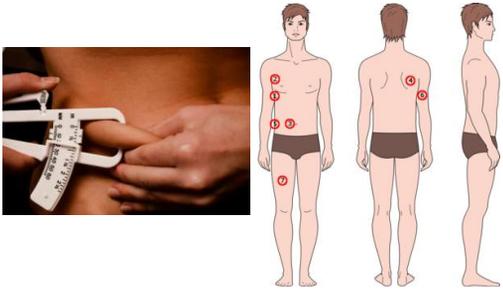
- BMI
- Waist circumference
- Underwater weighing (hydrostatic weighing):
- BOD POD
- Dual-energy X-ray absorptiometry (DEXA)
- Skin calipers
- Bioelectric impedance analysis (BIA)

BOD POD

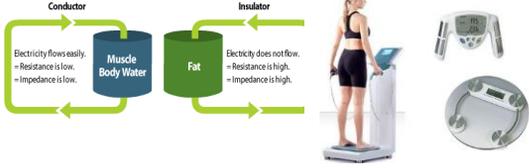


The BOD POD is a computerized, egg-shaped chamber. Using the same whole-body measurement principle as **hydrostatic weighing**, the BOD POD **measures a subject's mass and volume, from which their whole-body density is determined.** Using this data, body fat and lean muscle mass can then be calculated.

Skin calipers



Bioelectric impedance analysis (BIA)



Conductor: Electricity flows easily. Resistance is low. Impedance is low.

Insulator: Electricity does not flow. Resistance is high. Impedance is high.

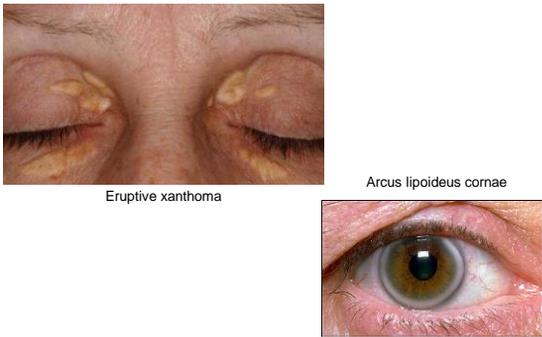
Set-up shown is typical of ImpediMed devices intended for estimation of whole body composition

Diagnostic criteria 2009
(IDF 2004-2006, AHA/NHLBI 2004, Consensus IDF-AHA 2009)

3 from 5 risk factors

- **Diabetes or IGT**
 - Fasting plasma glucose ≥ 100 mg/dl or specific medication
- **Obesity**
 - Higher risk: waist circumference ≥ 94 cm in males ≥ 80 cm in females
 - High risk: waist circumference ≥ 102 cm in males ≥ 88 cm in females
- **Dyslipidemia**
 - Hypertriglyceridemia: ≥ 150 TG's or specific medication
 - Low HDL cholesterol: $<40(M)$ and $<50(F)$ or specific medication
- **Hypertension**
 - Systolic blood pressure ≥ 130 mm or diastolic BP ≥ 85 mm, or specific medication
- **Other risk factors**
 - Inflammation
 - Disorders of the hemostasis

Hyperlipidemia



Eruptive xanthoma

Arcus lipoideus cornae

Obesity and health problems

Obesity can cause day-to-day health problems such as:

- breathlessness
- increased sweating
- snoring
- inability to cope with sudden physical activity
- feeling very tired every day
- back and joint pains
- low confidence and self esteem
- feeling isolated

