Measurement of metabolic syndrome and cardiovascular diseases (CVDs)

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science and policy for a healthy future

Introduction to metabolic syndrome

- One of the major causes of morbidity in Europe

- Prevalence around 25% in Europe

- Increases the risks of cardiovascular diseases (CVD) and type 2 diabetes (T2DM)

- Associations seen for metabolic syndrome or its components with
  - bisphenols, phthalates, PAHs, PFAS, pesticides, cadmium, arsenic, mercury and lead

Many definitions available

For HBM studies, there is no common agreement on which metabolic syndrome definition to use
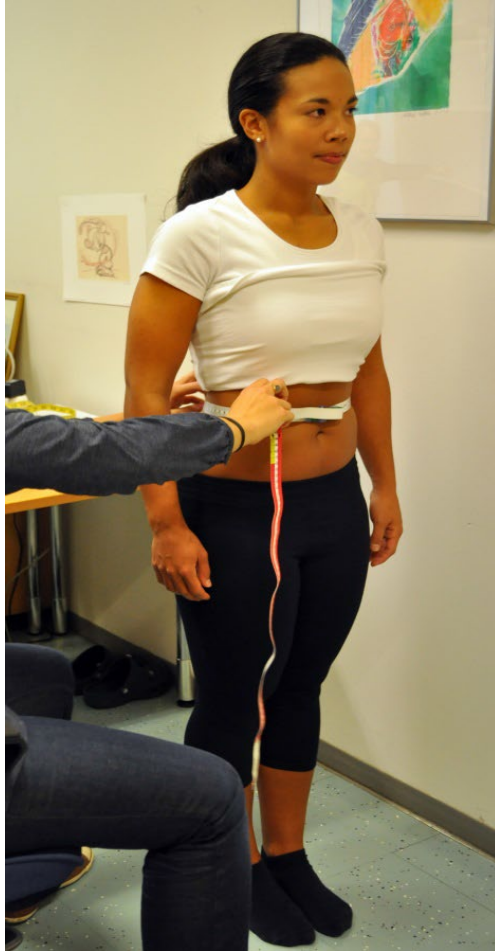
The most used definitions by:

- World Health Organisation (WHO) (1998)

- European Group for Study of Insulin Resistance (EGIR) (1999)

- American Association of Clinical Endocrinologists' (AACE) (2003)

- National Cholesterol Education Program Adult Treatment Panel III's (NCEP-ATP III) (2004)

- American Heart Association and National Heart Lung and Blood Institute (AHAA/NHLBI) (2004)

- International Diabetes Federation (IDF) (2005)

- Joint Interim Statement of the International Diabetes Federation Task Force (2009) (JIS)

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- The latest definition harmonizing the previous criteria, thus presented here

- At least 3/5 of the criteria are needed for diagnosis
  - Waist circumference
  - Triglycerides (TG)
  - High-density lipoprotein cholesterol (HDL-C)
  - Blood pressure
  - Glucose

Waist circumference

Cut-off values

- Population- and country specific definitions
- Cut-off values for European populations:
  - ✓Male: ≥ 94 cm
  - ✓Female: ≥ 80 cm

Measurement protocol

- The participant stands with his/her weight evenly balanced on both legs, hands hanging loosely by the side

- The measurement place is midway between the lower rib margin and the iliac crest

- Measurement is taken at the end of a light exhalation during normal breathing

- Available in European Health Examination Survey (EHES) Manual, Part B
  http://www.ehes.info/manuals.htm

Lipid metabolism

Blood samples needed

- Triglycerides:
  - ✓ ≥ 150 mg/dl (1.7 mmol/l)
  - ✓ or receiving medication for elevated triglycerides
- HDL-C:
  - ✓ Male: < 40 mg/dl (1.0 mmol/l)
  - ✓ Female: < 50 mg/dl (1.3 mmol/l)
  - ✓ or receiving medication for reduced HDL-C

Blood pressure

Cut-off values (in JIS definition)

- Systolic blood pressure ≥ 130 or

- Diastolic blood pressure ≥ 85 or

- receiving antihypertensive medication

Measurement protocol

- Back supported
- Cuff at heart level
- Arm supported
- Feet not crossed
- Feet firmly on the floor
- Right arm used for measurement
- No talking during the measurement

- Available in http://www.ehes.info/manuals.htm in Part B, specific protocols both for mercury sphygmomanometer and automated blood pressure monitoring device

Blood glucose, cut-off values

- fasting plasma glucose ≥ 100 mg/dl (5.6 mmol/l), or
- receiving medication for elevated glucose

Glucose analysed from **fasting** blood samples

Following standardized protocols is crucial!

- Blood pressure measurement
  - Back/feet unsupported during measurement

  → increases systolic blood pressure 5-10 mmHg and diastolic blood pressure 6 mmHg

  - Talking during measurement

  → increases systolic blood pressure 10-15 mmHg and diastolic blood pressure 6-10 mmHg

- Blood samples
  - Fasting, equipment, sample draw, centrifugation, transfer into freezer…

Metabolic syndrome in HBM studies

Objective measurements of the metabolic syndrome components are needed

- Questionnaire data does not provide sufficient information

- Register data seldomly provides reliable information
    - Should include measured data on the components
    - ICD-10 code E88.81 but metabolic syndrome diagnosis is largely under-recorded in registers

Introduction to cardiovascular disease (CVD)

- The leading cause of disease burden in the world
  - accounts for 45% of all deaths in Europe

- Focus on three cardiovascular conditions
  - Hypertension
  - Coronary heart disease (CHD)
  - Stroke

- Associations seen for total CVD, hypertension, CHD or stroke with
  - arsenic, bisphenols, cadmium, flame retardants, lead, mercury, pesticides, PAHs, PFAS and phthalates

Hypertension

= elevated blood pressure

- Blood pressure measurement is essential
  - protocol presented shortly previously

- Cut-offs for hypertension:
  - systolic blood pressure ≥140 mmHg, and/or
  - diastolic blood pressure ≥90 mmHg
  - Use of antihypertensive medication preferably included in the definition

Questionnaire data

- Self-reported information collected with questionnaires
  - use of antihypertensive medication
    - Needed as a part of the hypertension criteria
  - general questions on elevated blood pressure
    - Useful especially if blood pressure measurement cannot be included in the survey

- Standardized questions are available in HBM4EU, European Health Interview Survey (EHIS) and European Health Examination Survey (EHES) questionnaires

Register data

ICD-10 codes for hypertension:
- I10-I16

Coronary heart disease (CHD)

Clinical examinations

- Coronary angiography
- Computed tomography (CT) coronary angiography
- Carotid ultrasound
  - Carotid Doppler ultrasonography protocol available in HBM4EU Deliverable 11.4 https://www.hbm4eu.eu/deliverables/
- Electrocardiogram (ECG)
  - ECG has been used in survey settings
  - Protocol for ECG measurement can be found in HBM4EU Deliverable 11.3 https://www.hbm4eu.eu/deliverables/

These methods are often not feasible in HBM study settings

Questionnaire and register data

Questionnaire and register data are important data sources in identifying CHD among survey participants

- Standardized questions are available in HBM4EU, EHIS and EHES questionnaires
- ICD-10 codes for CHD:
  - I20-I25

Stroke

Three major types:
- ischemic stroke
- hemorrhagic stroke and
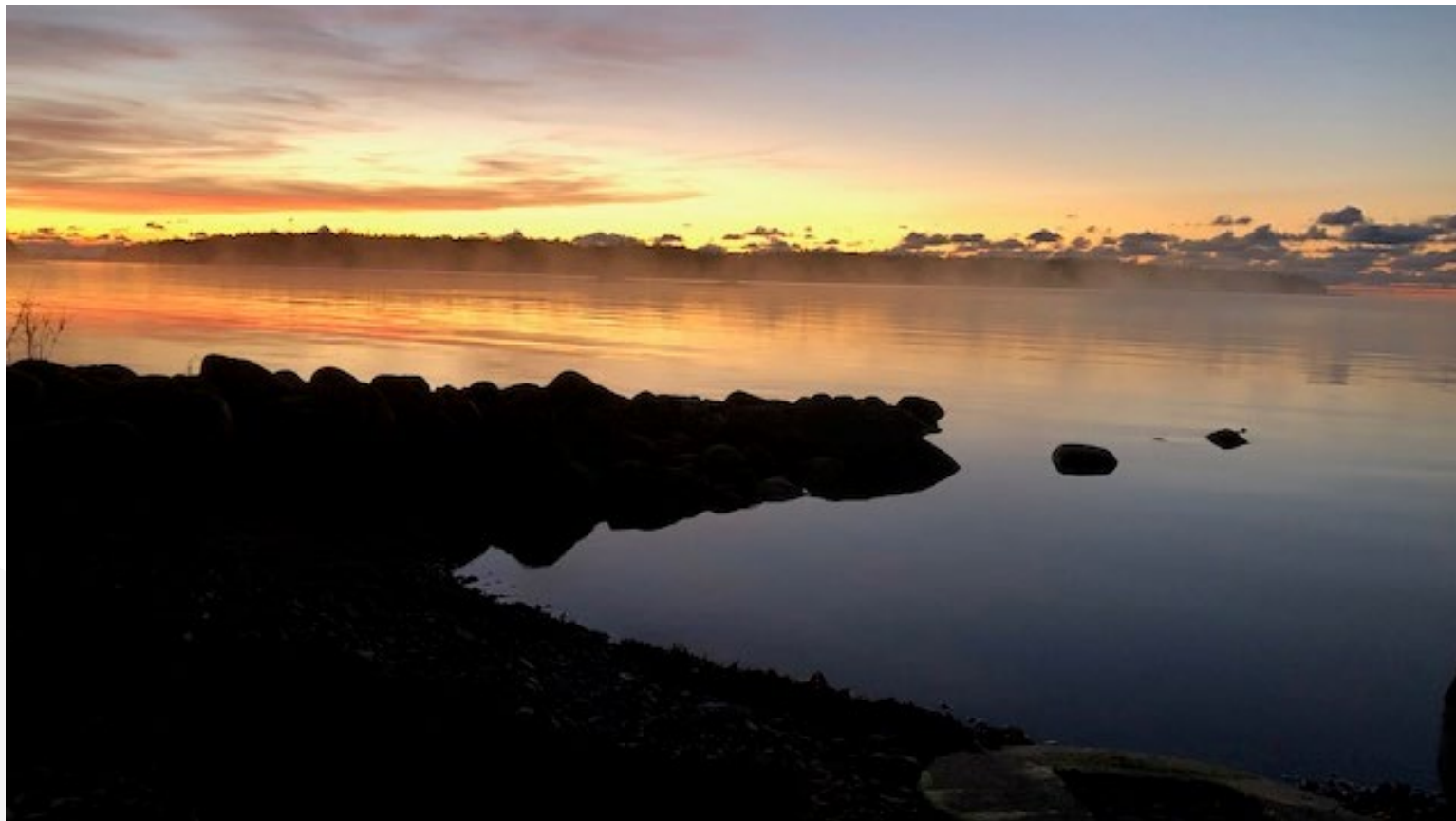- transient ischemic attack (TIA)

Stroke an acute event
→ clinically used examinations not feasible

Questionnaire and register data

Questionnaire and register data are important data sources in identifying previously diagnosed stroke events

- Standardized questions are available in HBM4EU, EHIS and EHES questionnaires
- ICD-10 codes for stroke:
  - I60–I69

Thank you!

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