

BMSH4302

Introduction to Chronic Disease

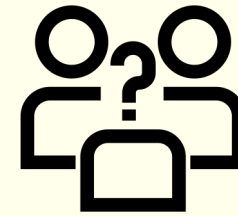
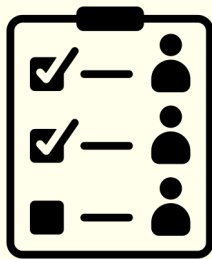
Level 4



www.uwtsd.ac.uk

BMSH4302 Introduction to Chronic Disease

Housekeeping:



Today's Session

By the end of this lecture, you will be able to:

- Describe the aetiology and pathology of the most common Cardiovascular (CVD) conditions
- Identify the key signs and symptoms of each condition
- Explain the common comorbidities associated with CVD
- Identify biological, lifestyle, and environmental risk factors

Week 1 Recap

Q1: According to WHO, health is complete physical, mental and _____ well-being?

✓ **Social**

Q2: What does 'prevalence' mean?

✓ **How many people have it NOW**

Q3: What does 'incidence' mean?

✓ **How many NEW cases develop**

Q4: High blood pressure is a sign or symptom?

✓ **Sign (measured)**

Week 1 Recap

Q5: What does 'aetiology' mean?

✓ **What causes a disease**

Q6: Which 'Big Four' NCD causes most deaths?

✓ **Cardiovascular disease**

Q7 Chronic diseases are typically...

✓ **Managed, not cured**

Q8: What is 'comorbidity'?

✓ **Multiple conditions at once**

Cardiovascular Disease (CVD)

What does Cardiovascular mean?

- **CARDIO** = Heart (from Greek 'kardia')
- **VASCULAR** = Blood vessels (from Latin 'vasculum' = small vessel)

CARDIOVASCULAR = The heart and blood vessels working together

Also referred to as the circulatory system

The Cardiovascular System: What Does It Do?

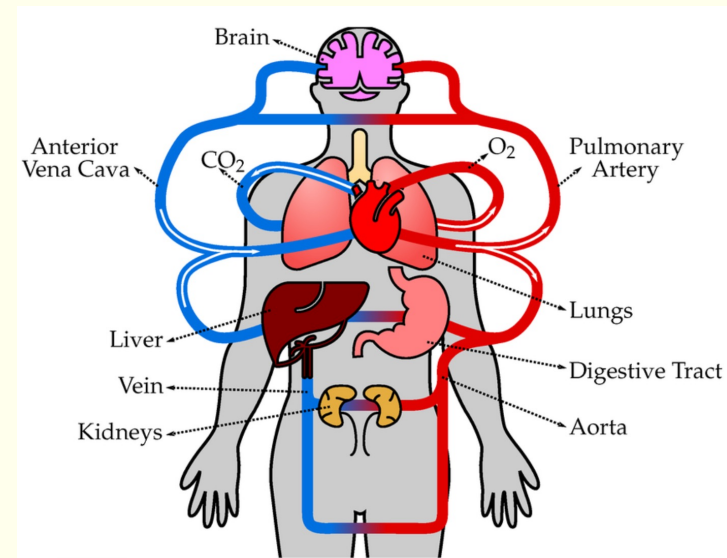
The heart is a pump (about the size of your fist)

Blood vessels are the pipes:

- **ARTERIES** carry blood AWAY from the heart (to deliver oxygen)
- **VEINS** carry blood back TO the heart
- The heart pumps ~5 litres of blood per minute at rest

The heart itself needs blood supply too

→ The **CORONARY ARTERIES** supply the heart muscle



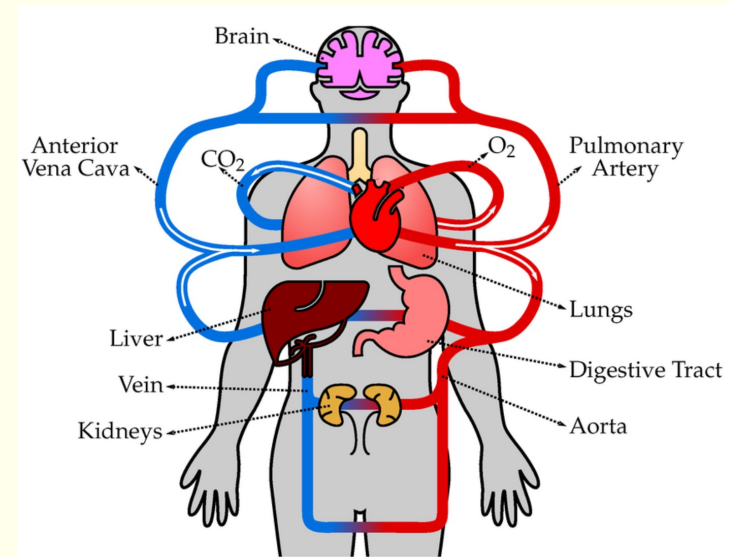
Source: Syed, Faiz & Khan, Sahar & Toma, Milan. (2023). Modeling Dynamics of the Cardiovascular System Using Fluid-Structure Interaction Methods. Biology. 12. 1026. 10.3390/biology12071026.

The Cardiovascular System: What Does It Do?

Continuously delivers:

- Oxygen
- Nutrients
- Hormones

to cells while removing waste products like carbon dioxide



Source: Syed, Faiz & Khan, Sahar & Toma, Milan. (2023). Modeling Dynamics of the Cardiovascular System Using Fluid-Structure Interaction Methods. Biology. 12. 1026. 10.3390/biology12071026.

What is Cardiovascular Disease (CVD)?

An umbrella term for diseases affecting:

- The heart
- The blood vessels
- Or both

Today's four conditions:

- Coronary Heart Disease (CHD): arteries supplying the heart
- Heart Failure: the heart as a pump
- Hypertension: pressure in blood vessels
- Stroke: blood supply to the brain

Other Cardiovascular Diseases

Other vascular diseases (not covered today):

Peripheral Artery Disease (PAD)

- Reduced blood flow to the legs
- Pain when walking, poor wound healing

Aortic Disease

- Weakening/bulging of the main artery (aneurysm)

Venous Disease

- Blood clots in veins (deep vein thrombosis/DVT)

Valvular Heart Disease

- Heart valves don't open or close properly

Vascular Dementia

- Reduced blood flow to the brain over time
- Causes problems with thinking, memory, reasoning

CVD in Numbers: Why This Matters

The Scale of the Problem

Globally:

#1 cause of death worldwide
17.9 million deaths per year

The good news: up to 80% is preventable

In Wales:

CVD causes ~9,700 deaths per year
(average of 27 per day)

→ Leading cause of death

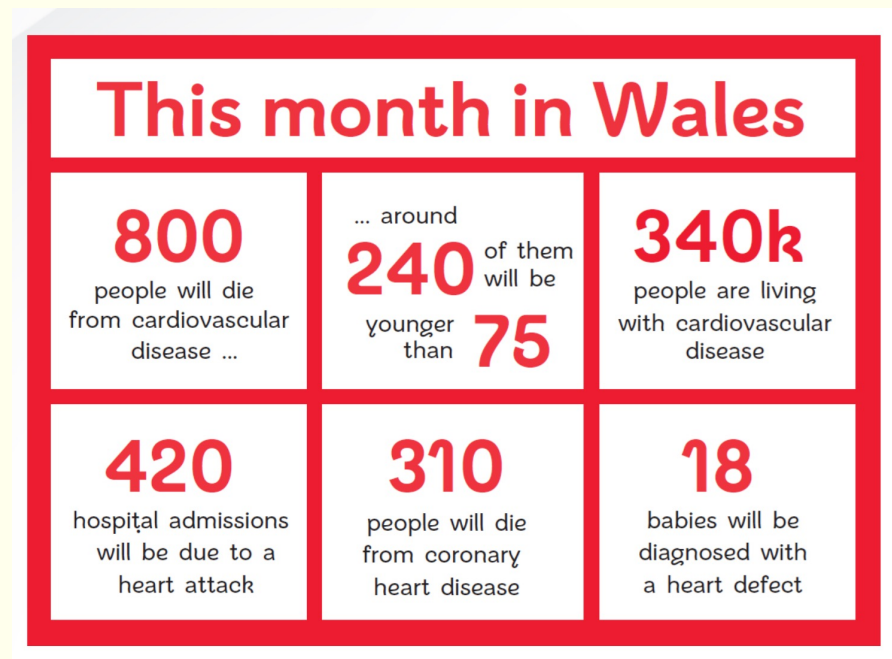
~27% of all deaths (more than 1 in 4)

CVD in Numbers: Why This Matters

August 2025 snapshot:

9.38% of the population living with Cardiovascular disease

Almost 1 in 10



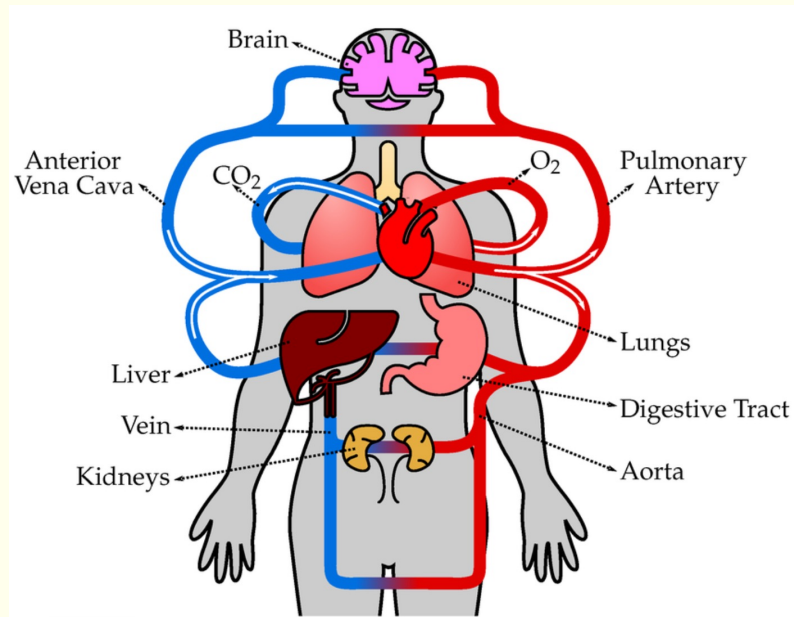
CVD in Numbers: Why This Matters

- Total NHS expenditure on cardiovascular disease (CVD) in Wales each year is estimated at up to £770 million.
- CVD's overall cost to the Welsh economy (including premature death, long-term care, disability and informal costs) is estimated to be £1.7 billion each year.

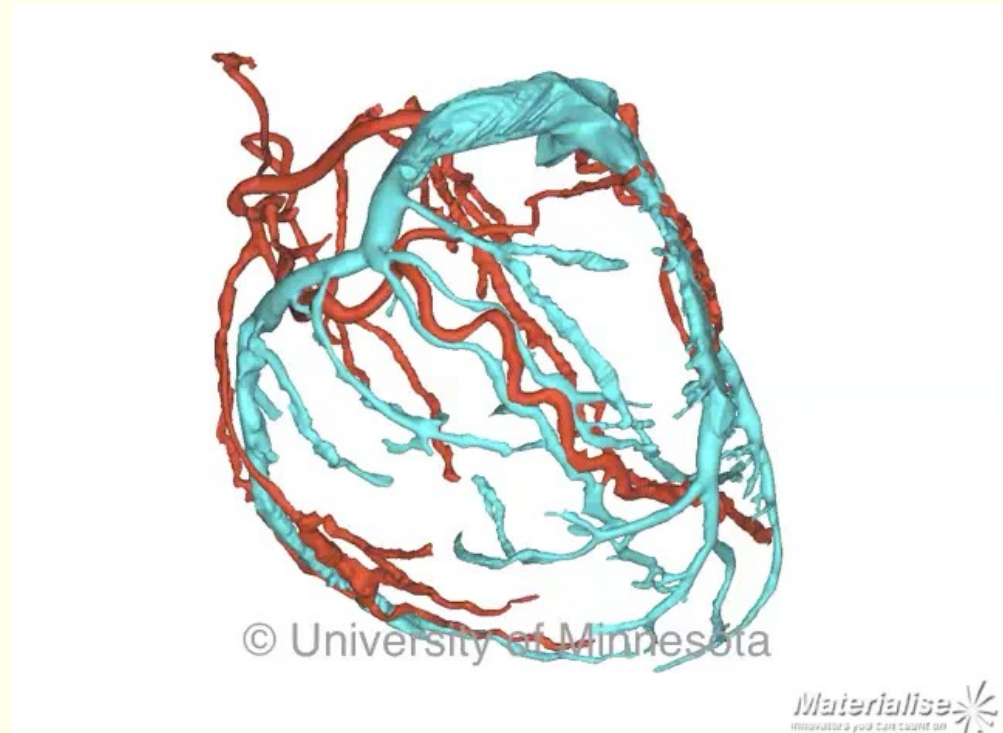
Coronary Heart Disease (CHD)

aka Ischaemic Heart Disease/Coronary Artery Disease (CAD)





Source: Syed, Faiz & Khan, Sahar & Toma, Milan. (2023). Modeling Dynamics of the Cardiovascular System Using Fluid-Structure Interaction Methods. *Biology*. 12. 1026. 10.3390/biology12071026.



CHD Prevalence: how common is it?

Coronary Heart Disease: The Scale

UK: ~2.3 million people living with CHD

Wales: ~170,000 people

- About 5.5% of the population (1 in 18 people)
- Leading cause of death in Wales

Trends:

- Fewer people developing CHD (better prevention)
- Similar numbers living with it (better survival)

Cholesterol and why it matters to CHD

Cholesterol is a fatty substance that circulates in the bloodstream

The body NEEDS it (cell membranes, hormones, vitamin D)

Most is made by the LIVER, some comes from food

It can't travel alone in blood → carried by proteins = **LIPOPROTEINS**

Think of it as a delivery and collection service:

LDL = delivery van (drops off)

HDL = recycling truck (picks up)

Types of cholesterol

LDL (Low-Density Lipoprotein)

- Carries cholesterol FROM liver TO tissues
- Can deposit in artery walls

HDL (High-Density Lipoprotein)

- Carries cholesterol AWAY from tissues → BACK to liver
- Protective effect

CHD Aetiology: why does it happen?

(Part 1 - Atherosclerosis)

The process:

1. **LDL** cholesterol in your blood enters the artery wall
2. **LDL** becomes damaged inside the wall → triggers inflammation
3. Material builds up over years → forms a '**plaque**'
4. **Plaque** grows → narrows the artery → less blood can flow through

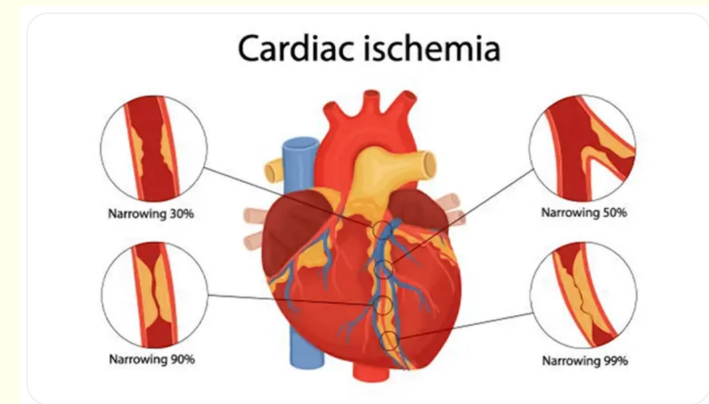
HDL cholesterol does the opposite and carries cholesterol AWAY from tissues back to the liver

CHD Pathology: how it progresses

From Plaque to Symptoms

Stable plaque:

- Artery narrowed but plaque surface intact
- Less blood flows through during exertion
- Causes **ANGINA** (chest pain with activity)

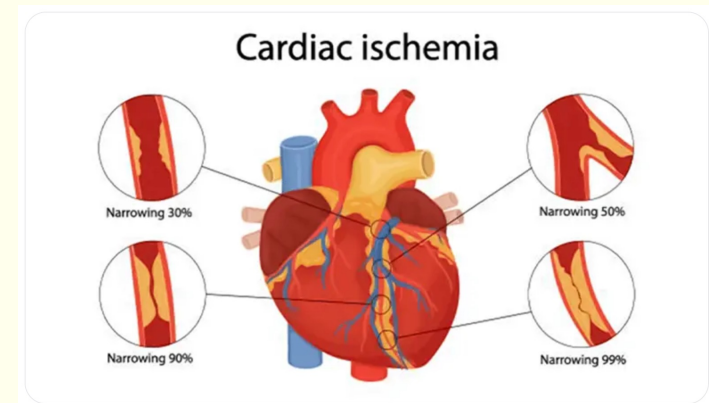


CHD Pathology: how it progresses

Unstable plaque:

- Plaque surface ruptures
- Blood clot forms at the rupture site
- Artery blocked completely
- Causes **Myocardial Infarction** (heart attack)

This is why 'sudden' heart attacks happen in people who seemed healthy



CHD: Signs and Symptoms

How would you recognise it?

ANGINA:

- Can be triggered by exertion, stress, cold weather or eating a big meal
- Central chest pain, pressure, or tightness
- Women's symptoms may include feeling sick, sweaty, dizzy and breathless
- May spread to the arm, jaw, neck, or back
- Relieved by rest (usually within minutes)

CHD: Signs and Symptoms

How would you recognise it?

HEART ATTACK:

- Similar but **MORE SEVERE**
- Lasts longer (>15 minutes)
- NOT relieved by rest
- Often with sweating, nausea, breathlessness

⚠ BUT: Not everyone gets classic symptoms

CHD: Timeline of a heart attack

When a coronary artery is blocked:

0-20 minutes:

- Heart muscle starts to be starved of oxygen (ischaemia)
- Cells are stressed but still alive
- Damage is REVERSIBLE at this stage

CHD: Timeline of a heart attack

When a coronary artery is blocked:

20-60 minutes:

- Cells begin to die (necrosis)
- Damage becomes IRREVERSIBLE
- The longer the blockage, the more muscle dies

CHD: Timeline of a heart attack

When a coronary artery is blocked:

Days to weeks :

- Dead muscle is replaced by SCAR TISSUE
- Scar tissue cannot contract like healthy muscle
- Heart's pumping ability is permanently reduced

‘Time is muscle’, fast treatment saves heart tissue

CHD: Atypical Presentations

⚠ Not Everyone Gets Classic Symptoms

WOMEN often have:

- Fatigue, weakness
- Breathlessness
- Nausea, 'indigestion'
- Back or jaw pain (not chest)

OLDER PEOPLE and **DIABETICS**

may have:

- Minimal or no chest pain ('silent' heart attack)
- Confusion
- Just 'feeling unwell'

This knowledge saves lives. If in doubt → call 999

CHD: Risk Factors

Non-modifiable Risk Factors

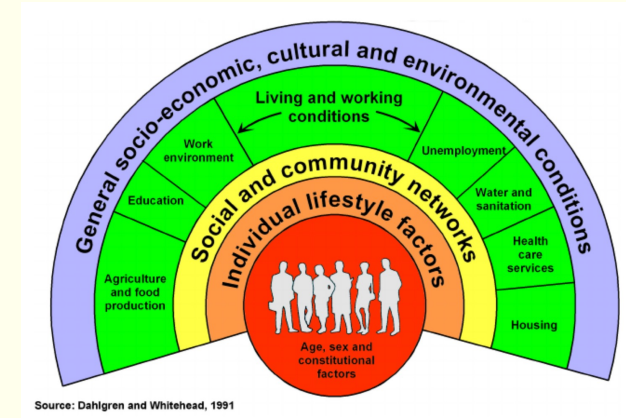
Age

Sex

- Men: develop CHD earlier on average
- Women: risk rises significantly after menopause due to the loss of oestrogen's protective effect
- CHD is a leading cause of death in women but is often under-recognised

Family history

Ethnicity



CHD: Risk Factors

Modifiable Risk Factors

SMOKING (strongest)

High cholesterol

High blood pressure

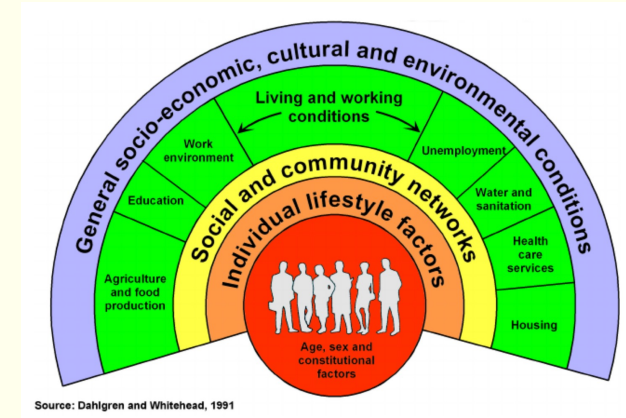
Diabetes (Type 2)

Obesity

Inactivity

Poor diet

Excess alcohol



CHD: Comorbidities

Common Comorbidities

Hypertension

Diabetes

High cholesterol

Stroke

Peripheral artery disease

Heart failure

Depression/anxiety

CHD: Quality of Life

Quality of Life Impact

- Activity limitations, multiple daily medications
- Anxiety about future events
- Impact on work, relationships, sexual function

Quiz

Q1 What is 'atherosclerosis'?

✓ **Build-up of fatty deposits in artery walls**

Q2: Which type of cholesterol deposits in artery walls?

✓ **LDL**

Q3: What is the main difference between angina and heart attack?

✓ **Heart attack is more severe and not relieved by rest**

Q4: Which group might NOT have typical chest pain in a heart attack?

✓ **Women, elderly, diabetics**

Q5: What is the strongest MODIFIABLE risk factor for CHD?

✓ **Smoking**

Heart Failure

Heart Failure Prevalence: how common is it?

Heart Failure: The Scale

UK: ~920,000 people living with heart failure

Wales: ~50,000 people

Prognosis:

~50% die within 5 years

Worse than many cancers

Heart failure does NOT mean the heart has stopped, it means the heart isn't pumping as well as it should

Heart Failure Aetiology: why does it happen?

The Heart Can't Pump Effectively

Either:

- Heart muscle too WEAK to pump properly
- Heart muscle too STIFF to fill properly

Heart Failure Aetiology: why does it happen?

Main causes:

Damage from heart attack (most common) - muscle replaced by scar

Long-term high blood pressure - heart overworked for years

Disease of the heart muscle itself

Faulty heart valves

Abnormal heart rhythms

Toxic substances (alcohol, some chemotherapy drugs)

→CHD and hypertension **can LEAD TO** heart failure

Heart Failure Pathology: The Vicious Cycle

When the heart can't pump enough blood:

1. COMPENSATION → the body tries to help

- Heart beats faster
- Heart muscle thickens (works harder)
- Blood vessels constrict to maintain pressure
- Kidneys retain fluid to increase blood volume

Heart Failure Pathology: The Vicious Cycle

2. These help SHORT-TERM but cause problems LONG-TERM:

- Faster heart rate = heart works even harder
- Thicker muscle = stiffer, harder to fill
- Fluid retention = congestion in lungs and tissues

3. THE VICIOUS CYCLE:

- Weak heart → compensation → extra strain → weaker heart

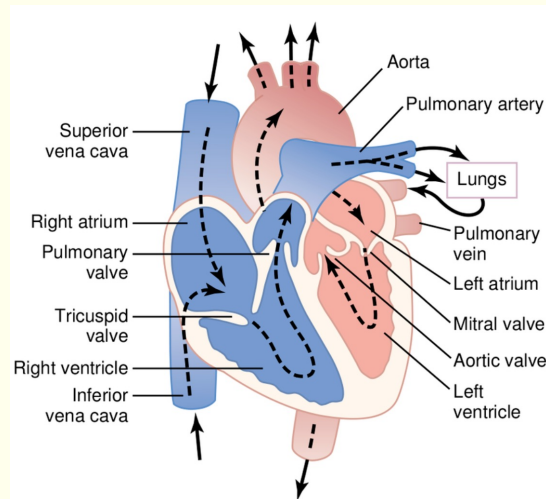
This is why heart failure is PROGRESSIVE without treatment

Heart Failure: Signs and Symptoms

How you recognise it depends on which side it falls

LEFT side failing (blood backs up into LUNGS):

- Breathlessness - first with activity, then at rest
- Breathlessness when lying flat (need extra pillows)
- Waking at night gasping for breath
- Tiredness



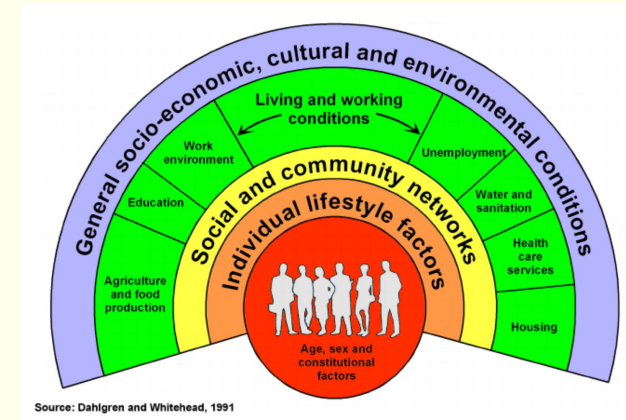
1: Structure of the heart. Blood flow through the chambers and heart valves. Figure extracted from Guyton & Hall "Textbook of Medical Physiology" (Saunders, 2000).

RIGHT side failing (blood backs up in BODY):

- Swollen ankles and legs
- Swollen abdomen
- Feeling full quickly
- Often both sides are affected

Heart Failure: Risk Factors

- Previous heart attack
- Long-term high blood pressure
- Diabetes
- Obesity
- Heart valve problems
- Toxic substances (alcohol, some chemotherapy)



Heart Failure: Common Comorbidities

- CHD
- Irregular heart rhythm (atrial fibrillation)
- Chronic kidney disease
- Diabetes
- COPD
- Anaemia
- Depression

Heart Failure: Quality of Life

- NYHA Classification: I (no limits) to IV (symptoms at rest)
- Classification is based upon physical ability to do things and severity of symptoms
- Frequent hospital admissions
- Multiple medications,
- Dietary modifications to restrict fluid and salt
- May need devices (pacemakers, defibrillators)

Quiz

Q1: What does 'heart failure' mean?

✓ Heart not pumping effectively

Q2: What is the MOST COMMON cause of heart failure?

✓ Damage from heart attack

Q3: If the LEFT side of the heart fails, which symptom is most likely?

✓ Breathlessness

Q4: If the RIGHT side fails, which symptom is most likely?

✓ Swollen ankles/legs | Breathlessness | Chest pain | Dizziness

Q5: What does 'NYHA Class IV' mean?

✓ Symptoms at rest

Break

Hypertension

Hypertension Prevalence: how common is it?

Hypertension: The Scale

UK: ~14.4 million people (28% of adults)

Wales: ~500,000 diagnosed

~5 million across UK don't know they have it

'The Silent Killer'

- Most people feel completely fine
- No symptoms until damage is done
- Often only found by chance

→ This is why routine blood pressure checks matter

What IS Blood Pressure?

Blood Pressure = the force of blood pushing against artery walls

- Systolic - pressure when the heart BEATS (pumps)
- Diastolic - pressure when the heart RESTS (between beats)
- Normal: around 120/80
- High (Hypertensive): 140/90 or above consistently

Hypertension Aetiology: why does it happen?

Primary (essential) hypertension 90-95% of cases:

No single cause

Combination of factors:

- Genetic (runs in families)
- Ageing (arteries stiffen over time)
- Lifestyle factors

Secondary hypertension 5-10% of cases:

Caused by another condition:

- Kidney disease
- Hormone disorders
- Certain medications

Hypertension Pathology:

How high pressure damages the body

Blood vessels are designed to handle normal pressure

Chronic high pressure causes structural damage:

IN THE ARTERIES:

- Artery walls thicken and stiffen
- Damages the inner lining → easier for LDL to enter
- Accelerates atherosclerosis
- Weakens vessel walls → risk of aneurysm

Hypertension Pathology:

How high pressure damages the body

IN THE HEART:

- Heart must pump against higher resistance
- Left ventricle thickens (works harder)
- Eventually becomes stiff and fails

IN SMALL BLOOD VESSELS:

- Tiny vessels in kidneys, eyes, brain are damaged
- Leads to kidney disease, vision problems, vascular dementia

→ This damage happens silently over YEARS

Hypertension: Signs and Symptoms

How to recognise it

Usually NONE (The Silent Killer)

- Most people have NO symptoms
- Feel completely well
- High blood pressure discovered by chance at health checks

Hypertension: Signs and Symptoms

How to recognise it

Severe hypertension may cause:

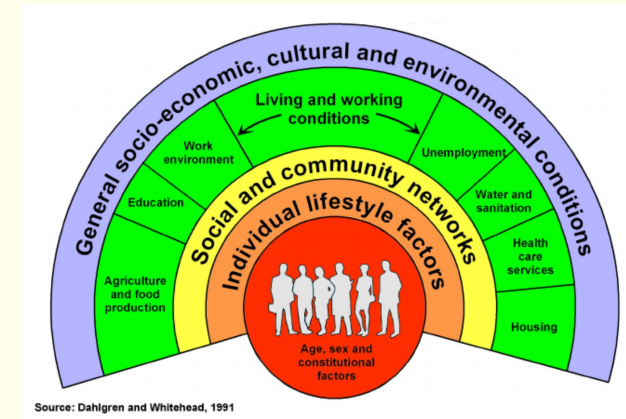
- Headaches (back of head, mornings)
- Vision changes
- Nosebleeds
- Dizziness

By the time symptoms appear, damage is often already caused

Hypertension: Risk Factors

Non-modifiable Risk Factors

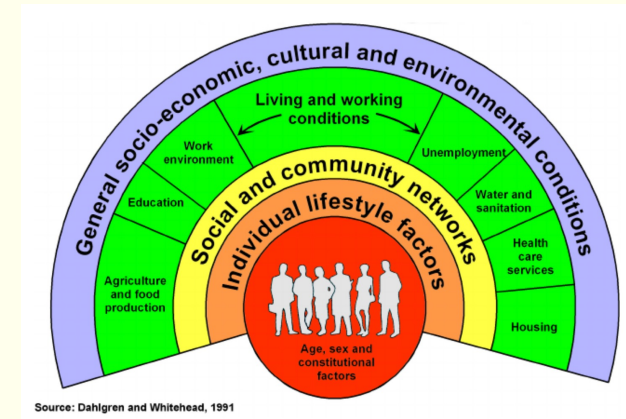
- Age
- Family history
- Ethnicity



Hypertension: Risk Factors

Modifiable Risk Factors

- Smoking
- Diet
- Obesity
- Physical inactivity
- Alcohol consumption
- Stress
- Potassium deficiency



Hypertension: Comorbidities

Why Treatment Matters: “Target Organ Damage” (TOD)

Brain → Stroke, vascular dementia

Eyes → Damage to blood vessels

Heart → CHD, heart failure

Kidneys → Chronic kidney disease

Arteries → Peripheral artery disease

Hypertension: Quality of Life

Quality of Life Paradox:

- Feel fine but have a 'disease'
- Medication side effects may feel worse than the condition
- Lifelong monitoring and treatment

Quiz

Q1: What blood pressure reading defines hypertension?

✓ 140/90

Q2: Why is hypertension called 'the silent killer'?

✓ Usually no symptoms

Q3: Name ONE organ damaged by long-term high blood pressure

✓ Brain/heart/kidneys/eyes

Q4: Which ethnic groups have higher rates of hypertension?

✓ Black African, Caribbean and East Asian

Stroke

Stroke Prevalence: how common is it?

The Scale

UK:

- ~1.3 million stroke survivors
- ~100,000 strokes per year (one every 5 minutes)

Wales:

- ~66,000 stroke survivors
- ~7,400 strokes per year

Impact

- 4th leading cause of death in UK
- LEADING cause of adult disability

Stroke Aetiology: why does it happen?

ISCHAEMIC STROKE (85%):

- Blood clot blocks an artery to the brain
- Clot forms locally in brain's arteries, OR
- Clot travels from elsewhere (often the heart)

Stroke Aetiology: why does it happen?

HAEMORRHAGIC STROKE (15%):

- Blood vessel in the brain bursts
- Blood leaks into brain tissue
- Often linked to high blood pressure

Stroke Aetiology: why does it happen?

TIA ('Mini-stroke'):

- Same cause as ischaemic stroke, but blockage clears quickly
- Symptoms resolve within 24 hours
- MAJOR warning sign - call 999

Stroke Pathology:

What happens to the brain?

Brain cells need CONSTANT oxygen supply

They cannot survive more than a few minutes without it

ISCHAEMIC STROKE (clot blocks artery):

- Core zone: cells die within minutes (cannot be saved)
- Penumbra: surrounding area is 'stunned' but alive
- The penumbra CAN be saved if blood flow is restored quickly

This is why speed matters. It's a race to save the penumbra

Stroke Pathology:

What happens to the brain?

HAEMORRHAGIC STROKE (bleed into brain):

- Blood leaks into brain tissue
- Direct damage from the bleed itself
- Pressure builds up inside the skull
- Pressure damages surrounding healthy tissue

Different brain areas control different functions

→ Symptoms depend on WHERE the stroke happens

Stroke: Signs and Symptoms

How to recognise it

“FAST” Campaign

F - FACE: Has their face dropped on one side? Can they smile?

A - ARMS: Can they raise both arms and keep them there?

S - SPEECH: Is their speech slurred? Can they repeat a sentence?

T - TIME: Time to call 999 if you see ANY of these

Stroke: Signs and Symptoms

How to recognise it

Other signs:

- Sudden confusion
- Vision problems
- Severe headache
- Loss of balance

Stroke: Signs and Symptoms

How to recognise it

SUDDEN onset

→ Stroke symptoms come on abruptly. The person was fine, then suddenly they were not

Speed matters

→ For ischaemic stroke, there are treatments to dissolve clots but they only work within a few hours.

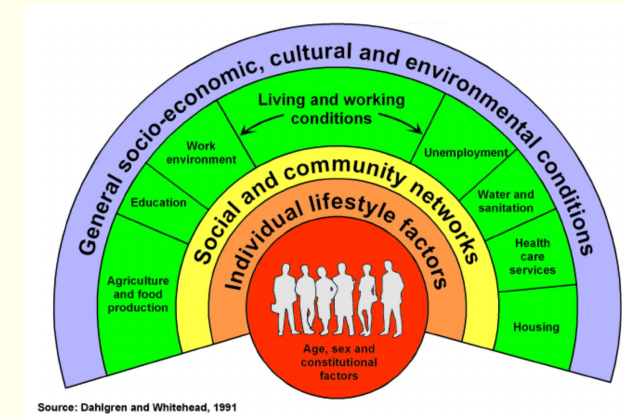
'Time is brain'

→ Every minute of delay, more brain is lost

Stroke: Risk Factors

Non-modifiable

- Age
- previous stroke/TIA
- Family history
- Ethnicity



→ Same risk factors as CHD and heart failure

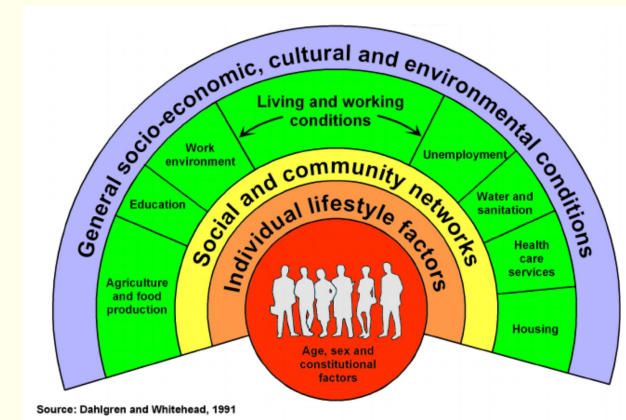
→ Same prevention = multiple benefits

Stroke: Risk Factors

Modifiable:

- HIGH BLOOD PRESSURE (strongest factor)
- Atrial fibrillation (irregular heartbeat)
- Smoking, diabetes, high cholesterol
- Obesity, physical inactivity
- Excess alcohol

→ Same risk factors as CHD and heart failure
→ Same prevention = multiple benefits



Stroke: Comorbidities

Common Comorbidities:

- High blood pressure
- Atrial fibrillation
- CHD
- Diabetes
- Depression (very common after stroke)
- Vascular dementia
- Epilepsy (can develop after stroke)

Stroke: Quality of Life

Quality of Life is highly variable:

Some recover fully

Some have significant long-term disability:

- Weakness/paralysis on one side
- Speech and communication difficulties
- Memory and thinking changes
- Emotional changes
- Loss of independence

Quiz

Q1: What percentage of strokes are caused by blood clots (ischaemic)?

✓ 85%

Q2: What does TIA stand for, and why does it matter?

✓ Transient ischaemic attack - warning sign

Q3: In FAST, what does the 'A' stand for?

✓ Arms

Q4: What is the STRONGEST modifiable risk factor for stroke?

✓ High blood pressure

Q5: Why is 'time' so important in stroke?

✓ Treatments only work within hours; brain dies every minute

CVD Risk Factors

Traditional risk factors



High blood pressure



High cholesterol



Diabetes



Unhealthy diet



Physical inactivity



Obesity



Drinking too much alcohol



Vaping or tobacco use

Women-specific risk factors



Early or late first period



Polycystic ovary syndrome



Pregnancy complications*



Early menopause



Autoimmune diseases**



Depression**



Hormone treatments



Some cancer treatments

*Including high blood pressure in pregnancy, preeclampsia, gestational diabetes.

**These conditions affect women more commonly than men.

Next Week: Pulmonary Disease

Asthma, COPD, and ILD affect over 10 MILLION people across the UK

COPD is the 3rd leading cause of death WORLDWIDE (WHO)

Next week we'll explore why it happens, who's at risk, and what that actually means for real people

Questions?

