

Metabolic Syndrome

- Syndrome
 - Lay definition – “A group of signs and symptoms that occur together and characterise a particular abnormality or condition”
 - Medical definition – “A collection of symptoms and findings without necessarily tying them to a single identifiable pathogenesis”

Metabolic Syndrome

- Metabolic syndrome is a cluster of risk factors for CVD and type 2 diabetes mellitus, which occur together more often than by chance
 - Excess abdominal weight
 - Dyslipidaemia (lipid quantity abnormalities) – high LDL and triglycerides, low HDL
 - Hypertension
 - Elevated glucose levels
- Any 3 of 5 possible criteria are diagnostic of metabolic syndrome
 - Elevated waist circumference
 - Differing values for males and females and different nationalities
 - Elevated triglycerides
 - Triglyceride = glycerol and 3 fatty acids
 - Reduced HDL-C
 - Highest density lipoprotein and smallest in size
 - Contains high proportions of proteins and phospholipids
 - Contains low proportions of free cholesterol, cholesterol esters and triglycerides
 - Elevated blood pressure
 - BP is the measurement of the pressure of blood in the artery
 - Peaks when the heart contracts and pumps blood (systole)
 - Falls when the heart relaxes and refills (diastole)
 - BP over 140/90 mmHg is considered high
 - Elevated fasting blood glucose
 - Normal BGL ~ 5mmol/L

Metabolic Syndrome as a Social and Political Sickness

- Public health measures
 - Incidence – rate at which new cases of a disease occur in a population during a specified period
 - Prevalence – proportion of a population that have the disease at a point in time
 - Appropriate measure only in relatively stable conditions
 - Unsuitable for acute disorders
 - Risk factor – something that increases your chance of getting a disease
 - Could be an act of ours (e.g. smoking) or something beyond our control (e.g. age)
- Some important population health questions we can ask about metabolic syndrome
 - Who has it? What are the characteristics of the people that develop it?
 - Where do they live? Is there something significant about where they live?
 - How widespread is it (prevalence)?
 - Is it something in the environment?
- Obesity trends amongst US adults
 - In 1985, very small proportion of people were classified as overweight and highest proportion noted was 10-14%
 - By 1991, proportion of overweight grew (new highest proportion group 15-19%)
 - By 1997, new highest proportion group emerged ($\geq 20\%$)
 - By 2001, new highest proportion group emerged ($\geq 25\%$)
 - By 2005, new highest proportion group emerged ($\geq 30\%$)
 - By 2010 there was an obesity epidemic
 - Trends
 - White non-Hispanic people were less likely to be overweight, except in Pennsylvania where all the factories and mines were closed (poverty-stricken)
 - Hispanic people were likely to be overweight and black non-Hispanic people were even more likely to be overweight, as these people were generally poorer (slavery past and underfed)
- More adults are obese in more unequal rich countries
 - Japan has the least income inequality and hence the lowest prevalence of obesity

- Greece and USA have the greatest income inequality and subsequently the highest prevalence of obesity
- Obesity is a disease of poverty amongst affluence in developed countries (inequality)
 - The rise in obesity has been faster than the rise in inequality
 - Now obesity is a marker of poverty, whereas before thinness used to be
- Epigenetics and deep history
 - Centuries of marginal diet and famine have existed in the Irish, urban British, most Europeans (except Dutch), Russians, Chinese, south Asia and West Africans, etc.
 - This had a negative impact on the health of subsequent generations (epigenetics)
 - 1890 survey – Irish had higher death rates even 1-2 generations after famine
 - 1920 census – Irish had high rates of organic heart disease 2 generations later
 - However, epigenetics is an insufficient explanation – we must look at the total social and economic environment
 - Whilst obesity has increased, so has income inequality
 - Areas where unions exist protect from income inequality to a certain extent
- Activity levels
 - New evidence suggests that becoming overweight causes people to become inactive, not the other way around
 - People perhaps walk less but the decline in walking happened earlier
- Relation of food history to current obesity epidemic
 - Early 1970s – high food prices and falling farm incomes → Richard Nixon elected
 - Earl Butz brokered free trade deal with Malaysia to export cheap, subsidised corn in return for palm oil
 - US corn growers urged to plant corn → destroyed Mexican corn farmers' exports → illegal immigration to US
 - Sugar can growers (Cuba, Australia) lost market to high-fructose corn syrup (HFCS55)
 - Fast food industry able to cut costs of production of sweet drinks, French fries and popcorn → massive increase in affordability of fast food over real food
- Corn syrup
 - 7 times sweeter than cane sugar → lower prices and bigger portions
 - Protected frozen food against freezer burn
 - Kept long-life products tastier
 - Made baked products cheaper, tastier and seemingly browned in the oven
 - Has resulted in 80% of supermarket products containing HFCS55 or sugar
 - Subsequent explosion of prepared foods, processed foods, frozen meals (cheaper, tastier, easier)
 - Australia uses cane sugar, but sugar is still added for all these other properties
- Fructose
 - Bypasses the usual complex breaking down processes in the body and goes straight to the liver (metabolic shunting)
 - Some argue that it produces insulin resistance quickly
 - A glass of fruit juice isn't good for you → no fibre to break down the sugar and concentrated fructose
 - Fructose in large undiluted quantities is dangerous
- Palm oil
 - Imported in deal on free trade
 - Mid 1970s – palm oil became a viable commercial fat for use in food
 - As dense and saturated as beef lard and more saturated than pig lard
 - Cheap, 'good in the mouth', stable (products don't biodegrade on shelf, last longer)
 - Hence also don't biodegrade in the body
 - Increase BP, cholesterol and body fat
- Economic results
 - Food prices fell dramatically
 - Pre-prepared, cheap, tasty, sweet and fatty food available for consumers
 - In USA animal feed prices fell dramatically → farm animals fed mass produced subsidised corn
 - However, resulted in high calories in the animals as they had not evolved to eat corn → hypergrowth
 - High profits from food → mass industrialised food production highly profitable → factory farming or food lots
 - Food production became automated, centralised and used unregulated labour
- Changes in human diet and human shape
 - Changes to our food in industrialised economies in the last 40 years have been greater than since the rise of agriculture

- Metabolic syndrome epidemic has come from a profound change in the food provided for us by industry combined with sudden affluence in populations genetically selected for scarcity (survived famine)
- Remedies from public health
 - Education and incentives to change population's knowledge base
 - Regulation of the food or beverage found to be dangerous to health
 - Consumer behaviour modification via price: e.g. taxing
 - Regulation of advertising
 - Economic policy to reduce price of fresh food at the expense of fast food

Learning Objectives

- Metabolic syndrome arises from an interaction between biology and the social environment
- But in OECD countries, it is a marker of poverty; in developing countries, it is a condition of the affluent
- The biology is shaped by the intergenerational epigenetic effects
- The environment is shaped by rising inequality
- The food is shaped by economic and environmental drivers that make fresh food expensive and industrialised food relatively cheaper
- It is a complex socioeconomic and political problem that requires political intervention combined with health promotion and a changed private behaviour

Cardiovascular Risk Factors

- Cardiovascular disease is the most common cause of death in Australia
 - Heart attack (CHD) – coronary artery blockage
 - Stroke – either blockage of artery supplying part of brain or haemorrhage in brain
- Risk factors
 - If reversing a variable reduces occurrence/risk of CVD then it is a risk factor
 - Established CVD risk factors
 - Age
 - Blood pressure
 - Cholesterol
 - BMI
 - Smoking
 - Diabetes
 - (Other) Risk factors (have not been proven with reversal – possible but not established)
 - Left ventricular size → reflects BP, weight, diabetes status
 - Fibrinogen (clotting factors) → blocks blood flow (via clot formation)
 - Other lipids
 - Homocysteine (sulphur-containing amino acid)
 - Risk factors tend to aggregate
 - Weight gain promotes major CVD traits (important stimulus)
 - High BP, blood lipids and fibrinogen, insulin resistance
- Age – single most important and independent risk factor (wear and tear)
 - 80% of CVD occur in people over 65
- Sex
 - Men die earlier and more frequently from CVD
 - Women are protected before menopause, and even after menopause, male risk is still higher than female
 - Hormone therapy in menopause does not reduce CVD risk (in fact made it worse)
- Family history
 - If a first degree relative has CVD, your risk increases 4-fold
 - Combination of both genes and (family) environment
- CVD genes
 - Individual genetic variants explain small amount of risk
 - Therefore, CVD must be polygenic – addition of all genetic variant risks will give individual risk
- Lipids
 - Cholesterol (carried by lipoproteins in blood)
 - Bad = LDL/VLDL – go from liver to arteries where they can deposit
 - Good = HDL – go from periphery to liver (reverse cholesterol transport)
 - Triglycerides
- Overweight (especially central adiposity)
 - Results in high BP, high lipids and insulin resistance
 - Men have a hormonal predisposition to central adiposity

- Alcohol – 2 units per day is best for CVD risk
 - Gives lowest risk of CVD, after which it increases (J-curve)
- Stress – unproven but popular explanation
- Graded risk effects
 - The risk of CHD increases with incremental increase in BP
- Individual vs population risk
 - The majority of people who die from CHD have average BP levels – more deaths occur because there are more people who fall within this 'average BP' category. Likewise, relatively fewer deaths occur in the small number of people at high risk with high BP (CVD population paradox)
 - Relative risk – comparing risk between populations (i.e between people overweight vs not overweight, or risk compared to somebody who does not have the disease)
 - Richard – an individual's risk of CVD relative to the general population
 - Absolute risk – individual risk (size of your own risk)
 - Richard – an individual's actual risk of CVD event occurring in a given time period (usually in the next 5 or 10 years)
- Reducing CVD
 - Public health prevention
 - For everybody – to reduce absolute risk
 - Must be safe, cheap and effective
 - Better diet, more exercise
 - Treatment (medical model)
 - For patients – to reduce individual risk
 - Can be non-pharmacological (e.g. diet, exercise) or pharmacological (e.g. drugs)
 - When to treat?
 - Treat when the risk of treatment is less than the benefit of the treatment
 - To evaluate this you have to do clinical trials
 - A high CV risk is defined as >15% CV event risk over 5 years (National Heart Foundation)
 - BP → systolic > 180, diastolic > 110, high pulse pressure
 - New guidelines:
 - Systolic > 140 or diastolic > 90 with
 - Associated conditions (diabetes, existing CV/renal disease) or
 - High CV risk (>15% over 5 years)
- Standard risk factors
 - Age
 - Systolic pressure
 - Total:HDL cholesterol ratio
 - Smoking
- End organ damage
 - Left ventricular hypertrophy
 - Low eGFR
 - Microalbuminuria (small amounts of albumin in urine)
 - Increased pulse wave velocity – indicates stiffer, aged arteries
 - Intima-media thickness – with high BP, intima thickens and this ratio decreases
- CVD is a modern epidemic
 - Emerging as a major cause of death in developing countries
 - On a global level, CVD is no.1
 - Rising in central and eastern Europe
 - Falling in North America and Australasia
 - Falling from low levels in Japan
 - CVD mortality was high after war, then fell drastically
 - Low medical care and high smoking rates but excellent nutrition – low dietary fat intake, polysaturated:saturated ratio 1:1
 - French paradox – rich diet but small portions and eat in moderation

Learning Objectives

- Understand the major forms of CV disease
- Know the risk factors for CV disease
- Understand CV risk in the medical model and public health context
- Understand the rise and fall of the CV disease 'epidemic'

