

DIETARY FATS

OUTLINE

- The need for fat
- What is fat?
- Types of fats
- Dietary sources of the different types of fat
- Evidence for cardiovascular health benefit of fish omega-3 and omega-6 fatty acids
- Possible mechanisms of action
- Current intakes & recommendations
- Summary.



The need for fat in the diet

- An important source of food energy (38 kJ/g, 9 Kcal/g)
- Provides and enables the absorption of fat soluble vitamins (A, D, E & K)
- Provides the essential fatty acids
- Palatability – mouth-feel (fat globules) and carries flavours
- Structural lipids (58% body weight) – mainly from phospholipids and cholesterol – important in cellular membranes (e.g. brain)
- Protects and cushions delicate organs
- Substrate for hormone and prostaglandin production
- Subcutaneous fat reduces loss of body heat (very important in newborns).



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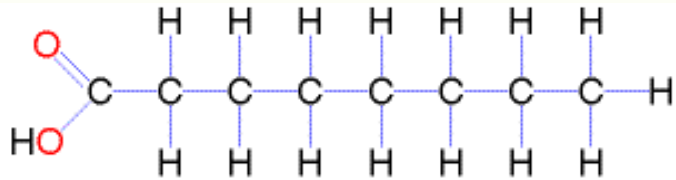
What is fat?

- Fat is made up of fatty acids and their esters
- The most common fats / lipids are
 - Triacylglycerols
 - Phospholipids
 - Cholesteryl esters
- Dietary fat consists predominantly of triacylglycerols (90-98%).

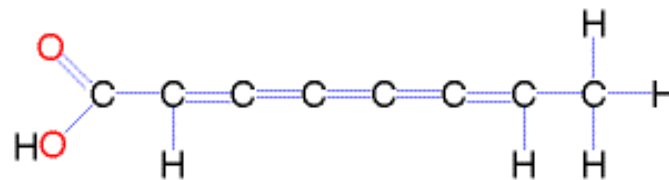


Fatty acids

- Consist of a carbon backbone terminated by a carboxyl group (COOH) at one end and a methyl group (CH₃) at another end
- Differ in:
 - Number of carbons
 - Number of double bonds
 - Position and geometry (*cis* or *trans*) of double bonds.



Saturated

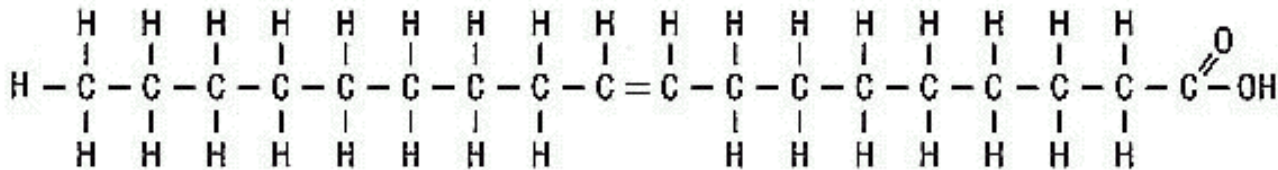


Unsaturated

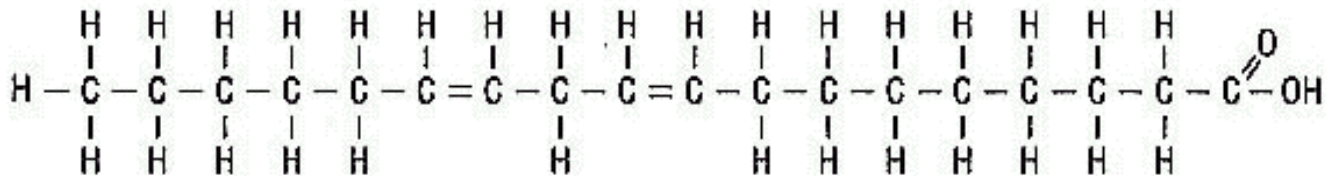


Unsaturated fatty acids

- Contain one or more double bonds
- Commonly 16-22 carbon atoms long
- Double bonds can exist in two forms: *cis* or *trans*
 - One double bond – MUFA, e.g. oleic acid (olive oil)



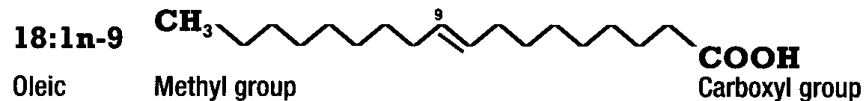
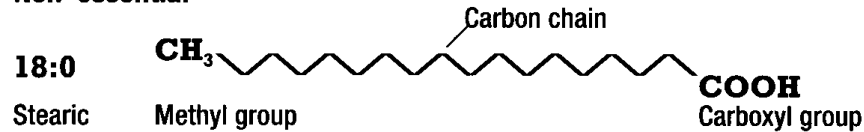
- Two or more double bonds – PUFA, e.g. linoleic acid (sunflower oil).



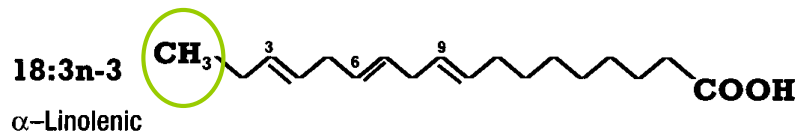
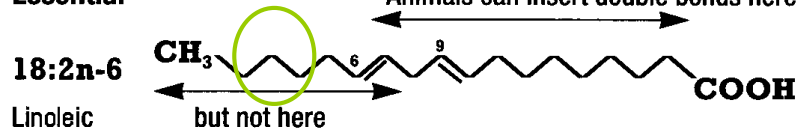
Essential Fatty acids

- Polyunsaturated fatty acids that cannot be made in the body but are essential for normal physiological functioning
 - n-6 series derived from linoleic acid
 - n-3 series derived from linolenic acid.

Non-essential



Essential

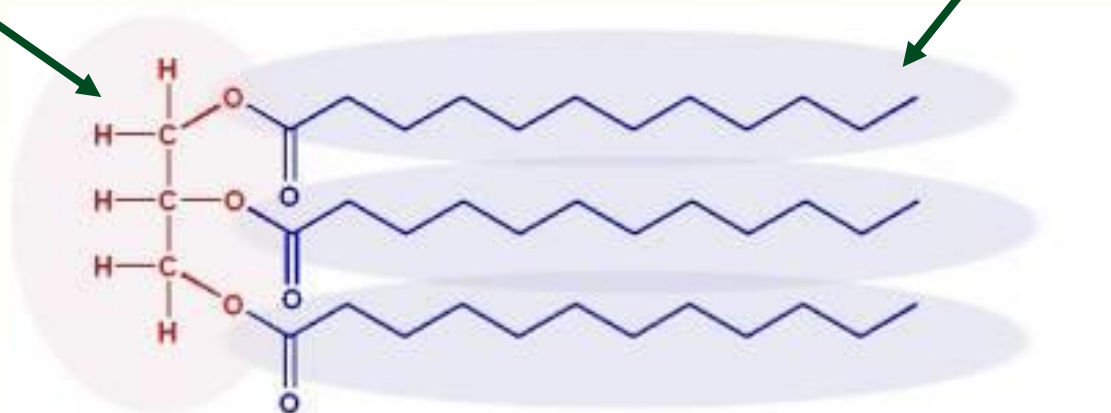


Triacylglycerols

- Triacylglycerols (also referred to as triglycerides [TAG]) consist of three fatty acids linked to a glycerol molecule - building blocks of dietary fat
- The fatty acids will determine the properties of the TAG (such as melting point, saturation).

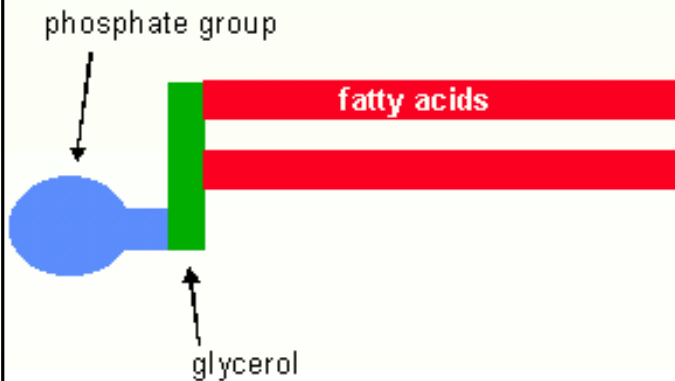
Glycerol

Fatty acid



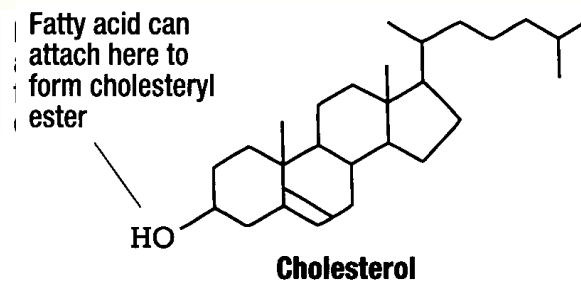
Phospholipid

- Phospholipids - Two fatty acids linked to a glycerol and PO_4 group linked to a polar head group (choline, ethanolamine, inositol or serine)
- Phospholipids play an important structural role in membranes.

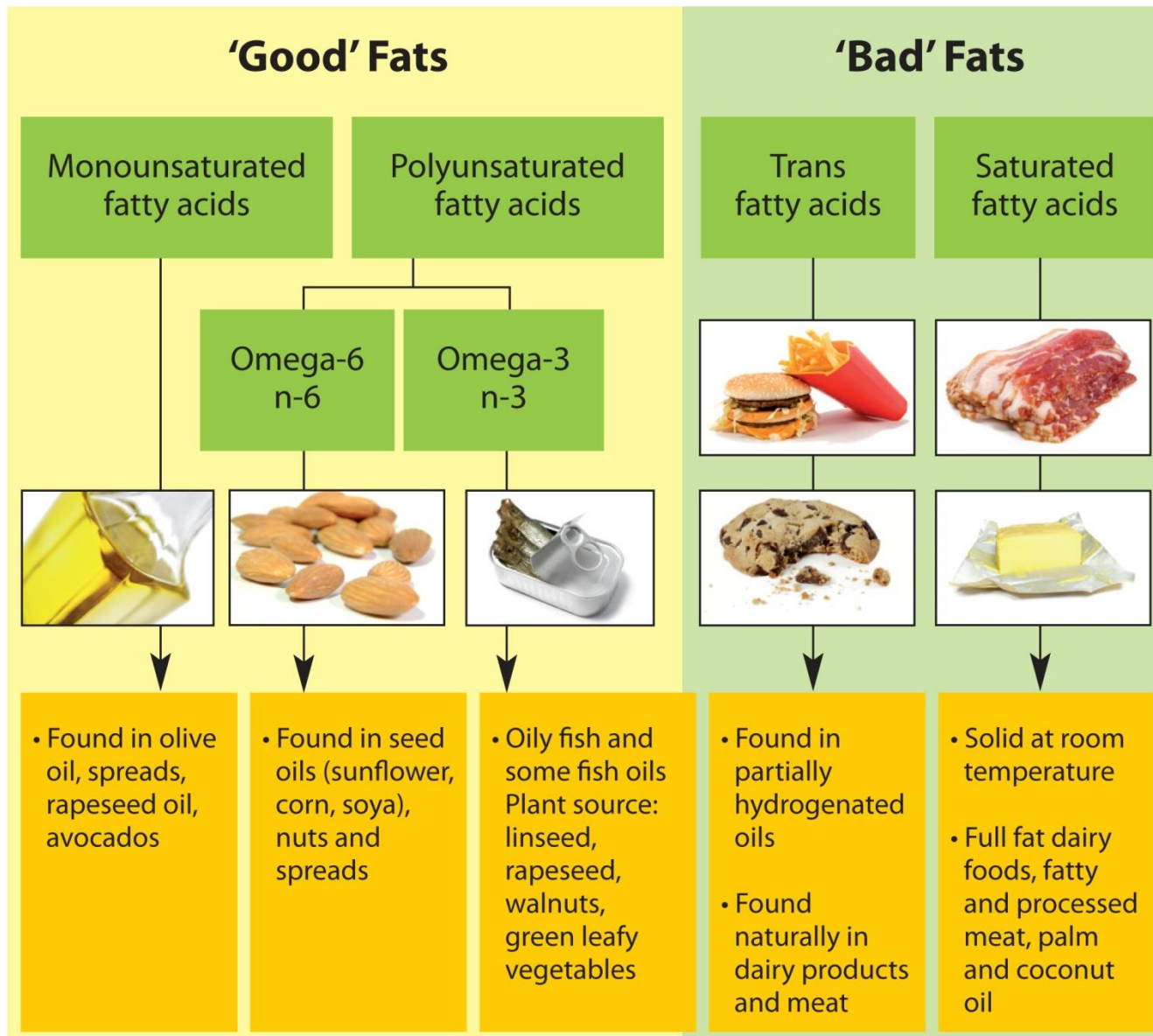


Cholesterol

- Cholesteryl esters - One fatty acid linked to cholesterol
- Present in animal fat (butter & lard)
- Cholesterol is an important component of membranes and precursor of bile acids, vitamin D and steroid hormones.



Different types of fatty acids



The effects on heart health of ‘Good’ vs. ‘Bad’ fatty acids



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	PUFA		MUFA	SAFA	TFA
Effects on heart health	ALA				
	↑ HDL cholesterol	↑ HDL cholesterol	↑ HDL cholesterol	↑ HDL cholesterol	↓ HDL cholesterol
	↓ LDL cholesterol when used instead of carbohydrates (CHO) and SAFA	↓ LDL cholesterol when used instead of CHO and SAFA	↓ LDL cholesterol when used instead of SAFA	↑ LDL cholesterol	↑ LDL cholesterol
	↓ Total cholesterol when used instead of CHO and SAFA	↓ Total cholesterol when used instead of CHO and SAFA	↓ Total cholesterol when used instead of SAFA	↑ Total cholesterol	↑ Total cholesterol
	↓ EPA & DHA triglyceride				



EXERCISE 1

1. Group the following foods into 'good' and 'bad' fats:

- Salmon
- Butter
- Sunflower oil
- Walnuts
- Palm oil
- Avocado

2. Foods contain different levels of (total) fat and saturated fatty acids. But what are the important figures?

- What is a lot?
- What is a little?

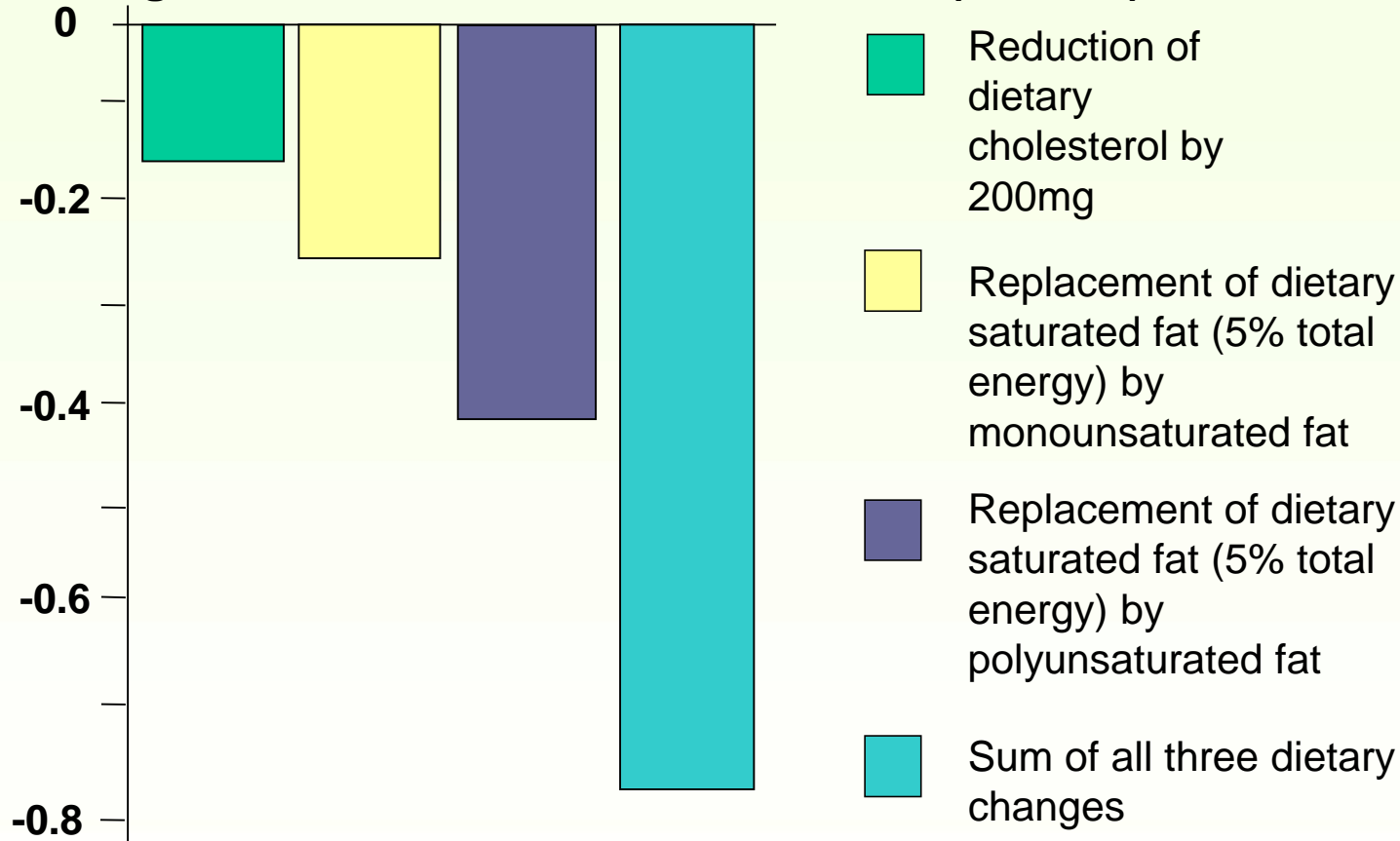


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Type of fat eaten impacts blood cholesterol

Changes in total blood cholesterol levels (mmol/L)



Polyunsaturated fatty acids

- **Omega-3:**
 - **Plant sources** – ALA (α -linolenic acid) **essential** fatty acid
e.g. linseed (flaxseed), rapeseed, soya, spreads and oils made from these, green leafy vegetables, walnuts
 - **Oily Fish** – EPA (Eicosapentaenoic acid) & DHA (Docosahexaenoic acid) e.g. salmon, trout, fresh tuna, herrings
- **Omega-6:**
 - LA (Linoleic acid) **essential** fatty acid
e.g. most vegetable oils (sunflower, corn, safflower) and spreads made from these, seeds.



Omega 3 – Plant sources

- **Alpha-linolenic acid (ALA)**
 - Beneficial for heart health due to lowering cholesterol level
 - possibly by other mechanisms
- **Where are they found?**
 - plant sources
 - rapeseed oil, soybean oil, linseeds and linseed oil, walnuts and spread and mayonnaise made with these oils



Dietary sources of omega-3 fatty acids, oily fish

Marine sources – EPA & DHA

- Fresh tuna
- Mackerel
- Trout
- Salmon
- Herring
- Sardines & pilchards
- All canned fish, except tuna & shellfish

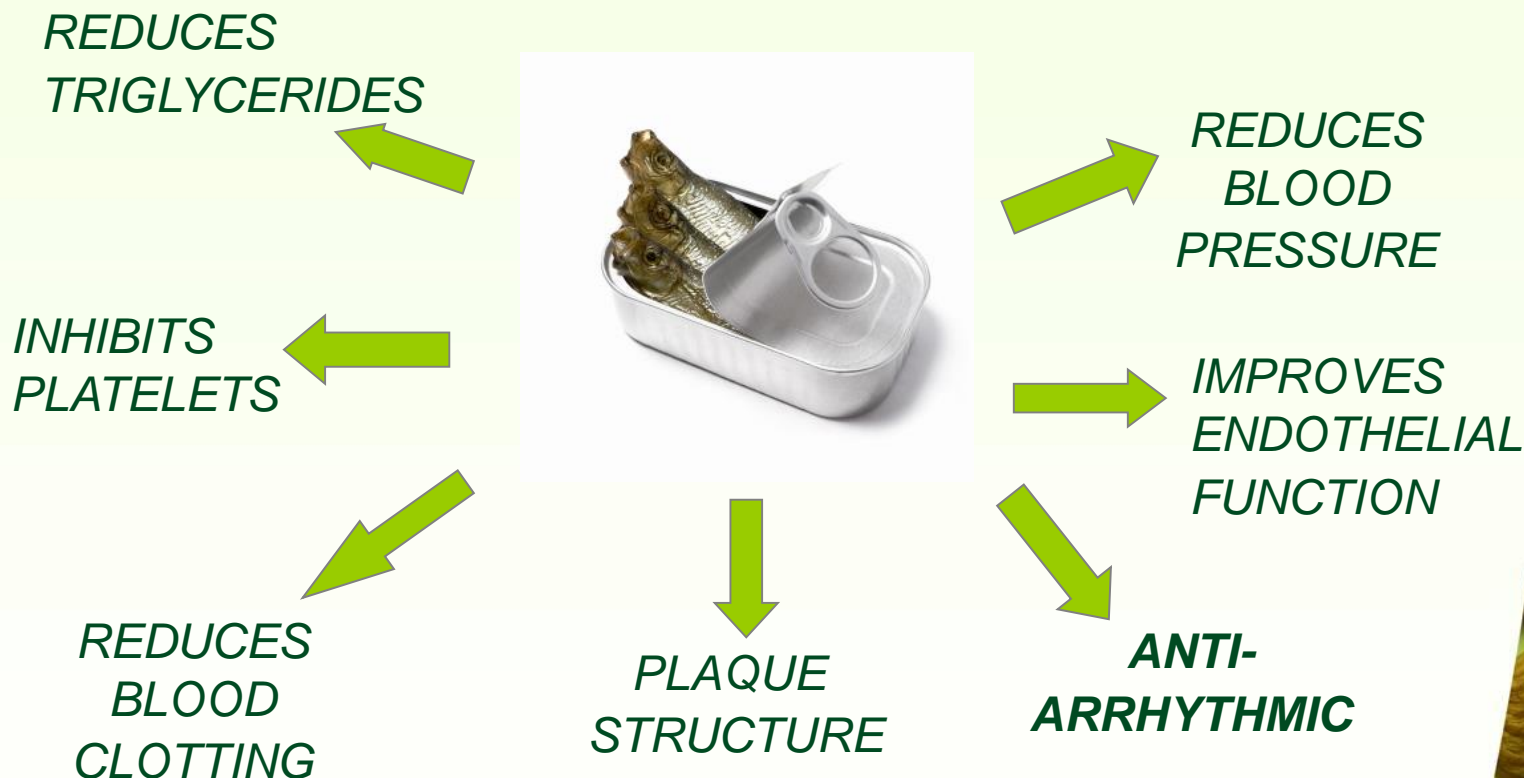


EPA and DHA are not essential fatty acids as they can be synthesized from ALA. However, conversion rate is estimated to be max. 5-10% for EPA and much lower for DHA*.



Cardio-protective effects of fish omega-3

Several mechanisms for the beneficial effect of EPA and DHA on heart health have been proposed. These include:



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Guidelines and recommendations for omega-3 intake

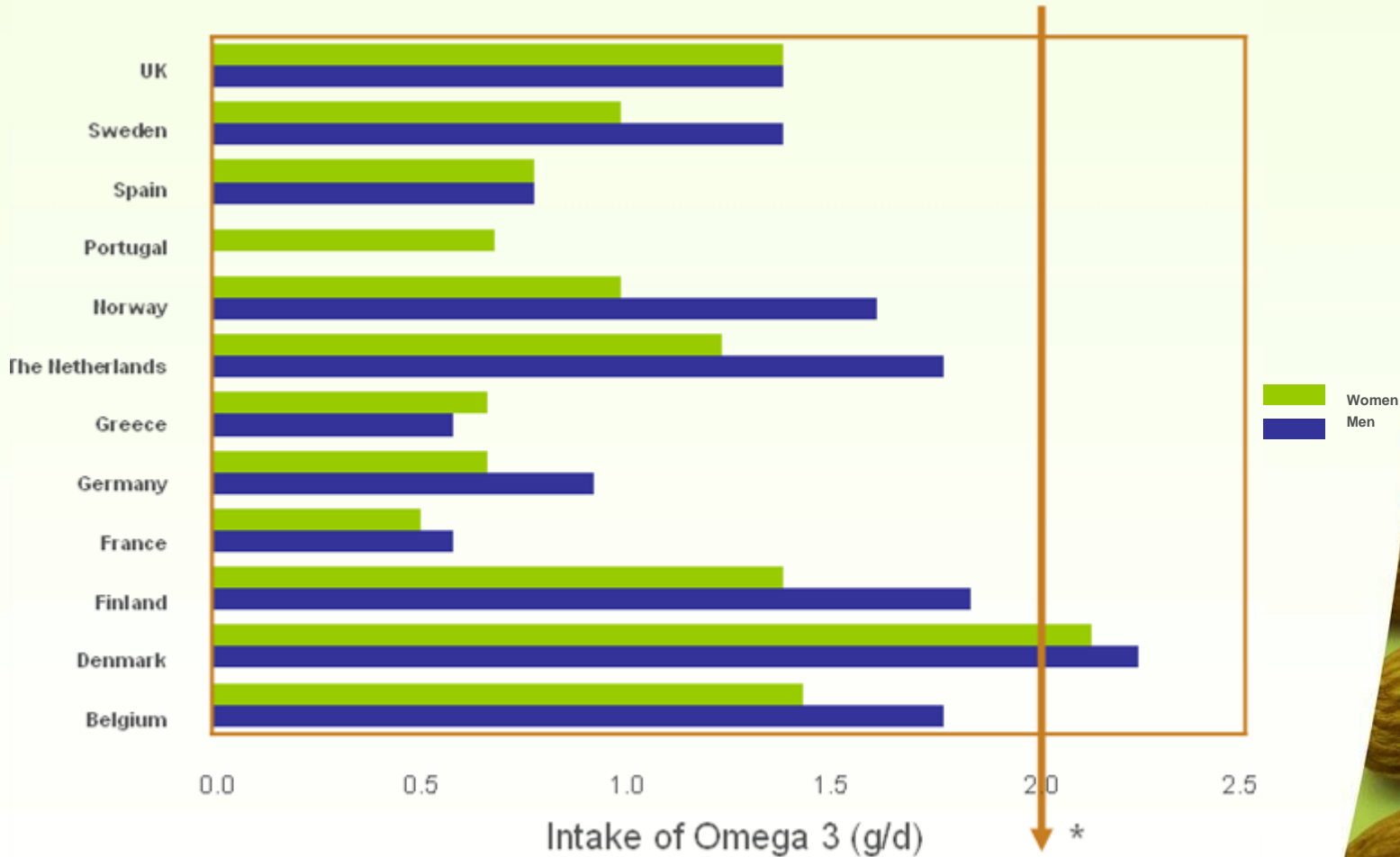
- **ALA**
 - minimum intake for individuals to prevent deficiency symptoms, 0.2% daily total energy intake
 - 2g a day recommended for optimal heart health.
- Department of Health recommends the population should eat at least two portions of fish per week, one of which should be oily
- **EPA & DHA**
 - 450mg a day recommended for heart health.



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Gap between intake of alpha-linolenic acid (Omega-3) in Europe as compared to WHO recommendations



* Recommended intake of Omega-3 (the PUFA alpha-linolenic acid) (WHO/FAO 2003)



How much fish omega-3 we are eating?

- On average, adults in the UK are eating 1/3 of a portion of oily fish per week
- 70% of adults eating no oily fish at all



Good fats' polyunsaturated fats – Omega 6

- **Polyunsaturated fats (omega 6)**
 - reduce blood cholesterol levels
 - essential for normal growth and development and maintaining health
 - essential to eat in the diet as the body cannot make them
- **Where are they found?**
 - Sunflower seed oil, soybean oil and maize oil. Spreads and mayonnaise made from these oils. Nuts and seeds



Monounsaturated fatty acids



- Monounsaturated fatty acids are unsaturated fatty acids. Like polyunsaturated fatty acids, they are regarded as 'Good Fats' and are good substitutes for saturated fatty acids
- Monounsaturated fatty acids are not 'essential' fatty acids
- Found in olive oil, spreads, rape seed oil and avocados
- Monounsaturated fatty acids lower cholesterol, but to a lesser extent than polyunsaturated fatty acids.



Saturated fatty acids

Saturated fatty acids increase total and LDL-cholesterol levels

Where are they found?

- Saturated fatty acids are mostly found in animal products, such as full fat dairy products including butter, cream and cheese, fatty meats and pastries.

Intake:

- Although in the UK we are eating about the right **amount** of fat, we are eating the wrong **type** of fat.
- Saturated fatty acid intake in our diets is around 20% higher than official Government recommendations (13% of food energy versus the recommended 11% of food energy).
- It is important for us to reduce our intake of saturated fats.
- We should try to reduce saturated fats and replace with unsaturated fats



Practical tips for your patients

Simple ways to reduce saturated fatty acids intake:

- Cut visible fat off meat
- Grill, poach, steam and bake instead of frying foods
- Choose reduced fat dairy products
- Avoid cakes, biscuits, pastries and choose fresh fruit instead as a snack
- Swap from butter to a polyunsaturated fat spread
 - Two small pats (20g) butter provides 10.8g saturated fatty acid = more than half (54%) of GDA
 - Spread rich in polyunsaturates provides 2.4g of saturated fats.



Foods with less than 10.8g saturated fatty acid – found in 20g butter

2 slices



9 squares



11 cookies



3 doughnuts



5½ slices



4 fingers



5½ rashers



9 biscuits



Trans fatty acids

Trans fatty acids increase LDL 'bad' cholesterol and reduce HDL 'good' cholesterol

Where are they found?

- Trans fatty acids are naturally present in the stomach of cattle and sheep – e.g. dairy foods including butter and some meats
- Partial hydrogenation of liquid oil into solid fat – e.g. pastries, cakes, biscuits, deep-fried fast foods.

What about the health impacts?

- Both sources of trans fatty acids are equally harmful.

However:

- Gram for gram, trans fatty acids are thought of as more dangerous by experts than saturated fatty acids, but we eat ten times more saturated fatty acids than trans fatty acids
- In fact, the current intake of trans fatty acids is within the recommended levels, therefore it's saturated fatty acids that need to be reduced.



Trans fatty acids vs. saturated fatty acids – the scale of the problem

- Recently trans fatty acids have been a hot topic in the media
- However, in the UK, intakes of saturated fatty acids are 10 times greater than trans fatty acids.
- Whereas dietary guidelines in the UK recommend an upper limit for trans fatty acids intake of 2% total energy, actual intake of trans fatty acids is as low as 1% of energy (FSA 2007):
 - Consumption of trans fatty acids has fallen from 2.1% of total energy in 1985
 - Mainly due to the reformulation of products such as margarine and spreads.

It is important to keep the focus on saturated fatty acids



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EXERCISE 2

1. Swap shop – how to reduce intake of saturated fatty acids

Swap:

Beef burger →

Mild cheddar cheese →

Butter →

Meat pie →

Cream →

2. Rank the fish below in accordance of their EPA AND DHA omega-3 level:

- 100g of Salmon
- 100g Sardines (in tomato sauce)
- 100g Tuna (canned in brine)
- 100g Cod
- 100g Plaice
- 100g Mackerel



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Current & recommended average population intakes of fat in diets of adult men and women

Type of fat	Current intakes (Male/Female) as % of food energy	Recommended intakes as % of food energy
Total fat	35.8/ 34.9	< 35
Saturated fats	13.4 /13.2	< 11
trans unsaturated fats	1.2	< 2
cis Monounsaturated fats	12.1/11.5	13
cis n-6 Polyunsaturated fats	5.4/5.3	6.5
n-3 Polyunsaturated fats	1%	<0.2%

- Saturated fat intake remains higher than recommended levels, so still requires attention from Healthcare professionals (HCPs)
- Intake of trans fatty acids is below the recommended levels and this trend should be continued
- HCPs should be advising their patients to eat at least two portions of fish per week, one of which should be oily.



Summary of dietary fats

- Fat is an important component of our diet
 - Membrane structure, fuel reserve, flavour and texture to food, supply of fat soluble vitamins & essential fatty acids, cushions organs
- Types of fat:
 - Polyunsaturated and monounsaturated fatty acids are considered 'good' fats
 - Saturated & Trans fatty acids are considered 'bad' fats
- Current intakes & recommendations.



CASE STUDY 1

- Mrs Smith, 68yrs, family history CVD
- Total cholesterol: 6.2mmol/L, HDL 1.1mmol/L, LDL 3.5mmol/L, TGs 2.8mmol/L
- Average daily intake:
 - Breakfast – Two slices white toast, butter & marmalade. One mug tea with whole milk
 - Lunch – chunk of cheese in a roll & butter or biscuits. Tomato, yogurt & coffee (black, no sugar)
 - Snack – small chocolate bar & tea. Apple occasionally
 - Dinner – ready meal with vegetables. Glass of wine. No dessert

Interactive exercise

Break into groups and plan an alternative meal using basic food swaps



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Thank you

Questions?

