PSYU3352- Notes

Lecture 1, Part 1: Introduction

Why study feeding and drinking?

- Eating and drinking are essential to survival
- Consequently, much of our behaviour, physiology and anatomy has been shaped by evolutionary forces related to ingestion
    - Colour vision (from primates and ripe fruit)
    - Liking for junk food (hard wired for sugar and fat) – sugar and fat provide signals that food is energy dense
    - Disposition to gain weight not lose it (saving fat to survive famines)
    - Bipedalism for predator detection and hunting (running)
    - Gut and teeth design, and face structure (chewing)
- Understanding feeding behaviour (and its physiology) is important for several reasons

Why study feeding and drinking?

- In the developing world around 1.2 Billion (1200 million or about 60x the population of Australia) people are malnourished, underweight and hungry, yet in the West, 1.2 Billion people are overweight or obese
- This is important because:
    - Malnourishment kills, lowers IQ, cuts earnings and entrenches poverty;
    - Obesity shortens lifespan, induces chronic diseases and is very costly
- What biological, psychological, social and economic factors contribute to obesity and malnourishment?
- Why are some people starving whilst others are eating themselves into an early grave?

- In the west 15% of individuals are alcohol dependent, with 100,000 preventable alcohol related deaths/year in the US alone
- What biological, psychological, social and economic factors contribute to alcohol dependence?
- And we might now add processed food as well when we think about dependency
    - Mice preferring sugar to cocaine
    - Mice withdrawing from sugar

Why study feeding and drinking?

- Eating disorders - especially anorexia which is the most lethal of all psychiatric conditions - affect approximately 1-2% of college-age women in the West
- Eating disorders seem to be coming more common, and they are also involved in obesity, notably binge eating disorder
- What biological, psychological, social and economic factors contribute to eating disorders?

Answers?

- To study these varied conditions - obesity, alcoholism, starvation, malnutrition and eating disorders - we need to know how eating and drinking (ingestion) occur normally
    - Why do we choose to eat certain things and not others?
        - Lamb chops over human chops, chips over apples….
    - How do we perceive food and drink?
        - Why is fat – fatty, and chilli pepper - hot?
    - What starts and stops eating?

        - How do we get hungry and full, and are we in charge of what we eat or are we physiological zombies?
    - What societal factors influence ingestion?
        - Why don't we eat 'desert shrimps' (and other insects)?
    - What economic factors govern eating and drinking?
        - Fast food, dual incomes, cars, TV and obesity…
    - In fact as you'll come to see, the whole structure of our society seems engineered to help us eat more and move less

Energy Metabolism

- The basic purpose of food is to provide energy
- Food provides chemical energy which the body converts into
    - Mechanical energy (muscles)
    - Electrical energy (nerves)
    - Heat (maintaining optimal temperature)
    - Other forms of chemical energy (fat; proteins)
- The key food constituents (macronutrients) that provide energy are carbohydrates, proteins and fats

Main metabolic pathways

1. Three principal methods of **generating energy** – metabolic pathways (Glycolysis – the breaking down of glucose and the primary means of obtaining energy), (Kreb's cycle, aerobic- most frequent), (Lactic acid cycle, anaerobic) Fitness determined by capacity to get oxygen to muscle (VO2 max).
2. Two principal methods of **energy storage**
    a. Glycogen (short term store) → Muscles (500g) and Liver (100g) → normally sufficient for day to day, except in marathon runners. You need to use A LOT of energy to get through this.
    b. Fat stores → 20 – 40% of body mass
3. Note that **all** energy sources (proteins, carbohydrates and fat) can be converted to fat

Measuring the energy in food

- The measure we will use is the Kcal (kilo calorie)
    - To convert to the SI unit, Kilo Joule (KJ), multiply the Kcal value by 4.184
- One Kcal is the energy needed to raise 1L of water by 1 degree centigrade
- This is measured using a bomb calorimeter
- The amount of energy contained per gram, differs for fats, carbohydrates and proteins
    - Proteins & Carbohydrate yield 4 Kcal/g
    - Fats yield 9 Kcal/g
    - (Alcohol yields 7 Kcal/g)
- This is why fats are called energy dense foods

What are the bodies energy needs?

- At rest, the body expends considerable energy - termed the **basal metabolic rate (BMR)**
- Most of the food (i.e., energy) you consume goes to **maintaining your BMR** – about 70-80%
- BMR includes energy for cellular physiology (pumps), breathing and blood flow, muscle tone and protein synthesis (e.g., immune system)
- Women need about 0.9 Kcal per kg/hour of bodyweight to maintain BMR and men around 1.0 Kcal per Kg/hour
- Over 24 hours, a 70 kg man would need around 1680 Kcal just to maintain BMR (i.e., 24x70x1.0)

- BMR varies a lot dependent upon lactation, pregnancy, muscle/fat bulk, physical fitness, illness and age

Activity

- On top of BMR we expend additional energy on 'doing things'
- To give you some idea here is the amount of energy you would expend if you did these 'things' for one hour (for a 70 kg person)
    - Shopping 190 Kcal
    - Walking 300 Kcal
    - Running 750 Kcal
- To put this in perspective…
    - A big mac provides 550 Kcal, a standard sized mars bar 224 Kcal, and an apple 52 Kcal
    - So… 3hrs of hard shopping burns away a big mac, while 5 mins of running burns away an apple

Calculating energy needs

- Most tables that report the caloric intake that you need are based upon calculating your BMR and then estimating a light to moderate level of activity
    - Very light (BMR x 1.3)
    - Light (men x 1.6, women x 1.5)
    - Moderate (men x 1.7, women x 1.6)
    - Heavy (men x 2.1, women x 1.9)
- Most westerners have activity levels that are typically in the very light to light range

Consequences

- According to standard tables then, an 85 kg man (Mr Average in Australia [Ms weighs in at 71kg]) would need around 3270 Kcal / day (with light levels of activity)
- To put this in perspective, Mr Average in Australia eats around 3400 Kcal / day
- At the other end of the spectrum Nazi concentration camp inmates were fed about 700 Kcal / day
- It is not surprising then that many Australian adults slowly gain weight and that many camp inmates died of starvation

Carbohydrates

Types

- **Simple**
    - **Monosaccharides**
        - Glucose – corn, grapes
        - Fructose – honey, many fruits
        - Galactose – avocados
    - **Discaccharides** (2 monosaccharides joined together)
        - Sucrose – 'sugar' → a glucose joined to a fructose
        - Lactose - milk sugar → glucose and galactose
        - Maltose - beer → x2 glucose joined together
- **Complex**
    - Polysaccharides - starch, cellulose, inulin (humans can't break these last two down)

Function

- Primarily to provide energy

High fructose corn syrup (HFCS), used in soft drinks mainly in the USA. Quantities consumed have increased enormously. In 1955 an average soft-drink serve was 207ml, it is now around 600ml.

Fats

- Or more properly **Triglycerides** → A glycerol with three fatty acid tails
- **Types** (These are the different types of tail the glycerol can have)
    - **Saturated** (animal, coconut, palm) – some may increase LDL (bad cholesterol)
    - **Monounsaturated** (olive oil, canola) – some may increase HDL (good cholesterol)
    - **Polyunsaturated**
        - Omega 6 (vegetable)
        - Omega 3 (deep sea fish) – may increase HDL and lower LDL
    - **Trans-saturated**
        - Artificially produced from Mono or Polyunsaturated fats
        - Have significant commercial benefit/use (storage/non-animal)
        - Have negative health consequences (CHD, Diabetes, Obesity) more so than saturated fats.
    - Health controversies → split on whether saturated fats actually do contribute to heart disease
- **Function**
    - Structural (nerves), hormone synthesis, fat soluble vitamins, insulation & padding, energy storage

Protein

- **Types**
    - All proteins built from Amino acids
    - Some are essential and some can be synthesised by the body (meat provides all essential amino acids, but combinations of vegetables and legumes can do so as well)
- **Function**
    - Tissue maintenance & growth, hormone, enzyme and protein synthesis, fluid balance, energy
- The body also needs certain Minerals and Vitamins and these are termed micronutrients…

Micronutrients – Vitamins

- Deficiencies relatively rare in Western nations, yet almost a third of the US population consume them (supplement sales are a 30 Billion US dollar industry)
- **Fat soluble vitamins** (A, D, E & K)
    - A (eyes, skin, bones, reproduction & immunity) - Night blindness, xerophthalmia
    - D (bone formation, hormonal control) - Rickets
    - E (cell membrane integrity) - Hemolytic anemia
    - K (blood clotting) - Infant haemorrhage (hence neonatal K shots)
        - Vulnerabilities after obesity surgery & lipase inhibitors
- **Water soluble vitamins** (**C, B1**, 2, Niacin, 6, Folate,12, Pantothenic acid, Biotin)
    - C (collagen formation, iron absorption) - Scurvy
    - **B1 (energy metabolism) –** Important for normal function of the brain → Beri beri (thiamine & Korsakoff's syndrome)
    - B2 (energy metabolism) - Glossitis, Seborrheic dermatitis
    - Niacin (energy metabolism) - Pellagra
    - B6 (amino acid synthesis) - Anemia
    - Folate (DNA synthesis) - Anemia, (Neural tube defects in pregnancy)
    - B12 (DNA synthesis) - Renal failure
    - Pantothenic acid (energy metabolism)- Burning feet syndrome
    - Biotin (protein metabolism) - Hair loss