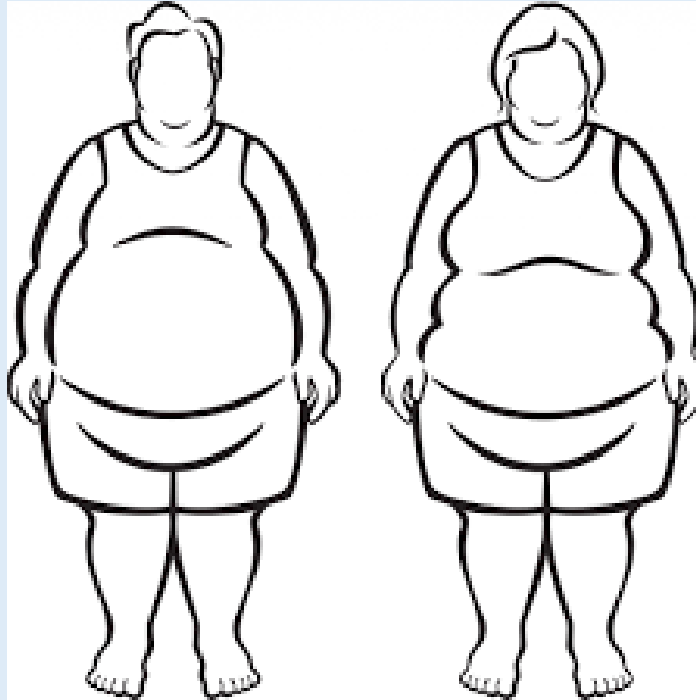


Obesity



<https://www.oecd-ilibrary.org/docserver/67450d67-en.pdf?expires=1598220144&id=id&accname=guest&checksum=C4E068561D4E6B4DE455D4CE871B4D78>

<http://www.health.govt.nz/your-health/healthy-living/food-and-physical-activity/obesity>

What is obesity?



- The World Health Organization says:

Overweight and obesity are defined as **abnormal or excessive** fat accumulation that may impair health.

<https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight>

<https://www.who.int/features/factfiles/obesity/en/>

Key facts

- Worldwide obesity has nearly tripled since 1975.
- In 2016, more than 1.9 billion adults, 18 years and older, were overweight. Of these over 650 million were obese.
- 39% of adults aged 18 years and over were overweight in 2016, and 13% were obese.
- Most of the world's population live in countries where overweight and obesity kills more people than underweight.
- 38 million children under the age of 5 were overweight or obese in 2019.
- Over 340 million children and adolescents aged 5-19 were overweight or obese in 2016.
- Obesity is preventable.

Obesity in New Zealand



Adult obesity statistics

- The New Zealand Health Survey 2018/19 found that:
- around 1 in 3 adults (aged 15 years and over) were obese (30.9%)
- the prevalence of obesity among adults differed by ethnicity, with 66.5% of Pacific, 48.2% of Māori, 29.1% of European/Other and 13.8% of Asian adults obese
- adults living in the most socioeconomically deprived areas were 1.6 times as likely to be obese as adults living in the least deprived areas*
- the adult obesity rate has increased from 29% in 2011/12, but has not changed significantly since 2012/13.

Child obesity statistics

- The New Zealand Health Survey 2018/19 found that:
- around 1 in 9 children (aged 2–14 years) were obese (11.3%)
- the prevalence of obesity among children differed by ethnicity, with 28.4% of Pacific and 15.5% of Māori obese, followed by 9.9% of Asian and 8.2% of European/Other children
- children living in the most socioeconomically deprived areas were 2.7 times as likely to be obese as children living in the least deprived areas*
- there has been no significant change in the child obesity rate since 2011/12.

<https://www.youtube.com/watch?v=Vtki3ZM6UiY>

<https://www.youtube.com/watch?v=oCLfYJGmKjA>

Socio-economics differences

- In New Zealand, prevalence of obesity 2013/2014:
 - Quintile 5 (most **disadvantaged** neighbourhoods) – 44.5%
 - Quintile 4 – 30.8%
 - Quintile 3 – 27.9%
 - Quintile 2 – 22.1%
 - Quintile 1 – 18.4%

Source: Ministry of Social Development

Measuring obesity

- Obesity can be measured in various ways.

(1) Population Means

- Getting the **mean weight** of a population (e.g., a country)
- Then determining whether an individual is below average, average or above average
 - **Mild** obesity – 20-40% overweight
 - **Moderate** obesity – 41-100% overweight
 - **Severe** obesity – >100% overweight

Measuring obesity

- **(2) BMI (Body Mass Index)**

- Calculated using the equation: **kg/m²**
 - **Normal** weight (20-24.9)
 - **Overweight** (grade 1: 25-29.9)
 - **Clinical** obesity (grade 2: 30-39.9)
 - **Severe** obesity (grade 3: 40+)

- **Problems:**

- Doesn't account for **location** of fat.
- Doesn't allow for differences in weight of **muscle and fat**
- (most strength-focused athletes are considered obese).

<https://www.kiwicover.co.nz/your-health/bmi/calculator>



2.

Diagnostic Categories

BASED ON BMI + SCREENING FOR WEIGHT-RELATED COMPLICATIONS

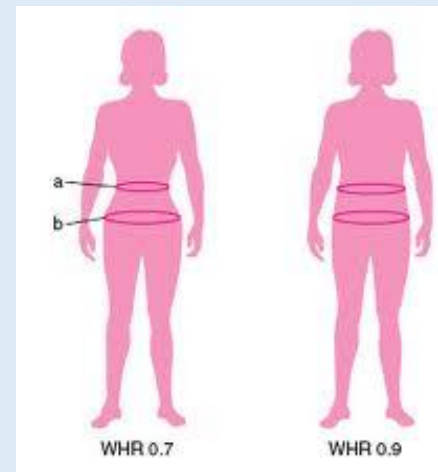
NORMAL WEIGHT	STAGE 0	STAGE 1	STAGE 2
No obesity	No complications	One or more mild-to-moderate complications or may be treated effectively with moderate weight loss	At least one severe complication or requires more aggressive weight loss for effective treatment
BMI <25 <23 IN CERTAIN ETHNICITIES	BMI 25–29.9 OVERWEIGHT BMI ≥30 OBESITY	BMI ≥25	BMI ≥25

Measuring obesity

- **(3) Waist-to-Hip Ratio (W/H)**
 - Lower ratio indicating less visceral fat (around organs), which is good.

Waist to Hip Circumference Ratio Standards for Men and Women

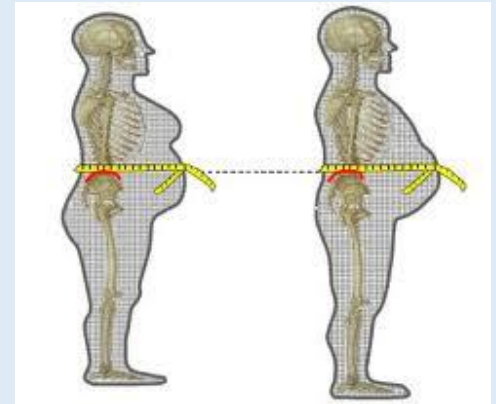
		Disease Risk Related to Obesity			
	Age (years)	Low	Moderate	High	Very High
MEN	20-29	<0.83	0.83-0.88	0.89-0.94	>0.94
	30-39	<0.84	0.84-0.91	0.92-0.96	>0.96
	40-49	<0.88	0.88-0.95	0.96-1.00	>1.00
	50-59	<0.90	0.90-0.96	0.97-1.02	>1.02
	60-69	<0.91	0.91-0.98	0.99-1.03	>1.03
WOMEN	20-29	<0.71	0.71-0.77	0.78-0.82	>0.82
	30-39	<0.72	0.72-0.78	0.79-0.84	>0.84
	40-49	<0.73	0.73-0.79	0.80-0.87	>0.87
	50-59	<0.74	0.74-0.81	0.82-0.88	>0.88
	60-69	<0.76	0.76-0.83	0.84-0.90	>0.90



Measuring obesity

- (4) **Waist circumference:**

- Waist reduction is recommended when:
 - >102 cm in men
 - > 88 cm in women
- High waist circumference is associated with risk for:
 - Cardiovascular Disease
 - Insulin resistance & development of Type-2 diabetes



Waist Circumference Limits and Risk Categories

Metabolic Risk Category	Males: Waist Circumference	Females: Waist Circumference
Normal	Less than or equal to 94 cm	Less than or equal to 80 cm
Increased Risk	Greater than 94 cm	Greater than 80 cm
Greatly Increased Risk	Greater than 102 cm	Greater than 88 cm



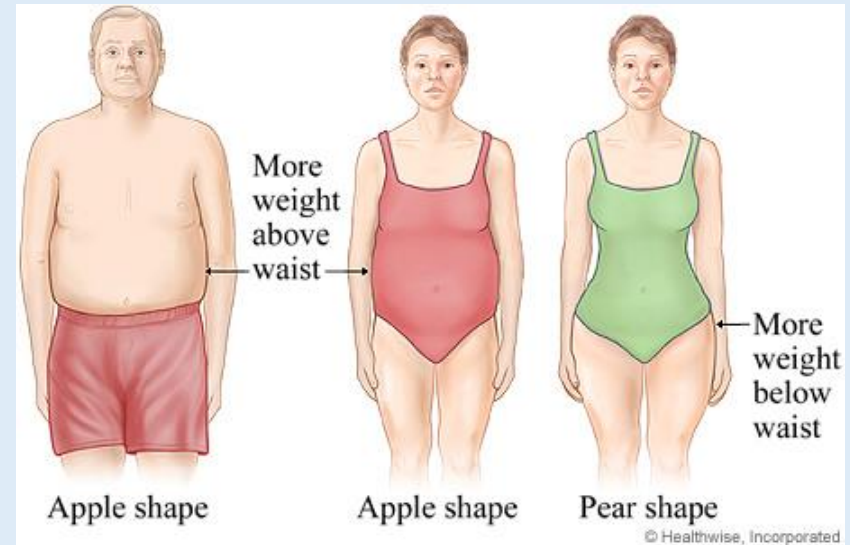
Measuring obesity

- (5) **Percentage body fat**
 - Basic assessment: skinfold thickness using callipers – at upper arm, upper back, lower back
 - Advanced assessment – **bioelectrical impedance analysis** – measured using a bioelectrical current between a person's hand and foot
 - Water conducts electricity and fat is an insulator – therefore the current can be used to calculate the ratio between water and fat

Description	Women	Men
Essential fat	10–13%	2–5%
Athletes	14–20%	6–13%
Fitness	21–24%	14–17%
Average	25–31%	18–24%
Obese	32%+	25%+

Body types

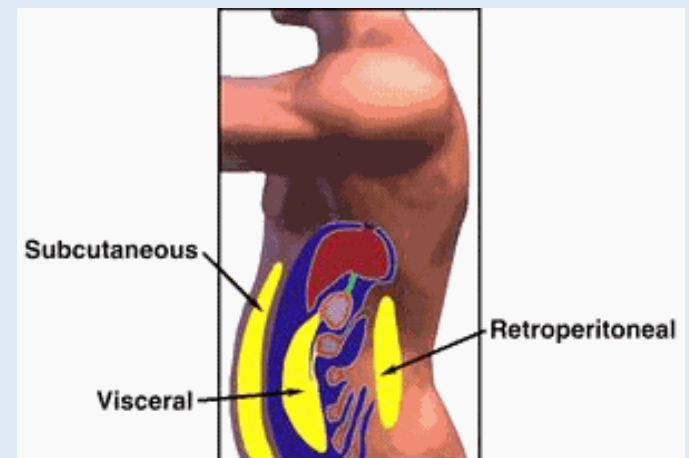
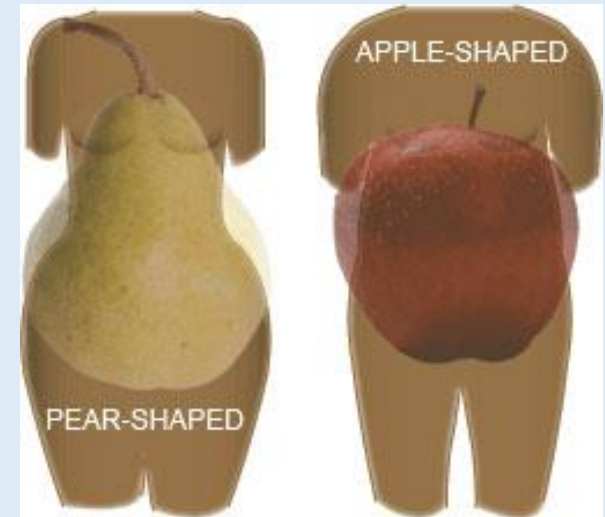
- Fat around the **abdomen** is particularly troublesome
 - Increased **risk** for: cardiovascular disease, diabetes, hypertension, and cancer
 - “**apples**” (central fat distribution) vs. “**pears**” (peripheral distribution)
 - Obesity is also linked to joint and back problems



<https://www.kiwicover.co.nz/your-health/bmi/waist-metrics>

Body types

- Why are apple-shaped people at risk for health problems?
 - Fat can be **subcutaneous** (under the skin) or
 - **visceral** (around the organs)
 - The greatest concern is that **visceral fat** can interfere with the functioning of vital organs
 - Fat deposits around the middle are associated with **visceral fat (ie. Apple-shaped body)**

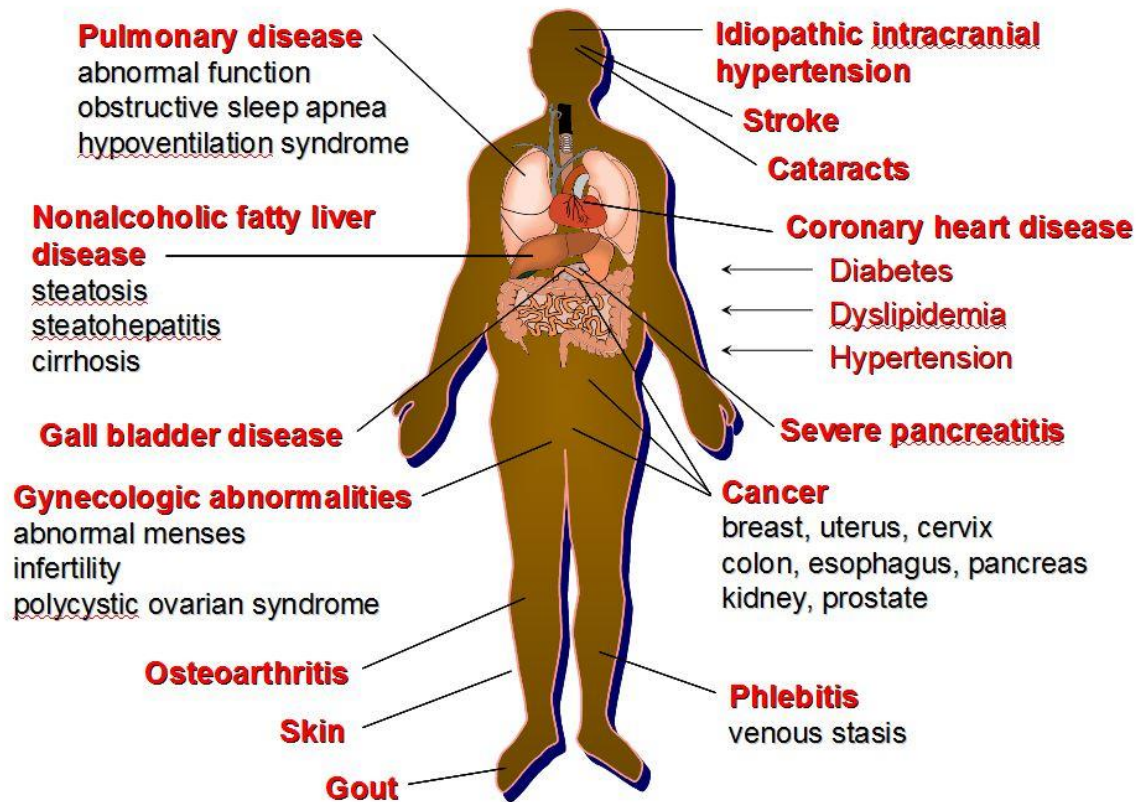


Risk factors for obesity

1. **Genetics** – twin studies, adopted and the familial studies provide evidence for the role of genetics in obesity
2. **Age** – increased risk with age
3. **Sex** – women have higher BMI than men
4. **SES**
5. **Sedentary** Lifestyle
6. **Psychological** Factors
7. **Eating Behaviours** – hypercaloric diet
8. **Sleeping Behaviours**

What's the problem?

Medical Complications of Obesity



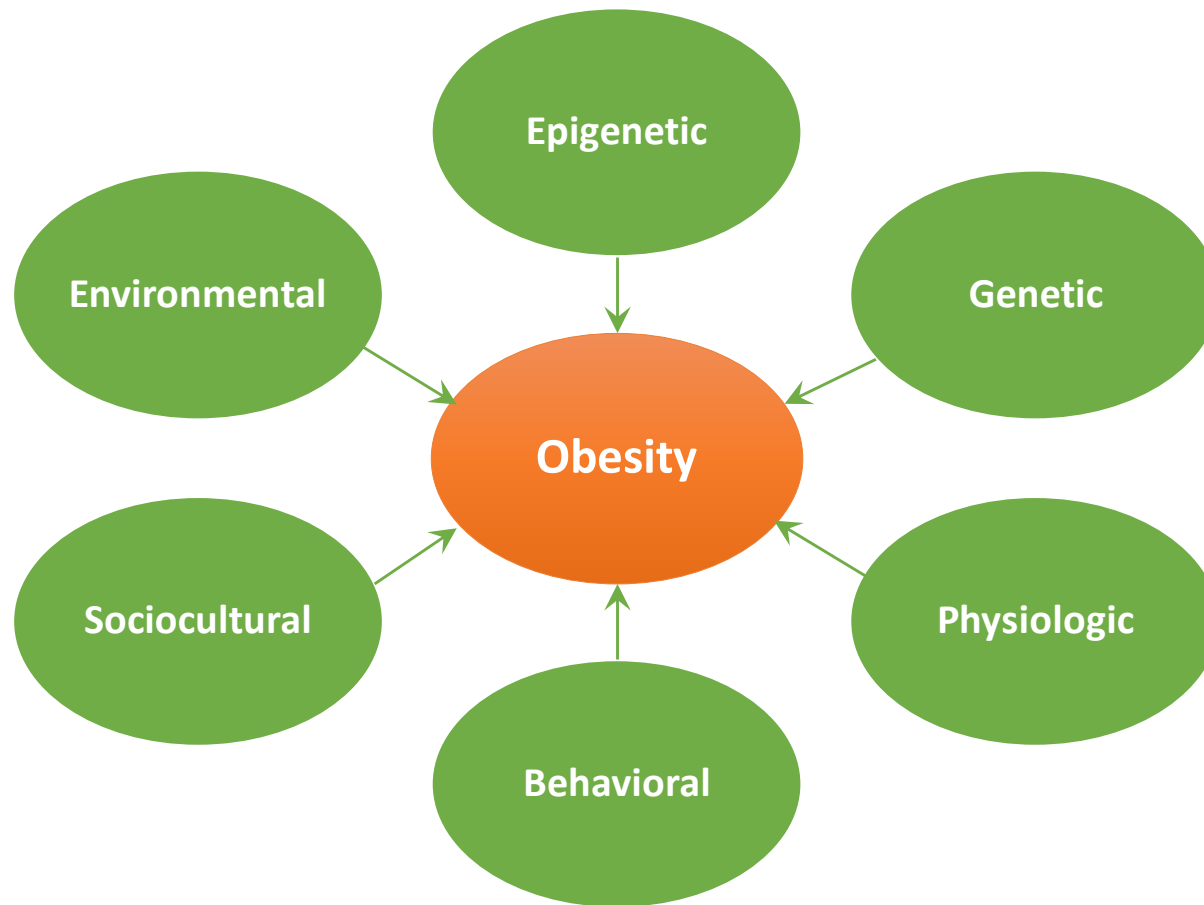
Obesity-Related Abnormalities: Mechanical Problems

- Breathing disorders (sleep apnea, asthma)
- Osteoarthritis
- Urinary stress incontinence
- GERD - gastroesophageal reflux disease.

Obesity-Related Abnormalities: Metabolic and Organ Dysfunction

- Appetite dysregulation
- Abnormal energy balance
- Endocrine dysfunction
 - Elevated leptin levels
 - Insulin resistance
- Dysregulated adipokine signaling (hormones)
- Abnormal endothelial function
- Hypertension
- Infertility
- Nonalcoholic fatty liver disease (NAFLD)
- Dyslipidemia (abnormal lipids/fatty substances in blood)
- Systemic inflammation
- Adipose tissue inflammation

Obesity Has Multiple Pathophysiologic Origins



Potential role of psychology in obesity

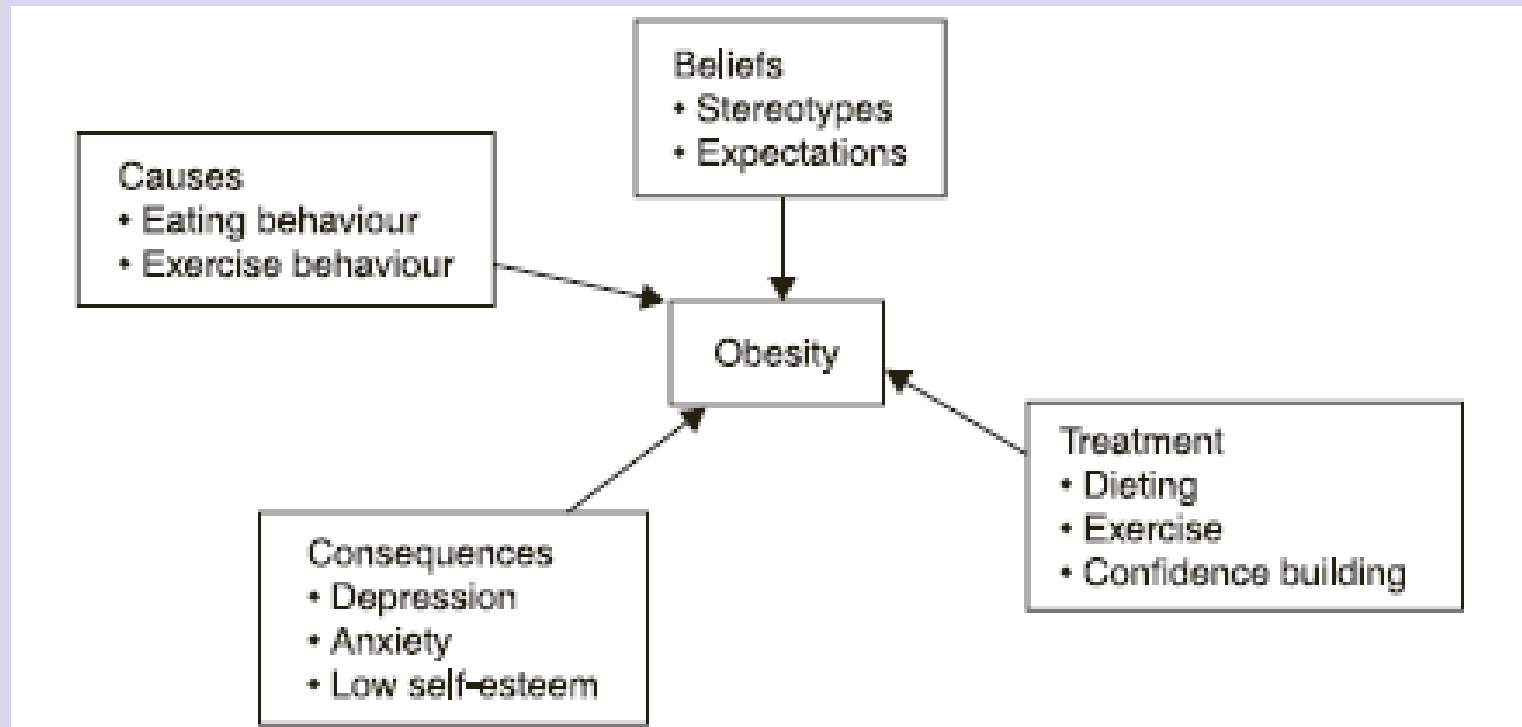


Fig. 15-2 Potential role of psychology in obesity

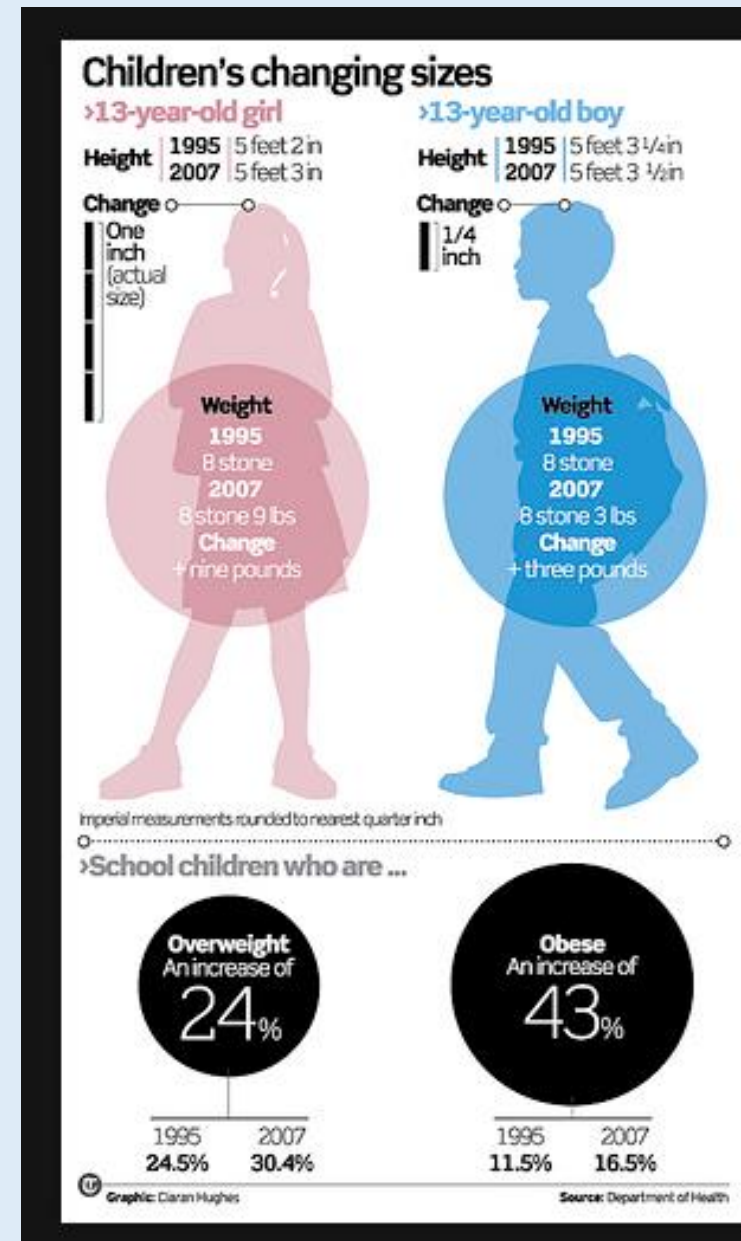
Obesity and psychological problems

- Cross-sectional surveys of health service users indicate people with obesity - higher rates of **depression**.
- However, **confounded** by fact obese people with depression **more likely to seek help**.
- Other studies (e.g. Ross, 1994, using random sampling via telephone), show **lack of a relationship** between obesity & psychological problems.
- **Stereotype** obese as **slow, lazy, and sloppy, less sincere, less friendly, meaner, & more obnoxious** – Rychman et al. (1989)
- **African American women** are less critical of large AA women than white women are of large white women (NZ??)
- **Negative social attitudes** even in young children age 5 – Richardson et al. (1961)
- Reasons for negative attitudes – it is **under the person's control** he/she could stop eating if he/she wanted to stop – Dejon (1980) study of likeability of normal weight & overweight pictures of girls

Obesity in childhood

Biggest risk factors:

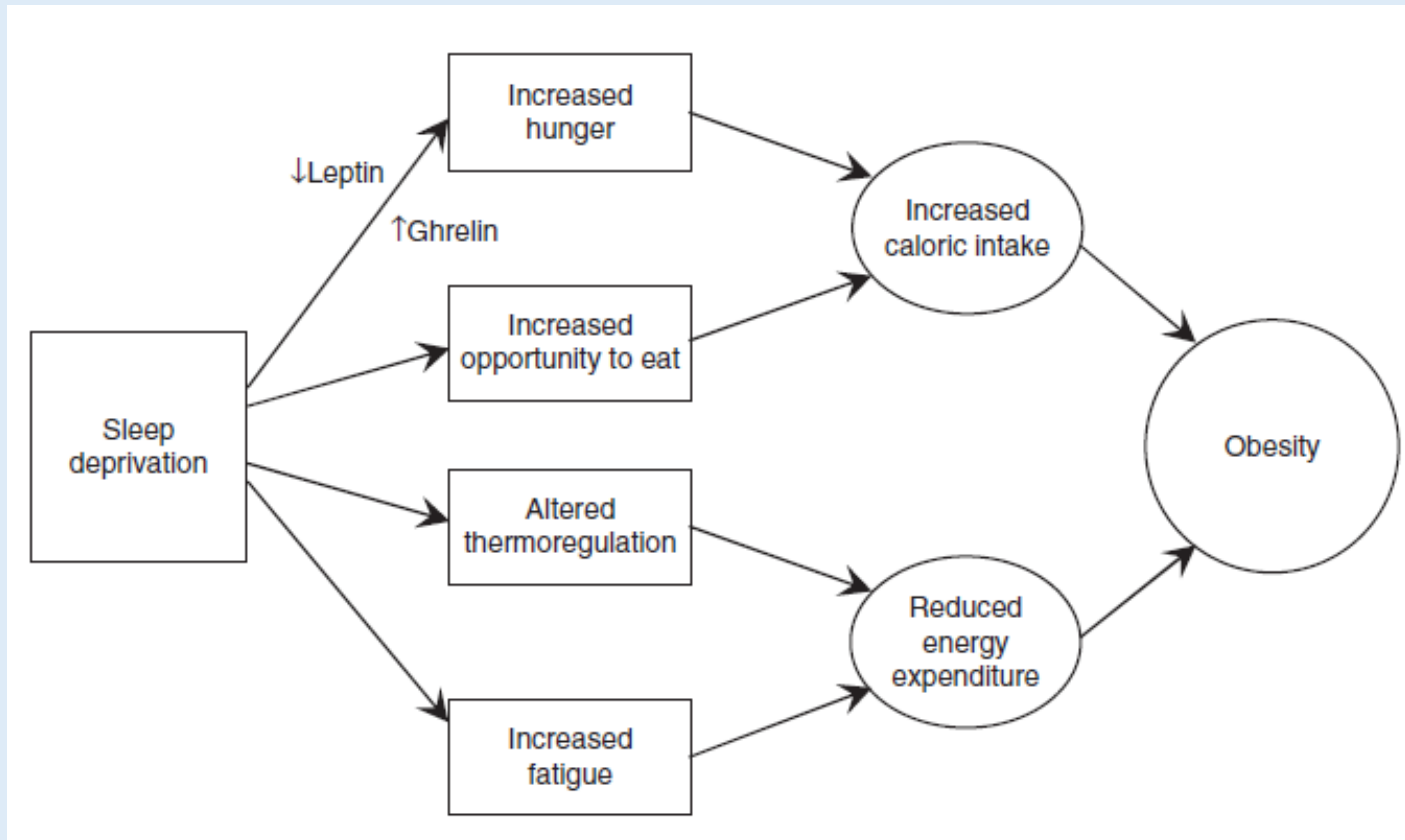
- Low **birth weight** (nutritionally deprived new-borns "programmed" to eat more because develop less neurons in region of brain that controls food intake)
- Low **SES**
- **Parental** obesity
 - Genetics vs. food preferences
- **Sleep** duration
 - More sleep is **protective** against the development of obesity
 - **Physically active children** may be more likely to sleep throughout the night.
- **Television viewing**
 - Decreased energy expenditure



'New' risk factor: lack of sleep

- Sleeping **less than 6 hours per night** has been found to be a risk factor for the development of obesity

Possible Mechanisms: Short Sleep and Weight Gain



Physiological theories: What causes obesity?

1. Genetic Theories:

- 1 obese parent → 40% chance of having an obese child
- 2 obese parents → 80% chance of having an obese child

Evidence from:

- **Twin Studies** – Stunkard et al. (1990) found that 60-70% of variance in body weight was determined by genetics.

BUT the role of genetic appears to be greater in lighter twins.

- **Adoptee Studies** – strong relationship between adopted child & biological parents' weight class (especially mother). No relationship with adoptee parents' weight class.

- Possibly due to: metabolic rate, number of fat cells, appetite regulation

Physiological theories: What causes obesity?

2. Metabolic Rate Theory:

- The **rate of energy** use for biological processes that keep us alive (e.g., respiration, heart rate, blood pressure) is called: ***resting metabolic rate (RMR)*** – which is highly heritable.
- *Relationship between metabolic weight gain:*
 - Researchers studied RMR of Pima Native Americans (80% obesity rate) through breathing over a 40-min period – oxygen consumed and CO₂ were measured
 - After 4 years, the participants who **gained weight** had the **lowest metabolic rates**. **Similar results in other studies.**
 - However – other research indicates that **overweight** people have **slightly higher metabolic rate**, although they might have lower rates prior to their weight gain.

Physiological theories: What causes obesity?

3. Fat Cell Theory

- People of average weight – 25-35 billion fat cells
- **Mildly obese** people have **larger cell sizes**
- Severely obese: **100-125 billion fat cells**
- Cell number is mainly determined by **genetics**
- Growth in number of fat cells occurs during gestation & early childhood
- Fat cells are **typically stable** – once made, they can never be lost (only emptied)

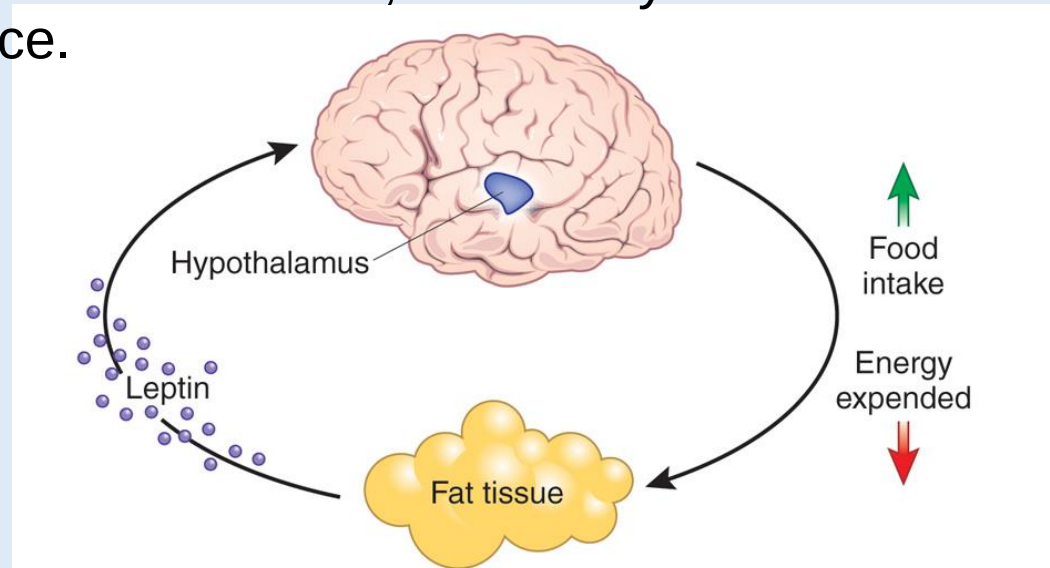
Physiological theories: What causes obesity?

4. Set-Point Theory

- There is an **internal control** for fat storage & weight which matches appetite & energy-expenditures
- **Genetic factors** are the primary determinants of weight set-points
 - Retention of weight **lower** than one's physiological set-point can trigger **hunger & distress**
 - Hunger, in turn, can lead to **preoccupation with food**, which can result in **loss of control and binge eating**
- Problems with this theory is that it can't explain the the “obesity epidemic” or psychological and social influences on hunger & eating.

The role of leptin

- A **hormone** released by the fat cells → decreases food intake and increases energy expenditure
 - Plays a role in **feeling full**
- The role of leptin was found during an experiment in **mice**:
 - Following a genetic mutation, **leptin was not produced** in some mice – these mice did not feel full, and therefore **ate excessively**.
- However, injections of leptin is not the answer, as obesity is associated with leptin resistance.



Behavioural Theories: What causes obesity?

Physical Inactivity

- Only 20% of men &
- 10% of women are employed in **active occupations**
- TV viewing –
 - 13 hours/week in 1960s,
 - 26 hours/week in the 1990s

Research Questions:

Are changes in obesity related to activity?

Do obese people exercise less?

Do the obese exercise less?

- Early research by Bullen et al. (1964) involved **time-lapse photography** to determine whether **obese girls at a summer camp** were less active than non-obese girls
 - During swimming – **more floating** than swimming
 - During tennis – **inactive for 77% of time** (vs. non-obese who were inactive 56% of the time)
- Other research shows:
 - Obese walk less and are less likely to use stairs or escalators
- **But:** cause or effect?

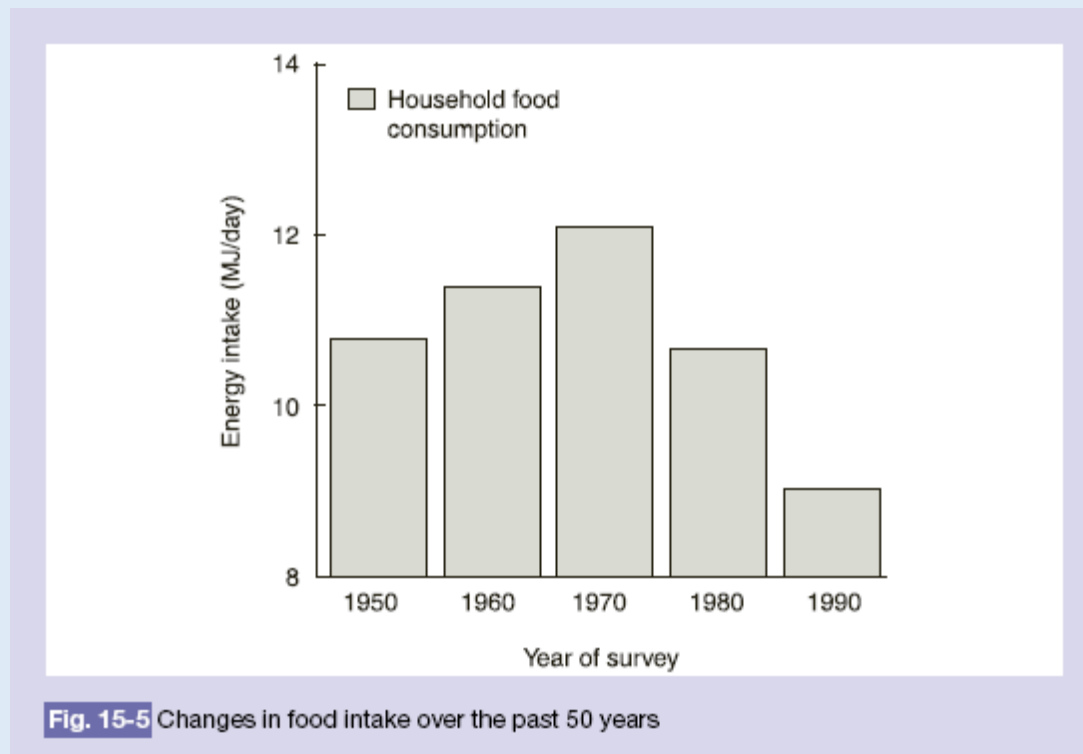
“Fat-but-fit” paradox

However:

- Recent research indicates that obese people are **not necessarily** at higher **risk** for disease than the non-obese
 - People with a high BMI are more likely to have health problems.
 - But **20% may be doing fine**.
 - **“Healthy Obese”**
 - Metabolically healthy with adequate fitness levels have **30-50% lower** risk of mortality than unfit obese people (Ortega et al., 2013)
- *metabolic fitness – may be key.

Behavioural Theories: What causes obesity?

- ***Are changes in food intake at home associated with changes in obesity?***
 - In-home calorie consumption increased between **1950 and 1970**
 - Since 1970 there has been a decrease in our food intake in households



Behavioural Theories: What causes obesity?

- At population level, there does not seem to be a relationship between caloric intake and obesity.

Behavioural Theories: What causes obesity?

- However, a New Zealand study **cautions** us about accepting the reliability of dietary intake data from many studies and health surveys, as this kind of information may often be under-reported.

European Journal of Clinical Nutrition (2014) **68**, 259–264

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www.nature.com/ejcn

ORIGINAL ARTICLE

Under-reporting remains a key limitation of self-reported dietary intake: an analysis of the 2008/09 New Zealand Adult Nutrition Survey

L Gemming¹, Y Jiang¹, B Swinburn², J Utter² and C Ni Mhurchu¹

Nutritional Theories: What causes obesity?

- There is **mixed** evidence whether people with obesity **eat more** than those with healthy body weights.
- It seems that the **type of food consumed** plays a more important role
- (more **fat** consumed).
- **Calories from fat** lead to **more weight gain** than calories from **carbohydrates**.

Nutritional Theories: What causes obesity?

The fat proportion theory of obesity (Blundell & Macdiarmid, 1997) – Possible Mechanisms

1. Benefits of Complex Carbohydrate Use – it takes **more energy** to burn carbohydrates than fat. Carbohydrates are burned, fat is stored.

2. Benefits of Complex Carbohydrates to Hunger – carbs reduce hunger due their **bulk/fibre** content

3. Costs of Fat to Hunger – **fat does not switch off the desire to eat**, making it easier to eat more fat without feeling full

Types of eating

1. External eating – Schachter's Externality theory of obesity
2. Emotional eating – Psychosomatic theory (Bruch, 1964)
3. Restrained eating (Herman & Polivy, 1980)

1. External eating

- According to externality theory, eating in people with obesity is **triggered by external cues**, not by internal ones.
- People should learn to rely on **internal physiological cues** of hunger and satiety – determined by **gastric contractions**
- Some people might **not have learned** to recognise these internal cues – may therefore be **more inclined to follow external cues** – e.g., presence of tasty foods, time of day, smell or taste

Consequence: **eating in absence of hunger**, and consumption of larger amounts than necessary

1. External eating

- Eating **speed** is correlated with risk of obesity in children.
- An experimental study by Hill and McCutcheon (1984) showed that overweight people are more likely to have **higher eating rates and larger bite sizes**.
- Thus, fast eaters may eat too fast for **satiety feedback**.

2. Emotional eating: Psychosomatic Theory

- Overeating as a reaction to **emotion**
- People learn to **label** negative feelings (e.g., depression, anxiety) as hunger
- Develop habit of **overeating** to react against **emotional** feelings

3. Restrained eating

- Overeating as a consequence of **unsuccessful dieting**
- Chronic diet is impossible → eventually leads to **relapse**
- **Ignoring of internal cues** (e.g., hunger) leads to **heightened sensitivity** to external cues (which can lead to overeating)
- **Emotional and external eating** are thus consequences of **dieting**

Reasons for the increase in prevalence of obesity?

- Thrifty Genotype Hypothesis (Neel, 1972).

Natural selection favoured individuals with a highly efficient rate of **fat storage** during periods between famines.

But:

- Famines only become a regular occurrence with the introduction of **agriculture** (10,000 years ago)
- Most people in famine die of **disease** rather than starvation
- People who die in famines tend to be those of **non-reproductive age** (children and elderly)

Thrifty Phenotype Hypothesis

Hales and Barker (1992)

Gene expression is triggered by **environmental cues**.

The pathways of foetal development are determined by *anticipated* environmental conditions.

In response to “hard times”, the foetus makes a series of **metabolic adaptations** to increase chances of **survival in postnatal life**.

Metabolism is then geared towards **being small, hoarding calories, and avoiding exercise**.

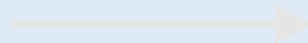
Developmental Origins of Human Adult Disease (DOHAD) Hypothesis

Also known as *foetal programming*. This is the notion that **impaired fetal growth causes adult disease**.

In response to “**hard times**”, foetus makes a series of metabolic adaptations to survive.

These adaptations, or their effects, **persist into adult life** & can lead to insulin resistance, hypertension etc.

Many **metabolic, endocrine & cardiovascular disorders** are thus the result of a mismatch between predicted & actual environment.



Social consequences of obesity

- **Psychological correlates of obesity in children**
 - Decreased **quality of life**
 - **Depression** (bi-directional?)
 - **Self-worth** negative associated with obesity
 - **Low self-esteem**: Franklin et al., 2006, although certainly not all.
 - But **boys** are less affected.

Weight-related victimisation

- Reported by **24% of teenagers**

- Thin boys and obese girls
- Distress and binge eating

(Neumark-Sztainer et al., 2002)

- Fat-teasing

- Reported by **18% of 9-year olds**
- **14% of 12 year olds**

(Hill & Murphy, 2000)

Treating obesity – dieting

- The history of dieting fads is a fascinating topic in itself. Many stick around longer than others. Some that did not, include:
 - chewing gum
 - diet soap
 - tape worms
 - smoking

Treating obesity

- **Traditional Approach** – address inappropriate *eating habits and physical exercise*.
- But after losing weight, most regain weight.
 - Success linked to **self-efficacy and social support**
- **Psychological problems with obesity treatment:**
 - Research has found **increased depression** with obesity treatment
 - **Dieting** can lead to bingeing – precipitated by anxiety, frustration, depression, & unpleasant emotions
 - Weight cycling and regain; denial, guilt, low self-esteem
- **Physiological problems with obesity treatment:**
 - **Yo-yo dieting and negative health consequences**

Benefits of weight loss

- **Weight loss is linked to:**

- Elation, **improved self confidence**, wellbeing
 - Improved **blood pressure**
 - Reduction in **CHD** risk
 - Improvements for **diabetics**
 - Even if weight loss is fairly small.
-
- However, risk of weight regain & its negative consequences.
 - According to restraint theory, restrained eating should be avoided; **different kinds of food and exercise instead** (although more beneficial for weight loss maintenance)

Other treatments for obesity

- Drug Treatments

- Fenfluramine and dexfenfluramine – both have been pulled from the market due to association with heart disease; should be used only when other options have failed

- (1) Drugs targeting CNS and suppress appetite, e.g. Phentermine

- Side effects: nausea, dry mouth, constipation

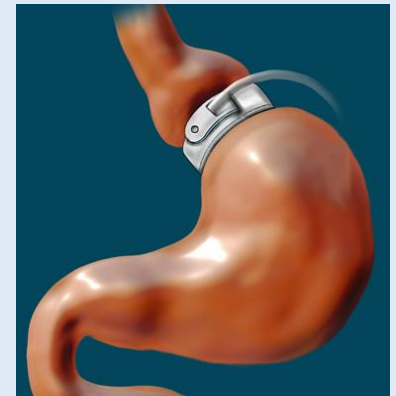
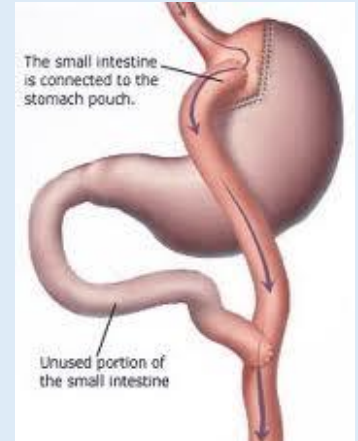
- (2) Drugs targeting gastrointestinal system, e.g. Orlistat

- Reduce fat absorption
 - Side effects: liquid stools, anal leakage (especially after a high-fat meal)

Other treatments for obesity

- Surgical Treatments

- 21 different surgical treatments for obesity
- Two most popular: **gastric bypass** and **gastric binding**:
- **Gastric bypass** – stomach into two pouches (one upper/one remaining lower) that connect to the small intestine
- **Gastric band** – silicone device placed around top of stomach
- Only recommended for people with **BMI > 35** who have not shown substantial weight loss following dietary or drug treatment



Summary

- Obesity is a disease
 - **Genetic, environmental, and behavioral factors** all contribute to its pathogenesis
 - Impairments in **physical and physiologic functioning** contribute to high rates of morbidity and mortality