Can diabetes be reversed?

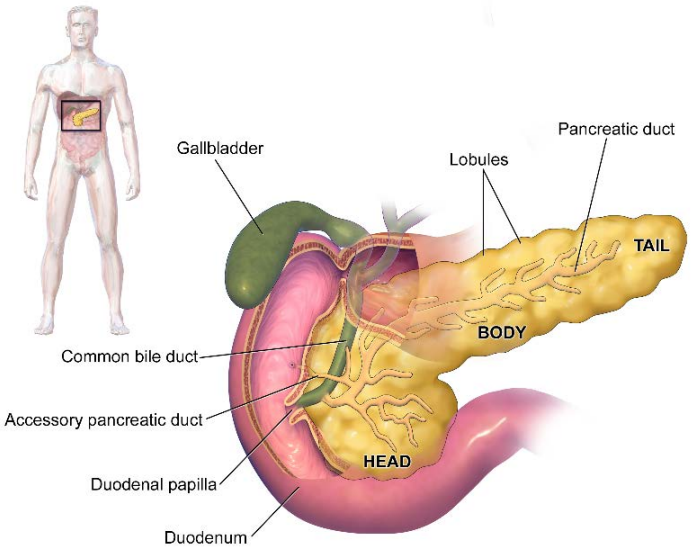
Presented by Dr Alan Barclay, PhD

My inspiration

Introduction

Insulin and glucagon

- Produced by the pancreas - a small tadpole shaped organ that's behind the stomach.
- It secretes digestive juices and hormones.
- Insulin lowers blood glucose.
- Glucagon raises blood glucose.



Types of diabetes

Type 1

- The pancreas no longer produces insulin.
- Insulin every day by either injection or a pump

Type 2

- The pancreas is able to produce insulin, but not enough to meet all of the body's requirements
- Lifestyle → medication → insulin

Gestational

- Develops around 24th week of pregnancy
- Lifestyle → insulin → medication

Pre-diabetes

Impaired fasting glycaemia

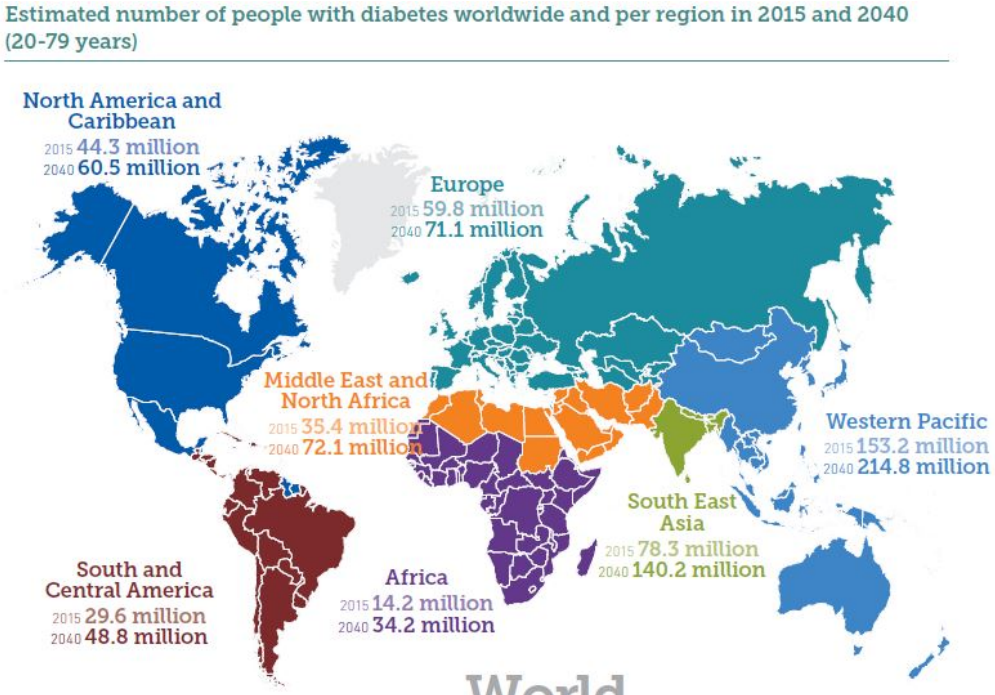
- Fasting blood glucose is higher than normal (>5.5 mmol/L) but not high enough to have diabetes (< 7.0 mmol/L)

Impaired glucose tolerance

- Oral Glucose Tolerance Test result more than 7.8 but less than 11.0 mmol/L at 2 hours

“Pre-Diabetes”

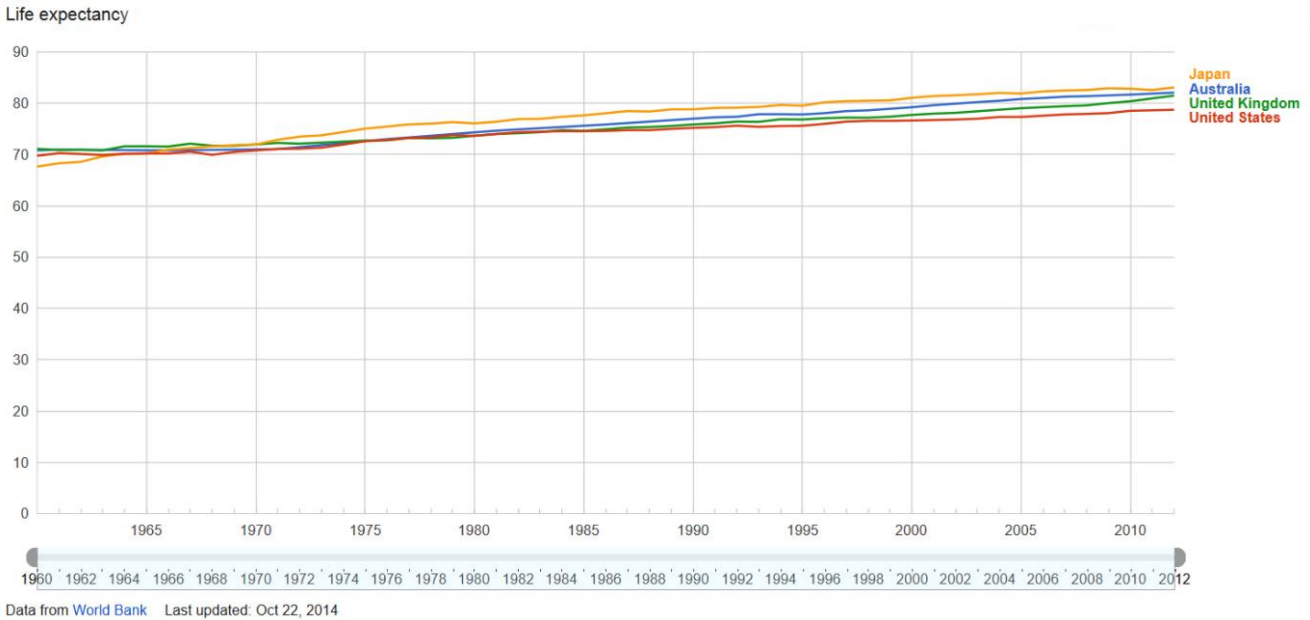
Diabetes around the



Source: International Diabetes Federation, 2015

Why are diabetes rates increasing?

Ageing population



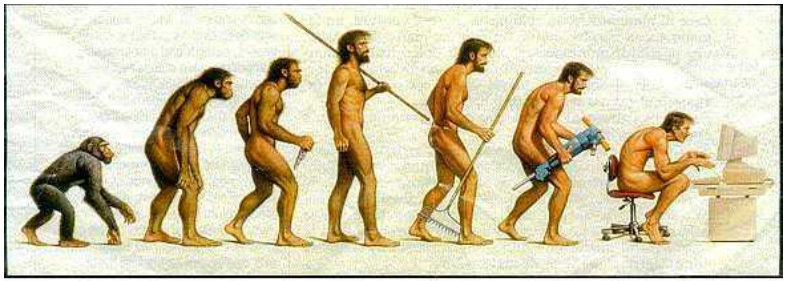
- Average life expectancy in Australia in 1960 – **70.8 years**

Why are diabetes rates increasing?

Physical inactivity

- Mechanisation at home, in the workplace and of transport.

- Decreased muscle mass, increased body fat and as a consequence increased insulin resistance.



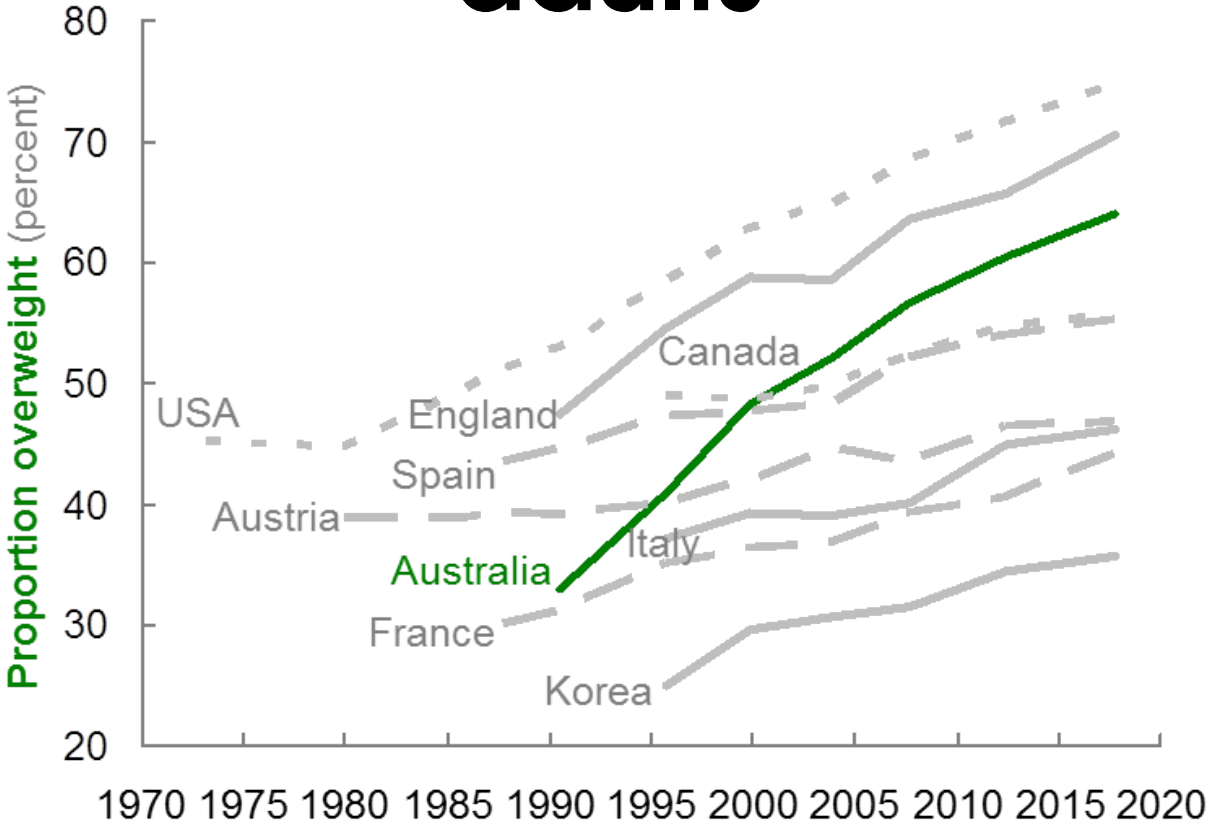
Somewhere, something went terribly wrong

Why are diabetes rates increasing?

Food and nutrition

- The cost of living is high…men and women both work to pay mortgages, cars, school fees, etc…so are time poor.
- Increased reliance on convenience food
- Relatively cheap and tasty.
- High in refined ingredients.
- Energy dense, but nutrient poor.
- High glycemic load
  (High glycemic index and total carbohydrate).

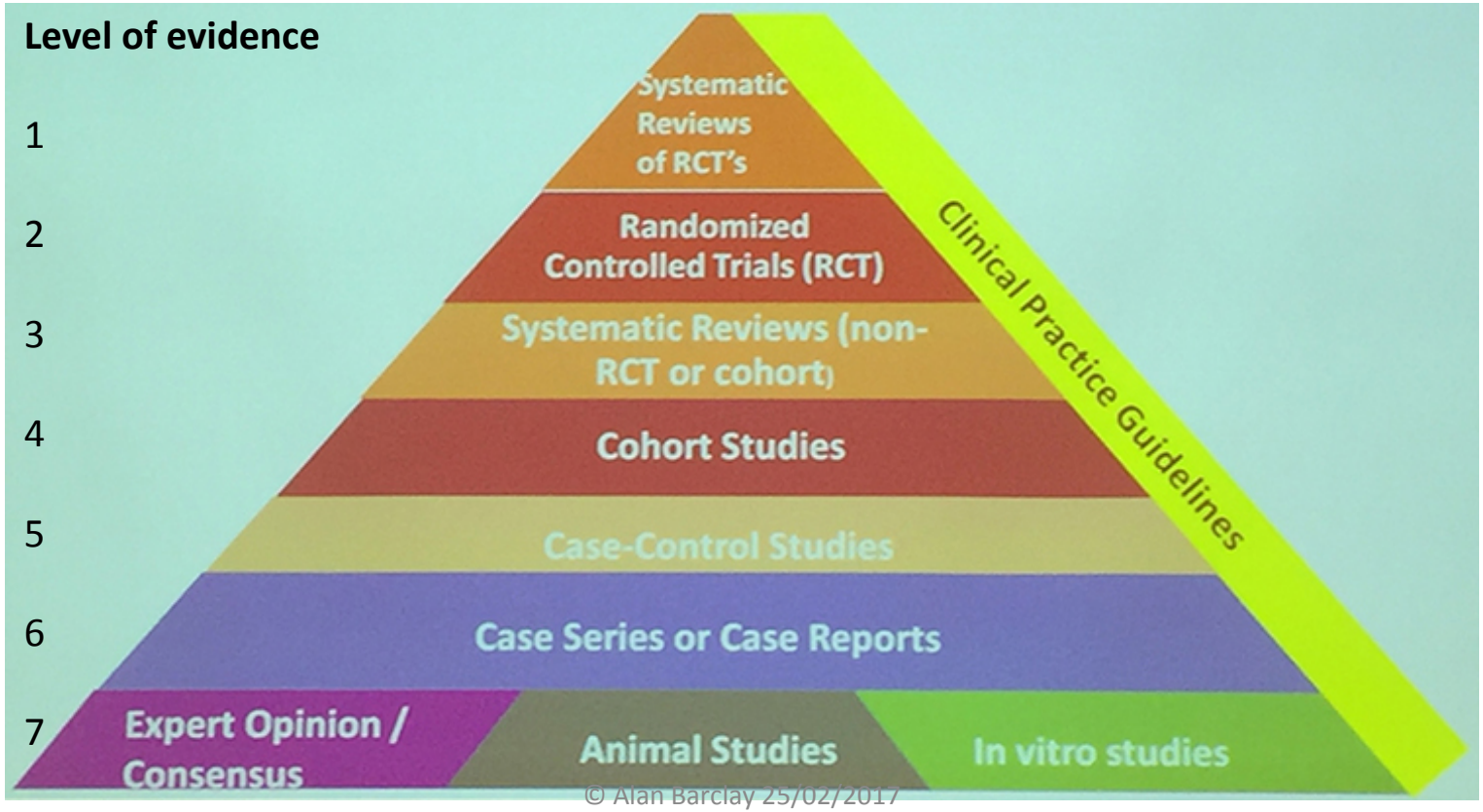
Overweight / obesity is increasing in adults



SOURCE: OECD Obesity and the Economics of Prevention: Fit not Fat - Australia Key Facts, OECD Obesity Update 2012

Can diabetes be reversed?

Scientific evidence hierarchy



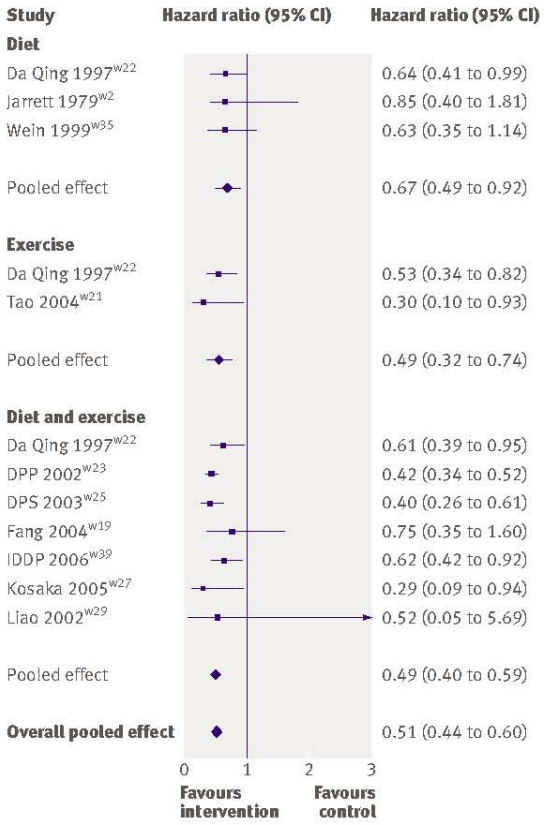
Can diabetes be reversed?

Pre-diabetes[1]

- Systematic reviews of RCTs (level 1 evidence) including >8,000 people:

  - 5 – 10% weight loss
  - Reduced energy diet (↓ 2000 kilojoules / day)
  - Low saturated fat, high in dietary fibre
  - 150 minutes of exercise a week

- > 5 out of 10 people can prevent type 2 from developing in the long-term (> 2 years)



1. Gillies et al. BMJ. 2007; 334(7588):299

Diabetes remission[2]

- Remission requires the absence of ongoing hypoglycemic medication use, and can be defined as either:

Partial: at least 1 year of hemoglobin A1c levels 5.7– 6.4% (39–46 mmol/mol);

Complete: at least 1 year of normoglycemia (HbA1c level <5.7% (<39 mmol/mol))

- Only applies to type 2 diabetes

2. Karter et al. Diabetes Care, 2014

Diabetes remission[2]

- Remission is not the same as "cure".
- Type 2 diabetes may re-occur years later, either due to people slowly regaining weight or simply due to advancing age.
- There are 3 main approaches for putting type 2 diabetes into remission:

  1) Insulin therapy; 2) Bariatric surgery; 3) Lifestyle

2. Karter et al. Diabetes Care, 2014

Insulin therapy[3]

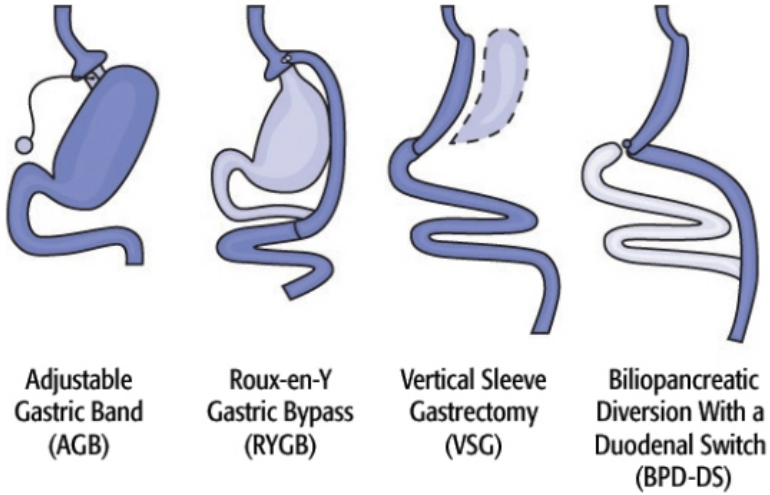
- Short-term insulin therapy for newly diagnosed people with type 2 diabetes.
- Daily injections of insulin for 2 – 3 weeks.
- Systematic reviews of RCTs including >800 people indicate that:

  > 4 out of 10 people are in remission for > 1 year

3. Kramer et al. Lancet, 2013

Bariatric surgery[3]

- The aim of bariatric surgery is to restrict food intake and decrease the absorption of food in the small intestine.
- There are 4 main types:



3. Kramer et al. Lancet, 2013

Bariatric surgery[4,5]

- Systematic reviews of RCTs and cohort studies including 675 people with type 2 diabetes indicate that:

  Gastric bands led to remission in 28.6% of people with diabetes

  Roux-en Y gastric bypass led to remission in 66.7 %.

- For more than 2 years

- However, type 2 diabetes re-occurs in up to 40% of cases in RCTs with ≥5 years of follow-up.

4. Buzzetti R, et al JAMA. 2014; 5. Maleckas et al. Sc J Surg, 2015.

Bariatric surgery[4,5]

- BMI > 35 and between $10,000-18,000 *after* Medicare rebates
- As with all types of surgery, bariatric surgery is associated with risks including internal bleeding, deep vein thrombosis, infections, and pulmonary embolism.
- People who have had bariatric surgery still need to adhere to a rigorous and lifelong food and exercise plan to prevent complications and to avoid putting on weight after surgery.

4. Puzziferri, et al JAMA, 2014; 5. Maleckas et al. Sc J Surg, 2015.

Lifestyle[6]

- Reduced, low or very low energy (kilojoule) diets + regular physical activity / decreased sedentarism
- Systematic reviews of RCTs including ~800 people indicate that:

  1 out of 8 people are in remission for > 2 years

6. Gloy et al. BMJ, 2013

Lifestyle[6]

- **Very low energy** (kilojoule) diets prov
  < 3,300 kJ (800 Calories/day) a day
  45 - 90 g of carbohydrate a day
  2 - 20 g fat a day

- Typically skim-milk based "shakes" but can be achieved with real food.
- Most shakes provide 100% of the recommended dietary intakes (RDIs) for most vitamins and minerals.

6. Gloy et al. BMJ, 2013

Lifestyle[7]

- **Low energy** (kilojoule) diets provide:

  4,200 - 6,300 kJ (1,000 – 1,500 Calories/day) a day

- Consist of main meals, snacks, desserts, etc...

- Nutritionally complete (provide enough protein, fat, carbohydrate, vitamins and minerals for the typical adult).

7. Rehackova et al Diabet Med 2016

Lifestyle[8]

- Reduced energy diets tailor-made to the individual.
- Based on evidence-based diabetes guidelines and dietary guidelines for the general population (whe vice for people with diabetes is

8. Evert et al. Diabetes Care, 2013

Can diabetes be reversed?

Type 1 diabetes

- Prevention - potential dietary factors:
  - Infant feeding practices
  - Omega 3 fats
  - Vitamin D
  - Glycemic index
  - Microbiome
- Reversal:
  - Transplants (pancreas or islet cell)
  - Closed-loop insulin pumps (with continuous glucose monitors)

Can diabetes be reversed?

Preventing complications[9]

The most common complications that occur in people with diabetes include:

- retinopathy, which affects the eyes
- neuropathy and peripheral vascular disease, which affect the feet
- kidney disease (nephropathy)
- erectile dysfunction, which causes impotence
- cardiovascular disease, which affects the heart and blood vessels in the brain
- periodontal disease, which affects the gums.

9. RACGP and DA, 2016

Can diabetes be reversed?

Preventing complications[9]

- It is not inevitable that all people with diabetes will develop complications – they can be prevented.
- The best way to prevent them is to *achieve* and *maintain* **blood glucose** levels, **cholesterol** and **triglyceride** profiles and **blood pressure** levels in the normal range or as close to

HEALTH MEASURE	RECOMMENDED RANGE
Blood glucose levels	6–8 mmol/L fasting* 8–10 mmol/L after a meal or snack*
Glycated haemoglobin (HbA1c)	Less than or equal to 7% (range 6.5–7.5)* Less than or equal to 53 mmol/mol (range 48–58)*
Blood cholesterol	Total less than 4.0 mmol/L HDL greater than or equal to 1.0 mmol/L LDL less than 2.0 mmol/L
Blood triglycerides	Less than 2.0 mmol/L
Blood pressure	Less than or equal to 130/80 mmHg

** Primarily for people with type 2 diabetes or pre-diabetes. People with type 1 diabetes may have different targets that should be determined in conjunction with their health professional team.*

9. RACGP and DA, 2016

Nutritional management

Goals of nutritional management of diabetes[8]

1) **Achieve and maintain** blood glucose levels, lipid and lipoprotein profiles and blood pressure levels in the normal range or as close to normal as is safely possible

2) **Prevent**, or at least slow, the rate of development of the **chronic complications** of diabetes by modifying nutrient intake and lifestyle

3) **Address individual nutrition needs**, taking into account personal and cultural preferences and willingness to change

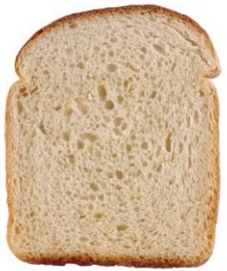
4) **Maintain the pleasure of eating** by only limiting food choices when indicated by scientific evidence

8. Evert et al. Diabetes Care, 2013.

Blood glucose

Carbohydrates have the most powerful effect

- Fruit
- Vegetables
- Milk and yoghurt
- Legumes
- Grains and pastas
- Bread and crispbreads
- Breakfast cereals
- Savoury snacks
- Hot chips/French fries
- Soft drinks, juice, ice tea, etc
- Confectionery
- Table top sweeteners



Carbohydrates are an essential nutrient[9,10]

- Primarily an energy source for our bodies:
  → the preferred fuel for our brains and nervous systems, and for our exercising muscles
- Structural (within cells)
- Genetic (RNA and DNA)
- Function of certain proteins (glycoproteins)
- Adds taste, texture and colour to our foods and drinks.

9. Mann and Truswell. 2012; 10. Wahlqvist, 1988.

Minimum carbohydrate requirement[9]

- Adult brains require 140 g of glucose per day
- Red blood cells require 40 g of glucose per day
- Therefore minimum requirement is 180 g glucose / day
- However, gluconeogenesis (lactic acid, amino acids and glycerol) can supply ~130 g glucose per day
- So absolute minimum is 50 g glucose per day
- However, judgement can be impaired and

9. Mann and Truswell. Essentials of Human Nutrition. 2012

Are sugars and starches different[11]?

- All are digested to the monosaccharide's:
  - glucose
  - fructose
  - galactose
- All monosaccharide's are converted to:
  - glucose
  - pyruvate
  - lactate
- All are used for fuel:
  - brain and nervous system
  - kidneys
  - red blood cells
  - muscles

11. Carbohydrates in human nutrition. 1998. FAO Food and Nutrition Paper – 66.

Nutritionally, refined sugar ≈ refined starch[12]

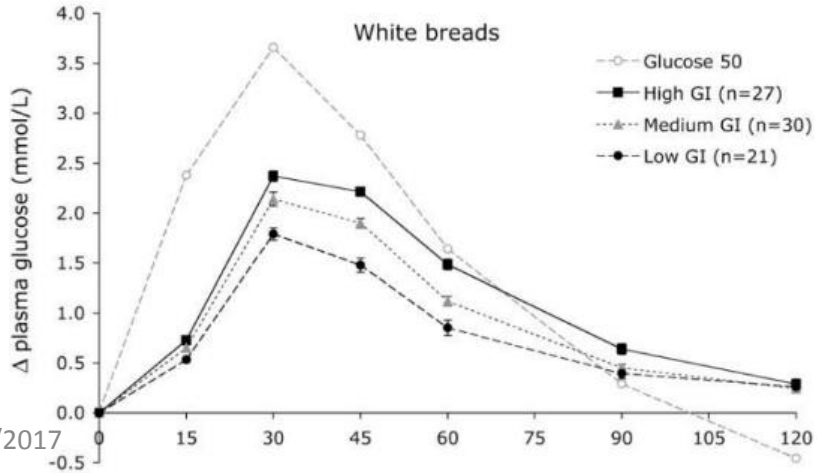
Nutrients in 1 teaspoon (5g) sugar versus cornstarch

Nutrient	Sugar	Cornstarch
Energy (kJ)	79	73
Carbohydrate (g)	4.9	4.2
Sugars (g)	4.9	0.01
Starch (g)	0.01	4.2
Fibre (g)	0	0
GI	65	70+
Sodium (mg)	0.1	0.6
Potassium (mg)	1.1	0.8
Calcium (mg)	0.5	0.4
Iron (mg)	0	0
B1 (mg)	0	0

12. AusNut2011/2, FSANZ, 2013.

Glycemic Index (GI): a better system for classifying carbohydrates[13]

- Compares equal quantities of available carbohydrate in foods
- Is a measure of their effect on blood glucose levels in 10+ healthy people over a
- Is a percentage
- ISO 26642 2010



13. International Standards Organisation, 2010.

Glycemic Index (GI): Ranking

Individual food portion[14]:

Low	55 or less
Moderate	56 - 69
High	70+

Whole day[15]:

Low	45 or less
Moderate	46-59
High	60+

14. Standards Australia, 2007
15. Brand-Miller, Nutrition & Dietetics 2009; 66: 136–137

Glycemic load (GL)

- The combination of a food's glycemic index and its total available carbohydrate content:

Glycemic Load = GI (%) x Carbohydrate (g)

- Using an apple as an example:

  GI value = 38%; Carbohydrate per serve =15 g

  GL = 0.38 x 15 = 6

  The GL of a typical apple is 6

Glycemic Load (GL): Ranking

Individual food portion[16]**:**

Low	0-10
Moderate	11-19
High	20+

Whole day[17]**:**

Low	< 100 g 8,700 kJ/d diet

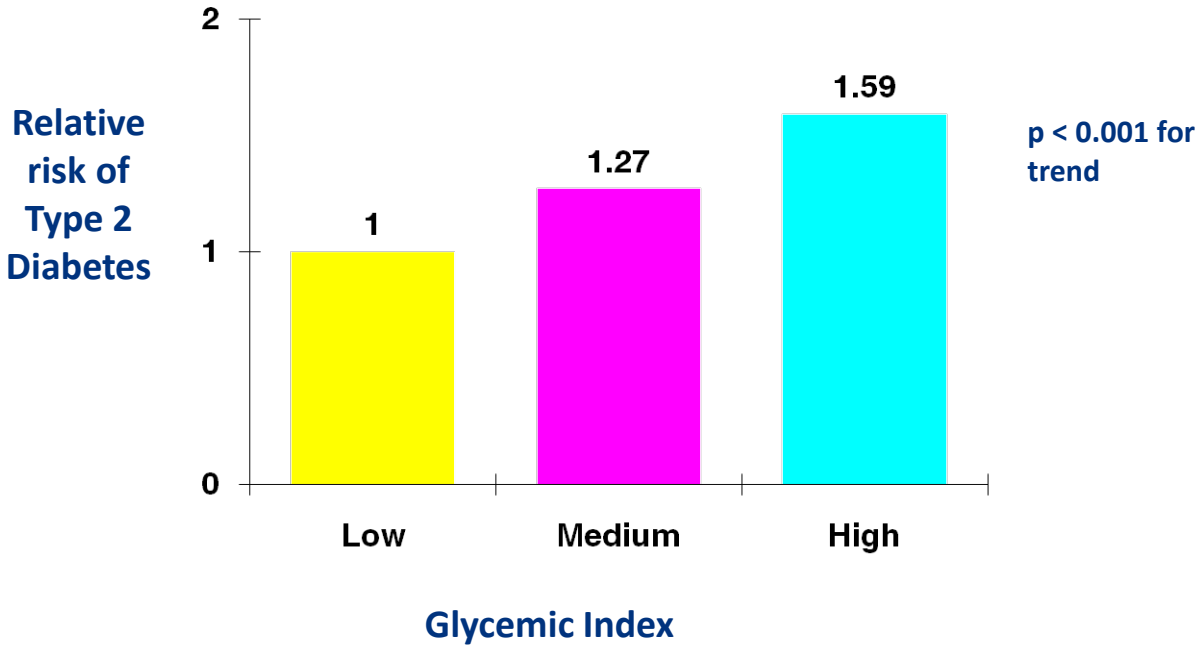
16. Brand-Miller JC, Holt SHA, and Petocz P. Glycemic load values:2002. Am J Clin Nutr. 2003; 77 (1): 993-5.

17. Livesey et al, AJCN. 2013.

Low GI diets and risk of Type 2 diabetes

Glycemic Index, glycemic load, and dietary fibre intake and incidence of type 2 diabetes in younger and middle-aged women[18]

Design	Observational study
Participants	91,249 US Women, aged 24-44
Results	High GI diet increase risk by 59%
Diet	**Carb intake 224 g/day (50% E)**
Fibre intake	18.5 g/day
Median GI	49



18 Schulze et al Am J Clin Nutr, 2004; 80:348-356

Systematic review and meta-analysis of low GL diets and prevention of type 2 diabetes[17]

- All evidence available from cohort studies
- People consuming a low GL diet (<95g/8,400kJ/day)
- Decrease risk of developing type 2 diabetes by 45%
- This can be achieved by either:

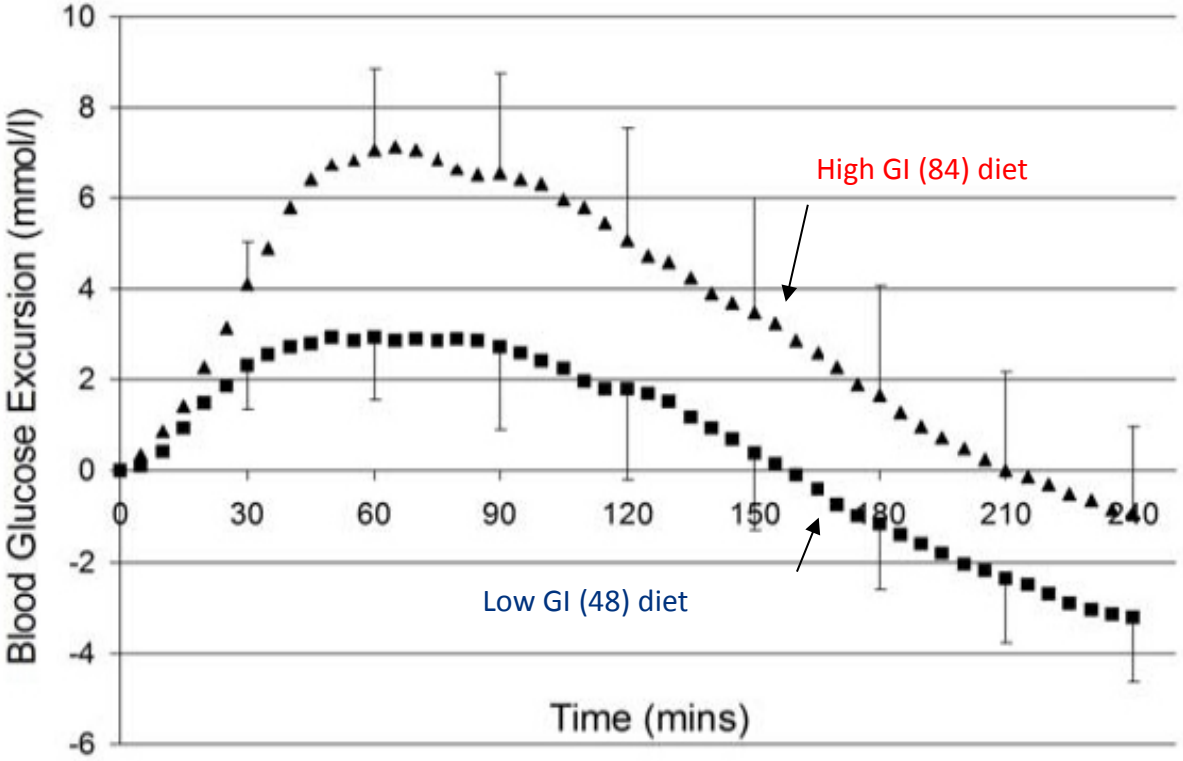
  consuming 200 g carbohydrates (~40% kJs) a day with a GI of 50, or

  250 g carbohydrates (~50% kJs) a day with a GI of 40

17. Livesey, et al. AJCN 2017.

GI and BGLs in children with type 1[19]

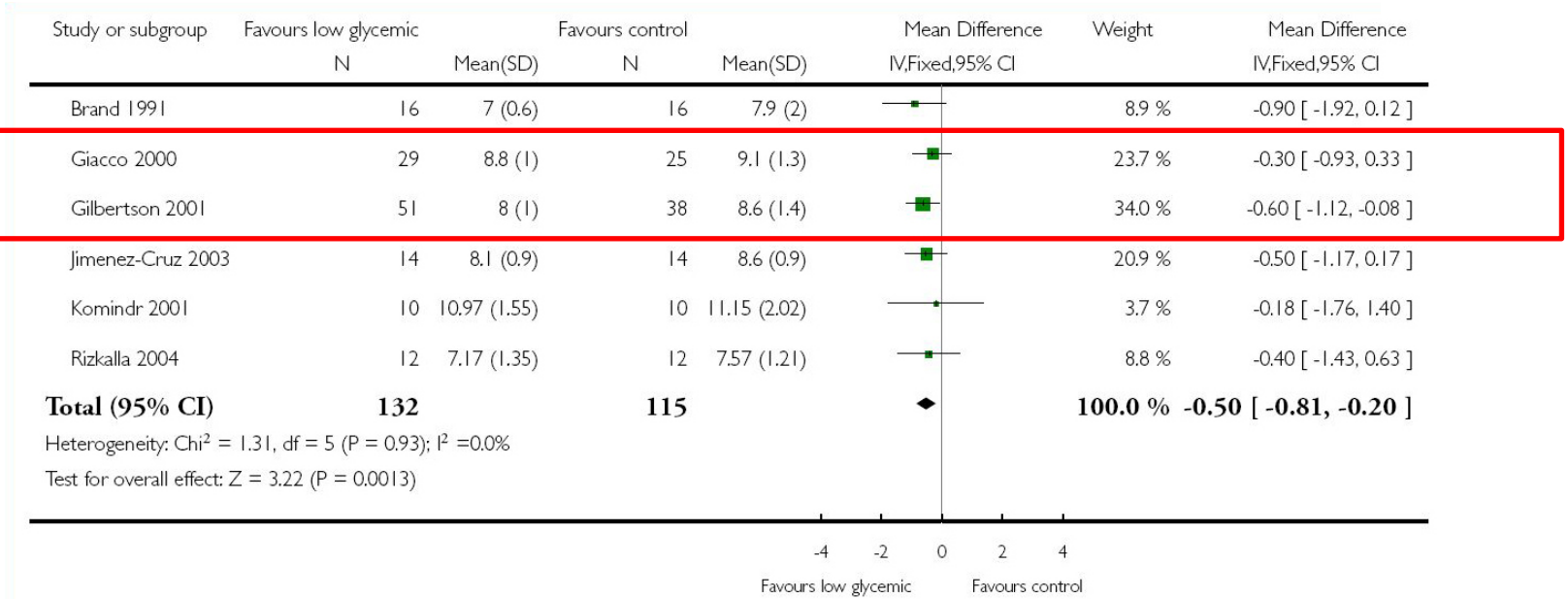
Randomised cross-over trial, 20 Australian children aged 7-17 yrs.



19. Ryan et al. Diabetes Care. 2008 ;31(8): 1485-90

GI and glycated hemoglobin[20]

11 RCT's. 402 participants



Study or subgroup	Favours low glycemic N	Mean(SD)	Favours control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Brand 1991	16	7 (0.6)	16	7.9 (2)		8.9 %	-0.90 [-1.92, 0.12]
Giacco 2000	29	8.8 (1)	25	9.1 (1.3)		23.7 %	-0.30 [-0.93, 0.33]
Gilbertson 2001	51	8 (1)	38	8.6 (1.4)		34.0 %	-0.60 [-1.12, -0.08]
Jimenez-Cruz 2003	14	8.1 (0.9)	14	8.6 (0.9)		20.9 %	-0.50 [-1.17, 0.17]
Komindr 2001	10	10.97 (1.55)	10	11.15 (2.02)		3.7 %	-0.18 [-1.76, 1.40]
Rizkalla 2004	12	7.17 (1.35)	12	7.57 (1.21)		8.8 %	-0.40 [-1.43, 0.63]
Total (95% CI)	**132**		**115**			**100.0 %**	**-0.50 [-0.81, -0.20]**

Heterogeneity: Chi² = 1.31, df = 5 (P = 0.93); I² =0.0%

Test for overall effect: Z = 3.22 (P = 0.0013)

- Significantly less hypos

(difference of -0.8 episodes per patient per month, P < 0.01).

20. Thomas and Elliot. The Cochrane Collaboration, 2009.

Blood fats (lipids)

Fats and oils have the most powerful effect

- The quality of the fat consumed is very important.
- **Less saturated fats** and **avoid trans fats** like those found in cheap margarines, Copha, fatty meat, commercial biscuits, cakes, chips and deep fried takeaway foods.
- **More mono** and **polyunsaturated fats** like olive or Canola, peanut or sesame oil.
- Saturated : unsaturated fat **ratio of 1 : 2**
- Increase HDL (good) and decrease LDL (bad) cholesterol

Blood pressure

Sodium and potassium have the most effect

- Australians consume too much salt (sodium chloride) = 2,430 mg sodium a day.
- Processed foods are the main source.
- Choose salt-reduced varieties and limit salt and salty ingredients in recipes.
- Aim for between 920 and 2,300 mg a day.
- Consider **increasing your potassium intake** to balance the sodium.
- WHO recommend a sodium : potassium ratio of ≤ 1 : 1
- Improve systolic and diastolic blood pressure.

Putting evidence in to practice

Dietary Patterns[8]

Eating patterns	A variety of eating patterns (combinations of different foods or food groups) are acceptable for the management of diabetes. Personal preferences (e.g., tradition, culture, religion, health beliefs and goals, economics) and metabolic goals should be considered when recommending one eating pattern over another.	E

Type of eating pattern	Description
Mediterranean style (96)	Includes abundant plant food (fruits, vegetables, breads, other forms of cereals, beans, nuts and seeds); minimally processed, seasonally fresh, and locally grown foods; fresh fruits as the typical daily dessert and concentrated sugars or honey consumed only for special occasions; olive oil as the principal source of dietary lipids; dairy products (mainly cheese and yogurt) consumed in low to moderate amounts; fewer than 4 eggs/week; red meat consumed in low frequency and amounts; and wine consumption in low to moderate amounts generally with meals.
Vegetarian and vegan (97)	The two most common ways of defining vegetarian diets in the research are vegan diets (diets devoid of all flesh foods and animal-derived products) and vegetarian diets (diets devoid of all flesh foods but including egg [ovo] and/or dairy [lacto] products). Features of a vegetarian-eating pattern that may reduce risk of chronic disease include lower intakes of saturated fat and cholesterol and higher intakes of fruits, vegetables, whole grains, nuts, soy products, fiber, and phytochemicals.
Low fat (98)	Emphasizes vegetables, fruits, starches (e.g., breads/crackers, pasta, whole grains, starchy vegetables), lean protein, and low-fat dairy products. Defined as total fat intake <30% of total energy intake and saturated fat intake <10%.
Low carbohydrate (88)	Focuses on eating foods higher in protein (meat, poultry, fish, shellfish, eggs, cheese, nuts and seeds), fats (oils, butter, olives, avocado), and vegetables low in carbohydrate (salad greens, cucumbers, broccoli, summer squash). The amount of carbohydrate allowed varies with most plans allowing fruit (e.g., berries) and higher carbohydrate vegetables; however, sugar-containing foods and grain products such as pasta, rice, and bread are generally avoided. There is no consistent definition of "low" carbohydrate. In research studies, definitions have ranged from very low-carbohydrate diet (21–70 g/day of carbohydrates) to moderately low-carbohydrate diet (30 to <40% of calories from carbohydrates).
DASH (99)	Emphasizes fruits, vegetables, and low-fat dairy products, including whole grains, poultry, fish, and nuts and is reduced in saturated fat, red meat, sweets, and sugar-containing beverages. The most effective DASH diet was also reduced in sodium.

8. Evert et al. Diabetes Care. 2013

Is one pattern better than another?

- Systematic review and meta-analysis of 20 RCTs of 7 different dietary patterns following 3,073 people for ≥6 months[21]
- Low-CHO, low-GI, Mediterranean, and high protein diets all effective in ↓ HbA1c by 0.12-0.47% points

"*Dietary behaviors and choices are often personal, and it is usually more realistic for a dietary modification to be individualized rather than to use a one-size-fits-all approach for each person.*"

21. Ajala et al, . AJCN, 2013.

Vegetarian diets

- Systematic review and meta-analysis of 6 RCTs including 255 people followed for an average of 24 weeks (range 4-74 weeks)[22]
- ~10% of energy from fat, 15% protein, 75% carbohydrate
- Consumption of vegetarian diets was associated with a significant reduction in HbA1c –0.39 % points

22. Yokoyama Y, et al. Cardiovasc Diagn Ther. 2014

Macronutrient consumption in Australia 1995–2011/2[23,24]

National representative surveys of Australians:

14,000+ in 1995 and 12,000+ in 2011/2

		1995 National Nutrition		National Nutrition and Physical Activity Survey 2011-	
		Mean (%)	Mean (g)	Mean (%)	Mean (g)
Protein		16.7	93	18.4	94
Total Fat		31.8	81	30.9	72
	Saturated fat	12.5	32	11.5	27
	Monounsaturated	11.6	30	11.8	28
	Polyunsaturated fat	4.9	12	4.8	11
	Saturated: unsaturated fat ratio		0.8		0.7
Total Carbohydrate		45.3	251	43.5	222
	Total sugars	19.8	117	19.2	104
	Total starch	25.3	140	23.4	119
Dietary fibre		2.1	25	2.2	24
Alcohol		3.6	12	4.8	14

23. ABS. National Nutrition Survey. Com of Aust, 1998; 24 ABS. Australian survey. Com of Aust, 2014..

Sample meal plan for overweight adult with type 2 diabetes

Breakfast

45g Traditional muesli

1/2 cup milk (↓ fat)

1 x toast

+ Canola margarine

Lunch

2 x toast

+ Canola margarine

210 g NAS Baked Beans

Dinner

1 1/3 Cup Spaghetti Bolognaise Sauce

+ 2 cups salad

+ vinaigrette

Morning Tea

Fruit biscuits (2 small)

Apple)

Afternoon Tea

200 mL yoghurt

(NNS)

Supper

Fruit (eg, 1 sml

Nutrient analysis of sample meal plan

- **Comparison to key recommended intakes:**

Energy	=	5,400 kJ
Protein	=	64 g (0.76g/kg or 19% of energy)
Total Fat	=	27 g (18 % of energy)
Saturated Fat	=	6 g (4% of energy)
Carbohydrate	=	200 g (56% of energy)
Fibre	=	30 g (5g/1000kJ)
GI	=	45 (~45 / day)
GL	=	90 (<100 / day)
Sodium	=	1,137 mg (920 – 2300)

Sample Cantonese menu plan – modified[25]

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Breakfast **7-8 am**	Steamed rice noodle rolls Tea Calcium enriched soymilk	Fish congee Tea Calcium enriched soymilk	Steamed buns Tea Calcium enriched soymilk	Fried rice noodle rolls Tea Calcium enriched soymilk	Minced beef congee Tea Calcium enriched soymilk	Steamed buns Tea Calcium enriched soymilk	Plain congee Radish cake Tea Calcium enriched soymilk
Lunch **12-1 pm**	Yangzhou fried rice with prawns Boiled lettuce Calcium enriched soymilk Pear	Fresh noodles with beef and garlic chives Stir-fried baby bok choy Calcium enriched soymilk Apple	Roasted duck noodle soup Stir-fried Chinese Broccoli Calcium enriched soymilk Apple	White cut chicken with rice Boiled baby bok choy Calcium enriched soymilk Orange	Fresh noodle with beef and garlic chives Stir-fried Chinese Broccoli Calcium enriched soymilk Pear	BBQ pork with rice Boiled lettuce Calcium enriched soymilk Pear	Steamed rice with chicken and mushroom Stir-fried baby bok choy Calcium enriched soymilk Banana
Dinner **7-8 pm**	Uncle Ben's Jasmine Rice Tomato and egg soup Stir-fried beef with spring onions Chinese broccoli in oyster sauce Orange	Uncle Ben's Jasmine Rice Sliced fish and coriander soup Stewed chicken wings and water chestnut Ma Po tofu Apple	Uncle Ben's Jasmine Rice Tomato, potato and pork bone broth Steamed chicken and mushrooms Stir-fried bok choy Pear	Uncle Ben's Jasmine Rice Mixed vegetable soup Steamed fish Stir-fried eggs and tomato Grapes	Uncle Ben's Jasmine Rice Cantonese corn soup Sweet and sour pork Boiled lettuce Orange	Uncle Ben's Jasmine Rice Seaweed and egg soup Steamed egg custard with prawns Spicy eggplant Apple	Uncle Ben's Jasmine Rice Carrot and pork bone broth Braised tofu Steamed spare ribs with black bean sauce Orange

25. Fong, PS. MND thesis. University of Sydney, 2010.

Nutrient analysis of Cantonese menu plan

CANTONESE	Estimated intake	Australian RDIs
Energy (kJ)	7590	6900-9100
Protein	25%	10-25%
Total Fat	22%	25-35%
Saturated fat	4.8%	<10%
Carbohydrate	48% (214 g)	45-60%
Sodium (mg)	2284	920- 2300
Iron (g)	15	8
Calcium (mg)	1044	1000
Fibre (g)	30	30
GI	48	45
GL	102	80-145

Sample Greek menu plan - modified

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Breakfast **9-10pm**	Greek coffee Koulouraki (Semi-sweet shortbread biscuits) Low fat Greek yoghurt	Greek coffee Apple Low fat Greek yoghurt	Greek coffee Low GI white bread with olives	Greek coffee Low GI white bread with jam	Greek coffee Paximadia (Dry plain biscuits) Low fat Greek yoghurt	Greek coffee Low GI white bread with reduce-fat feta cheese	Greek coffee Low GI white bread with honey
Lunch **1-2pm**	Low GI white bread Greek salad Lamb and artichokes stew Grapes Low fat Greek yoghurt	Low GI white bread Broccoli salad Beef casserole with onions Orange Low fat Greek yoghurt	Low GI white bread Tomato and cucumber salad Green beans with tomato and feta cheese Strawberries Low fat Greek yoghurt	Low GI white bread Cauliflower salad Lamb and potato casserole Grapes Low fat Greek yoghurt	Low GI white bread Green salad Broad beans with artichokes Orange Low fat Greek yoghurt	Low GI white bread Potato, onion and caper salad Baked fish with potato and coriander Apple Low fat Greek yoghurt	Low GI white bread Roasted chicken Pear Low fat Greek yoghurt
Dinner **8-9 pm**	Low GI white bread Spinach and feta salad Apple	Low GI white bread Lentil salad Pear	Low GI white bread Calamari salad Grapefruit	Low GI white bread Greek salad with haloumi Melon	Low GI white bread Marinated anchovy, potato and onion salad Peaches	Low GI white bread Leek soup Plums	Low GI white bread Tomato soup Pastitsio (Beef macaroni) Orange

Nutrient analysis of Greek menu plan

GREEK	Estimated intake	Australian RDIs
Energy	7780	6900-9100
Protein	23%	10-25%
Total Fat	35%	25-35%
Saturated fat	8.7%	<10%
Carbohydrate	36% (165 g)	45-60%
Sodium (mg)	2165	92-2300
Iron (g)	13	8
Calcium (mg)	1073	1000
Fibre (g)	32	30
GI	47	45
GL	77	80-145

Sample South Indian menu plan

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Breakfast **8:00- 9:30am**	Sambhar (Dhal) Dosa (rice pancake)	Chana Masala (Spicy chickpea) Puris (deep-fried unleavened bread)	Sambhar (Dhal) Idlis (steamed rice cakes)	Upma (Semolina hot cereal) Coconut chutney	Potato masala Sambhar	Oothsppam (Rice Pancakes) Dhal	Potato dosa Coconut chutney
Lunch **1- 2pm**	Basmati Rice Potato song Spicy lentil rasam Low fat yoghurt Tomato pickle	Basmati Rice Spinach and potato curry Lentils with vegetables Low fat yoghurt Mango pickle	Basmati Rice Vegetable Korma Ordinary rasam Low fat yoghurt Coriander chutney	Basmati Rice Potato curry Dhal Low fat yoghurt Mango chutney	Basmati Rice Cauliflower and dhal sambar Dhal Low fat yoghurt Mint chutney	Basmati Rice Buttermilk sambar Mysore rasam Low fat yoghurt Tomato pickle	Basmati Rice Mixed vegetable sagu Dhal Low fat yoghurt Mint and coriander chutney
Tea **4-5pm**	Banana	Orange	Mango	Banana	Mango	Orange	Mango
Dinner **8-9 pm**	Basmati Rice Mixed vegetable curry Tomato rasam Fresh cucumber salad Low fat yoghurt Mango chutney	Basmati Rice Mashed green gram dal Ginger rasam Coconut curd salad Low fat yoghurt Eggplant chutney	Basmati Rice Potato with chickpeas Garlic rasam Mixed vegetable curd salad Low fat yoghurt Sweet tomato chutney	Basmati Rice Mixed vegetable coconut sambar Cumin seed and pepper rasam Mango curd salad Low fat yoghurt Eggplant chutney	Basmati Rice Parippu (Dried lentil) Ordinary rasam Vegetable Medley Low fat yoghurt Mint chutney	Basmati Rice Mixed Vegetable Kootu Lemon rasam Tomato and onion salad Low fat yoghurt Mango pickle	Basmati Rice Sweet and sour chickpeas Buttermilk rasam Carrot salad Low fat yoghurt Tomato chutney

Nutrient analysis of South Indian menu plan

SOUTH INDIAN	Estimated intake	Australian RDIs
Energy	8640	6900-9100
Protein	15%	10-25%
Total Fat	23%	25-35%
Saturated fat	7.0%	<10%
Carbohydrate	56% (285 g)	45-60%
Sodium (mg)	1259	92-2300
Iron (g)	21	8
Calcium (mg)	1051	1000
Fibre (g)	47	30
GI	45	45
GL	128	80-145

Summary and conclusions

- People with pre-diabetes can prevent type 2 diabetes developing
- Insulin therapy, bariatric surgery and lifestyle interventions can all put type 2 diabetes into remission but it may return later in life
- Type 1 diabetes cannot be prevented or reversed by lifestyle changes
- Healthy eating is an important part of diabetes management
- The amount and type of carbohydrate, fat and protein are important but one dietary pattern does not fit all

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