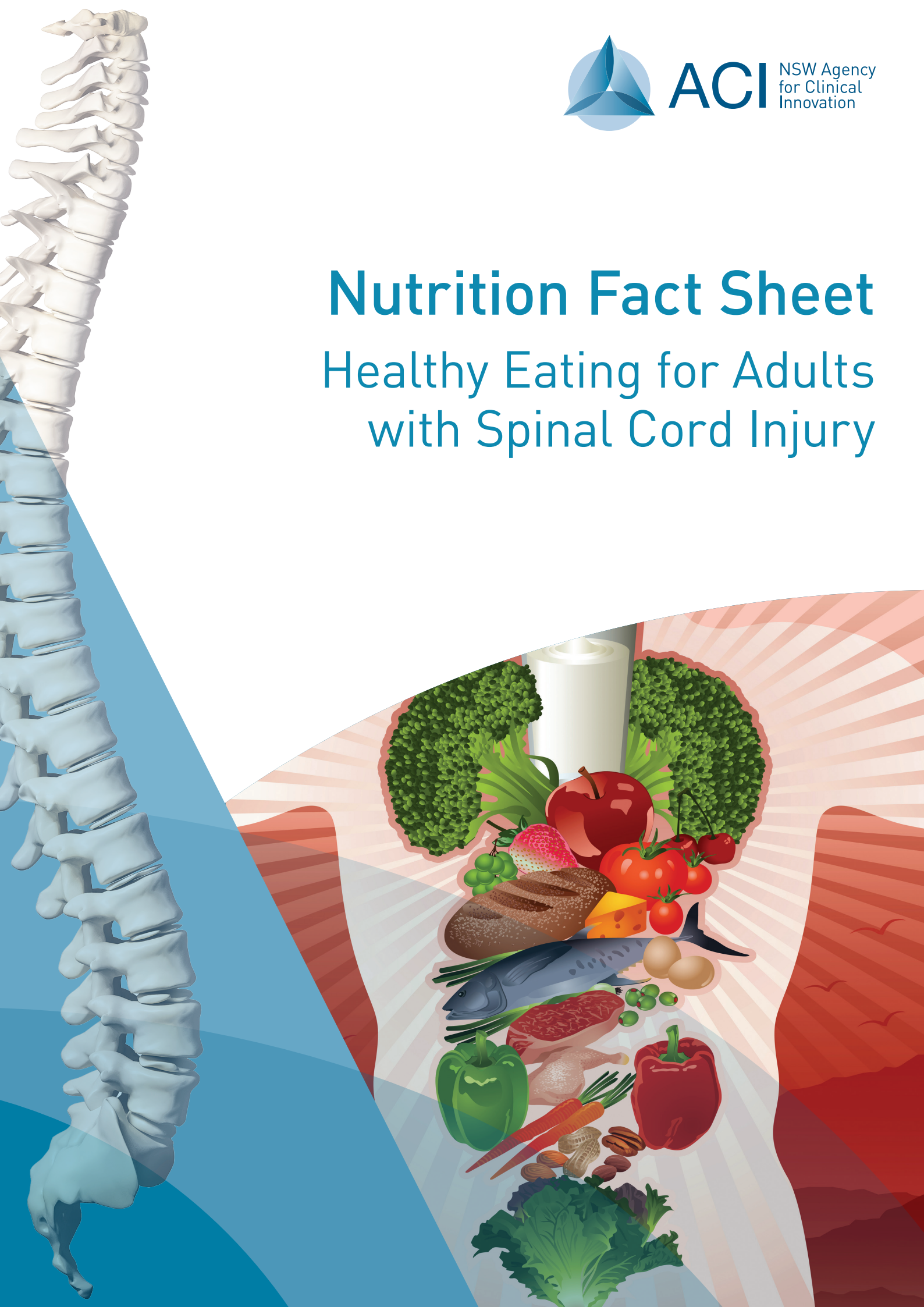
ACI NSW Agency for Clinical Innovation

Nutrition Fact Sheet

Healthy Eating for Adults with Spinal Cord Injury



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All recommendations are for patients with SCI as a group.

Individual therapeutic decisions must be based on clinical judgment with a detailed knowledge of the individual patient's unique risks and medical history, in conjunction with this resource.

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1. INTRODUCTION

1.1 Why is nutrition important after a spinal cord injury?

Adequate nutrition is vital for good health and wellbeing. Consuming a diet that is nutritionally complete and does not contain too much energy is important for individuals with a spinal cord injury (SCI) as they are at increased risk of developing secondary complications such as obesity,[1,2,3] diabetes,[4] metabolic syndrome[5], cardiovascular disease,[6,7] pressure injuries[8] and osteoporosis.[9]

Evidence shows that weight increases over time, with a significant increase in the year after discharge from inpatient rehabilitation.[2] It is therefore recommended that attention is given to weight management protocols that focus on diet and physical activity, in order to encourage a healthy lifestyle.[2]

1.2 Dietitian

A dietitian should be a member of the multidisciplinary team providing care for patients with SCI in the acute phase, rehabilitation setting and the community.[10] Evidence suggests that medical nutritional therapy provided to patients with SCI by a dietitian results in improved nutrition related outcomes, such as adequate nutrient intake, management of serum lipids, weight management, dysphagia, bowel function, bone health, skin integrity, and improved overall quality of life.[10] Additional benefits of care may include a reduction in the risk of onset and progression of nutrition related comorbidities such as malnutrition, pressure ulcers, cardiovascular disease, and diabetes.[7,10,11,12] Medical nutrition therapy may also increase the patient's ability to participate in exercise and other community activities.[10]

Annual dietetic assessment in the community setting is recommended for patients with chronic SCI and then follow up as requested by the individual's dietitian.[10] To find an Accredited Practicing Dietitian please refer to the Dietetic Association of Australia website (daa.asn.au) or contact your local hospital.

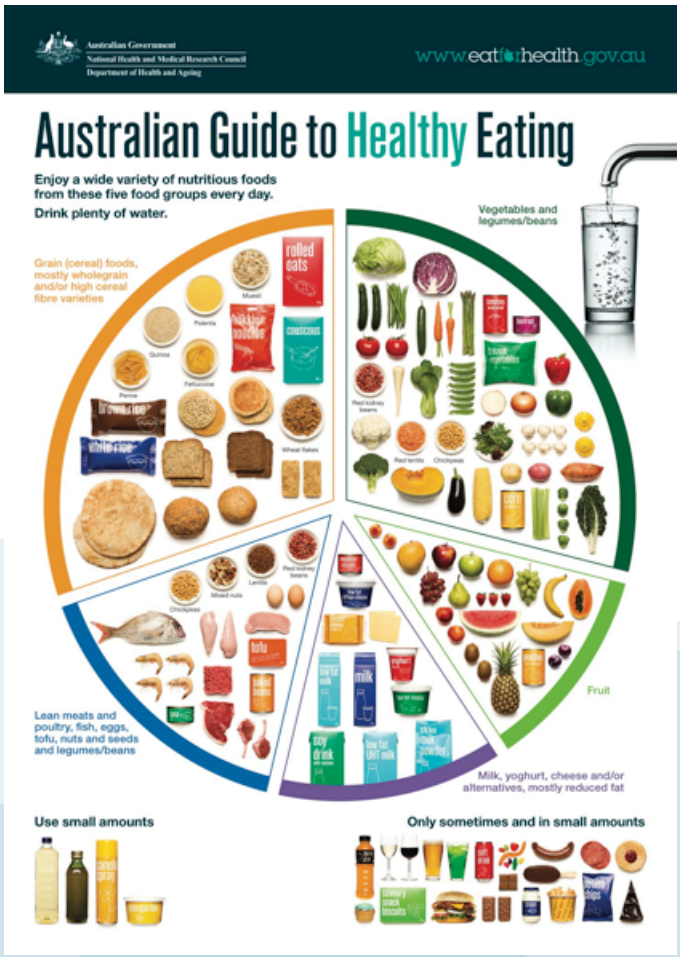
2. HEALTHY EATING AFTER A SPINAL CORD INJURY

2.1 Australian Dietary Guidelines 2013

The Australian Dietary Guidelines 2013 (www.eatforhealth.gov.au) provide evidenced-based advice about the amount and types of foods we need to eat for health and wellbeing.[13] There is no dietary guidelines specifically for the SCI population at this stage.

By eating the recommended amounts from the five food groups and limiting foods that are high in saturated fat, added sugars and added salt, patients will consume sufficient nutrients that are essential for good health. This may also reduce their risk of developing chronic diseases.[13]

The Australian Guide to Healthy Eating (AGTHE) shown below is a practical guide representing the proportion of the Five Food Groups recommended each day.



Source: The Australian Guide to Healthy Eating. National Health and Medical Research Council. Eat for Health, Educators Guide. 2013. Canberra: Commonwealth of Australia. [13]

2.2 How much should a person weigh after a spinal cord injury?

Ideal body weight standards have not yet been established or validated for individuals with SCI.

The World Health Organisation (WHO) advocates use of the body mass index (BMI = kg/m^2) which is the most useful population level indicator of obesity for able bodied persons.[14,15] BMI is used in clinical practice and research in persons with SCI, as there is a lack of other alternate validated measures. However, one problem with using BMI in persons with SCI is that this population have a significantly higher fat mass (8-18% higher) and lower lean mass, which can underestimate obesity.[16,17] Mean percentage fat mass of persons with SCI ranges from 27.5-36.3%, which is consistent with obesity fat mass values.[18] Therefore an adjusted BMI cut-off of >22kg/m^2 may be used to classify persons with SCI at high risk for obesity and obesity-related chronic diseases. Another reason for the underestimation of obesity using BMI may be potential measurement error associated with assessing weight and or height in persons with SCI.[16]

There is some low level evidence to suggest that height and weight tables can be adjusted for persons with a SCI.[19] A reduction of 5-10% (or subtracting 4.5-7kg) for a person with paraplegia and a reduction of 10-15% (or subtracting 7-9kg) for persons with tetraplegia is suggested in the literature.[10,19,20,21] These adjustments attempt to compensate for muscle atrophy in individuals with SCI, but have not been validated in a prospective, randomised study. The Metropolitan Life Insurance ideal body weight standards for a given sex and height, which are discussed in the literature, are not generally used in clinical practice in Australia (**Appendix 1**).[22]

It is important to note that being underweight can also influence a patient's health and increase their risk of malnutrition, infections and pressure injuries.[11,23] Bioelectric impedance analysis (BIA) or dual-energy x-ray absorptiometry (DEXA) can also be used to assess body composition in SCI patients who are medically stable.[10] However, these are not routinely accessible or used in the clinical setting.

2.3 Energy requirements

Positive energy balance increases the risk of obesity, which is a common secondary complication of SCI.[24] Total daily energy expenditure comprises the resting metabolic rate, thermic effect of food and physical activity.[24] The age of the person, the level of injury, and having a pressure injury or infection can also influence a patient's daily energy requirements.[24]

Individuals with an established SCI have a reduced resting metabolic rate (14-27% lower) due to a reduced fat free mass and altered sympathetic nervous system activity.[24] They therefore need less energy than non-paralysed individuals. A dietitian will be able to assess your patient's individual energy requirements. As a general guideline in SCI patients who are medically stable 22.7 calories per kilogram of body weight is used for patients with tetraplegia and 27.9 calories per kilogram of body weight is used for patients with paraplegia (1 calorie = 4.2 kilojoules).[10,21] This evidence is based on a small study of 22 patients who were actively participating in rehabilitation.[21] Energy expenditure was measured by indirect calorimetry and a 20% activity factor was applied. This study however, did not control for all factors that could impact total daily energy expenditure.[3]

Equations validated in able-bodied populations to predict resting metabolic rate overestimate measured requirements in patients with an established SCI by 5-32%.[24] The Schofield equation, for example has been shown to significantly overestimate resting metabolic rate in paraplegic patients.[25]

It is important to note that there can be wide variation in energy requirements between individuals. Further research is needed to define energy needs in this population. New equations that predict energy requirements need to be validated and tested in a large sample of men and women with complete and incomplete paraplegia and tetraplegia.[24] If available in your clinical setting indirect calorimetry is currently the best method of determining energy expenditure in SCI patients.[20,25]

2.4 Protein requirements

Dietary protein is important for tissue growth, maintenance and repair.[20] Protein requirements for patients with a SCI are the same as the general population, unless the patient has a pressure injury, an infection or medical condition that requires increased protein needs.[10]

- Individuals with SCI who do not have pressure ulcers: 0.8-1.0g/kg/d [10]
- Individuals with stage II pressure ulcers: 1.2 to 1.5g/kg/d [10,20,26]
- Individuals with stage III and IV pressure ulcers: 1.5-2.0 g/kg/d [10,20,26]

Refer to the Evidence Based Practice Guidelines for the Dietetic Management of Adults with Pressure Injuries for more detailed information on nutrition and wound healing.[27] If a patient has a pressure injury it is important to refer to a dietitian for nutrition assessment. Nutritional supplements may be prescribed to ensure adequate wound healing, if a patient's dietary intake is inadequate.

Eating more protein than is recommended will contribute excess energy and may have a negative impact on a patient's health. Lean meats and poultry, fish, eggs, tofu, nuts and seeds, and legumes/beans are all dietary sources of protein. Men require 2.5-3 serves each day and women require 2-2.5 serves each day depending on age and level of physical activity.[13]

A standard serve is 500-600kJ:[13]

- 65g cooked lean meat such as beef, lamb veal, pork, goat or kangaroo (90-100g raw)
  Note: Limit lean meat to 455g per week.
- 80g cooked lean poultry such as chicken or turkey (100g raw)
- 100g cooked fish fillet (115g raw) or one small can of fish
- 2 large eggs (120g)
- 1 cup (150g) cooked or canned legumes/beans such as lentils, chick peas or split peas (no added salt)
- 170g tofu
- 30g nuts, seeds or peanut or almond butter or tahini or other nut paste

2.5 Grains

Grain foods provide carbohydrates, protein and dietary fibre and they are also a good source of vitamins and minerals including folate, thiamine, riboflavin, niacin, vitamin E and iron. Eating wholegrains may help reduce the risk of heart disease, type 2 diabetes, weight gain and some cancers.[13,28]

Adults require 3-6 serves each day depending on age, gender, level of injury and physical activity.[13]

A standard serve (500KJ) is:[13]

- 1 slice bread (40g)
- ½ medium roll or flat bread (40g)
- ½ cup (75-120g) cooked rice, pasta, noodles, barley, buckwheat, semolina, polenta, bulgur or quinoa
- ½ cup (120g) cooked porridge
- ⅔ cup (30g) wheat cereal flakes
- ¼ cup (30g) muesli
- 3 crisp breads (35g)
- 1 crumpet (60g)
- 1 small English muffin or scone (35g)

2.6 Vegetables

Vegetables are a good source of vitamins, minerals, antioxidants and dietary fibre. Including vegetables in a variety of colours and legumes/beans in the diet can provide a range of nutrients that may help reduce the risk of obesity, some cancers and chronic disease.[13,29] Because of their low energy density, diets that are high in vegetables are important in helping to maintain a healthy weight. 5-6 serves each day is required for adults.[13]

A standard serve of vegetables is about 75g (100-350KJ) or:[13]

- ½ cup cooked green or orange vegetables (for example broccoli, spinach, carrots or pumpkin)
- ½ cup cooked dried or canned beans, peas or lentils
- 1 cup green leafy or raw salad vegetables
- ½ cup of sweet corn
- ½ medium potato or other starchy vegetables (sweet potato)
- 1 medium tomato

2.7 Fruit

Fruit is a good source of vitamins, including vitamin C and folate. Fruit also provides potassium, dietary fibre and carbohydrate. Including fruit in the diet regularly has been shown to reduce the risk of heart disease and some cancers.[13,29] Patients should be encouraged to choose fruits in season for better value and availability. Adults require 2 serves of fruit every day.[13]

Fruit juice is acidic and frequent consumption is not recommended as it increases the risk of dental erosion and contributes extra energy that can cause weight gain.[13]

A standard serve of fruit is about 150g (350KJ) or:[13]

- 1 medium apple, banana, orange or pear
- 2 small apricots, kiwi fruits or plums
- 1 cup diced or canned fruit (with no added sugar)

Or only occasionally:

- ½ cup of fruit juice
- 30g dried fruit (1½ tablespoons of sultanas)

2.8 Dairy and/or alternatives

This food group is an excellent source of dietary calcium, which is an important nutrient for maintaining bone strength. Patients with SCI are at increased risk of developing osteoporosis.[9]

These foods are also a good source of protein, riboflavin and B12. Low fat and reduced fat varieties should be consumed to lower the total daily intake of saturated fat.

Approximately 2.5-3 serves each day is required, depending on gender and age.[13]

- **A standard serve is (500-600KJ):[13]**
- 1 cup (250ml) fresh, UHT long life, reconstituted powered milk or butter milk
- ½ cup (120ml) evaporated milk
- 2 slices (40g) hard cheese, such as cheddar
- ½ cup (120g) ricotta cheese
- ¾ cup (200g) yoghurt
- 1 cup (250ml) soy, rice or other cereal drink with at least 100mg of added calcium per 100ml
  NOTE: Choose low fat varieties

2.9 Dietary fats

Fats can be categorised as saturated fats, polyunsaturated fats and monounsaturated fats. Fats in the diet provide energy and some provide essential fatty-acids and fat-soluble vitamins such as Vitamin A, D, E and K. Foods that provide dietary fats are also high in energy, so the amount consumed needs to be limited, to avoid weight gain. Where possible it is recommended to replace foods containing saturated fats (palm oil, butter, coconut cream, commercial biscuits and pastries, fat on meat and in dairy products) with foods that have polyunsaturated fats (for example, walnuts, flaxseed oil, sunflower oil and salmon) and monounsaturated fats (for example, olive oil, avocado, nuts and canola oil), which can benefit blood cholesterol levels.[13] Studies show that individuals with a SCI are at increased risk of cardiovascular disease.[6,7]

A serve of spread is 10 grams, a serve of oil is 7 grams and a serve of tree nuts or nut pastes is 10 grams. 2-4 serves each day are required depending on an individual's gender, weight, level of injury, and amount of physical activity.[13]

2.10 Discretionary choices

These foods are not an essential part of our dietary intake and are associated with increased risk of obesity and other chronic diseases, such as heart disease.[13] These foods are high in saturated fat, energy, added sugar, added salt or alcohol.[13] Examples of these foods include cakes, biscuits, pastries, pizza, fried hot chips, soft drinks, sausages, potato chips, chocolate, sweets, ice cream, beer, wine and spirits. Some of these foods are also known to contribute to dental decay.[13]

Patients with SCI have lower energy requirements than able bodied persons and therefore their consumption of these foods should be restricted as much as possible to avoid gaining weight and displacing other more nutritious foods from the diet.

2.11 Alcohol

Alcohol is a drug that slows down the brain and nervous system. Alcoholic drinks should be consumed only in small amounts or not at all. Alcohol is not recommended for pregnant or breastfeeding women.[13, 30] There is evidence that alcohol increases an individual's risk of some cancers and can also result in weight gain.[30]

The NHMRC Australian Guidelines to Reduce Health Risk from Drinking Alcohol recommend drinking no more than 2 standard drinks on any day to reduce the lifetime risk of harm from alcohol related disease.[30]

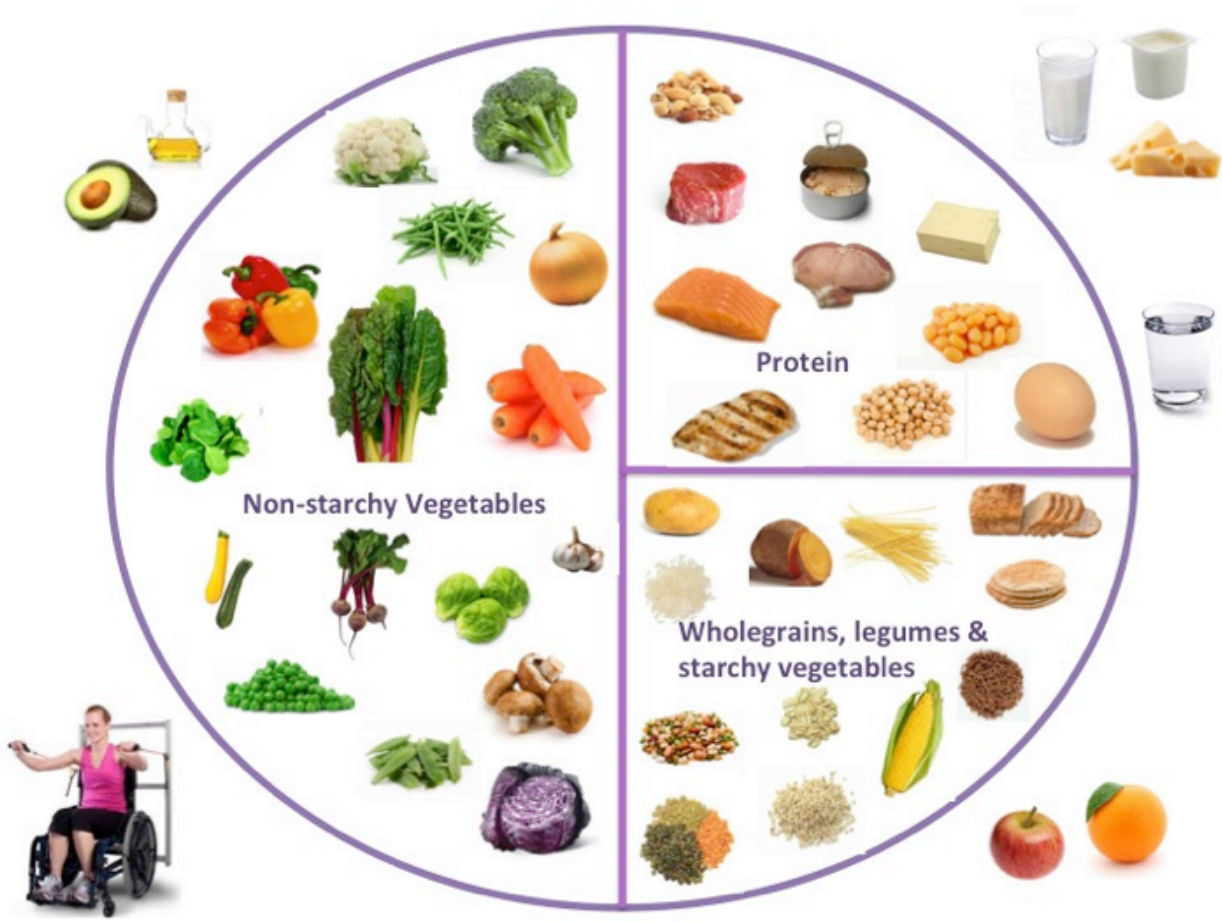
A standard drink contains 10 grams of pure alcohol. It is important to note that drink serving sizes are often more than one standard drink. There are no common glass sizes used in Australia. The label on an alcoholic drink container states the number of standard drinks in the container.[30]

How much is a standard drink?	
Can/stubbie low-strength beer	= 0.8 standard drink
Can/stubbie mid-strength beer	= 1 standard drink
Can/stubbie full-strength beer	= 1.4 standard drinks
100ml wine (13.5% alcohol)	= 1 standard drink
30ml nip spirits	= 1 standard drink
Can spirits (approx 5% alcohol)	= 1.2 to 1.7 standard drinks
Can spirits (approx 7% alcohol)	= 1.6 to 2.4 standard drinks

Source: National Health and Medical Research Council. Australian Guidelines to Reduce Health Risks from Drinking Alcohol. 2009. Canberra: Commonwealth of Australia.

3. HEALTHY SPINAL CORD INJURY PLATE MODEL

This is a visual guide that has been developed to assist health professionals and patients understand what proportion of their plate should be non-starchy vegetables, protein and wholegrains, legumes and starchy vegetables. Eating the correct portion size and choosing the right nutrients from foods is essential for weight management and maintaining good health.

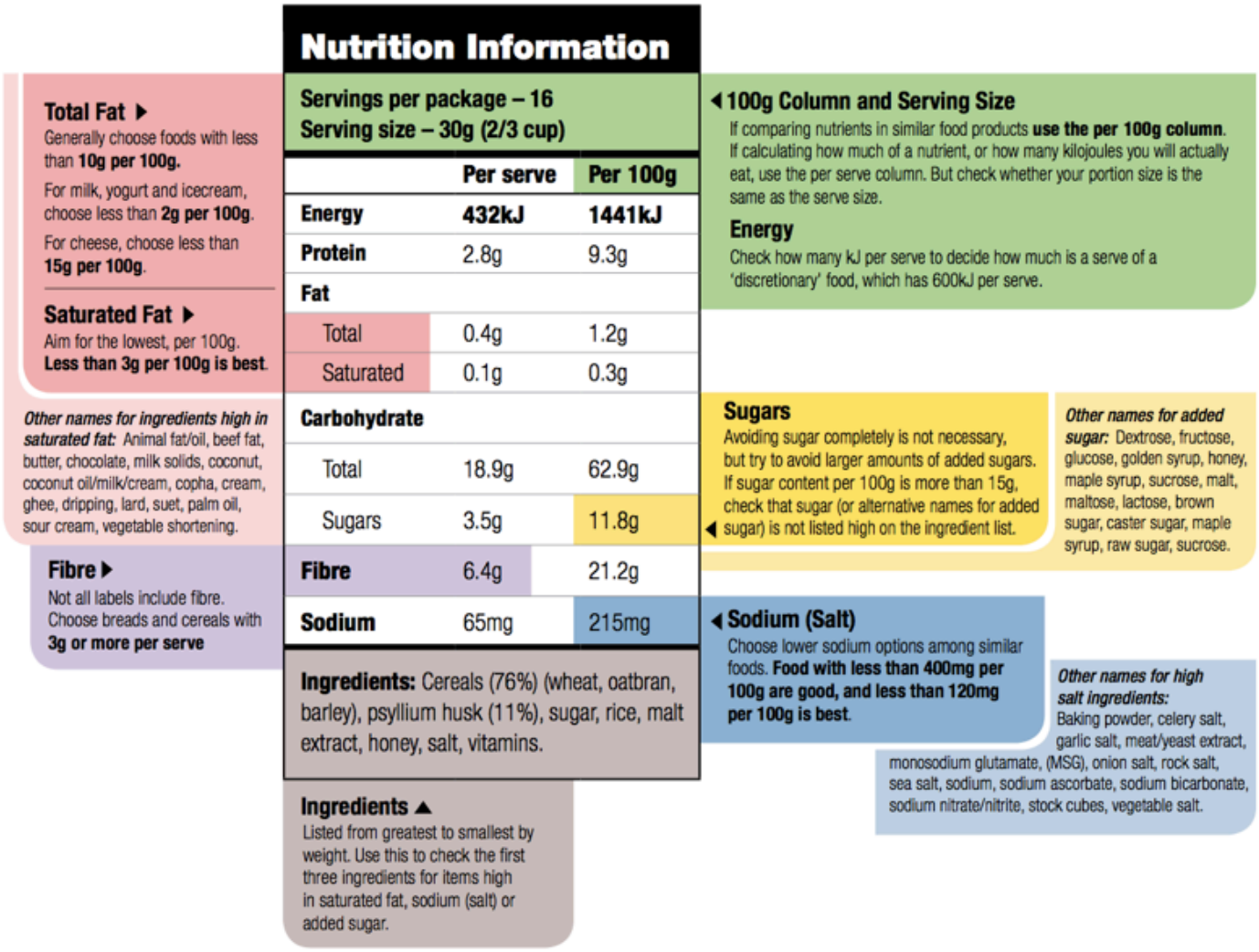


Healthy Spinal Cord Injury Plate Model Guidelines

- 50% of the plate should be non-starchy vegetables. Choose a variety of colours.
- 25% of the plate should be a protein source, such as poultry, lean red meat, fish, tofu, eggs, nuts, beans or low fat cheese. Limit processed meats and remove the fat from meat and the skin from poultry before eating.
- 25% of the plate should be wholegrains, legumes and starchy vegetables such as oats, quinoa, corn, lentils, and multigrain bread.
- Choose 2 serves of whole fruit each day.
- Choose 2.5-3 serves of low fat dairy each day.
- Consume healthy oils and spreads, nuts and seeds and avocado in small amounts.
- Drink mainly water. Avoid cordial, juice and soft drink.
- Aim to include regular physical activity.

4. MAKING INFORMED FOOD CHOICES

It is important that patients are educated on how to read and understand food labels so that they can make healthy choices. The nutritional information panel below outlines the key points to look at when buying packaged foods.



Source: How to Understand Food Labels. National Health and Medical Research Council. Eat for Health, Educator Guide. 2013. Canberra: Commonwealth of Australia.

5. NEUROGENIC BOWEL (INCLUDING FIBRE AND FLUID)

Patients who have had a SCI require an individually tailored bowel program. Bowel dysfunction following SCI is an area of major physical and psychological difficulty.[31] The level of SCI, a person's premorbid bowel habits and any pre-existing medical conditions may all influence a patient's pattern of bowel evacuation post injury.[32] As a result successful bowel management needs to have a multifaceted approach.[32]

Dietary fibre, the indigestible cell wall component of plant materials, plays an important role in human health and bowel habits.[28] It has been shown to help prevent or treat hyperlipidemia, cardiovascular disease, hypertension, obesity, certain cancers, gastrointestinal disorders, and diabetes in the general population.[28,33]

There is currently limited evidence for specific dietary fibre recommendations for patients with SCI. In practice an initial fibre intake of 15g per day is recommended, with gradual increases up to 30g per day of fibre, as tolerated from a variety of sources.[10] A fibre intake of 15g per day may be associated with significant improvements in bowel function.[10,34,35] However, a fibre intake greater than 20g per day may be associated with delayed intestinal transit times in persons with SCI.[36]

Dietary fibre can be found in fruits, vegetables, legumes, nuts and seeds and wholegrain breads and cereals. Most sources of dietary fibre tend to have a combination of both soluble and insoluble fibre in varying proportions. By encouraging a diet that contains adequate serves of grain (cereal) foods, fruits and vegetables an individual will meet the minimum 15g fibre recommendation.

Adequate fluid intake is also important in bowel management as it promotes colonic transit by keeping the stool soft. Fluid requirements need to be assessed on an individual basis, as certain patients may require fluid restrictions or additional fluid depending on their medical background, level of physical activity, metabolism and if they are going to be exposed to hot environments.[37]

The Consortium for Spinal Cord Medicine recommend fluid intake should be approximately 500ml/day greater than the standard guidelines used to estimate the needs of the general public (for example: 1ml of fluid/kcal of energy needs + 500ml).[38] This is because the prolonged colonic transit time typically seen in individuals with neurogenic bowel can result in excessive fluid reabsorption and the formation of hardened stools.[38,39] However, this recommendation is based on expert consensus only and there is no scientific evidence to support this recommendation.[38]

The National Health and Medical Research Council recommend an adequate intake of 2.6L of fluid a day for men and 2.1L of fluid a day for women (from plain water, milk and other drinks).[40] The adequate intake of total water from food and fluids is set at 3.4L for men and 2.8L for women.[40] In clinical practice 35ml/kg or 1ml/kcal may also be used.[37, 41] Patients should be encouraged to drink plain water as their main fluid and they should space their intake of fluid over the day.[42] Further research is required to assess fluid requirements in the SCI population.

Physical activity continues to contribute to bowel function after SCI and individuals should be encouraged to be involved in regular physical activity.[43] For more information on bowel management in patients with SCI please refer to the International Spinal Cord Society (ISCoS) eLearning education initiative http://www.elearnsci.org/ (Accessed January 2014) managing neurogenic bowel dysfunction in persons with SCI, or refer to the Agency for Clinical Innovation fact sheet on the management of the neurogenic bowel for adults with spinal cord injuries http://www.aci.health.nsw.gov.au/networks/spinal-cord-injury/resources (Accessed January 2014).

6. NEUROGENIC BLADDER

After a SCI patients may have loss of bladder control (urinary incontinence), inability to empty their bladder, increased urinary frequency and urinary tract infections (UTI).[42]

Having an adequate fluid intake is important. Further research is required to establish fluid intake guidelines for this population. Fluid intake should be moderate and spaced throughout the day.[42] The main fluid should be water. Fluoridation of tap water provides an additional benefit for development of strong teeth, making it a good choice to ensure adequate hydration.[13] Sugar sweetened cordials, soft drinks and sports drinks should be avoided as they provide excess energy and sugar, which can cause weight gain.[13]

Evidence suggests that cranberry in juice or supplement form does not reduce the UTI free period free period or decrease bacteriuria or white blood cell count in persons with SCI.[10,44] Currently cranberry does not seem to be effective in preventing or treating UTIs in the SCI population. More rigorous clinical research is needed to confirm this.[44]

7. BONE HEALTH

Osteoporosis is a known complication of SCI, occurring predominantly in the pelvis and lower extremities.[9,45] A decline in bone mineral density occurs as early as six weeks after a SCI and is well documented in SCI patients.[9] The significance of osteoporosis after SCI is that it results in skeletal fragility and increased risk of fractures.[9] As a result, persons with SCI should reduce all modifiable secondary causes of bone loss, such as vitamin D deficiency and inadequate calcium intake.

Vitamin D deficiency may cause osteoporosis by secondary hyperparathyroidism and increased bone resorption.[46] There is a higher prevalence of vitamin D deficiency in persons with SCI.[47] Vitamin D is a hormone that assists the body in absorbing calcium and is essential for the health of bones and muscles. Sun exposure is the primary source of vitamin D, other than supplements. Adequate vitamin D levels should be at least 50nmol/L at the end of winter.[48] This can be measured by a simple blood test that measures a form of vitamin D in the blood called 25-hydroxyvitamin D (25-OHD).

Dietary restriction of calcium should not be applied to SCI patients. Calcium deficiency reduces bone mass by increasing bone resorption to preserve the extracellular fluid ionised calcium level.[46] Calcium is required for the normal development and maintenance of the skeleton as well as for the proper functioning of neuromuscular and cardiac function.[49] Daily calcium recommendations are 1000mg per day for adults, increasing to 1300mg per day for women over 50 and men over 70 years.[49] It is recommended that these levels be achieved through diet. The best dietary sources of calcium are reduced fat milk and dairy foods, with smaller amounts being found in bony fish (tinned salmon and sardines), nuts and tahini, tofu-calcium set, selected dark leafy vegetables and calcium fortified products.[49]

Taking part in physical activity, being a healthy weight, limiting caffeine and alcohol and not smoking all play an important role in optimising bone mass and preserving bone density, in the general population.[46]

8. LIPID ABNORMALITIES

Coronary heart disease is now a major cause of morbidity and mortality in persons with SCI.[7,50] After SCI there is a tendency toward elevated low density lipoprotein (LDL) cholesterol, total cholesterol and triglycerides and lower high density lipoprotein (HDL) levels compared with able-bodied persons.[7]

To lower the risk of coronary heart disease, The Heart Foundation recommends that all Australians should:[51]

1. Consume about 500mg per day of combined docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA) though a combination of the following:
   - 2-3 serves (150g serve) of oily fish per week, for example salmon.
   - Fish oil capsules or liquid.
   - Food and drinks enriched with marine omega 3 polyunsaturated (n-3 PUFA) fatty acids.
2. Consume at least 2 grams per day of alpha-linolenic acid (ALA), a plant based n-3 PUFA. Food sources include linseeds, and walnuts.[51]

   Health professionals should advise adult Australians with elevated triglycerides to take fish oil capsules or liquid and marine n-3 PUFA enriched foods as first line therapy by:[51]
   - Starting with a dose of 1200mg per day of DHA and EPA; and if appropriate
   - Increase the dose to 4000mg per day of DHA and EPA and check the patient's response every 3-4weeks when the dose is changed, until target triglyceride levels are reached.

Patients with SCI should also be educated on limiting their dietary intake of saturated fat and smoking should be discouraged.

Note: Patients should follow advice from Food Standards Australia and New Zealand on the mercury content of fish, particularly if pregnant or breastfeeding. http://www.foodstandards.gov.au/consumer/chemicals/mercury/pages/default.aspx (Accessed January 2014)

9. MEAL PREPARATION AND SHOPPING

Meal planning is important as it allows patients to consistently prepare healthy meals. Other benefits of meal planning include saving money, shopping more efficiently and eating an increased variety of foods each week. There are a variety of websites and applications that can assist patients with weekly menu planning.

Supermarkets now offer online grocery shopping, which allows customers to create custom lists and search for recipe ideas. Patients can view the weekly specials and plan meals to suit their budget. Having fresh and healthy food delivered to the home means persons with SCI can have greater access to fresh food and more time to prepare food.

If shopping in a grocery store the application "FoodSwitch" allows you to scan food products using a smartphone or tablet and it identifies healthier choices by comparing the overall nutritional value of foods. Calorie King, www.calorieking.com.au (Accessed January 2014) may also assist patients with understanding the nutritional value of Australian foods, which is important for weight management. There are a variety of websites and applications that can assist patients with weekly menu planning.

Carers may need to cook healthy meals, if food preparation ability is limited, to reduce reliance on take away food which may be high in energy, sodium and saturated fat. Companies such as Lite n' Easy and Tender Loving Cuisine are also very useful alternatives for many patients, as they provide healthy meals delivered to their home.

An occupational therapist may be able to assist with modified cutlery or home modifications to make meal preparation easier and safer. Some patients will require assistance with feeding to ensure adequate food and fluids are consumed.

Refer to the Healthy Spinal Cord injury Plate Model to assist patients with meal planning.

10. SUPPLEMENTS

Health professionals should ask patients the type, dose and frequency of supplements being taken as this population is known to have high dietary supplement usage and it can have an impact on dietary assessment results.[52,53]

Persons with a SCI do not need special nutritional supplements unless they have a proven deficiency or a health professional has recommended it. Vitamin D deficiency is common in this population, so patients should have their blood levels checked and replaced to normal range if deficient.[47]

11. PHYSICAL ACTIVITY

Persons with chronic SCI should be encouraged to engage in physical activity to optimise their health.[54] Regular physical activity has been shown to be effective in increasing physical capacity and muscular strength and can also improve the psychological well being of patients.[55,56] Physical activity improves blood lipid parameters and weight, which may reduce a person's risk of developing diabetes, metabolic syndrome and cardiovascular disease.[54,57]

A physiotherapist, occupational therapist or exercise physiologist will be able to write a personalised exercise programme based on the patient's level of injury and medical background. If the patient lives in Sydney the *Burn Rubber Burn program* http://www.pcycnsw.org/prime_sparts_burn_rubber (Accessed January 2014) offers supervised exercise sessions in a number of community fitness centres, for individuals with disabilities.

12. QUIZ

1. Energy requirements are reduced in people with SCI because
   a) They have a lower lean body mass
   b) They don't need as much fat as able bodied people
   c) They have a lower resting metabolic rate
   d) Both a and c are true

2. Recommended fibre intake in patients with spinal cord injury is
   a) 15-30 grams per day, as tolerated
   b) Less than 15 grams per day
   c) Greater than 30 grams per day
   d) 25-30 grams per day, as tolerated

3. BMI range 18.5-24.9kg/m^2 is not appropriate for persons with a spinal cord injury because
   a) It is difficult to get an accurate weight
   b) It should be higher to allow for the weight gain post injury
   c) They have a higher fat mass and lower lean mass
   d) Height changes post injury

4. People with SCI are at increased risk of:
   a) Cardiovascular disease
   b) Metabolic complications
   c) Bone disease
   d) All of the above

5. The Healthy Spinal Cord Injury Plate Model recommends:
   a) 25% of the plate to be non-starchy vegetables
   b) 50% of the plate to be non-starchy vegetables
   c) 50 % of the plate to be a source of protein
   d) 50% of the plate to be wholegrains, legumes & starchy vegetables

6. Protein requirements for patients with a SCI with no pressure injury or infection) are
   a) Higher than the general population
   b) The same as the general population
   c) Lower than the general population
   d) 1.5-2.0g/kg/day

Answers: 1: d, 2: a, 3: c, 4: d, 5: b, 6: b

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14. APPENDIX 1: METROPOLITAN HEIGHT AND WEIGHT TABLES 1983.[22]

These tables are based on the 1979 Build study and were derived from measurements on life insurance policyholders aged 25 – 59 years from 1950-1971. The applicability of these tables to the general population, especially young adults and the elderly is questionable.

The Metropolitan Life Insurance height and weight tables show weight ranges for which people should have the greatest longevity. They do not refer to weights that minimize illness or incidence of disease. [22]

IDEAL WEIGHTS (KG) FOR FEMALES				IDEAL WEIGHTS (KG) FOR MALES			
HEIGHT (In Shoes)	Small Frame	Medium Frame	Large Frame	HEIGHT (In shoes)	Small Frame	Medium Frame	Large Frame
cm				cm			
148	46.4 - 50.6	49.6 - 55.1	53.7 - 59.8	158	58.3-61.0	59.6-64.2	62.8-68.3
149	46.6 - 51.0	50.0 - 55.5	54.1 - 60.3	159	58.6-61.3	59.9-64.5	63.1-68.8
150	46.7 - 51.3	50.3 - 55.9	54.4 - 60.9	160	59.0-61.7	60.3-64.9	63.5-69.4
151	46.9 - 51.7	50.7 - 56.4	54.6 - 61.4	161	59.3-62.0	60.6-65.2	63.8-69.9
152	47.1 - 52.1	51.1 - 57.0	55.2 - 61.9	162	59.7-62.4	61.0-65.6	64.2-70.5
153	47.4 - 52.5	51.5 - 57.5	55.6 - 62.4	163	60.0-62.7	61.3-66.0	64.5-71.1
154	47.8 - 53.0	51.9 - 58.0	56.2 - 63.0	164	60.4-63.1	61.7-66.5	64.9-71.8
155	48.1 - 53.6	52.2 - 58.6	56.8 - 63.6	165	60.8-63.5	62.1-67.0	65.3-72.5
156	48.5 - 54.1	52.7 - 59.1	57.3 - 64.1	166	61.1-63.8	62.4-67.6	65.6-73.2
157	48.8 - 54.6	53.2 - 59.6	57.8 - 64.6	167	61.5-64.2	62.8-68.2	66.0-74.0
158	49.3 - 55.2	53.8 - 60.2	58.4 - 65.3	168	61.8-64.6	63.2-68.7	66.4-74.7
159	49.8 - 55.7	54.3 - 60.7	58.9 - 66.0	169	62.2-65.2	63.8-69.3	67.0-75.4
160	50.3 - 56.2	54.9 - 61.2	59.4 - 66.7	170	62.5-65.7	64.3-69.8	67.5-76.1
161	50.8 - 56.7	55.4 - 61.7	59.9 - 67.4	171	62.9-66.2	64.8-70.3	68.0-76.8
162	51.4 - 57.3	55.9 - 62.3	60.5 - 68.1	172	63.2-66.7	65.4-70.8	68.5-77.5
163	51.9 - 57.8	56.4 - 62.8	61.0 - 68.8	173	63.6-67.3	65.9-71.4	69.1-78.2
164	52.5 - 58.4	57.0 - 63.4	61.5 - 69.5	174	63.9-67.8	66.4-71.9	69.6-78.9
165	53.0 - 58.9	57.5 - 63.9	62.0 - 70.2	175	64.3-68.3	66.9-72.4	70.1-79.6
166	53.6 - 59.5	58.1 - 64.5	62.6 - 70.9	176	64.7-68.9	67.5-73.0	70.7-80.3
167	54.1 - 60.0	58.7 - 65.0	63.2 - 71.7	177	65.0-69.5	68.1-73.5	71.3-81.0
168	54.6 - 60.5	59.2 - 65.5	63.7 - 72.4	178	65.4-70.0	68.6-74.0	71.8-81.8
169	55.2 - 61.1	59.7 - 66.1	64.3 - 73.1	179	65.7-70.5	69.2-74.6	72.3-82.5
170	55.7 - 61.6	60.2 - 66.6	64.8 - 73.8	180	66.1-71.0	69.7-75.1	72.8-83.3
171	56.2 - 62.1	60.7 - 67.1	65.3 - 74.5	181	66.6-71.6	70.2-75.8	73.4-84.0
172	56.8 - 62.6	61.3 - 67.6	65.8 - 75.2	182	67.1-72.1	70.7-76.5	73.9-84.7
173	57.3 - 63.2	61.8 - 68.2	66.4 - 75.9	183	67.7-72.7	71.3-77.2	74.5-85.4
174	57.8 - 63.7	62.3 - 68.7	66.9 - 76.4	184	68.2-73.4	71.8-77.9	75.2-86.1
175	58.3 - 64.2	62.8 - 69.2	67.4 - 76.9	185	68.7-74.1	72.4-78.6	75.9-86.6
176	58.9 - 64.8	63.4 - 69.8	68.0 - 77.5	186	69.2-74.8	73.0-79.3	76.6-87.6
177	59.5 - 65.4	64.0 - 70.4	68.5 - 78.1	187	69.8-75.5	73.7-80.0	77.3-88.5
178	60.0 - 65.9	64.5 - 70.9	69.0 - 78.6	188	70.3-76.2	74.4-80.7	78.0-89.4
179	60.5 - 66.4	65.1 - 71.4	69.6 - 79.1	189	70.9-76.9	74.9-81.5	78.7-90.3
180	61.0 - 66.9	65.6 - 71.9	70.1 - 79.6	190	71.4-77.6	75.4-82.2	79.4-91.2
181	61.6 - 67.5	66.1 - 72.5	70.7 - 80.2	191	72.1-78.4	76.1-83.0	80.3-92.1
182	62.1 - 68.0	66.6 - 73.0	71.2 - 80.7	192	72.8-79.1	76.8-83.9	81.2-93.0
				193	73.5-79.8	77.6-84.8	82.1-93.9

'Ideal' weights for U.S adults according to frame size at ages 25-59 years based on lowest mortality. Weight in kilograms in indoor clothing weighing 2.3kg (female) and 1.4kg (male). Heights include 2.5cm heels. Categories of frame size were developed from elbow breadth measurements. 50% of the population falls within the medium frame and 25% each fall within the small and large frame. Data from the 1979 Build study, Society of Actuaries and Association of Life Insurance Medical Directors of America, 1980. From Metropolitan Height and weight Tables (1983). Courtesy Statistical Bulletin, Metropolitan Life Insurance Company.[22]