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A resource about dairy-based nutrition
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Glucagon-like peptide-1 (GLP-1) therapy offers an opportunity for exceptional weight loss, but also brings an unprecedented risk of muscle loss and nutritional deficiency. This review describes how healthcare professionals can use dairy products as a practical strategy to mitigate the risk of sarcopenia and ensure optimal fat loss in patients on GLP-1 therapy.

A publication for health professionals

The role of dairy *in modern weight management*

South Africa's food-based dietary guidelines advise consumers to 'have milk, maas or yoghurt every day'.[1] The benefit of this recommendation is increasingly supported by evidence of the health effects of dairy, and that these are not merely the result of individual nutrients but a function of the 'dairy matrix'.[2,3] By integrating concepts such as the dairy matrix into guidelines, policies and labelling, nutritional management and health promotion can be improved.[4]

Dairy foods contain a varitety of nutrients, including protein, calcium and bioactive compounds.[4] These nutrients have an important role in the prevention of lifestyle diseases. Regular consumption of dairy has been linked to a lower risk of cardiovascular disease, type 2 diabetes, stroke, and hypertension, and improved gut health in the case of fermented products such as yoghurt.[5] The benefits of dairy are particularly relevant given the growing global burden of obesity, type 2 diabetes and cardio-vascular disease.

Weight loss is the primary therapeutic objective for individuals with obesity, as a reduction in total body mass is fundamentally linked to lowering metabolic risk factors, including insulin resistance, hypertension and dyslipidaemia.[6] Dairy foods can assist with weight regulation through different mechanisms, including by enhancing satiety, preserving muscle mass during energy restriction, and modulating appetite-regulating hormones through inter-actions in the gut.[7]

Unfortunately, the non-selective nature of tissue reduction during weight loss poses a significant physiological challenge.[8] Weight loss due to an energy-reduced diet often results in a significant decrease in fat-free mass, which can lead to sarcopenic obesity: a clinical state characterised by low muscle mass and impaired physical function.[8] To prevent sarcopenic obesity, it is important to maintain an adequate, nutritious diet with enough protein, together with engaging in regular resistance exercise to maintain muscle mass and manage body weight. Consuming dairy products has been shown to have significant beneficial effects on fat loss and maintaining muscle mass owing to their protein content, making them an ideal component of an energy-restricted diet.[7]

Pharmacologic weight loss with glucagon-like peptide-1 receptor agonists

The clinical landscape of obesity management has been significantly altered by the introduction of glucagon-like peptide-1 receptor agonists (GLP-1 Ras), also called incretin mimetics, by promoting

significant weight loss and improving obesity-related conditions.[9] GLP-1 RAs were originally developed for the management of type 2 diabetes owing to their ability to enhance insulin secretion, improve insulin sensitivity and suppress glycogen release, assisting with blood glucose regulation.[10] Further research showed that their beneficial effects on appetite regulation and gastric emptying promoted weight loss in conjunction with glycaemic control. This led to a shift in their clinical application, with GLP-1 RAs being used as both diabetes and obesity treatments.[9,10]

Since the US Food and Drug Administration's approval of liraglutide (2014), semaglutide (2021) and tirzepatide (2023),[11] GLP-1-based the rapies have reshaped the treatment of obesity, type 2 diabetes, cardiovascular disease, chronic kidney disease and obstructive sleep apnoea.[12] GLP-1 RAs mimic endo genous in cretin hormones, facilitating weight loss through two primary pathways: the pharmacological delay of gastric emptying and the modulation of hypothalamic appetite centres to enhance satiety while suppres sing hunger.[13,14]

In a systematic review and meta-analysis (*N*=32 884), GLP-1 RAs demonstrated superior weight loss efficacy compared to a placebo, with a weighted mean difference (WMD) of –8.53kg (95%CI:–12.38 to –4.68; $p<0.0001$).[15] Beyond weight reduction, these agents also showed significant improvements in glycaemic control, evidenced by a reduction in glycated haemoglobin (HbA1c) (WMD:–0.24mmol/L; $p<0.0001$), and cardio metabolic markers, including a decrease in systolic blood pressure (WMD: –4.16 mm Hg; $p<0.0001$).[15]

Although these pharmacological agents offer high efficacy in weight reduction, their use introduces specific nutritional challenges such as gastro-intestinal side effects, dehydration and loss of lean body mass, which highlight the need for targeted nutritional strategies.[14-17]

Gastrointestinal side effects

The pharmacological delay in gastric emptying frequently manifests as clinical gastrointestinal distress.[15] Statistical analysis of safety outcomes indicates a significantly higher risk of adverse events in the GLP-1 RA groups compared to control groups (relative risk (RR):1.11; 95% CI: 1.05–1.16; $p<0.0001$).[15] For example, nausea was experienced more frequently by participants on GLP-1RAs compared to controls (RR:2.70; 95%CI: 2.18–3.33; $p<0.001$).[15] In addition, the risk of vomiting was significantly elevated (RR: 3.85; $p<0.001$), alongside a higher risk of diarrhoea (RR: 1.97; $p<0.001$) and constipation (RR: 2.35; $p<0.001$).[15]

These gastro-intestinal symptoms, particularly early satiety and nausea, can significantly hinder a patient's ability to maintain an adequate intake of essential nutrients, leading to potentially harmful energy deficits and rapid, un-managed weight loss, which requires strategic dietetic intervention.[14-16,18]

Risk of accelerated sarcopenia

A primary concern during the rapid weight loss facilitated by incretin mimetics is the preservation of lean body mass.[14,19] Clinical data indicates that the loss of muscle mass can account for 20–50% of the total weight lost during GLP-1 RA therapy.[14,19] In some trials, up to 40% of weight lost was lean mass, a figure significantly higher than the 25% typically observed with conventional lifestyle-based energy restriction.[14] The loss of metabolic mass is particularly problematic given that muscle is a major determinant of resting metabolic rate.[19]

Sarcopenic obesity, i.e. high body fat (obesity) with low muscle mass and strength (sarcopenia), is the result of interactions between genetic, environmental and social factors, physical activity, health status and malnutrition.[20] The incretin mimetics can result in a decreased intake of adequate protein and other nutrients owing to low appetite, which can contribute to malnutrition and loss of muscle mass.[20]

The clinical consequences of this 'muscle deficit' are significant.[19] Weight rebound after the discontinuation of pharmacotherapy often occurs as fat mass rather than fat-free mass, as muscle loss is associated with a lower metabolism.[19] This phenomenon, termed 'fat overshoot', may worsen the patient's body composition and increase the risk of physical frailty over time.[19,21] Excess and abnormal adiposity can also exacerbate damage to muscle strength and structure, with detrimental effects on cardiovascular health.[19]

Furthermore, evidence from the STEP-1 trial (*N*=1 961) demonstrated that although semaglutide significantly reduced fat mass ($p<0.001$), the concurrent reduction in lean mass necessitates a focus on 'high-quality' weight loss, where the ratio of fat loss to lean mass is optimised.[14,22]

Consequently, strategies to minimise muscle loss, specifically through high-quality protein intake (1.2–1.5 g/kg/d), nutrient quality and resistance training, are encouraged to achieve long-term weight-loss maintenance and preserved metabolic health.[14,19,23]

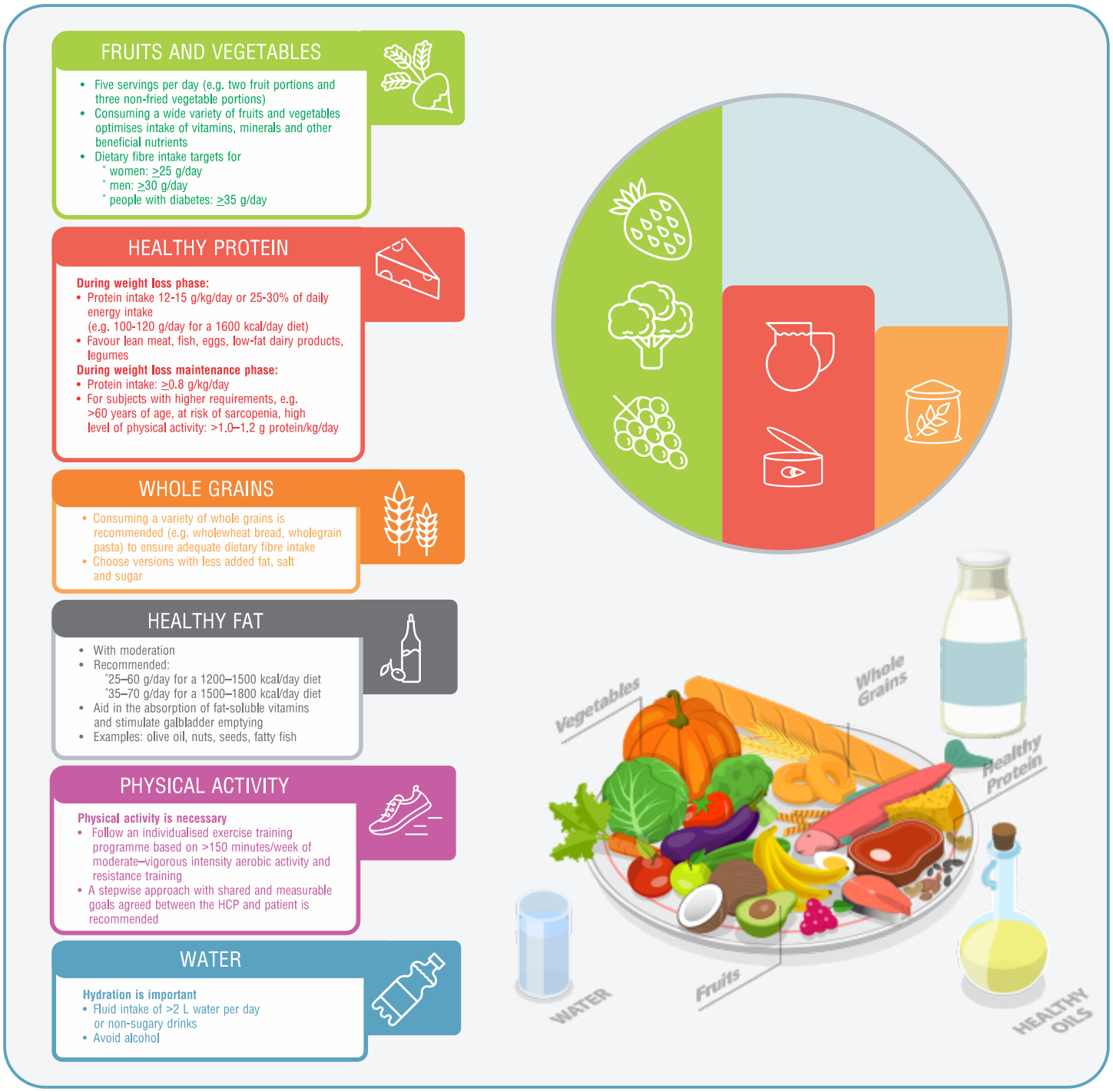


Figure 1: Healthy diet plate for weight management on GLP-1 therapy

The role of dairy in the management of GLP-1 therapy

By shifting from a reductionist nutrient approach to a holistic food-based model, healthcare professionals can use dairy as a strategic food group in addressing concerns such as nutrient density and muscle preservation during periods of GLP-1 RA therapy.[14,24] Figure 1 shows what a healthy plate should constitute of to ensure maximum fat loss and minimum muscle loss while on GLP-1 therapy.[16]

The 'dairy matrix' refers to the complex assembly of nutrients in dairy products and their structural organisation, which together dictate the rate and extent of nutrient digestion and absorption.[24]

Evidence increasingly suggests that the health effects of dairy foods are matrix dependent rather than nutrient dependent.[24,25] Dairy foods contain minerals, vitamins, lactose, proteins and live cultures (in the case of fermented dairy products) in a matrix.[4] Focusing on this matrix may support a multifaceted approach to managing the physiological shifts induced by the medication in patients on GLP-1 RA therapy.[14]

By providing high-quality protein, calcium and bioactive compounds, dairy foods can contribute to satiety regulation, the management of gut

symptoms, nutritional adequacy and preserving lean body mass.[7]

Mitigating loss of lean body mass: Dairy protein kinetics

Protein intake recommendations for patients on GLP-1 therapy range from 1.2 to 1.5 g/kg/d.[14,19] Dairy proteins are high-quality, complete proteins with a superior digestible indispensable amino acid score (DIAAS). This score reflects how well a protein is digested and its ability to provide all the essential amino acids in sufficient amounts for human requirements. Dairy proteins contain a high amout of branched-chain amino acids, specifically leucine, which acts as the primary molecular trigger for muscle protein synthesis.[3,27] In the context of the 20–50% loss in lean body mass associated with GLP-1 RAs, the structural organisation of dairy proteins may provide a nutritional advantage in mitigating this risk.[14,19]

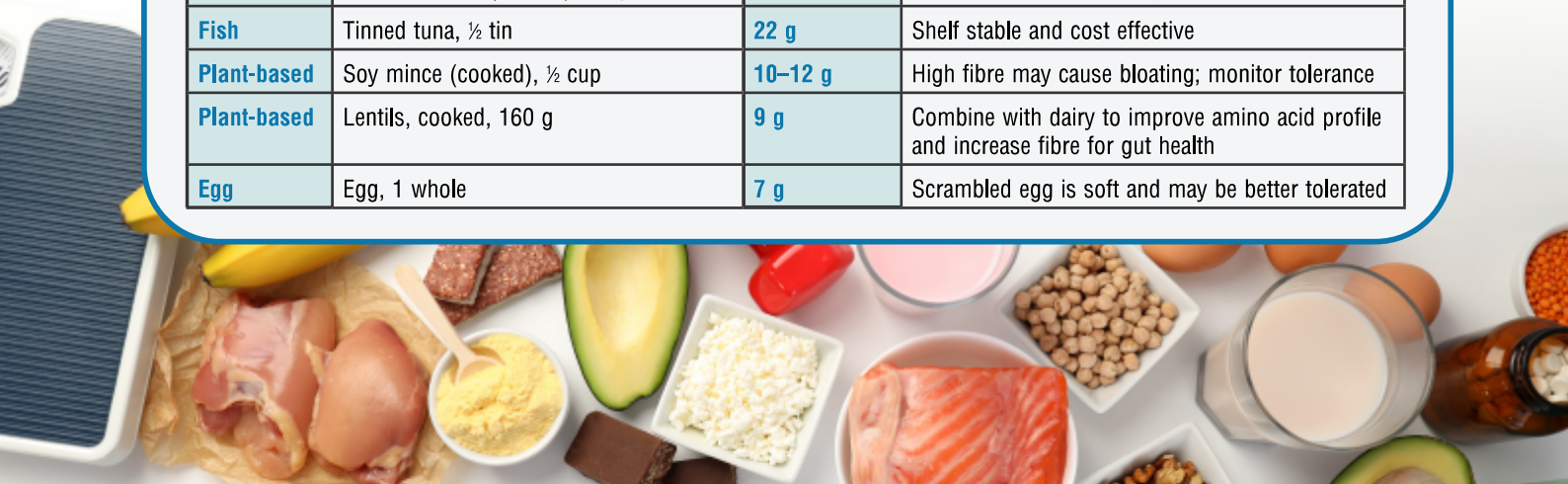
Whereas whey protein facilitates a rapid spike in plasma amino acids to stimulate muscle repair, casein (constituting approximately 80% of bovine milk protein) undergoes acid-induced coagulation in the stomach to form a semi-solid clot.[2,3] This physicochemical reaction results in a slow, sustained release of amino acids into the bloodstream over several hours, which effectively inhibits whole-body protein breakdown and preserves nitrogen balance.[3,24] To provide a continuous supply of anabolic substrates in patients who experience early satiety due to GLP-1 RA therapy, dairy can be consumed before sleep to reap the benefit of the slow-releasing effect of casein.[14,19]

Managing gastrointestinal symptoms

Fermented dairy products such as maas (amasi) and yoghurt provide bioactive peptides and live cultures that have been shown to support and manage dietary gastrointestinal distress,[3,23] often also associated with GLP-1 RA therapy. In a large systematic review (*N*=32 884), the use of GLP-1 RAs was associated with a significantly higher risk of gastrointestinal adverse events compared with placebo treatment (RR: 2.83; 95% CI:1.86–4.3; $p<0.001$).[15] Regular intake of fermented dairy products may modulate the gut microbiota and improve intestinal barrier function to assist in alleviating common side effects such as nausea and constipation.[3,13,16] Furthermore, the acidic nature (pH 4.3) and smooth texture of maas and yoghurt

Table 1: Protein-rich foods to meet higher protein requirements during GLP-1 RA therapy

Food category	Item and serving size	Protein content	Clinical note for patients
Dairy	Milk, 250 ml	8 g	Easy to consume when appetite is poor
Dairy	Flavoured milk, 250 ml	8 g	Easy to consume when appetite is poor
Dairy	High-protein milk, 250–350 ml	21–28 g	Protein dense; easy to consume when appetite is poor; long-life and fresh options available
Dairy	Amasi, 250 g	8 g	Low pH is often palatable during taste changes
Dairy	Yoghurt (plain), 200 g	8.8 g	Ideal for early satiety; well tolerated in the case of gastrointestinal concerns
Dairy	Greek-style yoghurt (plain), 200 g	12 g	High-density protein; ideal for early satiety
Dairy	Cottage cheese, 125 g (½ tub)	12g	Soft texture; easy to consume in small portions
Dairy	Mozzarella, 30 g	7.0 g	Easy to melt into meals, e.g. with scrambled eggs
Meat	Lean biltong, 30 g	15 g	Protein dense; chew slowly to aid digestion
Poultry	Chicken breast (cooked), 90 g	25 g	Can be shredded into dairy bases
Fish	Tinned tuna, ½ tin	22 g	Shelf stable and cost effective
Plant-based	Soy mince (cooked), ½ cup	10–12 g	High fibre may cause bloating; monitor tolerance
Plant-based	Lentils, cooked, 160 g	9 g	Combine with dairy to improve amino acid profile and increase fibre for gut health
Egg	Egg, 1 whole	7 g	Scrambled egg is soft and may be better tolerated



are often better tolerated by patients suffering from the delayed gastric emptying and altered taste sensations associated with incretin mimetic therapy.[14,16]

Bridging the nutrient gap: Calcium and nutrient density

GLP-1 RA patients may experience suboptimal nutrient intake owing to extreme appetite suppression.[13,14] As a nutrient-dense food with essential minerals, dairy may offer support in such cases, specifically owing to its high calcium content as the mineral regulates adipocyte metabolism through the suppression of parathyroid hormone and 1,25-dihydroxyvitamin D.[25,29] An additional benefit is that the high calcium intake promotes fat oxidation and suppresses lipogenesis (fat storage).[25]

Dairy calcium also forms insoluble 'calcium soaps' with long-chain saturated fatty acids in the intestinal lumen, which may reduce the net metabolisable energy of the diet owing to faecal fat excretion.[24,29]

Meta-analyses of cohort studies confirm that yoghurt consumption is associated with a lower body mass index and smaller waist circumference.[28,30] In trials investigating metabolic risk, higher dairy consumption was significantly associated with a reduced risk of obesity and type 2 diabetes ($p<0.05$).[31]

Glycaemic stability and satiety signalling

Beyond nutrient delivery, dairy proteins function as signalling molecules that stimulate the secretion of endogenous satiety hormones, including cholecystokinin and peptide YY, thereby complementing the pharmacological action of GLP-1 RAs.[2] The interaction between milk proteins and bioactive peptides also improves postprandial glycaemia and enhances insulin sensitivity.[2,29] This provides a stabilising glucose effect for patients undergoing rapid weight loss, ensuring that blood glucose levels remain steady despite irregular eating patterns often caused by medication side effects.[14,31] Owing to a reduced energy intake and improved insulin sensitivity in patients using a GLP-1 RA, the risk of hypoglycaemia increases.[14] Dairy products may support glycaemic stability by

Conclusion

A considerable body of evidence from the last decade confirms that dairy is not merely a source of calcium, but offers a sophisticated therapeutic matrix that is indispensable in modern weight management. The 'GLP-1 era' has presented a double-edged sword: exceptional weight loss combined with an unprecedented risk of muscle loss and nutritional deficiency.

To mitigate the risk of sarcopenia and ensure optimal fat loss, healthcare professionals should guide patients towards practical strategies to reach the higher protein requirements needed when using GLP-1 agonists. For example, for a patient weighing 80 kg, a daily intake of 96–120 g protein is required to meet the recommended target of 1.2–1.5 g/kg/d. Given the early satiety associated with pharmacotherapy, this target is best achieved through sources that contain both high-quality and high-density protein content per volume, without being overly rich or fatty and so trigger nausea. Table 1 provides a practical guide for healthcare professionals to help patients select protein-rich foods, including dairy, that are culturally relevant and well tolerated by patients during GLP-1 therapy.

Healthcare professionals should incorporate the energy value of dairy and recognise the unique synergy between whey and casein in preserving metabolic mass, the role of dairy calcium in promoting fat oxidation through the suppression of calciotropic hormones, and the satiety-inducing mechanisms of the dairy matrix.

By integrating nutrient-dense, easily tolerated options such as maas, high-protein milk and yoghurt into a protein-prioritised diet, healthcare professionals can help patients navigate the side effects of pharmacotherapy while ensuring that weight loss is predominantly due to lost fat mass. Ultimately, dairy provides a cost-effective, culturally relevant and physiologically superior framework for achieving sustainable health outcomes in the developing landscape of obesity treatment.

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SAMPLE MEAL PLAN FOR 80 KG PATIENT ON GLP-1 RA THERAPY

Breakfast:
Berrylicious smoothie
- 200 g Greek-style yoghurt (12 g protein) blended with fresh berries of choice

Mid-morning snack:
- 30 g lean biltong slices (15 g protein) with a handful of dried raisins

Lunch:
Cheesy eggs
- 2 scrambled eggs (14 g protein) with 30 g grated cheese (7 g) and diced vegetables

Afternoon snack:
- 1 x 200 ml plain yoghurt (8 g protein), used as a dip with vegetable fingers, e.g. baby corn, cucumber sticks, baby carrots

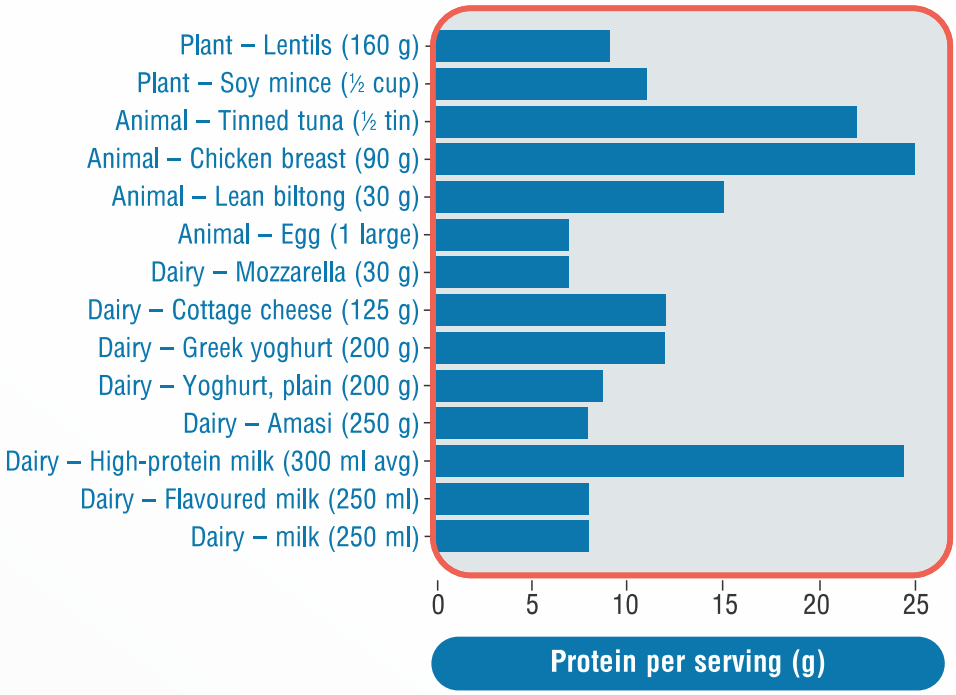
Dinner:
Tuna and brown rice salad
- 1 tin tuna (40 g) mixed with 2 tbsp plain yoghurt (1.5 g) with ½ cup brown rice and diced red onion and cucumber

Bedtime snack:
- Cinnamon milk: Glass (250 ml) of hot milk (12 g protein) with a dash of cinnamon

(TOTAL: 119 g PROTEIN; 1.4 g/kg)[14,19]

PROTEIN CONTENT PER SERVING OF VARIOUS FOODS

Protein content per serving of various foods



Protein content per serving (ranked highest to lowest)