



# Bariatric Surgery: Post-Operative Management

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## KEY MESSAGES FOR HEALTHCARE PROFESSIONALS



- Supporting patients with consistent use of post-operative behavioural plans (including managing nutrition and activity, thoughts and emotions, post-op vitamins and medications and skincare) can optimise obesity management and health while minimising post-operative complications.

- Working in partnership, healthcare professionals (HCPs) working at all levels of the Model of Care for Management of Obesity in Ireland need to support the patient living with obesity to establish and commit to a shared care model of chronic-disease management for long-term follow-up<sup>1</sup>.
- The primary care HCP should refer patients with post-bariatric surgery complications, that cannot be managed at Levels 1-3 of the Model of Care, back to Level 4 for specialist hospital care.

## RECOMMENDATIONS



1. Healthcare professionals (HCPs) can encourage people who have undergone bariatric surgery to participate and maximise their access to behavioural interventions and health and social care services at a Level 4 bariatric surgical centre (Level 2a, Grade B)<sup>2,3</sup> or the appropriate service for the level of care required (Level 4, Grade D, consensus). We suggest post-operative follow-up care is delivered at a Level 4 bariatric surgical centre for a minimum of two years (Level 4, Grade D, consensus).

2. We suggest that Level 4 bariatric surgical centres communicate a comprehensive care plan to the primary care HCP and other services as relevant on patients who are discharged, including bariatric procedure, emergency contact numbers, annual blood tests required, long-term vitamin and mineral supplements, medications, behavioural interventions and when to refer back (Level 4, Grade D, consensus).

#### KEY MESSAGES FOR HEALTHCARE PROFESSIONALS - Continued

3. We suggest that after a patient has been discharged from the Level 4 bariatric surgical centre, care provided at Levels 1-3 of the Model of Care should annually review nutritional intake, activity, compliance with multi-vitamin and mineral supplements and weight, as well as assess comorbidities, order laboratory tests to assess for nutritional deficiencies and investigate abnormal results and treat as required (Level 4, Grade D, consensus).
4. We suggest that primary care HCPs consider referral back to the Level 4 bariatric surgical centre or Level 3 specialist

services for technical or gastrointestinal symptoms, nutritional issues, pregnancy, psychological support, weight regain or other medical issues as described in this chapter related to bariatric surgery (Level 4, Grade D, consensus).

5. We suggest that Level 4 bariatric surgical centres provide follow-up and appropriate laboratory tests at regular intervals post-surgery with access to appropriate HCPs (as per the Model of Care) until discharge is deemed appropriate for the patient (Level 4, Grade D, consensus).

#### KEY MESSAGES FOR PATIENTS LIVING WITH OBESITY WHO HAVE HAD BARIATRIC SURGERY



- **If you have had bariatric surgery, it is essential for you to take your nutritional supplements lifelong and continue to follow the post-bariatric surgical nutrition and physical activity plans and any other recommendations agreed with your bariatric team.** By doing this, you will increase your chances of staying healthy and reduce complications that can arise from bariatric surgery.
- **Attend all scheduled appointments and programmes offered by your bariatric surgical service.** Once you are discharged from the bariatric surgical site, schedule annual appointments with your primary care healthcare professional (HCP); this may be your general practitioner and/or your local Level 2/3 Obesity service to check your bloodwork, reassess your medications and address any health issues related to changes in your weight.

- **After bariatric surgery, it is possible that there can be a negative impact on mood, relationships, body image, development of addictions and reduced ability to cope with stress.** If you are struggling, discuss this with your original specialist team or, if you have been discharged, with your primary care HCP.
- **Remember that your lowest weight post-surgery will typically occur between 12 and 18 months.** After this, there is a natural increase in weight that occurs. If you are re-gaining and concerned that this is affecting your health, discuss this with your bariatric team or primary care HCP.
- **Appropriate contraception should be used until rapid weight loss has stopped and/or weight stability has occurred.** If you are 12 to 18 months post-bariatric surgery and are planning a pregnancy, discuss this with your bariatric team, primary care HCP and obstetrician.

#### Duration of follow-up at bariatric surgical centres

Standardised, lifelong follow-up contributes to desirable and adequate outcomes following surgical treatment of obesity. Scheduled multi-disciplinary post-operative follow-up should be provided to every patient undergoing bariatric/metabolic surgery<sup>4</sup>. However, given the increasing number of bariatric patients, follow-up should be, at least in part, transferred to Levels 1-3 of the Model of Care over time<sup>5</sup>. Duration of follow-up at bariatric surgical centres may vary. Both the UK National Institute of Health and Care Excellence (NICE) and the British Obesity and Metabolic Surgery Society (BOMSS) recommended that people who have had bariatric surgery have a post-operative follow-up care package within the bariatric centre for a minimum of two years<sup>6,7</sup>.

#### Post-bariatric surgery health behaviours

##### Key components of a post-bariatric surgery nutrition care plan

- Small regular meals;
- Prioritise protein to achieve minimum of 60 g/day; and
- Ensure hydration with regular non-caffeinated sugar-free drinks consumed at least 20 minutes apart from the consumption of meals/snacks.

Bariatric centres will typically provide patients with a dietary

protocol following surgery. Initially, patients should make a gradual transition of food consistency in the first post-operative weeks from liquid, to soft and then to a solid diet, as tolerated. This progression should be individually tailored to tolerance. A clear liquid meal regimen can usually be initiated several hours after surgery. All patients should have access to a comprehensive nutrition and dietetic assessment with counselling on the macronutrient and micronutrient content of the diet based on the surgical procedure and the patient's nutritional status<sup>8</sup>.

Over the long term, patients are encouraged to follow a structured post-bariatric surgical nutrition care plan involving regular small meals and snacks that prioritise adequate protein, with gradual dietary progression to reintroduce sources of dietary fibre, as tolerated. Meals and snacks should be chewed well and consumed slowly. Foods high in fat and sugar should be avoided to prevent dumping syndrome and minimise nausea. To ensure adequate hydration, a minimum of 1.5 per day litres is recommended. Patients should not eat and drink at the same time, with a gap of 20-30 minutes suggested before and after meals to avoid feeling over full/nauseous when eating. Carbonated beverages and caffeinated drinks are to be avoided as the gas in carbonated beverages can cause gastric discomfort and reflux, and caffeinated beverages do not provide maximum hydration.

In the longer term after bariatric surgery, patients are recommended to follow a low-fat, moderate carbohydrate and high-protein diet. Post-operative protein recommendations range from 1.2 g/kg/day to 1.5 g/kg/day based on goal body weight (minimum of 60 g/day for laparoscopic sleeve gastrectomy (SG)/ Roux-en-Y gastric bypass (RYGB) and 80 g/day to 120 g/day for duodenal switch (DS)). Dietitians registered with CORU, the authority responsible for the regulation of health and healthcare professionals in Ireland can support changes in eating and guide patients on their nutrition needs<sup>9</sup>. There is no advantage to prescribing alternate diets (e.g., low carbohydrate, high protein), probiotics or amino acids<sup>10-12</sup>.

### Other behaviours to consider

**Alcohol:** Alcohol intake should be minimal or avoided due to changes in pharmacokinetics following surgery. For example, in women who are post-RYGB, two alcoholic beverages are equivalent in absorption to four alcoholic beverages<sup>13</sup>. Seven percent of patients report new high-risk alcohol use one year after bariatric surgery, while half who reported high-risk alcohol use before surgery discontinued high-risk drinking<sup>13</sup>.

**Activity:** Early mobilisation post-surgery should be encouraged as per local guidance. Patients should be encouraged to re-establish a routine of incorporating daily activity over the initial six to eight weeks post-surgery. Long term, a standard of 150 to 300 minutes of activity/week including strength training two to three times per week<sup>5</sup> is recommended for post-bariatric surgical patients. Post-operative higher-volume exercise can help promote further weight loss<sup>14-16</sup> but sustaining this level of activity is difficult<sup>17</sup>.

**Smoking cessation:** Abstention from cigarettes is recommended. Cigarette smoking can increase risk of peptic ulcer disease, particularly marginal ulcers<sup>18</sup>. For those patients who have quit smoking in advance of surgery, the importance of continued abstention should be highlighted. The Health Service Executive (HSE) provides a range of free services open to anyone who wants to quit smoking including clinic and the HSE Quit Programme. Further details are available at <https://www2.hse.ie/quit-smoking/>.

**Marijuana and other illicit substances:** There are a paucity of studies on the use of illicit substances post-bariatric surgery. One concern would be the impact of weight loss and the chronic use of marijuana, which is traditionally known for its "munchies" effect. Abstention is recommended.

### Post-bariatric surgery vitamin supplementation

- Life-long micronutrient supplementation is required after all bariatric surgery procedures<sup>7</sup>.
- Suggested supplements include calcium with vitamin D, complete multi-vitamin, intramuscular (IM) vitamin B12 and iron (see [Table 1](#) for dosage/preparation)<sup>7</sup>.
- Annual monitoring of micronutrient status and nutritional biochemistry is necessary after all bariatric surgical procedures<sup>7</sup>.

Practically, it makes sense that a standardised minimum prescription of vitamins be set for all bariatric surgeries. It is a natural human tendency to eventually forget to take supplements. Setting a standard means that clinicians can be consistent in their messaging about taking vitamins. Audit data from an Irish bariatric unit found that high adherence to supplement use at 12 months declined by 18 months (58% vs. 33% for calcium supplements, 77% vs. 47% for multi-vitamin and mineral preparation and 85% vs. 54% for iron and vitamin B12 preparations), reinforcing the need for long-term follow-up<sup>19</sup>. Deficiencies of vitamins and some minerals can leave serious and potentially non-reversible side effects. Frequency of laboratory monitoring may vary depending on the individual and type of procedure, but at minimum an annual check should be conducted to ensure that patients are not becoming malnourished. [Tables 1, 2 and 3](#) summarise the recommendations for vitamin supplementation, post-operative biochemistry monitoring and associated nutritional deficiencies that can occur. These have been adapted using the BOMSS Guidelines on Peri-operative and Post-operative Biochemical Monitoring and Micronutrient Replacement for Patients Undergoing Bariatric Surgery from 2020, as these are the guidelines most frequently referred to in Ireland<sup>7</sup>. [Table 4](#) summarises clinical features that may point toward a nutrient deficiency. A CORU-registered dietitian (RD) can help determine what combination of vitamins makes sense for a patient. There are many multi-vitamin preparations available, not all of which meet the recommended dosage across all vitamins. An increased dosage compared to the manufacturers' recommendations may be required to achieve the recommended

dosage. Gummy vitamins and vitamin sprays should be avoided as they are generally not complete as a multi-vitamin and mineral preparation.

## Post-bariatric surgery complications

The risk of gastrointestinal (e.g., dumping syndrome) and metabolic complications (e.g., bone, kidney stones) can be minimised by following the recommended post-bariatric surgery nutrition care plan and vitamin/mineral regimen.

### Dumping syndrome & post-prandial hypoglycaemia

- Dumping episodes can occur in up to 40% of patients following bariatric surgery<sup>20</sup>.
- Nutrition is key in managing dumping syndrome and dietary intervention improves both hypoglycaemia and dumping symptoms.
- Pharmacotherapy may be needed, especially in post-prandial hypoglycaemia when nutritional intervention hasn't been fully successful.

Dumping syndrome is divided into early and late phases. Early dumping syndrome occurs within the first hour after a meal. Because of the hyperosmolality of the food, rapid fluid shifts occur from the plasma compartment into the intestinal lumen, resulting in hypotension and a sympathetic nervous system response. Early dumping is characterised by gastrointestinal symptoms, such as abdominal pain, bloating, borborygmi, nausea and diarrhoea and vasomotor symptoms, such as fatigue, desire to lie down after meals (a classic symptom), flushing, palpitations, perspiration, tachycardia, hypotension and, rarely, syncope.

In contrast, late dumping or post-prandial hypoglycaemia usually occurs one to three hours after a meal and is a result of an incretin-driven hyperinsulinaemic response after carbohydrate ingestion. Hypoglycaemia-related symptoms are related to neuroglycopenia (fatigue, weakness, confusion, hunger and syncope) and autonomic/adrenergic reactivity (perspiration, palpitations, tremor and irritability)<sup>21</sup>.

Nutritional manipulation should be the first-line treatment for the management of dumping syndrome. Self-monitoring of food intake, portion size, timing and symptoms can be helpful in identifying the cause of dumping syndrome. Dietary management of post-prandial hypoglycaemia involves a reduced carbohydrate intake (< 30 g/meal or < 15 g/snack) comprising low glycaemic index foods, combined with protein and fat. Carbohydrates with high-glycaemic index/load should be avoided<sup>22</sup>.

Symptoms that persist despite counselling regarding an appropriate nutrition care plan, may benefit from a trial of either acarbose, a calcium channel blocker, diazoxide or octreotide. Referral to a bariatric medicine specialist or an endocrinologist

for management and to rule out other causes of hypoglycaemia (nesidioblastosis, insulinoma, factitious) may be warranted<sup>23</sup>.

### Abdominal discomfort

Abdominal discomfort has a long differential from eating poorly tolerated foods or portions that are too large for pouch volume, dumping syndrome, biliary colic, stenosis of the gastrojejunostomy, marginal ulcer or small bowel obstruction. Presentation for small bowel obstruction can come at any time but can be divided into early (< 30 days; secondary to adhesions or incarcerated hernias) or late (> one year; internal hernia, which can be seen after RYGB or DS). During the first year, there is a need for a higher level of suspicion for pain secondary to a surgical complication. Tachycardia, unstable vital signs and abdominal pain may be suggestive of a surgical leak, internal hernia or cholecystitis, which warrants immediate surgical referral. With diarrhoea, constipation or bloating, referral to an RD can help to identify dietary causes, such as larger-than-recommended portions, inadequate time between eating and drinking, high-fat or high-sugar food choices, inadequate fluid intake and low fibre intake. Probiotics may improve symptomatic gastrointestinal episodes.

There should be a high level of suspicion for gastroduodenal or stomal ulceration for patients who use non-steroidal anti-inflammatory drugs (NSAIDs). Referral to the bariatric surgical centre should be considered when clinical red flags appear, such as unexplained, frequent, moderate-to-severe abdominal pain; daily intolerance to most solid foods; daily nausea and vomiting; and/or a significant amount of weight regain (> 25% – 50% of total weight loss) in a short space of time. Every bariatric patient suffering from persistent vomiting severe enough to interfere with regular nutrition should be promptly started on oral or parenteral thiamine supplementation, even in the absence or before confirmatory laboratory data<sup>5</sup>.

### Bowel health/dysfunction

Changes to bowel habit are common in the initial weeks after bariatric surgery, with constipation a frequent complaint. A decrease in bowel motion, frequency and change towards firmer stools have been reported at six months post-surgery in Irish populations<sup>19</sup>, suggesting prolonged intestinal transit time after bariatric procedures<sup>24</sup>. For those patients who suffer from faecal incontinence, this has been shown to improve after RYGB<sup>25</sup>. A combination of a low-fibre intake, challenges achieving adequate hydration and iron supplementation are likely to contribute to constipation<sup>26</sup>. Dietary management should focus on hydration, and the gradual introduction of dietary fibre as tolerated. Prophylactic laxatives may be prescribed to be taken as required with guidance from the bariatric team to manage constipation<sup>27</sup>.

### Bone health

- Nutritional support with daily protein, calcium and vitamin D is key in maintaining bone health.

- Dual-energy X-ray absorptiometry should be considered two to three years after bariatric surgery.
- Oral bisphosphonates may cause gastric ulceration and should be avoided.

Post-bariatric surgery, bone demineralisation<sup>28-30</sup> and fracture risk<sup>31</sup>, particularly after DS, are increased. A major cause of bone loss is impaired intestinal calcium absorption, which leads to stimulation of parathyroid hormone (secondary hyperparathyroidism) and bone resorption<sup>30</sup>. The evidence for monitoring, prevention and treatment is not well described. At minimum, adequate protein intake in combination with routine physical activity in addition to the routine supplementation of calcium citrate and vitamin D are recommended<sup>30,32</sup>. It is recommended to adjust calcium and vitamin D intake to achieve normal serum calcium, vitamin D and parathyroid hormone levels. Calcium citrate is preferred over calcium carbonate as it is better absorbed in the absence of gastric acid; however, in practice, calcium citrate preparations with vitamin D are difficult to source in Ireland and so calcium carbonate with vitamin D may be used. Elevated parathyroid hormone in the setting of inappropriately high serum calcium and normal vitamin D level is suggestive of primary hyperparathyroidism and requires further investigation.

The role of bone mineral density testing prior to bariatric surgery is controversial<sup>33</sup>, particularly due to technical difficulties when patients are at a higher body mass index (BMI). We suggest ordering bone mineral density testing on a patient at two-years post-surgery, when weight is at its nadir. Subsequent bone mineral density testing can be ordered based on clinical need<sup>33</sup>. Evidence for the effect of osteoporosis pharmacotherapy in the context of bone loss after bariatric surgery is lacking. If a patient does have osteoporosis, then intravenous bisphosphonates (zoledronate 5 mg once per year, ibandronate 3 mg every three months) are the preferred choice, as there is a risk of anastomotic ulcer with oral bisphosphonates. Denosumab therapy can be considered, although prospective trial data in bariatric patients is lacking and hypocalcaemia remains a concern<sup>34</sup>. Prior to starting osteoporosis therapy (bisphosphonate or denosumab), it is important that vitamin D levels are fully replete to prevent the development of hypocalcaemia, hypophosphataemia and osteomalacia<sup>35</sup>.

### Nephrolithiasis

- Kidney stone formation (nephrolithiasis) is increased following bariatric surgery, especially RYGB.
- Oral calcium supplementation with meals, adequate fluid intake and reduced oxalate intake may all help prevent kidney stone formation.

Patients who have had bariatric surgery are at higher risk of new onset nephrolithiasis, with the mean interval from surgery to diagnosis of nephrolithiasis ranging from 1.5 to 3.6 years. The risk of nephrolithiasis, typically calcium oxalate stones, varies by procedure, being the highest for hypo-absorptive procedures

(22% – 28.7%), intermediate for RYGB (7.65% – 13%) and the lowest for purely restrictive procedures (laparoscopic adjustable gastric banding, laparoscopic SG) where it approaches that of non-operative controls<sup>36</sup>. Post-bariatric surgery, patients have a higher propensity for calcium oxalate stone formation. Basic therapeutic strategies to manage hyperoxaluria include calcium citrate supplementation, increased hydration, limiting dietary oxalate and adhering to a low-fat diet<sup>30,37</sup>. Commonly, individuals often believe that kidney stones are caused by taking too much calcium, and that calcium supplementation should be discontinued. The opposite is actually true, in that they should remain on their calcium citrate supplementation, which not only helps bind intestinal oxalate but also provides citrate for the urine. There is some evidence to suggest that pyridoxine (B<sub>6</sub>) deficiency plays a role in kidney stone formation, highlighting the importance of taking vitamin supplementation consistently<sup>38</sup>. Certain probiotics (containing either *Lactobacillus* alone or in combination with *Streptococcus thermophilus* and *Bifidobacterium*) may play a complementary role in reducing gastrointestinal oxalate absorption if basic strategies are insufficient<sup>39,40</sup>.

### Psychological complications and treatments post-op

- Refer to Chapter 7 [The Role of Mental Health in Obesity Medicine](#) and Chapter 10 [Effective Psychological and Behavioural Interventions for People Living with Obesity](#) for further details.

Though bariatric surgery is one of the most effective treatment options for obesity, HCPs should be aware of the potential post-bariatric psychological issues that may arise, including depression, suicide<sup>41,42</sup>, body image disorder, eating disorders<sup>43</sup> and substance and alcohol abuse<sup>13</sup>. Results from bariatric surgery may not meet a patient's expectations or may not lead towards hoped improvements in quality of life, thus impacting mood<sup>5</sup>. Adjustment to the post-operative nutrition care plan can be challenging for patients as they become accustomed to early satiety, planning and implementing regular meals, snacks and daily vitamin/mineral supplementation. Difficulty in adjusting to slower eating, awareness of changed satiety signals and managing physical symptoms may be overwhelming for some. Within a fully resourced Model of Care, support in Level 4 bariatric surgery centres psychology teams may help patients to navigate this time of change. HCPs should address improvements in patient's self-esteem and self-motivation. Patients who have had comprehensive post-bariatric behavioural support have a decreased risk for depression and improved health outcomes<sup>2,44,45</sup>. In some cases, primary care HCPs may need to refer the post-bariatric surgical patients for more in-depth psychological counselling, such as cognitive or dialectical behaviour therapy.

### Weight regain

Nadir weight (lowest weight point) occurs one to two years post-bariatric surgery. Weight loss slows and stops partly because of adaptive changes in the intestine, changed habits and metabolic adaptation<sup>46</sup>. After this, it is normal to expect some weight regain. While there is no consistent absolute number in the literature that

defines pathological weight regain post-bariatric surgery, some studies have suggested it should be defined as > 15% of weight from nadir<sup>47</sup>. Studies that have been conducted in the bariatric surgery population show that ≥ 15% gain of initial weight loss post-bariatric surgery occurs in 25% – 35% of people who undergo surgery two to five years after their initial surgery<sup>48</sup>. The underlying factors that influence weight regain following bariatric surgery are multi-factorial, and include endocrine and metabolic alterations, anatomic surgical failure, difficulties with post-operative nutrition recommendations, mental health challenges and lower levels of physical activity<sup>43</sup>.

Even prior to surgery, emphasising realistic weight trajectories and expectations may help to reduce the anxiety that some patients go through as they mentally try to transition from weight loss to weight maintenance. Patients who experience weight regain may perceive that the surgery has failed, or they may enter a cycle of blaming themselves and feeling ashamed. It is important that HCPs mitigate these feelings by explaining that some weight regain following bariatric surgery is normal, and then proceeding in a stepwise approach to address the weight regain if impacting health. It is neither necessary nor economical to order an oesophagogastroduodenoscopy or an upper gastrointestinal contrast study to evaluate the gastrointestinal tract on every patient who is experiencing weight regain following surgery. The following steps are suggested to address weight regain:

- Support the patient to follow the recommended post-bariatric surgery nutrition care plan and multi-vitamin/mineral supplementation regimen. Check nutritional biochemistry to ensure that vitamin and mineral levels are in the normal range. Referral to a RD can be helpful at this stage.
- Psychological intervention may be required to address mood, anxiety, disordered eating or for behavioural support. Also consider referral to physiotherapy for activity and pain support.
- Consideration of medications for obesity management post-bariatric surgery may be made for patients with regain in conjunction with post-bariatric surgery nutrition care plans including vitamin supplementation. Orlistat should not be used in patients who have had hypo-absorptive procedures. Retrospective reports have demonstrated that glucagon-like peptide 1 (GLP-1)<sup>49,50</sup> or naltrexone/bupropion<sup>51</sup> may play a role in reducing weight regain. Medications such as steroids, sulphonylureas, pioglitazone and insulin (among others) are associated with weight gain, so consideration should be given to alternative agents where possible.
- Refer to the Chapter 6 on the [Clinical Assessment of People Living with Obesity](#) for details on the medications that are associated with changes in weight.
- If weight regain is impairing health and remains a problem despite the above, then an esophagogastroduodenoscopy or upper gastrointestinal contrast study may rule out an anatomical failure. Detection of an anatomical failure would

lead to a referral back the bariatric surgical team.

- After all the above steps, if weight regain still remains an issue, then consider referring back to a bariatric surgery centre for evaluation of eligibility for surgical revision.

## Medications

Following bariatric surgery, many studies demonstrate a reduction of medications for type 2 diabetes, dyslipidaemia, cardiovascular and anti-hypertensive agents. There are a limited number of publications that focus on the pharmacodynamics of medications post-operatively (see [Table 4](#)). Ultimately, there remains a large inter-individual variation and the therapeutic effects of a medication must be individually dose adjusted. A pharmacist should be consulted if any concerns regarding medication dosage or absorption arise.

For the first three to eight weeks post-surgery, large medications may be consumed in a crushed or liquid form or by opening capsule contents if necessary<sup>52,53</sup>. Tablets that are enteric coated or sustained release should not be used. Effervescent formulations should be avoided because the build-up of gas in the pouch can be uncomfortable for the patient. The excess sodium in these formulations is also not appropriate for bariatric patients with hypertension. It is important that the liquid form does not contain absorbable sugars to avoid dumping syndrome<sup>54</sup>. Some medications, however, should not be crushed<sup>55</sup>. Post-RYGB and DS, the pharmacokinetic profile of many medicines may be altered due to changed intestinal absorption surface, lipophilicity of drugs, increased pH in the stomach, reduced cytochrome P450 enzyme activity and first-pass intestinal metabolism, time after bariatric surgery and changes in volume of distribution<sup>56</sup>. Immediate-release formulations are generally preferred over extended release. NSAIDs should be avoided after RYGB or DS due to risk of anastomotic ulceration/perforations. For other bariatric procedures, NSAIDs use should be accompanied with proton pump inhibitors (PPIs) for mucosal protection<sup>57</sup>. PPI prophylaxis should be considered for at least 30 days after RYGB<sup>8</sup>. There is insufficient evidence to provide a recommendation of PPI prophylaxis for SG but given the high number of patients with gastroesophageal reflux after the procedure, it may be considered for at least 30 days after surgery.

Ursodeoxycholic acid (UDCA) significantly reduces the risk of both asymptomatic and symptomatic gallstones after bariatric surgery. A dose of 600 mg/day is associated with improved adherence and better outcomes regardless of type of surgery<sup>58</sup>. UDCA should be considered for six months after bariatric surgery for patients without gallstones at the time of surgery<sup>8</sup>.

Post-operative thromboprophylaxis should be individualised depending on individual patient risk as there is no clear consensus on choice, dosing and duration following bariatric surgery<sup>59</sup>. Thromboprophylaxis should involve mechanical and pharmacological measures<sup>8</sup>. Patients who need to remain on low-dose aspirin for secondary prevention may do so but should have additional PPI protection. Especially for RYGB and DS procedures,

patients taking long-term warfarin require a post-operative dose reduction of > 20% with closely monitored international normalised ratio, this should be communicated to their anti-coagulation team post-operatively. Caution should be exercised in relation to direct oral anti-coagulants due to the potential for decreased drug absorption.

If a betablocker after bariatric surgery is needed, a hydrophilic compound like atenolol may be preferred. Bioavailability of oral contraceptives may be reduced post-bariatric surgery, and alternate methods of contraception need to be considered.

Hypoglycaemic agents with a risk for hypoglycaemia (such as sulfonylureas) should be discontinued and insulin doses adjusted. Metformin may be continued but the dose may need to be reduced due to increased absorption<sup>60</sup>. Primary care HCPs may benefit from working with a patient's community pharmacist for medication adjustments.

### Post-operative oxygenation

Both patients without obstructive sleep apnoea (OSA) or with uncomplicated OSA can be safely monitored in a surgical ward after the initial post-anaesthesia care unit stay. A low threshold for non-invasive positive pressure ventilation should be maintained in the presence of signs of respiratory distress. Patients with OSA on home continuous positive airway pressure therapy should use their equipment in the immediate post-operative period. Patients with obesity hypoventilation syndrome are at higher risk of respiratory adverse events. Post-operative bi-level positive airway pressure/non-invasive ventilation should be considered liberally during the immediate post-operative period, in particular in the presence of hypoxaemia<sup>8</sup>.

### Special considerations for bariatric surgery on fertility

Bariatric surgery should not be considered a treatment for infertility<sup>61</sup>. Many studies related to fertility in women post-bariatric surgery are small, and appropriate control groups have not always been included. Together, the evidence suggests that bariatric surgery improves fertility, whether it is through improvements of sex hormonal profiles or resolution of polycystic ovary syndrome markers, which influence fertility (including anovulation, hirsutism, hormonal changes, insulin resistance, sexual activity and libido)<sup>62</sup>. The type of surgery does not appear to be related to changes in fertility, as only the amount of weight lost (a BMI decrease of > 5 kg/ m<sup>2</sup>) and the BMI achieved at time of conception were predictive of becoming pregnant<sup>63</sup>.

In men, surgery-induced massive weight loss does not impact sperm quality, but it does increase the quality of sexual function, total testosterone, free testosterone and follicle-stimulating hormone and reduces prolactin<sup>64</sup>. Overall, in men, the balance between positive (hormonal, psychological and sexual improvements) and negative (nutritional depletion due to selective food maldigestion

and malabsorption) impacts will determine the final effect on seminal quality and fertility<sup>64</sup>.

Women who became pregnant before one year after bariatric surgery presented with a higher rate of foetal loss in comparison to women whose pregnancy occurred after this period of time (35.5% vs. 16.3%). Pregnancy is therefore not recommended in the period of rapid weight loss (one to two years) following bariatric surgery<sup>65</sup>, by which time weight is more stable and women are able to consume a nutritionally balanced diet. Thus, adequate contraception should be recommended to women of reproductive age who undergo bariatric surgery. As oestrogen is absorbed in the upper gastrointestinal tract, which is modified during bariatric surgery, oral contraception pills should be avoided for RYGB and biliopancreatic diversion/DS. Instead, other forms of hormonal contraception (etonogestrel implant<sup>66</sup> or a levonorgestrel-releasing intrauterine device<sup>67</sup>) may be considered. There is no definitive contraindication to oral contraception pills for gastric banding and SG<sup>5,68</sup>. Women should be counselled regarding contraception prior to surgery (see Chapter 12 [Bariatric Surgery Selection and Preoperative Work-up](#)) and the need for contraception discussed at post-operative reviews.

### Special considerations in women who have had bariatric surgery and pregnancy

Compared with women who have obesity and who have not undergone bariatric surgery, women who became pregnant after bariatric surgery had a lower risk of gestational diabetes, hypertensive disorders and macrosomia. However, risk of small-for-gestational-age newborns increases after bariatric surgery<sup>69</sup>.

### Pre-conception care

While [Table 3](#) outlines general recommendations from BOMSS relating to pregnancy and bariatric surgery, more detailed guidance and consensus recommendations are available from Shawe *et al.* in "Pregnancy after bariatric surgery: Consensus recommendations for periconception, antenatal and postnatal care"<sup>70</sup>. Women planning conception post-bariatric surgery should have daily oral supplementation with a multi-vitamin containing 5 mg folic acid, beginning at least three months before conception. Women should continue this regime until 12 weeks gestational age. From 12 weeks gestational age, continuing through the pregnancy, and for four to six weeks postpartum or as long as breast feeding continues, continued daily supplementation should consist of a multi-vitamin with 5 mg folic acid<sup>70,71</sup>. Vitamin B12 levels should be checked and corrected if deficient prior to initiation of additional folic acid. Women are advised to avoid vitamin and mineral preparations which contain vitamin A in the retinol form in the first 12 weeks of pregnancy, as supplements containing retinol may increase the teratogenic risk (especially in the first trimester). It is therefore recommended that pregnant women and those planning pregnancies following bariatric surgery are supplemented with vitamin A in the beta-carotene form.

## Nutritional monitoring during pregnancy

Standard complete multi-vitamin/mineral preparations routinely used post-bariatric surgery should be replaced by peri-natal multi-vitamins to reduce vitamin A intake and deliver it in the form of beta-carotene. Continue all other regular supplementation that the patient typically would be on, and then adjust according to laboratory testing. Laboratory testing at each trimester should include full blood count, ferritin, albumin, vitamin B<sub>12</sub>, 25-hydroxy vitamin D, calcium, parathyroid hormone and folate. Patients who have had hypo-absorptive surgery should additionally have zinc, copper and vitamin A levels (and possibly vitamin E and K levels with DS) monitored during pregnancy<sup>5,62,70,72</sup>. See Shawe *et al.* in “Pregnancy after bariatric surgery: Consensus recommendations for pericontraception, antenatal and postnatal care” for more detailed guidance<sup>70</sup>.

If the patient is vitamin A deficient, then supplementation should be in the form of beta-carotene vitamin A<sup>73</sup>. Patients suffering from nausea and intractable vomiting should have immediate vitamin B1 supplementation and careful monitoring of vitamin B1 levels. Nutrition advice from an experienced CORU RD should be offered to review deficiencies, vitamin supplementation and ensure a recommended daily protein intake of 60 g<sup>61</sup>. Possible recommended gestational weight gain would be based on pre-pregnancy BMI as per the Institute of Medicine<sup>74</sup> (see Chapter 18 [Weight Management for Adult Women Living with Obesity during Preconception, Pregnancy and Postpartum](#) for more information).

## Other considerations during pregnancy

In addition to nutritional deficiencies, there is also the potential for severe, life-threatening complications, such as internal hernias, bowel obstructions, volvulus, intussusception and gastric perforations, which generally occur one to three years after bariatric surgery. Because of the upward pressure from the gravid uterus, these late sequelae may present in pregnancy and during the immediate postpartum period. Abdominal pain in a post-bariatric surgical gravid woman would need to include these potential complications in the differential diagnoses. Radiologic evaluation with computed tomography scan should be reviewed by bariatric surgeons or radiologists with specialised expertise in this area<sup>75</sup>. Post-surgical patients may not tolerate the 50 g glucose solution commonly administered at 24–28 weeks of gestation to screen for gestational diabetes. Alternative measures to screen for gestational diabetes should be considered for patients who have undergone hypo-absorptive surgery. One proposed alternative is home glucose monitoring (fasting and two-hour post-prandial blood glucose) for approximately one week during the 24–28 weeks of gestation<sup>61</sup>. See Shawe *et al.* in “Pregnancy after bariatric surgery: Consensus recommendations for pericontraception, antenatal and postnatal care” for more detailed guidance<sup>70</sup>.

## Postpartum

Breast feeding should be encouraged. It is important that postpartum bariatric surgical patients continue their recommended vitamin/mineral supplementation, as there have been documented cases of nutritional deficiencies in breast-fed infants born to mothers who have had RYGB<sup>76</sup>.



Table 1: Post-Operative Vitamin and Mineral Supplementation Adapted from BOMSS Guidelines 2020<sup>7</sup>

Post-operative vitamin and mineral supplementation		Grade, evidence level (EL), (range of evidence)
General recommendations	Vitamin and mineral supplements should be reviewed regularly and adjusted accordingly.	GPP
	A complete multi-vitamin and mineral supplement (containing thiamine, iron, selenium, zinc and copper) is recommended daily after all bariatric procedures.	GPP
Iron	Following AGB, consider recommending a multi-vitamin and mineral supplement containing iron to people, especially adolescents, as oral dietary intake of iron may be low.	GPP
	Following SG, RYGB or malabsorptive procedures such as BPD/DS, recommend that people take additional elemental iron.	Grade B EL 2 (1+ to 2-)
	Consider starting with 200 mg ferrous sulphate, 210 mg ferrous fumarate or 300 mg ferrous gluconate daily and twice daily in menstruating women and adjust depending on blood results.	Grade B EL 2 (1+ to 2-)
	Consider advising people to take iron supplements with citrus fruits/drinks or vitamin C.	GPP
	Consider advising people to take calcium and iron two hours apart as one may inhibit absorption of the other.	GPP
Folic acid	Advise people to take a complete multi-vitamin and mineral supplement providing 400 µg to 800 µg folic acid per day.	Grade D EL 4 (1+ to 4)
Vitamin B <sub>12</sub>	Following SG, RYGB or malabsorptive procedures such as BPD/DS, recommend routine supplementation with vitamin B <sub>12</sub> intramuscular injections.	Grade B level 2 (1+ to 2-)
	Following SG, RYGB or malabsorptive procedures such as BPD/DS, recommended frequency of vitamin B <sub>12</sub> intramuscular injections is every 3 months.	GPP
Vitamin D	Adjust vitamin D <sub>3</sub> supplementation to maintain serum 25-hydroxy vitamin D levels of 75 nmol/L or higher.	Grade D EL 4 (2 to 4)
	Maintenance levels of between 2000 IU and 4000 IU oral vitamin D <sub>3</sub> per day may be required following SG and RYGB and higher following malabsorptive procedures such as BPD/DS.	Grade D EL 4 (2 to 4)
Calcium	Ensure good dietary calcium intake, recognising that requirements may be higher in individuals who have SG, RYGB or malabsorptive procedures such as BPD/DS. If PTH is raised, despite adequate serum 25-hydroxy vitamin D levels and calcium is normal then consider a combined vitamin D and calcium supplement.	GPP
	To aid calcium absorption, advise that calcium taken as equally divided doses; calcium carbonate with food; calcium citrate with or without food.	GPP
	Calcium citrate may be the preferred supplement for people at risk of developing kidney stones.	GPP
Vitamin A	Following bariatric surgery, recommend that individuals take a complete multi-vitamin and mineral supplement containing government dietary recommendations for vitamin A.	GPP
	Following RYGB, consider that some may require additional routine oral vitamin A supplementation, especially if symptoms such as deterioration in night vision and dry eyes are present.	Grade C EL 2 (1- to 4)
	Following malabsorptive procedures, such as BPD/DS, recommend daily supplementation with additional oral vitamin A.	Grade B EL 2 (1+ to 3)
	Following malabsorptive procedures, such as BPD/DS, we suggest starting at 10 000 IU (3000 µg) oral vitamin A daily and adjust as necessary.	GPP
Vitamin E	Following malabsorptive procedures, such BPD/DS, recommend daily oral supplementation with additional vitamin E.	Grade C EL 2 (1+ to 4)
	Following malabsorptive procedures, such BPD/DS, we suggest starting with 100 IU oral vitamin E daily and adjust as necessary.	GPP

Table 1: **Post-Operative Vitamin and Mineral Supplementation Adapted from BOMSS Guidelines 2020** - continued

Post-operative vitamin and mineral supplementation		Grade, evidence level (EL), (range of evidence)
Vitamin K	Following malabsorptive procedures, such as BPD/DS, recommend daily oral supplementation with additional vitamin K.	Grade C EL 2 (1+ to 4)
	Following malabsorptive procedures, such as BPD/DS, we suggest starting with 300 µg oral vitamin K daily.	GPP
Water-miscible forms of fat-soluble vitamins	Water-miscible forms of fat-soluble vitamins may improve absorption especially after malabsorptive procedures.	Grade D EL 4
Zinc and copper	Recommend a multi-vitamin and mineral containing at least the government recommended daily allowance for zinc.	Grade B EL 2
	Following RYGB and SG, the optimal level of zinc supplementation is not known; however, we recommend 15 mg zinc oral daily, which may be contained within the multivitamin and mineral supplement.	GPP
	Following malabsorptive procedures, such as BPD/DS, the optimal level of zinc supplementation is not known but will be higher than that for RYGB or SG. We recommend starting with at least 30 mg oral zinc daily, which may be contained within the oral multi-vitamin and mineral supplement.	Grade C EL 2
	Following RYGB, SG and BPD/DS, recommend complete multi-vitamin and mineral oral supplement containing 2 mg copper.	Grade D EL 4
Selenium	Recommend a complete multi-vitamin and mineral supplement containing selenium.	Grade D EL 2 (2-)
	Following malabsorptive procedures, such as BPD/DS, additional routine oral supplementation with selenium may be needed to prevent deficiency.	Grade B EL 2 (1+ to 2-)
Thiamine	Recommend a complete multi-vitamin and mineral supplement containing at least government dietary recommendations for thiamine.	Grade B EL 2
	Consider recommending oral thiamine or vitamin B co strong tablets for first 3 to 4 months post-surgery.	GPP
	Prescribe oral thiamine 200 mg – 300 mg daily, vitamin B co strong 1 or 2 tablets, three times a day to people with symptoms such as dysphagia, vomiting, poor dietary intake or fast weight loss.	Grade D EL 4
	Clinicians should be educated about the factors, which may predispose to thiamine deficiency and the importance of initiating immediate treatment.	GPP
	People should be educated about the risks of potential thiamine deficiency and asked to seek early advice if they experience prolonged vomiting or poor dietary intake.	GPP

AGB: Adjustable Gastric Band; BPD/DS: Biliopancreatic Diversion with Duodenal Switch; EL: Evidence level depicts where the majority of evidence lies; GPP: Good Practice Point; PTH: Parathyroid Hormone; RYGB: Roux-en-Y gastric bypass; SG: Sleeve Gastrectomy

Table 2: Post-Operative Care and Biochemical Monitoring Adapted from BOMSS Guidelines 2020<sup>7</sup>

Post-operative care and biochemical monitoring		Grade, evidence level (EL), (range of evidence)
General recommendations	Specialist post-operative dietetic support should be provided, including individualised nutritional supplementation, support and guidance to achieve long-term weight loss and weight maintenance.	Grade D EL 4
	People who have bariatric surgery should have a post-operative follow-up care package within the bariatric surgery service for a minimum of 2 years. This should include monitoring nutritional intake, dietary and nutritional assessment, advice and support.	Grade D EL 4
	People discharged from bariatric surgery service follow-up should undergo monitoring of nutritional status at least once a year as part of a shared care model of management.	Grade D EL 4
Urea and electrolytes, renal and liver function tests	Monitor renal and liver function 3, 6 and 12 months in the first year and then at least annually.	GPP
Haematinics Full blood count and ferritin	Check full blood count and serum ferritin at regular intervals post-surgery.	Grade B EL 2 (2+ to 2-)
	Consider the following frequency of monitoring of full blood count and ferritin levels: 3, 6 and 12 months in the first year and at least annually thereafter so that changes in status may be detected.	GPP
Folate	Check serum folate levels at regular intervals post-surgery.	Grade B EL 2 (1+ to 2-)
	Consider the following frequency of monitoring of serum folate levels: 3, 6 and 12 months in the first year and at least annually thereafter so that changes in status may be detected.	GPP
Vitamin B <sub>12</sub>	Check vitamin B <sub>12</sub> levels at regular intervals following SG, RYGB and malabsorptive procedures such as BPD/DS.	Grade B EL 2 (2++ to 2-)
	Consider the following frequency of monitoring of vitamin B <sub>12</sub> levels: 3, 6 and 12 months in the first year and at least annually thereafter so that changes in status may be detected.	GPP
Vitamin D	Check serum 25-hydroxy vitamin D levels at regular intervals post-surgery.	Grade B EL 2 (1+ to 3)
	Serum 25-hydroxy vitamin D levels of 75 nmol/L or greater are considered sufficient.	Grade D EL 4
	Ensure total 25-hydroxy vitamin D (D <sub>3</sub> and D <sub>2</sub> ) is measured if patient is on vitamin D <sub>2</sub> supplements, e.g., ergocalciferol.	GPP
	Consider the following frequency of monitoring of vitamin D levels: 3, 6 and 12 months in the first year and at least annually thereafter so that changes in status may be detected.	GPP
Calcium	Check serum calcium levels at regular intervals.	GPP
	Consider the following frequency of monitoring of serum calcium levels: 3, 6 and 12 months in the first year and at least annually thereafter so that changes in status may be detected.	GPP
Parathyroid hormone	Check parathyroid hormone (to exclude primary hyperparathyroidism) if it has not been checked prior to surgery.	GPP
Vitamin A	Consider checking serum vitamin A levels if patient reports steatorrhoea or symptoms of vitamin A deficiency, e.g., night blindness or protein malnutrition.	Grade D EL 4 (2+ to 4)
	Check serum vitamin A levels at regular intervals following malabsorptive procedures such as BPD/DS.	Grade B EL 2 (1+ to 2)
	Consider the following frequency of monitoring of serum vitamin A levels following malabsorptive procedures such as BPD/DS: every 3 months and then annually once levels are stable.	GPP

Table 2: **Post-Operative Care and Biochemical Monitoring Adapted from BOMSS Guidelines 2020** - continued

Post-operative care and biochemical monitoring		Grade, evidence level (EL), (range of evidence)
Vitamin E	Check serum vitamin E levels at regular intervals following malabsorptive procedures such as BPD/DS.	Grade B EL 2 (1+ to 2+)
	Consider monitoring of serum vitamin E levels at least annually following malabsorptive procedures such as BPD/DS.	GPP
	Check serum vitamin E levels if unexplained anaemia or neuropathy.	Grade D EL 4
Vitamin K	Check vitamin K1 and PIVKA-II levels at regular intervals following malabsorptive procedures such as BPD/DS.	Grade B EL 2 (1+ to 3)
	Consider monitoring of serum vitamin K1 and PIVKA levels at least annually following malabsorptive procedures such as BPD/DS.	GPP
Zinc	Check serum/plasma zinc levels at regular intervals following SG, RYGB or BPD/DS.	Grade B EL 2 (1+ to 3)
	Consider monitoring serum/plasma zinc levels at least annually following SG, RYGB or BPD/DS.	GPP
	Check serum/plasma zinc levels if unexplained anaemia, hair loss or changes in taste acuity.	GPP
Copper	Check serum copper levels at regular intervals following SG, RYGB or BPD/DS.	Grade C EL 3 (2– to 3)
	Consider monitoring serum copper levels at least annually following SG, RYGB or BPD/DS.	GPP
	Serum copper levels if unexplained anaemia or poor wound healing.	GPP
	Serum copper should be monitored in patients taking zinc supplements and vice versa.	GPP
Selenium	Check serum selenium levels if there is chronic diarrhoea, metabolic bone disease, unexplained anaemia or unexplained cardiomyopathy.	Grade D EL 4
	Check serum selenium levels at regular intervals following RYGB.	Grade D EL 2 (2–)
	Check serum selenium levels at regular intervals following malabsorptive procedures such as BPD/DS.	Grade C EL 2 (2+)
	Consider monitoring serum selenium levels at least annually following RYGB or malabsorptive procedures such as BPD/DS.	GPP
Thiamine	If the patient presents with rapid weight loss, poor dietary intake, vomiting, alcohol abuse, oedema or symptoms of neuropathy, initiate treatment for thiamine deficiency immediately. Do not delay pending blood results.	GPP
HbA1c	Monitor HbA1c in patients with pre-operative diabetes.	GPP
Lipid profile	Monitor lipids in patients with pre-operative dyslipidaemia.	GPP

AGB: Adjustable Gastric Band; BPD/DS: Biliopancreatic Diversion with Duodenal Switch; EL: Evidence level depicts where the majority of evidence lies; GPP: Good Practice Point; HbA1c: Glycated haemoglobin; PIVKA-II: Protein Induced by Vitamin K or antagonism; RYGB: Roux-en-Y gastric bypass; SG: Sleeve Gastrectomy

Table 3: **Abnormal Test Results, Clinical Problems, Pregnancy and Adolescents Adapted from BOMSS Guidelines 2020** <sup>7</sup>

Post-operative care and biochemical monitoring		Grade, evidence level (EL), (range of evidence)
Protein malnutrition/ protein energy malnutrition/ oedema	If people present with signs/symptoms of protein malnutrition/protein energy malnutrition/oedema, investigate potential causes and refer back to bariatric centre.	GPP
Iron deficiency anaemia	Sources of blood loss should be considered, investigated and excluded in individuals who present with iron deficiency anaemia.	Grade D EL4
	For people over 12 years old and pregnant women diagnosed with iron deficiency anaemia, treat iron deficiency following NICE CKS Anaemia—iron deficiency.	Grade D EL4
	<ul style="list-style-type: none"> <li>• Can increase oral non-heme iron intake in divided doses to provide 150 mg – 200 mg elemental iron daily (e.g., ferrous sulphate 300 mg tds).</li> <li>• Take separately from calcium supplements, acid-reducing medications – if no response, then consider parenteral iron administration.</li> </ul>	Additional guidance adapted from Obesity Canada CPG 2020
Vitamin B <sub>12</sub> deficiency	Treat vitamin B <sub>12</sub> deficiency immediately using NICE CKS: Anaemia—B <sub>12</sub> and folate deficiency. Do not give folic acid first as it may mask underlying vitamin B <sub>12</sub> deficiency and precipitate subacute combined degeneration of the spinal cord.	Grade D EL 4
	For people with neurological involvement, NICE recommend administering hydroxocobalamin 1 mg intramuscularly on alternate days until there is no further improvement, then administer hydroxocobalamin 1 mg intramuscularly every 2 months.	Grade D EL 4
	For people with no neurological involvement, NICE recommend administering hydroxocobalamin 1 mg intramuscularly 3 times a week for 2 weeks.	Grade D EL 4
	After treatment of vitamin B <sub>12</sub> deficiency, provide maintenance treatment with 1 mg intramuscularly every 2 – 3 months lifelong.	Grade D EL 4
	Seek urgent specialist advice from neurologist and haematologist if there is possible neurological involvement, such as unexplained sensory and/or motor and gait symptoms.	GPP
Folic acid deficiency	Check and treat for vitamin B <sub>12</sub> deficiency, before initiating folic acid treatment to avoid precipitation of subacute combined degeneration of the spinal cord.	Grade D EL 4
	Treat folic acid deficiency using *NICE CKS: Anaemia—B <sub>12</sub> and folate deficiency. Folic acid 5 mg orally daily for a minimum of 4 months is recommended and further investigations if there is suspicion of malabsorption.	Grade D EL 4
Unexplained anaemia/fatigue	For unexplained causes of anaemia or fatigue, investigate for other nutritional deficiencies including protein, zinc, copper and selenium.	GPP
Low vitamin D	In absence of local adult guidelines for vitamin D replacement, refer to UK National Osteoporosis Society guidance: Vitamin D and Bone Health: A Practical Clinical Guideline for Patient Management.	Grade D EL 4
	In absence of local children and young people guidelines for vitamin D replacement, refer to UK National Osteoporosis Society guidance: A Practical Clinical Guideline for Patient Management in Children and Young People or a paediatrician.	Grade D EL 4
	<ul style="list-style-type: none"> <li>• Vitamin D<sub>3</sub> is more potent than vitamin D<sub>2</sub> when comparing frequency and amount needed for repletion.</li> <li>• Vitamin D<sub>3</sub> 3,000 IU/day to 6,000 IU/day or vitamin D<sub>2</sub> 50,000 IU 1 – 3 times weekly.</li> <li>• Note: toxicity level: &gt;150 ng/mL.</li> </ul>	Additional guidance adapted from Obesity Canada CPG 2020
	If the person remains vitamin D deficient despite treatment, refer to a secondary care specialist	GPP
	In people with severe vitamin D deficiency, high dose vitamin D injections might be required, which should be given following specialist consultation in people with known history/high risk of hypercalcaemia, e.g., people with kidney stones, sarcoidosis, renal impairment and atrial fibrillation.	GPP

Table 3: **Abnormal Test Results, Clinical Problems, Pregnancy and Adolescents Adapted from BOMSS Guidelines 2020** - continued

Post-operative care and biochemical monitoring		Grade, evidence level (EL), (range of evidence)
Vitamin A deficiency/ disturbances in night vision/ xerophthalmia	In adults, treat vitamin A deficiency with 10,000 to 25,000 IU oral vitamin A daily for 1 – 2 weeks for clinical improvement. Recheck vitamin A levels at 3 months.	Grade D EL 4 GPP
	For vitamin A deficiency that does not respond to treatment, refer to specialist for assessment and consideration of intramuscular vitamin A injections.	GPP
	In adolescents with vitamin A deficiency, refer for specialist support.	GPP
	<ul style="list-style-type: none"> <li>• Corneal lesions present: 50,000 IU/day IM – 100,000 IU/day IM for 3 days followed by 50,000 IU/day IM for 2 weeks.</li> <li>• Note: toxicity level: &gt; 80 µg/dL.</li> </ul>	Additional guidance adapted from Obesity Canada CPG 2020
Vitamin E	Treat vitamin E deficiency with oral vitamin E 100 IU/day – 400 IU/day. Recheck levels after 3 months.	Grade D EL 4
	For vitamin E deficiency that does not respond to treatment, refer to specialist for assessment and consideration of intramuscular injections.	GPP
	When considering vitamin E nutritional status, adjustment should be made for serum lipids.	Grade D EL 4
Vitamin K	For vitamin K deficiency, treat with 1 mg to 2 mg oral vitamin K daily (Ketovite tablets, menadiol sodium phosphate or phytomenadione). Recheck levels after 3 months. For those on anticoagulants such as warfarin or for vitamin K deficiency that does not respond to treatment, refer to specialist for assessment.	GPP
Neurological symptoms/ Wernicke's encephalopathy	Treat for thiamine deficiency (see section prolonged vomiting/dysphagia/poor oral intake/risk of thiamine deficiency).	Grade D EL 4
	Check for vitamin B <sub>12</sub> , copper and vitamin E deficiencies and treat.	GPP
	Refer to neurologist and haematologist.	GPP
Zinc and copper	If both zinc and copper are low, consider prescribing two Forceval or equivalent daily for 3 months and recheck levels.	GPP
	Check both zinc and copper levels when considering zinc or copper replacement.	Grade D EL 4
	With mild zinc or copper deficiency, consider giving two Forceval or equivalent daily and recheck levels after 3 months.	GPP
	With severe zinc deficiency and normal or borderline copper levels, treat with high-dose zinc supplement for 3 months and recheck levels. If no improvement or copper levels fall, refer for specialist advice.	GPP
	With severe copper deficiency, refer for specialist advice.	GPP
	When giving additional zinc and copper, maintain a ratio of 8 mg - 15 mg zinc to 1 mg copper. Close monitoring is required if higher zinc or copper doses are indicated because each affects the absorption of the other. If necessary, ask for expert advice.	Grade D EL 4
	<ul style="list-style-type: none"> <li>• Mild-moderate deficiency (including low hematologic indices): 3 mg/day – 8 mg/day copper gluconate or sulphate.</li> <li>• Severe deficiency: 2 mg/day IV – 4 mg/day IV copper for 6 days or until serum levels return to normal and neurologic symptoms resolve.</li> <li>• Note toxicity levels: Zinc 24-hour urine &gt; 1,200 µg/day; copper women &gt; 155 µg/dL; copper men &gt;140 µg/dL.</li> </ul>	Additional guidance adapted from Obesity Canada CPG 2020

Table 3: **Abnormal Test Results, Clinical Problems, Pregnancy and Adolescents Adapted from BOMSS Guidelines 2020** - continued

Post-operative care and biochemical monitoring		Grade, evidence level (EL), (range of evidence)
Prolonged vomiting/ dysphagia/poor oral intake/ risk of thiamine deficiency	If people present with prolonged vomiting or dysphagia, refer back to the bariatric centre for investigation.	GPP
	People, who present with prolonged vomiting or dysphagia, are at risk of thiamine deficiency. Give additional thiamine and vitamin B co-strong immediately (thiamine 200 mg – 300 mg daily, vitamin B co-strong 1 or 2 tablets, three times per day).	Grade D EL 4
	For those unable to tolerate thiamine orally or with clinical suspicion of acute deficiency, intravenous thiamine should be given.	Grade D EL 4
	<ul style="list-style-type: none"> <li>• IV: 200 mg tds or 500 mg od-bd for 3–5 days, followed by 250 mg/day for 3–5 days or until symptoms resolve. IM: 250 mg od for 3–5 days or 100 mg – 250 mg monthly</li> <li>• Simultaneous administration of magnesium, potassium and phosphorus should be given to patients at risk for refeeding syndrome.</li> </ul>	Additional guidance adapted from Obesity Canada CPG 2020
Pregnancy	Women are advised to avoid pregnancy for the first 12–18 months following surgery to allow weight stabilisation and a varied nutritious diet.	Grade D EL 4
	Women with a BMI < 29.9 kg/m <sup>2</sup> , planning for pregnancy, should take an additional 400 µg/day folic acid prior to conception until the 12th week of pregnancy.	Grade D EL 4
	Women with type 2 diabetes mellitus or a BMI > 30 kg/m <sup>2</sup> should take 5 mg folic acid until the 12th week of pregnancy. Check for vitamin B <sub>12</sub> deficiency before starting.	Grade D EL 4
	Refer to specialist antenatal care.	Grade D EL 4
	Replace vitamin A in supplements from retinol to beta carotene form or take preconception or pregnancy-specific vitamin and mineral supplement.	Grade D EL 4
	Pregnant women, following bariatric surgery, should undergo nutritional screening during each trimester. This should include ferritin, folate, vitamin B <sub>12</sub> , calcium, vitamin D, vitamin A.	Grade D EL 4
	Pregnant women, following bariatric surgery, especially those who have had long-limbed bypass or BPD/DS procedures, may be at risk of low vitamins E and K levels. These should be monitored during pregnancy if clinically indicated.	Grade D EL 4
	A more frequent review with the specialist bariatric dietitian may be required.	Grade D EL 4
	Reference ranges change in pregnancy. Please refer to perinatal reference ranges when checking blood results. <a href="http://perinatology.com/Reference/Reference Ranges/Reference for Serum.htm">http://perinatology.com/Reference/Reference Ranges/Reference for Serum.htm</a>	GPP
Adolescents	Adolescents who have undergone bariatric surgery should be monitored for dietary adherence and nutritional assessment on a regular basis due to changes in body composition, growth and sexual development.	GPP
Malabsorptive procedures	Individuals who have malabsorptive procedures have a higher prevalence of post-surgery nutritional deficiencies and care should remain with the specialist centre.	GPP
	For OAGB/MGB with BP limb length of 150 cm or less, follow RYGB nutritional recommendations.	GPP
	For OAGB/MGB with BP limb length of greater than 150 cm or SADIs, follow BPD/DS nutritional recommendations.	GPP

AGB: Adjustable Gastric Band; BMI: Body Mass Index; BP: Biliopancreatic; BPD/DS: Biliopancreatic Diversion with Duodenal Switch; EL: Evidence level depicts where the majority of evidence lies; GPP: Good Practice Point; IM: Intramuscular  
OAGB/MGB: OAGB/MGB, One Anastomosis Gastric Bypass/Mini Gastric Bypass; od-bd: once daily-twice daily;  
RYGB: Roux-en-Y gastric bypass; SADIs: Single Anastomosis Duodenal Ileal Bypass with Sleeve Gastrectomy;  
SG: Sleeve Gastrectomy; tds: 3 times a day;

\*NICE CKS: National Institute for Health and Care Excellence Clinical Practice Summaries  
\*\* CPG: Clinical Practice Guidelines

Table 4: Clinical Features that Patients Might Present Post-Bariatric Surgery with Possible Related Nutrient Deficiency<sup>77,78</sup>

Clinical features	Possible micronutrient deficiency
<b>Hair</b>	
Alopecia	Iron, zinc, biotin, protein deficiency
Corkscrew hair	Vitamin C
<b>Eyes</b>	
Night blindness, ocular xerosis, keratomalacia, Bitot's spots	Vitamin A
Ophthalmoplegia	Thiamine, vitamin E
Optic neuropathy	Vitamin B <sub>12</sub> , thiamine (Wernicke), copper (rarely folate)
<b>Face/skin</b>	
Dermatitis: hyperpigmentation around sun-exposed skin: face, neck and hands	Niacin
impaired wound healing	Zinc, vitamin C, protein deficiency,
Petechia, purpura	Vitamin C, vitamin K
<b>Mouth</b>	
Soreness, burning	Riboflavin (B <sub>2</sub> )
Angular stomatitis or cheilitis	Vitamin B <sub>2</sub> , niacin, iron, vitamin B <sub>6</sub> , vitamin B <sub>12</sub> , or vitamin A toxicity
Pica	Iron, zinc
Hypogeusia or dysgeusia	Zinc
Glossitis (sore, swollen, red and smooth tongue)	Folate, riboflavin, niacin, vitamin B <sub>6</sub> , vitamin B <sub>2</sub> , folate, severe iron deficiency
Gingival bleeding	Vitamin C, niacin, folate, zinc, severe vitamin D deficiency; or vitamin A toxicity
Beefy red tongue	Folate, niacin, B <sub>12</sub>
<b>Nails</b>	
Beau's lines (transverse ridges, horizontal grooves)	Zinc, protein, calcium
Koilonychia	Iron, protein, anemia
Splinter hemorrhage	Vitamin C
Brittle, soft, dry, weak, thin, split easy	Magnesium; or vitamin A toxicity and selenium toxicity
<b>Musculoskeletal</b>	
Bone pain	Vitamin D
Calf tenderness, absent deep tendon reflexes, foot and wrist drop	Thiamine
Peripheral neuropathy, tingling, "pins and needles"	Folate, vitamin B <sub>6</sub> , pantothenic acid, phosphate, thiamine, vitamin B <sub>12</sub>
Muscle twitching, convulsions, tetany	Calcium, vitamin D, Mg deficiency, B <sub>6</sub> (or excess Mg and B <sub>6</sub> )
Muscle cramps	Chloride, sodium, potassium, magnesium, calcium, vitamin, dehydration
Muscle pain	Vitamin D, biotin
<b>Sexual</b>	
Hypogonadism, erectile dysfunction	Zinc
<b>Hematology</b>	
Anemia and fatigue	Protein, zinc, copper, selenium
Microcytic anemia	Iron, copper, pyridoxine, vitamin E
Macrocytic anemia	Vitamin B <sub>12</sub> , folate
Neutropenia	Copper
<b>Nervous System</b>	
Ataxia	Vitamin B <sub>12</sub> , copper
Myelopathy	Vitamin B <sub>2</sub> , copper (rarely folate, vitamin E)
Polyradiculopathy	Thiamine
Neuropathy	Vitamin B <sub>12</sub> , thiamine (Wernicke), copper (rarely pyridoxine, folate, niacin, vitamin E)
Myopathy	Vitamin D, vitamin E
Dementia	Niacin, vitamin B <sub>12</sub>
Amnesia, hallucinations, confabulation	Thiamine (Korsakoff)
Confusion, encephalopathy	Thiamine (Wernicke), vitamin B <sub>12</sub>
<b>Heart</b>	
Cardiomyopathy	Selenium
Heart failure	Thiamine

Source: Shiau, J.



Table 5: Pharmacotherapy After Bariatric Surgery

Increased concentration	Decreased concentration
Atorvastatin short-term 8 weeks <sup>79</sup> Metformin <sup>60</sup> Morphine <sup>80</sup> Acetaminophen Moxifloxacin <sup>81</sup>	Atorvastatin long-term 2 years <sup>79</sup> Levothyroxine <sup>54</sup> Cyclosporin <sup>54</sup> Phenytoin <sup>54</sup> Rifampin <sup>54</sup> Sertraline SRI (SSRI more likely to decrease than SNRI) reduced at 1 month and then normal at 1 year <sup>82</sup> Tamoxifen <sup>83</sup>
List of medications not to be crushed	
Alendronate, bisacodyl, bupropion, ciprofloxacin, diltiazem, dipyridamole/ASA, divalproex, felodipine, ferrous sulphate, fexofenadine, finasteride, glipizide, lansoprazole, lithium, loratadine, metformin, metoprolol, morphine, nifedipine, omeprazole, pantoprazole, phenytoin, piroxicam, prednisolone, pseudoephedrine, rabeprazole, tamsulosin, verapamil <sup>54</sup>	

SNRI: Serotonin-Norepinephrine Reuptake Inhibitor; SRI: Serotonin Reuptake Inhibitor; SSRI: Selective Serotonin Reuptake Inhibitor  
 Source: Shiau, J.

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