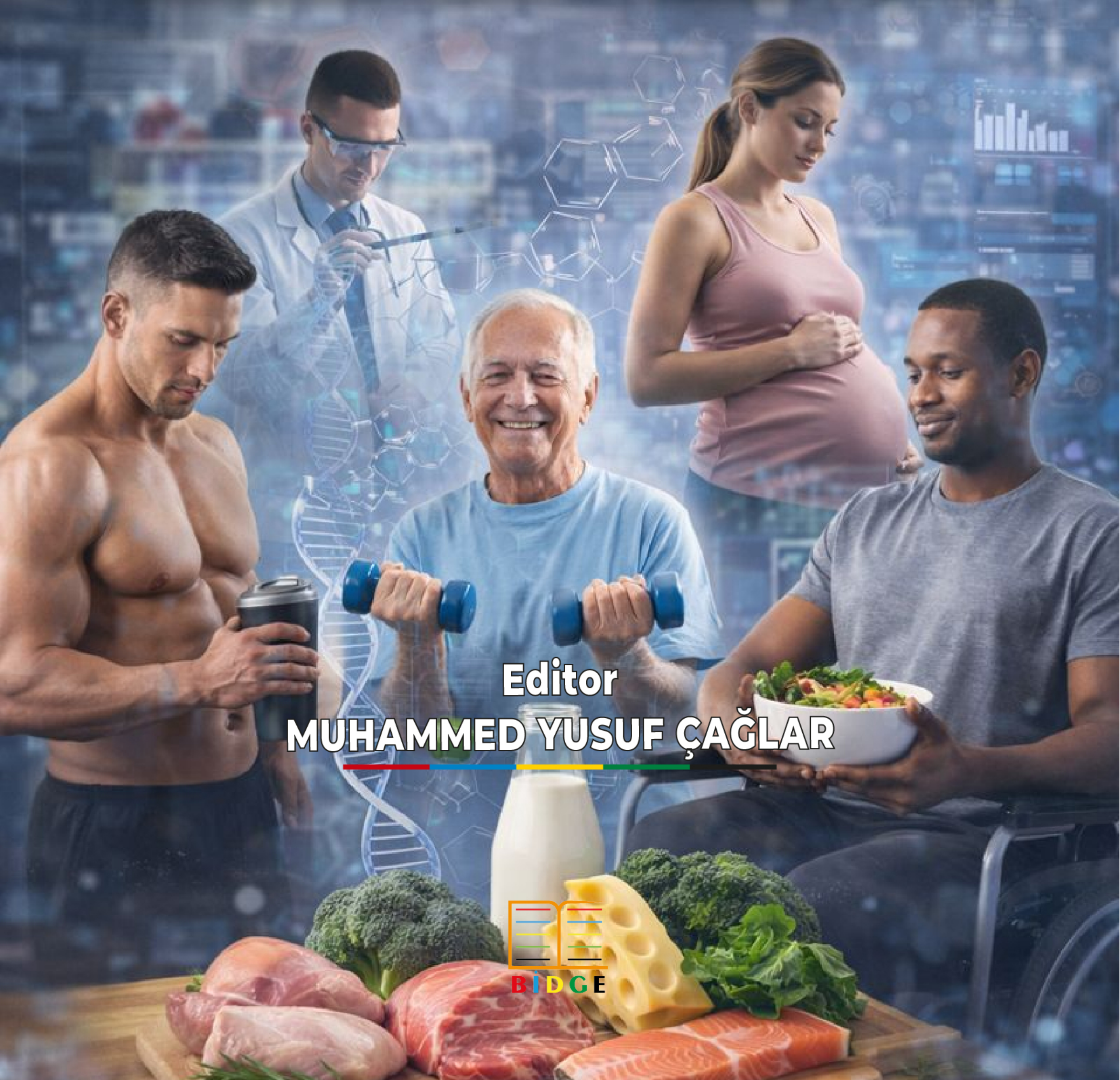
Nutrition
Metabolic Adaptation *and* Special Populations



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İÇİNDEKİLER

CHAPTER 1

THE IMPACT OF MEAL FREQUENCY AND DİET QUALİTY ON METABOLİC ADAPTATİONS, QUALİTY OF LİFE, AND POSTOPERATİVE RECOVERY

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1. Introduction

Dietary patterns are among the fundamental determinants of sustaining physiological functions, maintaining energy homeostasis, and preserving overall health. This pattern is shaped not only by the quantity or type of foods consumed but also by the frequency, timing, and distribution of food intake. Contemporary nutritional science places particular emphasis on two key factors influencing energy metabolism-meal frequency and diet quality (Ali et al., 2024). Meal frequency refers to the number of eating occasions per day and represents a behavioral component of energy balance regulation.

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Physiologically, eating frequency can influence postprandial glycemic excursions and hormonal responses involved in appetite and energy homeostasis (e.g., insulin, ghrelin, and leptin). Higher eating frequency has been associated with smaller postprandial glucose peaks in some contexts; however, potential effects on insulin sensitivity appear to depend strongly on overall energy intake and the nutrient composition and energy density of meals (Longo-Silva et al., 2024).

Some studies have reported that individuals who consume small, frequent meals experience reduced hunger, improved lipid profiles, and decreased low-density lipoprotein (LDL) levels. Nevertheless, when total energy intake is not adequately controlled, increased meal frequency may predispose individuals to obesity and insulin resistance (Yong et al., 2024).

Diet quality, on the other hand, is a measure that evaluates the overall contribution of dietary habits to health. Beyond energy balance, diet quality encompasses multidimensional factors such as macronutrient and micronutrient diversity, antioxidant capacity, fiber content, proportion of plant-based foods, and the balance of saturated fatty acids. High-quality diets-particularly the Mediterranean dietary pattern-have been shown to reduce the risk of cardiovascular disease, type 2 diabetes, and metabolic syndrome, whereas low-quality diets rich in ultra-processed foods increase inflammatory responses and contribute to metabolic dysregulation (Larruy-Garcia et al., 2024). Beyond macronutrient balance, the vascular effects of diet-derived bioactive compounds have also gained attention, particularly regarding endothelial function and smooth muscle tone. Experimental evidence indicates that certain plant-derived constituents can induce vasorelaxation via nitric oxide (NO)–cGMP signaling and ion-channel–dependent mechanisms, highlighting a plausible mechanistic bridge between diet quality and cardiometabolic risk modulation (Demirel, 2022a; Demirel, 2022b; Demirel, 2024).

The interaction between meal frequency and diet quality has become a focal point in understanding metabolic adaptations in recent years. Evidence suggests that high diet quality may attenuate the adverse metabolic effects associated with higher meal frequency, indicating that nutritional content may be a stronger determinant than meal frequency alone (Azizi-Shab Bidar et al., 2022; Bailey et al., 2022).

From a metabolic standpoint, the harmony between meal patterns and diet quality influences multiple biochemical processes, including mitochondrial function, fatty acid oxidation, thermogenesis, and overall energy expenditure. Regular consumption of high-quality foods contributes to reduced oxidative stress and enhanced efficiency of cellular energy production. In contrast, irregular meal patterns or low-quality diets may impair insulin signaling through increased production of reactive oxygen species, thereby reducing metabolic adaptive capacity (Mambrini et al., 2024). In this context, phytochemical-rich dietary patterns may be relevant not only through antioxidant effects but also through direct vascular signaling pathways. Reviews focusing on flavonoids and other plant constituents describe modulatory effects on vascular activity that intersect with inflammation, oxidative stress, and metabolic control—mechanisms central to long-term cardiometabolic adaptation (Demirel & Yilmaz, 2024; Demirel, 2024).

In the postoperative recovery period, the role of nutrition should be redefined beyond meeting basic physiological needs, positioning it as a clinical strategy that supports the body's metabolic adaptive capacity. Postoperative inflammation, hormonal fluctuations, and immune system activation increase energy and nutrient requirements, while postoperative anorexia, nausea, and gastrointestinal intolerance may significantly restrict dietary intake. An effective approach to these challenges involves tailoring meal frequency and composition according to individual tolerance. In particular, a “small and frequent” meal strategy using nutrient-dense foods may offer advantages in terms of glycemic stability and functional recovery (Buijs et al., 2013). Moreover, diet quality has been increasingly emphasized as being closely associated with clinical outcomes such as wound healing, infection development, and length of hospital stay. Diets rich in antioxidants, essential fatty acids, amino acids, and immune-supportive micronutrients not only accelerate tissue repair but also enhance the immune system’s capacity to mount effective responses against infections (Ham & Kim, 2025; Ellinger, 2014; Chow & Barbul, 2014).

Adequate and balanced nutrition in the postoperative period requires not only meeting caloric targets but also achieving a micronutrient-balanced dietary profile. Studies demonstrate that comprehensive nutritional support improves immune function, reduces wound infection rates, and significantly shortens hospital length of stay (Zhu et al., 2024). Additionally, diet quality may influence postoperative trajectories through mechanisms beyond substrate provision, including vascular and antimicrobial pathways. Plant-derived compounds and essential oils have been reported to exhibit antimicrobial activity against standard strains and clinical isolates, suggesting a potential ancillary link between dietary bioactives and infection-related outcomes (Demirel, 2022c). In particular, enteral nutrition has been shown to suppress inflammation, preserve intestinal integrity, and support protein anabolism more effectively than parenteral nutrition (Suzuki et al., 2009).

Diets enriched with antioxidants, omega-3 fatty acids, and amino acids such as arginine and glutamine accelerate cellular processes involved in wound healing and tissue regeneration (Fukatsu, 2019; Shields, 2021).

2. Meal Frequency: Metabolic Effects

Meal frequency is an important behavioral factor that regulates energy metabolism and directly influences the body's homeostatic balance. The number of meals consumed throughout the day plays a determining role in energy intake, nutrient distribution, hormonal responses, and metabolic flexibility. Metabolic responses to meal frequency may vary depending on an individual's energy balance, physical activity level, body composition, and dietary content (Theodorakis et al., 2024).

From a physiological perspective, meal frequency exerts critical effects on the glucose–insulin axis. More frequent eating may reduce postprandial glycemic fluctuations, thereby decreasing pancreatic beta-cell workload and promoting a more stable pattern of insulin secretion. Over the long term, this may contribute to the preservation of insulin sensitivity. However, frequent meal consumption-particularly when combined with energy-dense, low-quality foods-may lead to hyperinsulinemia and increase the risk of insulin resistance (Iodice et al., 2024). At the hormonal level, meal frequency influences the secretion of key metabolic regulators such as leptin, ghrelin, cortisol, and adiponectin. Frequent meal consumption may help regulate appetite by reducing peak levels of ghrelin, the primary hunger hormone, whereas prolonged fasting periods (e.g., consuming one to two meals per day) may amplify ghrelin fluctuations and intensify hunger sensations (Garutti et al., 2025). In addition, extended fasting periods may increase cortisol levels, triggering stress-induced gluconeogenesis and thereby complicating glycemic control. Conversely, in certain individuals-particularly those with insulin resistance or obesity-lower meal frequency may enhance metabolic flexibility and support fatty acid oxidation (Lengton et al., 2025). With regard to lipid metabolism, meal frequency represents an important variable influencing serum triglyceride and cholesterol levels. Research indicates that more frequent meal consumption may be associated with reductions in total cholesterol, low-density lipoprotein (LDL) cholesterol, and triglyceride levels, along with increases in high-density lipoprotein (HDL) cholesterol (Chen et al., 2023). However, these effects are highly dependent on the macronutrient composition of meals. Frequent meals dominated by carbohydrates and low in dietary fiber may stimulate insulin secretion and promote lipogenesis through increased glycemic load and insulin exposure (Ludwig et al., 2021; Moore, 2014; Santos et al., 2025). In contrast, meals rich in protein and fiber and characterized by a low glycemic index tend to yield more favorable outcomes in lipid metabolism, including reductions in total and low-density lipoprotein cholesterol (Goff et al., 2013; Ajala et al., 2013).

When examined in the context of metabolic syndrome (MetS), the relationship between meal frequency and cardiometabolic risk factors appears to be complex. A large population-based study conducted in Iran demonstrated a significantly higher prevalence of MetS among individuals consuming six or more meals per day, likely associated with excessive energy intake and increased snack consumption (Taftian et al., 2024). Similarly, analyses of NHANES data from the United States revealed that individuals consuming three main meals per day exhibited better diet quality and lipid profiles compared with those consuming two or fewer main meals daily (Murakami & Livingstone, 2016; Bailey et al., 2022). On the other hand, reduced meal frequency models-such as intermittent fasting or time-restricted feeding-have been reported to exert beneficial effects on mitochondrial biogenesis, autophagy activation, and insulin signaling. These findings suggest that under certain conditions, lower meal frequency may enhance metabolic adaptive capacity (Wells et al., 2024).

3. Diet Quality: Metabolic and Physiological Adaptations

Diet quality is a multidimensional concept that qualitatively evaluates the health impact of a dietary pattern based on the distribution of macro- and micronutrients. High diet quality is associated not only with the maintenance of energy balance but also with antioxidant capacity, fiber content, vitamin–mineral adequacy, and phytochemical density. For this reason, diet quality is regarded as one of the fundamental parameters determining an individual's metabolic adaptive capacity and cellular-level energy efficiency (Rosato et al., 2019).

In the scientific literature, the most commonly used indices for assessing diet quality include the Healthy Eating Index (HEI), the Mediterranean Diet Score (MDS), and the Diet Quality Index (DQI). These indicators evaluate dietary habits across components such as food groups, dietary diversity, types of fat, fiber intake, and added sugar consumption. For example, an HEI score above 80 is associated with a high-quality diet, whereas scores below 50 indicate poor diet quality. An analysis conducted in the United States reported that each additional daily eating occasion was associated with a 2–5 point increase in HEI score, primarily driven by higher consumption of vegetables, whole grains, and low-fat dairy products (Murakami & Livingstone, 2016).

From a metabolic perspective, high diet quality is associated with reduced oxidative stress, decreased levels of inflammatory cytokines (e.g., IL-6 and TNF-α), and improvements in insulin signaling pathways. Diets rich in fiber, polyphenols, and omega-3 fatty acids have been shown to suppress activation of the NF-κB pathway, thereby preventing the chronicity of inflammation and preserving insulin sensitivity in metabolic tissues, particularly skeletal muscle and the liver (Zelis et al., 2024). In addition, high diet quality has been shown to activate key pathways involved in mitochondrial biogenesis and energy production, including PGC-1α and AMPK signaling. This finding indicates that diet quality directly enhances metabolic adaptive capacity (Rosato et al., 2019). With respect to lipid metabolism, high-quality diets reduce total cholesterol and triglyceride levels while increasing high-density lipoprotein (HDL) cholesterol. Individuals adhering to a Mediterranean dietary pattern exhibit significantly lower levels of LDL oxidation compared with those consuming low-quality Western-style diets (Rosato et al., 2019). This effect is largely attributable to the synergistic actions of monounsaturated fatty acids (MUFA), dietary fiber, and plant sterols.

Deterioration in diet quality increases not only adverse metabolic markers but also the risk of obesity and lifestyle-related diseases. “Food Away From Home” (FAFH), defined as the frequency of eating outside the home, has been directly associated with poor diet quality. Nagao-Sato and Reicks (2022) reported that individuals who consumed meals outside the home four or more times per week had HEI scores approximately 9 points lower on average and exhibited a 21% higher risk of obesity (Nagao-Sato & Reicks, 2022). This association is likely related to the higher energy density, greater saturated fat content, and increased sodium levels of foods consumed outside the home. At the level of the gut microbiota, high-quality diets have been shown to promote the growth of beneficial bacterial genera such as Bifidobacterium and Lactobacillus, thereby increasing the production of short-chain fatty acids-particularly butyrate. In contrast, low-quality diets rich in highly processed carbohydrates have been associated with dysbiosis and endotoxemia (Walker et al., 2023).

4. Interaction Between Meal Frequency and Diet Quality

Meal frequency and diet quality are two fundamental nutritional parameters that shape metabolic balance, and a bidirectional, complex interaction exists between these two factors. The number of meals consumed influences not only total energy intake but also food choices, macro- and micronutrient balance, and consequently overall diet quality. Conversely, diet quality modulates the metabolic responses associated with meal frequency; therefore, these two components should be regarded not as independent variables but as interrelated systems operating in mutual interaction (Bailey et al., 2022).

Comprehensive analyses based on data from the NHANES (National Health and Nutrition Examination Survey) in the United States have shown that individuals consuming more than three main meals per day along with one to two snacks exhibit significantly higher overall diet quality. Individuals in this group consumed vegetables, fruits, whole grains, low-fat dairy products, and unsaturated fat sources more frequently, while their intake of added sugars and saturated fats was lower (Bailey et al., 2022).

These findings suggest that increasing meal frequency may indirectly enhance diet quality by promoting greater dietary diversity and micronutrient intake. However, this relationship is highly dependent on food content; frequent eating may yield opposite outcomes when high-energy, low-quality foods are preferentially consumed.

Indeed, snack frequency represents a critical determinant of diet quality. Bakan and Gezmen Karadağ (2024) demonstrated that the consumption of carbohydrate-rich, low-fiber snacks reduces overall diet quality and leads to unfavorable changes in body composition, such as increased fat mass and decreased lean mass (Bakan & Gezmen Karadağ, 2024).

This evidence indicates that meal frequency should be evaluated not only as a quantitative parameter but also as a qualitative one. Even when meal frequency is high, the preferential consumption of low-quality foods may disrupt overall energy balance, leading to insulin resistance, increased fat storage, and heightened metabolic stress.

An epidemiological study conducted in an Iranian population demonstrated that the relationship between meal frequency and metabolic syndrome (MetS) risk is mediated by diet quality (Azizi-Shab Bidar et al., 2022). In this study, high meal frequency alone was associated with increased MetS risk; however, when accompanied by high diet quality, this risk was significantly attenuated. In other words, high meal frequency confers metabolic advantages only when implemented alongside a high-quality diet. This finding clearly highlights the interdependent nature of meal frequency and diet quality. From a physiological perspective, the interaction between meal frequency and diet quality can be explained through several mechanisms regulating metabolic homeostasis:

Glucose–insulin cycle: Frequent consumption of high-quality, low–glycemic index foods reduces postprandial glucose fluctuations and helps preserve insulin sensitivity. In contrast, frequent intake of low-quality meals rich in refined carbohydrates promotes hyperinsulinemia and increased lipogenesis.

Leptin–ghrelin balance: Balanced energy content in high-quality meals supports the regulated secretion of hunger and satiety hormones. Low-quality snacks, however, may result in leptin resistance and chronic hunger sensations (La Bounty et al., 2011).

Microbiota interactions: High-quality dietary patterns rich in fiber, polyphenols, and probiotics strengthen gut microbiota composition, whereas frequent consumption of low-quality meals may induce dysbiosis and endotoxemia.

Mitochondrial function and oxidative stress: Frequent intake of high-quality meals helps maintain balanced mitochondrial oxidation and ATP production, whereas low-quality meals may increase the production of reactive oxygen species (Zelis et al., 2024).From a behavioral standpoint, individuals who engage in regular meal planning tend to exhibit greater nutritional awareness and make healthier food choices. In contrast, meal skipping or irregular eating patterns are generally characterized by poorer diet quality and higher energy density (Cho & Lee, 2023).

5. Quality of Life and Psychosocial Effects

Dietary habits exert profound effects not only on energy metabolism and physiological functions but also on psychological well-being, cognitive performance, and overall quality of life. Contemporary perspectives conceptualize nutrition not merely as a biological necessity but as a biopsychosocial process that shapes individuals' mental, social, and behavioral health (Walker et al., 2023).

Balanced and regular meal consumption directly influences psychophysiological systems such as circadian rhythm regulation, neurotransmitter synthesis, and stress responses. In particular, meal regularity has been shown to regulate activation of the hypothalamic–pituitary–adrenal (HPA) axis, thereby stabilizing cortisol secretion and reducing stress levels (Nouripour et al., 2021).

Irregular eating patterns or meal skipping may disrupt the diurnal rhythm of cortisol secretion, leading to impaired sleep quality and increased levels of fatigue and anxiety. In this context, meal timing is emphasized as being vital not only for metabolic regulation but also for neuroendocrine homeostasis.

High-quality diets (e.g., Mediterranean-type dietary patterns) support neuropsychological balance through the gut–brain axis. Micronutrients such as polyphenols, omega-3 fatty acids, magnesium, and tryptophan facilitate the synthesis of neurotransmitters including serotonin and dopamine, thereby improving mood and cognitive function (Şentürk et al., 2024; Rosato et al., 2019).

In addition, the role of the gut microbiota in these processes has received increasing attention. Diets rich in fiber, probiotics, and prebiotics have been shown to enhance gut microbial diversity and promote the production of short-chain fatty acids (butyrate, acetate, and propionate); these metabolites modulate brain function via the vagus nerve (Zelis et al., 2024). This effect yields particularly notable outcomes in terms of stress resilience, anxiety regulation, and sleep quality. At the psychological level, healthy dietary habits strengthen positive psychological constructs such as self-efficacy, life satisfaction, and motivation. Individuals adhering to high-quality diets exhibit lower levels of depressive symptoms and burnout, alongside significantly higher levels of subjective well-being (Nouripour et al., 2021).

The macronutrient composition of the diet-particularly the distribution of carbohydrates and protein-affects serotonin biosynthesis and plays a short-term regulatory role in mood. Consuming meals at regular intervals that include adequate protein and complex carbohydrates throughout the day contributes to emotional stability by supporting serotonin levels.

Within a sociocultural context, regular meal habits also shape social interactions and a sense of belonging. Shared meal practices, in particular, strengthen social bonds and enhance psychosocial resilience. A study conducted among international students demonstrated that healthy eating habits significantly improved not only physical health indicators but also social integration, academic performance, and overall quality-of-life scores (Walker et al., 2023).

The impact of dietary patterns on quality of life can be explained through psychophysiological feedback loops. For example, adequate nutrition stimulates dopamine release, thereby increasing motivation; increased motivation supports physical activity; and enhanced physical activity improves both energy metabolism and mood. This process represents a psychobiological mechanism referred to as the "nutrition–mood–motivation" cycle. Furthermore, irregular meal patterns have been shown to negatively affect not only mental well-being but also cognitive performance. Prolonged fasting or low-quality meals lead to marked declines in attention, memory, and decision-making processes; these effects have been shown to reduce quality-of-life scores, particularly among students and individuals employed in cognitively demanding occupations (Bailey et al., 2022).

6. Implications for the Postoperative Recovery Process

Postoperative recovery is a dynamic period that requires the simultaneous management of multidimensional processes, including the surgical stress response, inflammation, hormonal regulation, immune function, gastrointestinal tolerance, functional capacity, and psychosocial well-being. During this period, nutrition should be considered not merely as a means of providing energy and structural substrates, but as a clinical determinant that directs metabolic adaptation, supports tissue repair, modulates complication risk, and influences the patient's quality of life (Weimann et al., 2021). Meal frequency and diet quality become particularly critical in the postoperative period due to appetite fluctuations, nausea and vomiting, alterations in bowel motility, pain-related dietary restrictions, and stress responses commonly observed after surgery (Lobo et al., 2020).

6.1 Surgical Stress Response and Metabolic Adaptation

Surgical interventions trigger a predictable stress response in the body. The core components of this response include increased secretion of catecholamines, cortisol, and glucagon, elevation of inflammatory mediators, and the development of transient insulin resistance (Desborough, 2000). Metabolically, this profile is characterized by increased glucose production, reduced peripheral glucose utilization, and accelerated protein breakdown, resulting in a catabolic state. Clinically, these processes may manifest as a tendency toward hyperglycemia, loss of muscle mass, and prolonged recovery. Within this context, meal frequency and diet quality influence metabolic adaptation through two distinct yet complementary mechanisms:

- Meal frequency affects the magnitude of postprandial glycemic fluctuations and the rhythmicity of hormonal responses, thereby shaping metabolic load via the glucose–insulin axis. Particularly in the postoperative period, frequent consumption of low-quality or energy-dense meals may unnecessarily amplify insulin responses, reinforcing a hyperglycemia–hyperinsulinemia cycle. In contrast, well-planned, small, and balanced meals may help attenuate glycemic variability (Thorell et al., 2016).

- Diet quality plays a more qualitative regulatory role by influencing biochemical pathways related to inflammation, oxidative stress, and insulin signaling. Dietary patterns rich in fiber, healthy fatty acids, and antioxidants may contribute to a more controlled inflammatory response and preservation of metabolic flexibility (Calder, 2020).

6.2 Nutritional Components Related to Wound Healing and Tissue Repair

Wound healing is an energy- and substrate-intensive process consisting of hemostasis, inflammation, proliferation, and remodeling phases. In the postoperative period, tissue repair is influenced by multiple factors, including the extent of surgical trauma, comorbidities, glycemic control, oxygenation, and the presence of infection. Nutrition plays a dual role in this process by supporting cellular regeneration and modulating wound complication risk through immune function (Weimann et al., 2021). Within this framework, the roles of meal frequency and diet quality can be outlined as follows:

- **Protein and energy adequacy:** When postoperative energy and protein intake is insufficient, the body tends to mobilize endogenous protein stores to meet metabolic demands, accelerating muscle loss and impairing wound healing. The "small but frequent" approach may enhance tolerance and feasibility in clinical practice (Correia & Waitzberg, 2003).

- **Micronutrient emphasis:** Diet quality supports the biological foundation of wound healing through adequate vitamin and mineral intake. Nutrients such as zinc, iron, vitamins A and C, and folate are critical for collagen synthesis, epithelialization, and immune responses (Gupta et al., 2018).

- **Relationship between glycemic control and healing:** Hyperglycemia may impair collagen synthesis and neutrophil function. Therefore, in patients with diabetes or stress-induced hyperglycemia, diet quality (low glycemic load, fiber and complex carbohydrate balance) and meal planning (limiting abrupt glucose excursions) become particularly important (Vanhorebeek et al., 2019).

6.3 Postoperative Gastrointestinal Tolerance and Meal Planning

In the postoperative period, the gastrointestinal system may exhibit transient functional alterations due to anesthesia, opioid analgesia, immobilization, fluid–electrolyte imbalances, and surgical trauma. Symptoms such as nausea, vomiting, anorexia, early satiety, abdominal distension, constipation, and, in some patients, ileus risk directly affect nutritional tolerance (Lobo et al., 2020). Consequently, the success of postoperative nutrition depends not only on planned content but also on the degree to which patients can tolerate intake. Meal frequency emerges as a practical regulatory strategy in this context:

- The small and frequent meal approach may increase total intake in patients with early satiety or poor appetite while reducing nausea triggered by large-volume or high-fat meals.

- The quality of meal content is a key determinant of tolerance. Meals excessively high in fat, poorly selected fiber types, or highly processed foods may exacerbate gastrointestinal symptoms. In contrast, well-tolerated protein sources and low-irritant content may facilitate more sustainable intake. It is also noteworthy that smooth muscle regulation can be affected by bioactive constituents acting through ion-channel mechanisms. Experimental work on botanical essential oils has shown relaxation effects mediated by potassium channel subtypes in airway smooth muscle, underscoring that bioactive compounds may influence tolerance-related physiological responses via channel-dependent pathways (Demirel, 2022d).

- Timing and symptom management: Meal planning should be considered alongside postoperative symptom control. For example, appetite may decline during peak pain periods, and the timing of antiemetic or analgesic administration may indirectly influence meal tolerance.

6.4 Postoperative Functional Recovery

Functional recovery is associated with the patient's ability to mobilize, resume activities of daily living, experience reduced fatigue, and regain physical capacity. One of the major factors limiting functional recovery in the postoperative period is muscle loss. Catabolism driven by surgical stress, combined with reduced intake and immobilization, may result in declines in muscle mass and strength (van Stijn et al., 2013).

Meal frequency and diet quality may influence functional recovery through the following mechanisms:

- Adequate distribution of protein and energy intake throughout the day supports muscle protein balance and may help limit muscle loss.

- Diets with high micronutrient and antioxidant density may indirectly contribute to reduced fatigue perception, lower inflammatory burden, and improved overall well-being (Calder, 2020).

- Mobilization–nutrition cycle: Nutritional adequacy facilitates mobilization, while mobilization supports appetite and gastrointestinal motility. Therefore, in postoperative care, nutrition and mobilization should be addressed as mutually reinforcing processes.

6.5 Potential Associations With Complication Risk

Postoperative complications encompass a broad spectrum, including infections, wound-related problems, prolonged hospitalization, readmission, glycemic control issues, and delayed recovery. When examining the relationship between meal frequency, diet quality, and these complications, the most academically appropriate approach is to avoid causal claims and instead use cautious language such as "may be associated," "may influence risk profiles," or "may support management." Within this framework, potential associations can be summarized as follows:

- **Glycemic control:** Stress-induced hyperglycemia is more pronounced in patients with diabetes and has been associated with infection risk (Vanhorebeek et al., 2019).
- **Infection and immune function:** Low diet quality and inadequate protein or energy intake may weaken immune responses, creating a predisposition to infections (Correia & Waitzberg, 2003).
- **Prolonged hospitalization and delayed recovery:** When nutritional intolerance, insufficient intake, fatigue, and delayed mobilization coexist, discharge may be postponed. Individualizing meal frequency and optimizing diet quality may contribute to a more predictable recovery trajectory (Weimann et al., 2021).

7. Conclusion

Postoperative recovery should be addressed not merely as a process of physiological restitution, but as a multidimensional phenomenon in which metabolic adaptation, immune response, restoration of functional capacity, and psychosocial well-being are evaluated together (Atay & Çiftçi, 2025). Within this framework, nutrition is no longer limited to the provision of energy and structural substrates; rather, it becomes a clinical domain of intervention that determines both the direction and the pace of recovery.

This review clearly demonstrates the critical role of two fundamental nutritional components-meal frequency and diet quality-during the postoperative period. Meal frequency emerges as a functional strategy for enhancing the sustainability and tolerability of intake, particularly in the presence of postoperative anorexia, gastrointestinal intolerance, and challenges in glycemic control. Small and frequent meals not only facilitate food intake but also help limit postprandial glucose fluctuations, thereby stabilizing insulin responses.

Diet quality, in contrast, supports the recovery process through more qualitative mechanisms, including modulation of inflammation, reduction of oxidative stress, promotion of wound healing, and strengthening of immune function. Preference for meals rich in vitamins, minerals, fiber, and antioxidants, with a low glycemic load, may reduce complication risks and shorten hospital length of stay, especially in high-risk patient populations.

However, it should be emphasized that meal frequency and diet quality do not function as independent variables but as interrelated systems operating in mutual interaction. High meal frequency confers metabolic advantages only when accompanied by a high-quality diet. Otherwise, frequent consumption of low-quality meals may lead to adverse outcomes such as hyperglycemia, insulin resistance, and increased metabolic stress.

In conclusion, when developing nutritional strategies for the postoperative period, both meal frequency and dietary content should be addressed through a holistic approach and tailored to individual tolerance, clinical needs, and recovery goals. Such an approach may enable not only the prevention of complications but also the support of overall well-being and the enhancement of patients' quality of life.

8. References

Ajala, O., English, P., & Pinkney, J. (2013). Systematic review and meta-analysis of different dietary approaches to the management of type 2 diabetes. *The American Journal of Clinical Nutrition, 97*(3), 505–516. https://doi.org/10.3945/ajcn.112.042457

Ali, M. A., Macdonald, I. A., & Taylor, M. A. (2024). *Day-to-day variability in meal pattern and associations with body weight, metabolic syndrome components, and cognitive function: A systematic review*. Journal of Human Nutrition and Dietetics, 37(1), 316–353.
https://doi.org/10.1111/jhn.13167

Atay, M. E., & Çiftçi, B. (2025). Insomnıa ın Heart Faılure Patıents ın a Hospıtal Settıng: Causes, Consequences, and Interventıons. *Current Cardiology Reports*, *27*(1), 108.

Azizi, N., Shab-Bidar, S., Bazshahi, E., Lesani, A., Javanbakht, M. H., & Djafarian, K. (2022). Joint association of meal frequency and diet quality with metabolic syndrome in Iranian adults. BMC Nutrition, 8, 12. https://doi.org/10.1186/s40795-022-00507-w

Bailey, R., Leidy, H., Mattes, R., Heymsfield, S., Boushey, C., Ahluwalia, N., Cowan, A. E., Pannucci, T. R. E., Moshfegh, A., Goldman, J. D., Rhodes, D., Stoody, E. E., de Jesus, J., &

Casavale, K. (2022). *Frequency of eating in the US population: A narrative review of the 2020 Dietary Guidelines Advisory Committee report*. Current Developments in Nutrition, 6, nzac132. https://doi.org/10.1093/cdn/nzac132

Bakan, S., & Gezmen Karadağ, M. (2024). *The effect of meal frequency on body composition, biochemical parameters, and diet quality in overweight/obese individuals*. Journal of the American Nutrition Association, 44(3), 245–255. https://doi.org/10.1080/27697061.2024.2422476

Buijs, N., Wörner, E. A., Brinkmann, S. J., Luttikhold, J., van der Meij, B. S., Houdijk, A. P. J., & van Leeuwen, P. A. M. (2013). *Novel nutritional substrates in surgery*. Proceedings of the Nutrition Society, 72(3), 277–287. https://doi.org/10.1017/S0029665112003047

Calder, P. C. (2020). Nutrition, immunity and COVID-19. *Clinical Nutrition*, 39(7), 1966–1980. https://doi.org/10.1016/j.clnu.2020.03.022

Chen, J., Wang, Y., & Li, S. (2023). *Digital dietary interventions for hypertension and dyslipidemia: A systematic review*. Nutrients, 15(9), 2146. https://doi.org/10.3390/nu15092146

Cho, Y. M., & Lee, K. S. (2023). *Mediating effects of diet quality between meal frequency and cardiometabolic risk among Korean adults: Data from the 7th Korea National Health and Nutrition Examination Survey (KNHNES). Journal of Korean Critical Care Nursing, 16*(2), 67–80. https://doi.org/10.34250/jkccn.2023.16.2.67

Chow, O., & Barbul, A. (2014). Immunonutrition: Role in wound healing and tissue regeneration. Advances in Wound Care, 3(1), 46–53. https://doi.org/10.1089/wound.2012.0415

Correia, M. I. T. D., & Waitzberg, D. L. (2003). *The impact of malnutrition on morbidity, mortality, length of hospital stay and costs evaluated through a multivariate model analysis*. *Clinical Nutrition, 22*(3), 235–239. https://doi.org/10.1016/S0261-5614(02)00215-7

Demirel, S. (2022a). Rosa damascena Miller essential oil relaxes rat thoracic aorta through the NO-cGMP-dependent pathway. *Prostaglandins, Other Lipid Mediators, 162*, 106661. https://doi.org/10.1016/j.prostaglandins.2022.106661

Demirel, S. (2022b). Geraniol and β-citronellol participate in the vasorelaxant effects of *Rosa damascena* Miller essential oil on the rat thoracic aorta. *Fitoterapia, 161*, 105243. https://doi.org/10.1016/j.fitote.2022.105243

Demirel, S. (2022c). Medical evaluation of the antimicrobial activity of rose oil on some standard bacteria strains and clinical isolates. *Alternative Therapies in Health and Medicine, 28*(6), 52–56. PMID: 34653022

Demirel, S. (2022d). *Rosa damascena* Miller essential oil relaxes rat trachea via KV channels, KATP channels, and BKCa channels. *Prostaglandins, Other Lipid Mediators, 163*, 106673. https://doi.org/10.1016/j.prostaglandins.2022.106673

Demirel, S. (2024). Vasorelaxant effects of biochemical constituents of various medicinal plants and their benefits in diabetes. *World Journal of Diabetes, 15*(6), 1122–1141. https://doi.org/10.4239/wjd.v15.i6.1122

Demirel, S., & Yilmaz, D. A. (2024). Effects of flavonoids on vascular activity. *GTM, 3*(2), 2458. https://doi.org/10.36922/gtm.2458

Desborough, J. P. (2000). The stress response to trauma and surgery. *British Journal of Anaesthesia*, 85(1), 109–117. https://doi.org/10.1093/bja/85.1.109

Ellinger, S. (2014). Micronutrients, arginine, and glutamine: Does supplementation provide an efficient tool for prevention and treatment of different kinds of wounds? *Advances in Wound Care, 3*(6), 370–382. https://doi.org/10.1089/wound.2013.0505

Fukatsu, K. (2019). *Role of nutrition in gastroenterological surgery*. Annals of Gastroenterological Surgery, 3(2), 160–168. https://doi.org/10.1002/ags3.12237

Garutti, M., Sirico, M., Noto, C., Foffano, L., Hopkins, M., & Puglisi, F. (2025). Hallmarks of appetite: Hunger, appetite, satiation, and satiety. *Current Obesity Reports, 14*(1), Article 12. https://doi.org/10.1007/s13679-024-00604-w

Goff, L. M., Cowland, D. E., Hooper, L., & Frost, G. S. (2013). Low glycaemic index diets and blood lipids: A systematic review and meta-analysis of randomised controlled trials. *Nutrition, Metabolism and Cardiovascular Diseases, 23*(1), 1–10. https://doi.org/10.1016/j.numecd.2012.06.002

Gupta, M., Mahajan, V. K., Mehta, K. S., & Chauhan, P. S. (2018). Zinc therapy in dermatology: A review. *Journal of the American Academy of Dermatology*, 78(1), 72–80. https://doi.org/10.1016/j.jaad.2017.06.049

Ham, H. J., & Kim, J. (2025). *Targeted nutritional strategies in postoperative care*. Anesthesia and Pain Medicine, 20(1), 34–45. https://doi.org/10.17085/apm.24067

Iodice, V., Ingle, G., Mathias, C., & McNamara, P. (2024). Autonomic aspects of neurology. In R. Howard, D. Kullmann, D.

Werring, & M. Zandi (Eds.), *Neurology: A Queen Square Textbook* (3rd ed., pp. 1097–1136). Wiley.

La Bounty, P. L., Campbell, B., Wilson, J. M., Galvan, E., Berardi, J., Kleiner, S. M., Kreider, R. B., Stout, J. R., Ziegenfuss, T., Spano, M., Smith, A. E., & Antonio, J. (2011). *International Society of Sports Nutrition position stand: Meal frequency*. *Journal of the International Society of Sports Nutrition, 8*, 4. https://doi.org/10.1186/1550-2783-8-4

Larruy-Garcia, A., Mahmood, L., Miguel-Berges, M. L., Masip, G., Seral-Cortés, M., De Miguel-Etayo, P., & Moreno, L. A. (2024). *Diet quality scores, obesity and metabolic syndrome in children and adolescents: A systematic review and meta-analysis*. *Current Obesity Reports, 13*(4), 755–788. https://doi.org/10.1007/s13679-024-00589-6

Lengton, R., Schoenmakers, M., Penninx, B. W., Boon, M. R., & van Rossum, E. F. (2025). Glucocorticoids and HPA axis regulation in the stress–obesity connection: A comprehensive overview of biological, physiological and behavioural dimensions. Clinical Obesity, 15(2), e12725.

Lobo, D. N., Gianotti, L., Adiamah, A., Barazzoni, R., Deutz, N. E., & Ljungqvist, O. (2020). Perioperative nutrition: Recommendations from the ESPEN expert group. *Canadian Journal of Anesthesia*, 67(11), 1396–1410. https://doi.org/10.1007/s12630-020-01628-x

Longo-Silva, G., de Oliveira Lima, M., Pedrosa, A. K. P., Serenini, R., de Menezes Marinho, P., & de Menezes, R. C. E. (2024). *Association of largest meal timing and eating frequency with body mass index and obesity*. Clinical Nutrition ESPEN, 60, 179–186. https://doi.org/10.1016/j.clnesp.2024.01.022

Ludwig, D. S., Ebbeling, C. B., & Aronne, L. J. (2021). The carbohydrate–insulin model: A physiological perspective on the obesity pandemic. *The American Journal of Clinical Nutrition, 114*(6), 1873–1885. https://doi.org/10.1093/ajcn/nqab270

Mambrini, S. P., Grillo, A., Colosimo, S., Zarpellon, F., Pozzi, G., Furlan, D., Amodeo, G., & Bertoli, S. (2024). *Diet and physical exercise as key players to tackle MASLD through improvement of insulin resistance and metabolic flexibility*. Frontiers in Nutrition, 11, 1426551. https://doi.org/10.3389/fnut.2024.1426551

Moore, J. B. (2014). The role of dietary sugars and de novo lipogenesis in health and disease. *Nutrients, 6*(12), 5247–5263. https://doi.org/10.3390/nu6125247

Murakami, K., & Livingstone, M. B. E. (2016). Associations between meal and snack frequency and diet quality in US adults: National Health and Nutrition Examination Survey 2003–2012. *Journal of the Academy of Nutrition and Dietetics, 116*(7), 1101–1113. https://doi.org/10.1016/j.jand.2016.02.004

Nagao-Sato, S., & Reicks, M. (2022). *Food away from home frequency, diet quality, and health outcomes in adults: A systematic review*. Nutrients, 14(12), 2408. https://doi.org/10.3390/nu14122408

Nouripour, R., Mazloom, Z., Fararouei, M., & Zamani, A. (2021). *Protein and carbohydrate distribution among meals: Effect on mood, sleep, and metabolic responses in adults*. Food Science & Nutrition, 9(11), 6176–6185. https://doi.org/10.1002/fsn3.2570

Rosato, V., Temple, N. J., La Vecchia, C., Castellan, G., Tavani, A., & Guercio, V. (2019). *Mediterranean diet and cardiovascular disease: A systematic review and meta-analysis of observational studies*. European Journal of Nutrition, 58(1), 173–191. https://doi.org/10.1007/s00394-017-1582-0

Santos, H. O., Genario, R., Macedo, R. C. O., & Tinsley, G. M. (2025).
Revisiting the concepts of de novo lipogenesis and fat mass regulation in humans. *Nutrition, 121*, 112305. https://doi.org/10.1016/j.nut.2024.112305

Şentürk, E., Yıldız, M., Şentürk, M., Varol, E., Yildirim, M. S., Yilmaz, D. A., & Atay, M. E. (2024). Investigation of the effect of Ramadan fasting on serum levels of melatonin, cortisol, and serotonin: the case of Turkey. *Irish Journal of Medical Science (1971-)*, *193*(2), 1073-1077.

Shields, B. E. (2021). *Diet in wound care: Can nutrition impact healing?* Cutis, 108(6), 325–328.
https://doi.org/10.12788/cutis.0407

Suzuki, Y., Kawasaki, N., Urashima, M., Odaira, H., & Noro, T. (2009). Total enteral nutrition facilitates wound healing through preventing intestinal atrophy, keeping protein anabolism and suppressing inflammation. *Gastroenterology Research, 2*(2), 67–74.
https://doi.org/10.4021/gr2009.04.1286

Taftian, M., Sasanfar, B., Sarebanhassanabadi, M., Seyedhosseini, S., Khayyatzadeh, S. S., Madadizadeh, F., Motallaei, M., Beigrezaei, S., Golvardi-Yazdi, F., Mirjalili, F., & Salehi-Abargouei, A. (2024). *The association between dietary meal intake habits and coronary artery stenosis and cardio-metabolic risk factors*. BMC Nutrition, 10(1), 86. https://doi.org/10.1186/s40795-024-00895-1

Theodorakis, N., Kreouzi, M., Pappas, A., & Nikolaou, M. (2024). *Beyond calories: Individual metabolic and hormonal adaptations driving variability in weight management-A state-of-the-art narrative review*. International Journal of Molecular Sciences, 25(24), 13438. https://doi.org/10.3390/ijms252413438

Thorell, A., MacCormick, A. D., Awad, S., Reynolds, N., Roulin, D., Demartines, N., Vignaud, M., Alvarez, A., Singh, P. M., Lobo, D. N., & Ljungqvist, O. (2016). *Guidelines for perioperative care in bariatric surgery: Enhanced Recovery After Surgery (ERAS) Society recommendations*. *World Journal of Surgery, 40*(9), 2065–2083. https://doi.org/10.1007/s00268-016-3492-3

van Stijn, M. F. M., Korkic-Halilovic, I., Bakker, M. S., van der Ploeg, T., van Leeuwen, P. A. M., & Houdijk, A. P. J. (2013). *Preoperative nutrition status and postoperative outcome in elderly general surgery patients: A systematic review*. *JPEN Journal of Parenteral and Enteral Nutrition, 37*(1), 37–43. https://doi.org/10.1177/0148607112445900

Vanhorebeek, I., Gunst, J., & Van den Berghe, G. (2019). Critical care nutrition: Where do we stand? *Current Opinion in Clinical Nutrition and Metabolic Care*, 22(2), 110–115. https://doi.org/10.1097/CCM.0000000000003654

Walker, A. N., Weeto, M., Priddy, C. B., Yakubu, S., Zaitoun, M., Chen, Q., Li, B., Feng, Y., Zhong, Y., & Zhang, Y. (2023). *Healthy eating habits and a prudent dietary pattern improve Nanjing international students' health-related quality of life*. *Frontiers in Public Health, 11*, 1211218. https://doi.org/10.3389/fpubh.2023.1211218

Weimann, A., Braga, M., Carli, F., Higashiguchi, T., Hübner, M., Klek, S., Laviano, A., Ljungqvist, O., Lobo, D. N., Martindale, R., Waitzberg, D. L., Bischoff, S. C., & Singer, P. (2021). *ESPEN practical guideline: Clinical nutrition in surgery*. *Clinical Nutrition, 40*(7), 4745–4761. https://doi.org/10.1016/j.clnu.2021.03.031

Wells, R. C., Froy, O., & Panda, S. (2024). *Time-restricted eating and metabolic health: Mechanisms and clinical implications*. Nature Reviews Endocrinology, 20(3), 165–181. https://doi.org/10.1038/s41574-023-00942-9

Yong, A. S. J., Koo, R. W. X., Ng, C. M., Lee, S. W. H., & Teoh, S. L. (2024). *Effect of meal timing and frequency on lipid profile in adults: An overview of systematic reviews and meta-analyses*. Nutrition & Food Science, 54(5), 906–921. https://doi.org/10.1108/NFS-08-2023-0178

Zelis, M., Simonis, A. M. C., van Dam, R. M., Boomsma, D., van Lee, L., Kramer, M. H., Serné, E. H., van Raalte, D. H., Mari, A., de Geus, E. D., & Eekhoff, E. (2024). *Development of a Diabetes Dietary Quality Index: Reproducibility and associations with measures of insulin resistance, beta cell function, and hyperglycemia*. *Nutrients, 16*, 3512. https://doi.org/10.3390/nu16203512

Zhu, L., Cheng, J., Xiao, F., & Mao, Y. Y. (2024). *Effects of comprehensive nutrition support on immune function, wound healing, hospital stay, and mental health in gastrointestinal surgery*. World Journal of Gastrointestinal Surgery, 16(2), 289–299. https://doi.org/10.4240/wjgs.v16.i2.289

CHAPTER 2

NUTRİTİONAL COMPLİCATİONS AFTER BARİATRİC SURGERY AND NURSİNG MANAGEMENT

1. GÖKHAN DEGE[1]
2. VOLKAN GÖKMEN[2]

1. Introduction

Bariatric surgery has become an increasingly preferred approach for the long-term treatment of obesity, providing weight loss and metabolic improvements by altering the anatomical and physiological properties of the gastrointestinal system (Albaugh et al., 2016). These procedures do not merely aim to reduce gastric volume; they also influence hormonal pathways regulating energy homeostasis, bile acid metabolism, and gut microbiota, thereby generating significant changes in appetite, glucose metabolism, and inflammation (Zambrano et al., 2024); (Ferrannini et al., 2015). Contemporary surgical techniques can be summarized as restrictive procedures that limit energy intake, malabsorptive procedures that decrease nutrient absorption, and metabolic approaches that improve metabolic control by altering hormonal profiles (Knop & Taylor, 2013). Within this scope, sleeve gastrectomy**,** Roux-en-Y gastric

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bypass, and biliopancreatic diversion are the most commonly applied techniques (Ceriani et al., 2021); (Benaiges et al., 2015). Sleeve gastrectomy, originally designed as a restrictive procedure, also induces hormonal changes such as decreased ghrelin and increased GLP-1 secretion, resulting in additional metabolic benefits (Benaiges et al., 2015). Roux-en-Y gastric bypass provides rapid glycemic control and diabetes remission (Knop & Taylor, 2013), while biliopancreatic diversion induces profound changes in bile acid metabolism and insulin sensitivity (Ferrannini et al., 2015). The widespread adoption of minimally invasive surgical approaches has reduced morbidity, shortened hospital stays, and increased the global feasibility of bariatric surgery (Cirocchi et al., 2013); (Kafalı et al., 2017).

The global obesity epidemic provides a contextual backdrop that underscores the rising importance of bariatric interventions. Obesity is defined not merely as excess weight accumulation but as a complex health condition characterized by low-grade inflammation, metabolic dysfunction, and an elevated risk of multiple chronic diseases (Drenth et al., 2019). According to data from the World Health Organization, obesity prevalence continues to rise worldwide, influenced by genetic predisposition, sedentary behavior, and the consumption of ultra-processed foods (Rajabi et al., 2024). Conventional lifestyle modification and pharmacotherapy are frequently insufficient for individuals with severe obesity and advanced comorbidities; consequently, bariatric surgery has emerged as an effective intervention for improving clinical outcomes (Ji et al., 2021). Although surgical indications have traditionally been defined by body mass index (BMI) thresholds, a broader metabolic perspective now incorporates conditions such as type 2 diabetes, dyslipidemia, nonalcoholic fatty liver disease (NAFLD), and polycystic ovary syndrome (PCOS) in patient selection (Pappachan & Viswanath, 2015); (Charalampakis et al., 2016); (Bower et al., 2015). Multiple studies report that bariatric surgery can produce faster and stronger effects on type 2 diabetes than medical therapy alone, supporting its role as a cornerstone of modern metabolic medicine (Xu & Song, 2020); (Bhattacharya et al., 2021).

Collectively, these findings position metabolic surgery not merely as a weight-loss strategy but as a transformative approach to the prevention and treatment of metabolic disease in global health policy. Emerging evidence demonstrates that bariatric and metabolic surgeries significantly improve insulin sensitivity, glycemic control, and lipid metabolism through both weight-dependent and weight-independent mechanisms involving gut hormones, bile acid signaling, and microbiota modulation (Xu & Song, 2020). These interventions have shown superior outcomes in achieving remission of type 2 diabetes compared to medical therapy alone (Pappachan & Viswanath, 2015), while also improving comorbid conditions such as nonalcoholic fatty liver disease (NAFLD) and polycystic ovary syndrome (PCOS) through enhanced metabolic regulation and hormonal balance (Bower et al., 2015); (Charalampakis et al., 2016). The growing body of research thus supports the integration of metabolic surgery into comprehensive public health frameworks, recognizing its potential to mitigate the global burden of obesity-related diseases and redefine long-term chronic disease management (Rajabi et al., 2024); (Ji et al., 2021).

Postoperative nutritional management is one of the fundamental determinants of long-term success following bariatric procedures. Due to anatomical alterations, inadequate protein intake, micronutrient deficiencies, hydration problems, and gastrointestinal tolerance issues are frequently observed (O'Kane et al., 2020). Therefore, postoperative nutrition is conceptualized not merely as instructing patients on "what to eat," but as a therapeutic process designed to support metabolic adaptation, reduce complication risk, and enhance quality of life (Li et al., 2025). Nutritional protocols typically involve a staged progression from liquid to pureed, soft, and solid foods; the pace of this transition varies according to surgical technique, gastrointestinal tolerance, and individual healing dynamics (Osland et al., 2020).

Inadequate protein and micronutrient intake, rapid weight loss, and gastrointestinal symptoms can lead to serious complications, including gallstone formation, sarcopenia, thiamine deficiency, refeeding syndrome, and osteoporosis (Reytor-González et al., 2025); (Tan et al., 2024). The literature indicates that adherence to appropriate nutritional protocols significantly reduces complication rates, and that early enteral nutrition can attenuate inflammatory responses and accelerate recovery (Kamal et al., 2024). Consequently, postoperative nutritional management is an integral component of bariatric treatment, sustained through effective coordination of a multidisciplinary clinical team and comprehensive patient education (Benson-Davies et al., 2024).

In this context, bariatric surgery is conceptualized not solely as a surgical intervention but as a comprehensive treatment strategy encompassing metabolic, behavioral, and nutritional management. Effective nutritional planning and patient adherence in the postoperative period are primary determinants of long-term clinical success and quality of life (Zarshenas et al., 2022). Therefore, nursing practice plays a critical role in the early identification of complications, nutritional monitoring, patient education, and the support of behavioral change (Osland et al., 2020).

2. Types of Bariatric Surgery and Nutritional Physiology

Bariatric surgery is a complex intervention that alters energy intake and nutrient absorption through anatomical modification, while simultaneously exerting systemic effects on neurohormonal and metabolic regulation**.** Different surgical techniques act through mechanisms such as reduction of gastric volume, bypassing of intestinal segments, and modification of digestive physiology, which collectively modulate appetite, glucose metabolism, and lipid homeostasis (Ochner et al., 2011); (Jin & Liu, 2021). Procedures such as Roux-en-Y gastric bypass (RYGB) **and** sleeve gastrectomy (SG) induce not only mechanical restriction but also significant endocrine changes involving gut hormones like ghrelin, GLP-1, and PYY, which contribute to reduced hunger and improved insulin sensitivity (Wilbrink et al., 2024); (Benaiges et al., 2015).

Beyond hormonal regulation, postoperative microbiota alterations play an essential role in energy homeostasis and behavioral changes related to food reward and satiety (Hamamah et al., 2024). Each surgical approach therefore produces a distinct combination of restriction, malabsorption, and neuroendocrine response, necessitating postoperative nutritional management tailored to the specific physiological consequences of the chosen procedure (Bagheri et al., 2024). Understanding these mechanistic differences is critical for optimizing clinical follow-up, preventing deficiencies, and guiding patient education within a multidisciplinary care model (Arble et al., 2018).

2.1. Roux-en-Y Gastric Bypass (RYGB)

Roux-en-Y gastric bypass (RYGB) is one of the most commonly performed bariatric procedures and is considered highly effective, combining both restrictive and malabsorptive features. In this technique, a small gastric pouch is created to limit the volume of ingested food, and the distal segment of the jejunum is anastomosed to this pouch, bypassing the duodenum and proximal jejunum. Beyond reducing food intake, this anatomical modification decreases the absorptive surface area, resulting in reduced bioavailability of nutrients, particularly fats and fat-soluble vitamins (Svane et al., 2019).

In addition, diminished hormonal activity in the bypassed segment leads to lower ghrelin levels, thereby suppressing appetite (Peterli et al., 2012). Early stimulation of the distal jejunum increases glucagon-like peptide-1 (GLP-1) and peptide YY (PYY) secretion, changes that enhance insulin secretion and improve glycemic control (Dirksen et al., 2012); (Beckman et al., 2010); (Feris et al., 2022). Clinical literature indicates that RYGB is among the most effective procedures for achieving remission of type 2 diabetes, with improvements often occurring before substantial weight loss (Laferrère & Pattou, 2018); (Pop et al., 2018).

However, deficiencies in iron, vitamin B12, folate, calcium, and vitamin D are frequently observed and necessitate long-term monitoring and supplementation (O'Kane et al., 2020).

2.2. Sleeve Gastrectomy (SG)

Sleeve gastrectomy is a primarily restrictive bariatric procedure performed by removing a substantial portion of the gastric fundus and corpus. Owing to its technical simplicity, relatively low complication risk, and effective weight loss outcomes, it has become the most commonly performed bariatric surgery worldwide (Widjaja et al., 2022). The marked reduction in gastric volume induces early satiety, while removal of the fundus decreases ghrelin production, thereby suppressing appetite (Baraboi et al., 2015). This hormonal effect contributes to a significant reduction in food intake.

Although sleeve gastrectomy largely preserves nutrient absorption compared to malabsorptive procedures, theoretically limiting micronutrient deficiencies, nutritional issues remain common. Inadequate protein intake, deficiencies in iron and vitamin B12, and low overall energy consumption frequently occur due to reduced meal volume (Côté et al., 2024). The long-term success of this procedure depends on the restructuring of eating behaviors, portion control, and optimization of protein intake (Vennapusa et al., 2020).

2.3. Biliopancreatic Diversion (BPD/DS)

Biliopancreatic diversion with duodenal switch is a bariatric procedure that combines restriction and malabsorption in the most pronounced and aggressive manner (Baltasar et al., 2019). In this technique, gastric volume is reduced and a substantial portion of the small intestine is bypassed, resulting in a delayed mixing of ingested food with bile and pancreatic enzymes. While this anatomical alteration accelerates weight loss, it also markedly reduces fat absorption and impairs protein digestion (Baraboi et al., 2015).

Consequently, individuals become highly susceptible to protein–energy malnutrition and severe micronutrient deficiencies. Deficiencies in vitamins A, D, E, and K, as well as calcium and zinc, are particularly common (Nett et al., 2016); (Wang et al., 2023). Alterations in bile acid metabolism may contribute to gastrointestinal symptoms and metabolic changes (Pereira et al., 2018).

For this reason, postoperative nutritional management following BPD/DS requires far more intensive monitoring, aggressive supplementation, and long-term clinical follow-up compared to other surgical procedures (Abedalqader et al., 2025).

2.4. Mechanisms of Malabsorption Related to Anatomical Changes

The development of malabsorption following bariatric surgery is a direct physiological consequence of anatomical modification and involves alterations at structural, enzymatic, and hormonal levels. Reduction of the intestinal surface area decreases the capacity for nutrient absorption, which is particularly problematic for fat-soluble vitamins (Billeter et al., 2014). Delayed mixing of ingested food with bile acids and pancreatic enzymes impairs lipid digestion and may also adversely affect carbohydrate and protein absorption (Vujasinovic et al., 2017). Decreased gastric acid production reduces the bioavailability of micronutrients such as vitamin B12, iron, and calcium, thereby increasing the risk of hematological and neurological complications (Schafer, 2017); (Sawaya et al., 2012).

Additionally, postoperative changes in the gut microbiota can exert indirect effects on energy extraction, inflammation, and metabolic regulation (Liu et al., 2017). Altered bile acid metabolism, mediated through receptors such as FXR and TGR5, contributes to both improved glucose homeostasis and potential malabsorptive complications (Kaska et al., 2016). As a result of these mechanisms, bariatric surgery is effective for weight reduction but introduces new clinical risks, including micronutrient deficiencies, protein malnutrition, and gastrointestinal intolerance (Evenepoel et al., 2023); (Çalapkorur & Küçükkatirci, 2020). Therefore, postoperative nutritional management must extend beyond regulating caloric intake to adopt a comprehensive approach that considers nutrient absorption capacity, metabolic consequences, and individual tolerance (Steenackers et al., 2021).

3. Bariatric Surgery–Induced Metabolic Adaptation

Following bariatric surgery, the organism undergoes a comprehensive metabolic adaptation process that arises directly from the anatomical alterations induced by the procedure. This adaptation is not solely a consequence of mechanically restricting food intake; rather, it involves profound changes across multiple systems, including appetite regulation, glycemic control, energy expenditure, the microbial ecosystem, and cognitive eating behaviors (Xu & Song, 2020); (Sinclair et al., 2018). While rapid weight loss and metabolic improvement are striking in the short term, the sustainability of these physiological changes is closely linked to adequate nutritional intake and behavioral adherence (Marin et al., 2024). Thus, postoperative metabolic adaptation is not a singular biological event but a complex interplay of interconnected mechanisms that influence long-term clinical outcomes (Camastra et al., 2021).

3.1. Gastric Volume Reduction

The majority of bariatric procedures result in a dramatic reduction in gastric volume, and this anatomical alteration influences food intake through two primary mechanisms. First, the smaller stomach capacity induces early satiety, substantially reducing meal size. This restrictive effect limits caloric intake rapidly, facilitating pronounced and rapid weight loss (Ramasamy, 2024). Second, particularly in sleeve gastrectomy, the tubular configuration of the stomach accelerates gastric emptying, which may contribute to symptoms such as nausea, dumping syndrome, and reactive hypoglycemia in the early postoperative period (D’hoedt & Vanuytsel, 2023); (Scarpellini et al., 2020).

Although gastric restriction is advantageous in terms of caloric reduction, it also physically limits the intake of nutrients and fluids, thereby increasing the risk of malnutrition and dehydration (Bettini et al., 2020). For this reason, early postoperative care prioritizes small-volume, nutrient-dense dietary plans and consistent fluid intake distributed throughout the day (Sandoval & Patti, 2022).

3.2. Hormonal Changes (GLP-1, Ghrelin, and Others)

Bariatric surgery induces profound alterations in hormones produced by the gastrointestinal system, which regulate critical processes such as appetite, energy balance, and glycemic control. This hormonal reconfiguration is one of the primary mechanisms driving accelerated weight loss after surgery (Sweeney & Morton, 2014); (Sandoval, 2019). Ghrelin, a hormone synthesized in the gastric fundus that stimulates appetite, decreases markedly when the fundus is removed during sleeve gastrectomy, contributing to diminished oral intake and rapid postoperative weight loss (Martinou et al., 2022). However, ghrelin levels may partially recover over time, increasing susceptibility to weight regain.

In Roux-en-Y gastric bypass and similar procedures, early exposure of ingested food to the distal small intestine enhances the secretion of GLP-1 and PYY, which reinforce satiety and improve glycemic control by stimulating insulin secretion (Feris et al., 2022); (Ji et al., 2021). Clinically, one of the most striking observations is that type 2 diabetes can enter remission even before significant weight loss, highlighting the weight-independent endocrine benefits of surgery (Batterham & Cummings, 2016).

Additionally, increased bile acid circulation and activation of FGF-19 signaling may enhance energy expenditure and glucose regulation (Garruti et al., 2017). Postoperative restructuring of the gut microbiota further influences inflammation, insulin resistance, and energy extraction (Hamamah et al., 2024). Collectively, these mechanisms demonstrate that bariatric surgery functions as a form of biological reprogramming, integrating gastrointestinal, endocrine, and microbial networks to achieve durable metabolic improvement (Yin et al., 2023).

3.3. Metabolic Consequences of Rapid Weight Loss

Rapid weight loss observed in the postoperative period is one of the most striking outcomes of bariatric surgery; however, it triggers complex biological adaptation processes (Seeley et al., 2015). Loss of skeletal muscle alongside adipose tissue may lead to sarcopenia and protein–energy malnutrition, which reduce basal metabolic rate and physical performance (Ji et al., 2021). For this reason, daily protein intake is generally recommended at 1.0–1.5 g/kg, and up to 2.0 g/kg in high-risk individuals to preserve lean mass (Shetye et al., 2022).

Rapid fat mobilization increases circulating free fatty acids and ketone bodies, which elevate oxidative stress and inflammation, contributing to gallstone formation and hepatic dysfunction (Mulla et al., 2018). Altered gallbladder motility and cholesterol homeostasis heighten the risk of gallstone disease, underscoring the need for preventive nutritional strategies (Nguyen & Korner, 2014). Moreover, malabsorption and inadequate intake can precipitate deficiencies in thiamine, iron, vitamin B12, vitamin D, and calcium, leading to neurological, hematological, and skeletal complications (Abdeen & le Roux, 2015).

3.4. Clinical and Behavioral Reflections

The clinical manifestations of postoperative metabolic adaptation highlight the balance between short-term physiological benefits and long-term behavioral adherence (Al-Najim et al., 2018). While surgery modifies appetite and metabolism, the psychological and environmental determinants of eating behavior often lag behind physiological changes, increasing vulnerability to weight regain (Chapela-Álvarez et al., 2025).

In the postoperative phase, protein-centered nutrition, adequate hydration, micronutrient supplementation, and behavioral modification are critical for maintaining success (Martinou et al., 2022). Nursing professionals play a key role not only in clinical monitoring but also in patient education, motivation, and adherence support, ensuring that biological benefits translate into sustainable long-term outcomes (Pucci & Batterham, 2018).

4. Postoperative Nutritional Protocols

Postoperative nutritional management is a key determinant of clinical recovery following bariatric surgery, encompassing both physiological adaptation and behavioral change. After surgery, gastric volume decreases, absorptive surface area is reduced, and hormonal mechanisms are altered, thereby limiting oral intake in terms of both quantity and tolerance. Early feeding follows a gradual progression designed to minimize gastrointestinal stress and reduce complications (Martínez-Ortega et al., 2020). Typically, patients begin with clear liquids in the first few days, followed by full liquids, pureed or soft foods, and eventually a transition to solid foods. The pace of this progression varies according to surgical technique, individual healing dynamics, and gastrointestinal tolerance; therefore, a flexible, clinically guided approach is preferable to rigid standardization (Sherf Dagan et al., 2017).

The liquid phase in the early postoperative period is critical for preventing dehydration and electrolyte imbalance, and patients are encouraged to consume small sips frequently throughout the day (Flore et al., 2023). Given the limited gastric capacity, rapid or high-volume fluid intake may lead to nausea, vomiting, and abdominal discomfort; thus, establishing slow drinking habits is essential. By approximately the third day, full liquid diets can be introduced depending on tolerance, and caloric density and protein content are typically increased at this stage. Since most postoperative patients cannot meet their protein needs from food alone, high-protein liquid supplements are strongly recommended (Taselaar et al., 2023).

The subsequent transition to pureed and soft foods represents a critical adaptation phase in which chewing behavior, portion control, and recognition of satiety cues are reestablished. At this point, eating becomes not merely a physiological process but one that integrates psychosocial and behavioral components (Aguas-Ayesa et al., 2023).

4.1. Protein Intake

Protein intake is a major determinant of long-term success and prevention of complications following bariatric surgery. Rapid weight loss involves loss of both fat and lean mass, predisposing to sarcopenia and metabolic dysregulation. Maintaining adequate protein intake preserves metabolic rate and supports muscle integrity. Clinical guidelines recommend an average intake of 60–80 g/day (1.0–1.5 g/kg/day), with higher targets-up to 2.0 g/kg/day-for high-risk individuals (Ben-Porat et al., 2025). Protein deficiency can cause fatigue, hair loss, edema, immune suppression, and delayed wound healing. The PROMISE randomized controlled trial demonstrated that daily protein supplementation can significantly reduce fat-free mass loss during the first postoperative year (Taselaar et al., 2023).

4.2. Hydration and Fluid Management

Hydration is another essential component of postoperative care. Due to limited gastric capacity, patients may struggle to achieve adequate fluid intake, leading to dehydration, which often presents as dizziness, dark urine, fatigue, and orthostatic hypotension (Benson-Davies et al., 2024). Fluid intake should be spaced throughout the day in small sips, and liquids should be avoided during meals to prevent early satiety and reduce dumping syndrome risk (Mechanick et al., 2013).

4.3. Monitoring and Behavioral Adherence

Continuous monitoring of weight loss, muscle mass, micronutrient status, and gastrointestinal tolerance is essential for long-term success (Osland et al., 2020). In addition to physiological follow-up, restructuring eating behavior is crucial. Poor adherence to nutritional protocols may result in malnutrition, micronutrient deficiencies, and rebound weight gain (Acosta et al., 2025). Therefore, postoperative care should be conceptualized as an adaptive learning process that integrates behavioral modification, mindful eating, and self-management under the guidance of a multidisciplinary care team.

5. Postoperative Nutritional Complications After Bariatric Surgery

Nutritional complications following bariatric surgery arise from the interaction of multiple biological mechanisms, including anatomical modification, hormonal adaptation, rapid weight loss, and inadequate oral intake. Although surgery provides substantial metabolic benefits, malabsorptive processes and behavioral non-adherence can lead to macro- and micronutrient deficiencies with serious clinical consequences (Moizé, Laferrère, & Shapses, 2024). Understanding these mechanisms, their clinical manifestations, and management strategies is essential for patient safety and long-term outcomes (Nuzzo et al., 2021).

5.1. Dumping Syndrome

One of the most common complications specific to bariatric surgery is dumping syndrome, a pathophysiological condition resulting from the rapid transit of food from the stomach into the small intestine. *Early dumping* results from osmotic fluid shifts and manifests with abdominal cramping, diarrhea, tachycardia, and vasomotor instability. *Late dumping* occurs when exaggerated insulin secretion in response to postprandial hyperglycemia leads to reactive hypoglycemia, characterized by sweating, tremors, and confusion. While not a surgical failure, it reflects a predictable physiological adaptation, often manageable by dietary modification - reducing refined carbohydrates, lowering meal volume, and increasing fiber and protein intake (Tsenteradze et al., 2023); (Andrade et al., 2021).

5.2. Micronutrient Deficiencies

Micronutrient deficiencies are among the most prevalent postoperative complications. Deficiencies in iron, vitamin B12, folate, vitamin D, calcium, and zinc arise due to reduced gastric acid, diminished intrinsic factor, and bypass of absorptive surfaces (Reytor-González et al., 2025). These deficiencies can present with nonspecific symptoms such as fatigue, pallor, cognitive slowing, hair loss, or paresthesia and may progress to anemia, neuropathy, or osteopenia without prompt correction (Steenackers et al., 2022). Lifelong supplementation and regular biochemical monitoring are therefore considered essential standards of care (Lupoli et al., 2017).

5.3. Protein–Energy Malnutrition and Sarcopenia

Rapid postoperative weight loss, combined with low protein intake, can precipitate protein–energy malnutrition and sarcopenia. These conditions result in reduced basal metabolic rate, impaired immunity, and fatigue, thereby undermining weight maintenance (Soliman et al., 2025). Preservation of lean mass through adequate protein intake and resistance exercise is critical to prevent long-term weight regain and functional decline (Bettini et al., 2020).

5.4. Refeeding Syndrome

Refeeding syndrome may occur in severely malnourished patients during rapid caloric reintroduction. Sudden carbohydrate intake triggers insulin release, shifting phosphate, potassium, and magnesium into cells, resulting in hypophosphatemia, hypokalemia, and potentially fatal arrhythmias or respiratory failure (Nuzzo et al., 2021). Gradual caloric advancement and close electrolyte monitoring are mandatory for high-risk individuals (Bétry et al., 2017).

5.5. Gastrointestinal and Ulcerative Complications

Gastrointestinal complications - including nausea, vomiting, and marginal ulcers - often arise from poor tolerance, noncompliance, or irritant exposure (NSAIDs, alcohol, nicotine). Persistent symptoms exacerbate malnutrition and fluid imbalance. Ulcers require pharmacologic therapy (proton-pump inhibitors) and avoidance of aggravating factors (Binnetoğlu, 2023).

5.6. Neurological Complications

Thiamine (vitamin B1) deficiency represents a severe but preventable neurological complication, often precipitated by vomiting or poor intake. Wernicke encephalopathy, characterized by confusion, ataxia, and ophthalmoplegia, can be fatal if untreated (Becker, Balcer, & Galetta, 2012). Rapid recognition and prompt parenteral thiamine administration are essential in symptomatic or high-risk patients. Rapid weight loss and impaired gallbladder motility increase the risk of cholelithiasis after bariatric surgery. Accelerated fat catabolism elevates biliary cholesterol concentration, predisposing to stone formation. Nutritional strategies promoting gradual weight loss and the use of ursodeoxycholic acid have been shown to reduce incidence (Tsenteradze et al., 2023).

6. Nursing Care and Follow-Up Process

Beyond nutritional concerns, addressing sleep-related issues such as insomnia especially prevalent in patients with chronic disease profiles should be considered part of comprehensive postoperative nursing care (Atay & Ciftci, 2025). Additionally, attention to psychological resilience and family functioning-factors shown to be influenced by demographic characteristics-can enhance holistic postoperative recovery (Yildirim et al., 2025). This process requires a comprehensive approach that encompasses not only physiological monitoring and clinical interventions but also behavioral change, patient education, and motivational support (Puplampu & Simpson, 2016). In the postoperative period, routine assessment of clinical status, symptom monitoring, body weight and composition, oral intake capacity, and fluid-electrolyte balance constitutes core nursing responsibilities. Anthropometric measurements and biochemical tests provide critical data for evaluating nutritional status, and nurses must be able to integrate laboratory and physical findings to identify malnutrition risk at an early stage (Reytor-González et al., 2025).

A major component of nursing care involves providing structured nutritional education tailored to the patient's learning capacity and lifestyle. Bariatric surgery does not automatically correct eating behavior; therefore, individuals must relearn healthy dietary habits. Nurses play a key role in teaching fundamental principles such as meal planning, portion control, slow and mindful eating, regulation of fluid intake, and prioritization of protein-rich foods (Mohammed & Shahin, 2025). Many patients perceive rapid weight loss as an indicator of success and consequently deprioritize adequate nutrient intake; nursing education must address why this perception is clinically risky and actively support behavioral change.

Management of vitamin and mineral supplementation is also an integral element of nursing practice. Following surgery, the absorption of micronutrients such as vitamin B12, iron, folate, vitamin D, and calcium is impaired, and deficiencies can lead to hematological, neurological, and skeletal complications (Heber et al., 2010). Nurses should monitor supplementation protocols, assess tolerance and adherence, and evaluate laboratory results to detect deficiencies early. Irregular supplement use is one of the most common causes of complications in bariatric patients, making ongoing education and motivational reinforcement indispensable to clinical care (Budny et al., 2024).

Early recognition of complications requires a symptom-focused and systematic nursing approach. Symptoms such as dumping syndrome, dehydration, nausea, vomiting, dysphagia, refeeding syndrome, and abdominal pain warrant careful assessment, as each requires different interventions based on clinical presentation. Nurses should evaluate symptoms in terms of duration and severity and initiate timely referral when necessary (Maqueda-Martínez et al., 2024). Rapid decision-making in critical situations can prevent escalation of complications. In this context, the nurse functions not only as a provider of care but also as the first point of contact and a clinical decision-support agent.

Another essential dimension of postoperative care is patient motivation and behavioral regulation. Surgery alters physiological capacity but does not automatically transform eating behavior. As a result, patterns such as emotional eating, uncontrolled snacking, rapid eating, and preference for high-calorie foods may persist. Nursing approaches must recognize the psychological dimensions of eating behavior, evaluate the patient's emotional and cognitive processes, and refer to psychological or dietary counseling when appropriate (Grindel & Grindel, 2006). Psychological distress-such as anxiety, depression, and stress-can significantly alter patients' postoperative behavior, adherence, and recovery, as observed in hospitalized populations (Gökmen et al., 2025). Some patients may experience altered body image, social withdrawal, or performance anxiety following rapid weight loss; thus, psychosocial assessment is as important as physical evaluation in bariatric care.

Overall, nursing care after bariatric surgery requires an integrated implementation of monitoring, assessment, education, coordination, and motivational strategies (Zhang et al., 2020). In this process, the nurse acts not only as a manager of symptoms but also as a primary guide in facilitating patient adaptation to a new lifestyle. The quality of clinical care directly influences complication rates, hospital readmissions, sustainability of weight loss, and overall quality of life (Khee et al., 2023).

7. Patient and Family Education

Patient and family education in the postoperative period is one of the fundamental components of sustainable clinical outcomes following bariatric surgery. Although surgery can provide anatomical and metabolic improvement, long-term success is only achievable if patients learn and maintain new dietary and lifestyle behaviors (Sherf Dagan et al., 2017). Therefore, education must extend beyond practical postoperative instructions and include a comprehensive explanation of the physiological effects of surgery, potential complications, nutritional principles, and the necessity of long-term follow-up (Soliman et al., 2025). Many patients view surgery as a “solution” and postpone attention to eating behavior until after the procedure. This misconception, while compatible with rapid short-term weight loss, increases the risk of long-term failure and complications. Consequently, education and guidance should begin in the preoperative period and continue into the postoperative phase as a sustained process (Montastier et al., 2018).

A central goal of education is to facilitate restructuring of eating behavior. Postoperative guidelines often emphasize reduced portion sizes, slow eating, proper chewing, meal planning, and careful food selection (Sherf-Dagan et al., 2023). However, these behaviors are not internalized when conveyed merely as “recommendations”; therefore, patient education must provide a framework explaining how new eating habits are formed and why they are necessary. Emotional eating, compulsive snacking, and stress-related eating may persist after surgery and can negatively affect weight loss (Kaouk et al., 2019). Patients should be encouraged to recognize the psychosocial dimensions of eating behavior and seek professional support when needed.

Food safety and hygiene constitute another essential educational topic. Reduced gastric capacity and gastrointestinal adaptation lower digestive tolerance, making high-fat, fried, overly spicy, or high-sugar foods likely triggers of symptoms and complications. Additionally, eating too quickly, inadequate chewing, or consuming large portions may result in gastrointestinal discomfort, vomiting, or even anastomotic complications. Education must therefore address not only what to eat, but how to eat (Pinnock, 2021). Food storage, preparation methods, and contamination risks also require attention, as vomiting and diarrhea can adversely affect electrolyte balance and nutrient intake.

Vitamin and mineral supplementation forms a lifelong component of patient education. Due to the nature of bariatric surgery, absorption of micronutrients such as iron, vitamin B12, folate, vitamin D, and calcium is reduced, and deficiencies may progress without obvious symptoms (Spetz et al., 2022). Many patients discontinue supplements because they “feel fine,” despite the fact that clinical presentation is often asymptomatic until irreversible hematological or neurological complications develop (Mahawar et al., 2019). Education must therefore aim not only to transfer knowledge, but also to internalize supplementation behavior. Including family members in the process can provide significant support (Aguas-Ayesa et al., 2023).

The need for long-term follow-up is one of the most critical messages in bariatric education. Many patients view the period of rapid postoperative weight loss as an “endpoint” and disengage from clinical care. However, postoperative risks are not limited to the early phase; many complications emerge months or years after surgery (Montastier et al., 2018). Regular clinical evaluations, laboratory monitoring, nutritional counseling, and psychosocial support are necessary not only for preventing complications but also for maintaining long-term weight stability and quality of life. Education should therefore foster an understanding of bariatric surgery as a “lifelong clinical journey” (Ziegler et al., 2009).

One of the most effective strategies in patient and family education is the use of communication models that transform information into active learning and behavioral implementation. Rather than relying on one-way instruction, patients should be supported in identifying their own goals, recognizing barriers, and generating solutions (Ferraro, 2014).

8. Multidisciplinary Approach

Postoperative management following bariatric surgery cannot be undertaken by a single healthcare professional; the simultaneous anatomical, metabolic, psychological, and behavioral changes occurring in this period make a multidisciplinary approach indispensable (Marin et al., 2024). Collaboration among various professionals-such as surgeons, dietitians, nurses, psychologists, and physical activity specialists-not only reduces the risk of complications but also provides a critical framework for long-term weight maintenance and improved quality of life (Marshall et al., 2020). The technical success of surgery translates into durable clinical success only when supported by coordinated team efforts; otherwise, the procedure may devolve into a short-lived and risky intervention (Budny et al., 2024).

The role of the bariatric surgeon extends far beyond performing the operative procedure. The surgeon acts as a clinical leader, assessing risks associated with postoperative anatomical changes, identifying complications early, and initiating medical or surgical interventions when necessary. Additionally, as the clinician responsible for lifetime follow-up, the surgeon monitors long-term outcomes such as weight trajectory, weight regain, and metabolic dysfunctions. Bariatric surgery is not a short-term solution, but rather a chronic intervention model that necessitates an ongoing clinical relationship (Chaim et al., 2017).

Within this team, the dietitian functions as the architect of metabolic and behavioral adaptation. Postoperative nutrition cannot be reduced to caloric restriction; it involves complex targets such as protein intake, fluid management, vitamin and mineral supplementation, portion control, and restructuring of eating behavior (Kostecka & Bojanowska, 2017). The dietitian evaluates dietary habits, develops individualized plans, monitors clinical needs, and modifies strategies as required. Particularly in malabsorptive procedures, nutritional counseling becomes a medical intervention that substantially reduces health risks (Singhal et al., 2010).

Nursing practice is the most frequent point of contact within the multidisciplinary team. As the professional who interacts continuously with the patient, the nurse assesses symptoms, conducts clinical monitoring, provides education, supports behavioral change, and coordinates with other disciplines when necessary (Mendes et al., 2023). The success of bariatric care depends not only on surgical technique and nutritional planning, but also on patient motivation, engagement in follow-up, and early recognition of clinical risks. In this respect, nursing interventions are preventive as much as they are therapeutic (Cengiz Açıl et al., 2024).

Psychological support is an essential yet often overlooked component of postoperative care. Eating behavior is not solely dictated by physiological hunger and satiety mechanisms; emotional, cognitive, and social factors also shape it (Ratcliffe & Banting, 2023). Surgery alters physiological capacity but does not automatically transform psychological patterns. Consequently, many patients continue to experience emotional eating, low self-esteem, social withdrawal, performance anxiety, or body image disturbances despite rapid weight loss. Psychological counseling in this context identifies problems while supporting behavioral adaptation (Botros et al., 2025). Moreover, disrupted body image and compulsive health-seeking behavior are frequently associated with emotional dysregulation, further emphasizing the need for targeted psychological interventions (Demir Gökmen et al., 2024).

Another key dimension of the multidisciplinary model is systematic clinical coordination. Effective communication between disciplines, standardization of follow-up protocols, and information sharing are crucial for patient safety and clinical efficiency (Morales et al., 2014). Moreover, the integration of digital health technologies into postoperative follow-up protocols relies heavily on nurses' informatics competencies and digital literacy (Yildiz et al., 2023). Fragmented and uncoordinated follow-up can result in missed cases of malabsorption, malnutrition, micronutrient deficiencies, dehydration, or psychosocial problems, worsening clinical outcomes and increasing healthcare burden. In contrast, an integrated approach provides a clinical framework that recognizes patient needs in a timely manner and initiates early intervention (Maciel et al., 2024).

9. Clinical Outcomes and Quality of Life

Bariatric surgery is currently regarded not merely as a method for inducing weight loss, but as a comprehensive therapeutic intervention that improves metabolic diseases, reduces morbidity, and enhances quality of life (Arterburn & Courcoulas, 2014). Postoperative clinical outcomes reflect the combined effects of anatomical and hormonal changes. Weight loss is typically rapid and substantial during the first 6–12 months, involving reductions in both adipose tissue and lean body mass; however, with appropriate nutrition and physical activity, metabolic adaptation can reach a healthier equilibrium (Tan et al., 2022). In the long term, many individuals can lose more than 50% of their excess body weight, and a considerable proportion of this loss can be sustained. Nonetheless, weight loss alone should not be considered a sole marker of success; rather, the metabolic, psychological, and functional impacts of surgery must be evaluated collectively (Courcoulas et al., 2014).

Metabolic improvement is among the most remarkable outcomes of bariatric surgery. Chronic conditions such as type 2 diabetes, dyslipidemia, hypertension, and non-alcoholic fatty liver disease can demonstrate pronounced improvement in the postoperative period (Brethauer et al., 2013). Numerous clinical studies report higher remission rates of type 2 diabetes, particularly after Roux-en-Y gastric bypass, compared to medical therapy (Purnell et al., 2020). The observation that glycemic control may improve even before significant weight loss occurs highlights the metabolic impact of altered gastrointestinal hormone signaling (Meira et al., 2024). Nevertheless, maintaining metabolic improvement depends on factors such as ongoing monitoring, adequate nutrition, supplementation, and behavioral adherence (Cummings & Cohen, 2016).

The prevalence of postoperative complications varies according to surgical procedure, dietary compliance, supplement adherence, and quality of clinical follow-up (Kornyushin et al., 2021). Refeeding syndrome, dumping syndrome, micronutrient deficiencies, dehydration, gallstone disease, and gastrointestinal problems can emerge in either early or late phases. While some complications are mild and transient, others carry significant morbidity and even mortality. Severe malnutrition, hematologic disorders, and Wernicke encephalopathy associated with thiamine deficiency can lead to permanent disease burden when diagnosis is delayed (O'Brien et al., 2018). Clinical literature demonstrates that most complications are preventable through patient education, nutritional adherence, routine laboratory monitoring, and multidisciplinary care (Khaitan et al., 2021).

Quality of life is one of the most frequently investigated and increasingly valued outcomes of bariatric surgery (Chaturvedi et al., 2022). Postoperatively, most individuals experience improvements in physical capacity, mobility, sleep quality, and chronic pain. On a psychosocial level, enhanced self-esteem, increased social engagement, and improved body image are commonly reported (Damaskos et al., 2020). However, this process does not progress uniformly across individuals. Rapid weight loss, changing body image, excess skin, and altered social interactions may generate emotional stress and anxiety for some patients. Consequently, psychological support and social adjustment have become clinical priorities comparable to surgical outcomes (Altulaihi et al., 2025).

The long-term outcomes of bariatric surgery illustrate the complexity of the relationship between clinical success and patient satisfaction. Some individuals with substantial improvements in physical health may struggle with psychosocial adaptation, whereas others may report improved quality of life despite limited physical improvement. This variability indicates that bariatric surgery is not solely a biomedical intervention but also a psychological and sociocultural experience (Tan et al., 2022). Recognition and management of this multifaceted experience by the clinical team is essential for sustaining long-term outcomes (Brethauer et al., 2013).

10. Conclusion

Bariatric surgery represents an effective and evidence-based therapeutic intervention for the management of severe obesity and its related metabolic disorders. Beyond reducing gastric volume, it induces profound physiological and hormonal adaptations that improve energy balance, glucose metabolism, and appetite regulation. These multidimensional effects explain why bariatric surgery has become a cornerstone in obesity treatment worldwide.

Surgical success, however, depends on more than anatomical modification. Sustainable outcomes require comprehensive postoperative care that includes nutritional management, behavioral adaptation, and regular clinical monitoring. Early detection and management of nutritional complications such as dumping syndrome, dehydration, micronutrient deficiencies, sarcopenia, refeeding syndrome, and gallstone formation are critical to maintaining long-term health and preventing morbidity.

Nursing care holds a central position in this process, ensuring continuous clinical observation, patient education, and adherence to supplementation and lifestyle changes. Likewise, the multidisciplinary nature of postoperative management-integrating the expertise of surgeons, dietitians, nurses, psychologists, and physical activity specialists-provides a holistic framework that supports both metabolic recovery and psychosocial well-being.

Finally, the outcomes of bariatric surgery extend beyond physical health. Improvements in quality of life, self-perception, and social functioning depend on sustained behavioral change and psychosocial adaptation. Therefore, bariatric surgery should not be regarded as a one-time mechanical intervention but as a long-term, integrated treatment model requiring lifelong commitment from both patients and healthcare teams.

References

Abdeen, G., & le Roux, C. (2015). *Mechanism underlying the weight loss and complications of Roux-en-Y gastric bypass. Obesity Surgery, 26*, 410–421.

Abedalqader, T., Jawhar, N., Gajjar, A., Portela, R., Perrotta, G., El Ghazal, N., Laplante, S. J., & Ghanem, O. M. (2025). *Hypoabsorption in bariatric surgery: Is the benefit worth the risk? Medicina.*

Acosta, P. F. C., Heidl, A., Angeles, P. M., Farnesi, B.-C., Alcindor, P., Alberga, A. S., Erdstein, J., Saputra, S., & Cohen, T. R. (2025). *Evaluation of Protein Cards: A nutrition education tool for metabolic bariatric surgery. medRxiv.*

Aguas-Ayesa, M., Yárnoz-Esquíroz, P., Olazarán, L., Gómez-Ambrosi, J., & Frühbeck, G. (2023). *Precision nutrition in the context of bariatric surgery. Reviews in Endocrine & Metabolic Disorders, 24*, 979–991.

Albaugh, V. L., Flynn, C. R., Tamboli, R. A., & Abumrad, N. N. (2016). *Recent advances in metabolic and bariatric surgery* (Version 1; peer review: 2 approved). F1000Research, 5(F1000 Faculty Rev), 978. https://doi.org/10.12688/f1000research.7240.1

Al-Najim, W., Docherty, N., & le Roux, C. L. (2018). *Food intake and eating behavior after bariatric surgery. Physiological Reviews, 98*(3), 1113–1141.

Altulaihi, B., Sawlan, A. M., Alwahbi, N. A., Alshahrani, B., Alrayani, Y. H., & Alrayani, Y. H. (2025). *Long-term remission rate of type 2 diabetes following bariatric surgery: A retrospective cohort study. Cureus, 17*, e76819.

Andrade, L., Chiote, I., Santos-Cruz, A., Brito-Costa, A., Mendes, L., Silva-Nunes, J., & Pereira, J. (2021). Protein intake, adherence to vitamin–mineral supplementation, and dumping syndrome in patients undergoing one anastomosis gastric bypass. Obesity Surgery, 31(8), 3557–3564.

Arble, D. M., Evers, S., Bozadjieva, N., Frikke-Schmidt, H., Myronovych, A., Lewis, A., Toure, M., & Seeley, R. (2018). *Metabolic comparison of one-anastomosis gastric bypass, single-anastomosis duodenal-switch, Roux-en-Y gastric bypass, and vertical sleeve gastrectomy in rat. Surgery for Obesity and Related Diseases, 14*(12), 1857–1867.

Arterburn, D., & Courcoulas, A. (2014). *State of the art review: Bariatric surgery for obesity and metabolic conditions in adults. The BMJ, 349*, g3961.

Atay, M. E., & Ciftci, B. (2025). *Insomnia in heart failure patients in a hospital setting: Causes, consequences, and interventions*. Current Cardiology Reports. https://doi.org/10.1007/s11886-025-02256-1

Bagheri, M., Tanriverdi, K., Iafrati, M., Mosley, J. D., Freedman, J. E., & Ferguson, J. F. (2024). *Characterization of the plasma metabolome and lipidome in response to sleeve gastrectomy and gastric bypass surgeries reveals molecular patterns of surgical weight loss. Metabolism: Clinical and Experimental, 158,* 155955.

Baltasar, A., Bou, R., Pérez, N., Serra, C., & Bengochea, M. (2019). *Twenty-five years of duodenal switch: How to switch to the duodenal switch. Nutricion Hospitalaria.*

Baraboi, E., Li, W., Labbé, S., Roy, M. C., Samson, P., Hould, F., Lebel, S., Marceau, S., Biertho, L., & Richard, D. (2015). *Metabolic changes induced by the biliopancreatic diversion in diet-induced obesity in male rats: The contributions of sleeve gastrectomy and duodenal switch. Endocrinology, 156*(4), 1316–1329.

Batterham, R., & Cummings, D. (2016). *Mechanisms of diabetes improvement following bariatric/metabolic surgery. Diabetes Care, 39*, 893–901.

Becker, D., Balcer, L., & Galetta, S. (2012). The neurological complications of nutritional deficiency following bariatric surgery. Journal of Obesity, 2012.

Beckman, L., Beckman, T. R., & Earthman, C. (2010). *Changes in gastrointestinal hormones and leptin after Roux-en-Y gastric bypass procedure: A review. Journal of the American Dietetic Association, 110*(4), 571–584.

Benaiges, D., Más-Lorenzo, A., Goday, A., Ramón, J., Chillarón, J., Pedro-botet, J., & Flores-Le Roux, J. F. (2015). *Laparoscopic sleeve gastrectomy: More than a restrictive bariatric surgery procedure? World Journal of Gastroenterology, 21*(41), 11804–11814.

Ben-Porat, T., Lahav, Y., Cohen, T. R., Bacon, S. L., Buch, A., Moizé, V., & Sherf-Dagan, S. (2025). *Is there a need to reassess protein intake recommendations following metabolic bariatric surgery? Current Obesity Reports, 14.*

Benson-Davies, S., Frederiksen, K., & Patel, R. (2024). *Bariatric nutrition and evaluation of the metabolic surgical patient: Update to the 2022 Obesity Medicine Association (OMA) clinical practice statement. Obesity Pillars, 13,* 100154.

Bétry, C., Disse, E., & Chambrier, C. (2017). Need for more collaboration to manage nutritional complications after bariatric surgery. Clinical Nutrition, 36(2), 608.

Bettini, S., Belligoli, A., Fabris, R., & Busetto, L. (2020). *Diet approach before and after bariatric surgery. Reviews in Endocrine and Metabolic Disorders, 21*(3), 297–306.

Bhattacharya, S., Kalra, S., Kapoor, N., Singla, R., Dutta, D., Aggarwal, S., … Dutta, P. (2021). *Expert opinion on the preoperative medical optimization of adults with diabetes undergoing metabolic surgery. World Journal of Diabetes, 12*(10), 1587–1621.

Binnetoğlu, K. (2023). Nutrition and patient follow-up in bariatric surgery. The Eurasian Journal of Medicine, 55(S1), S70–S74.

Botros, N., Czymoniewicz-Klippel, M. T., van de Scheur, V., Deden, L. N., van den Berg, E. M., & Hazebroek, E. J. (2025). How well does it fit? Process evaluation of a multidisciplinary pre- and postoperative metabolic bariatric surgery support programme: A patients' perspective. Clinical Obesity, 15(4), e70006. https://doi.org/10.1111/cob.70006

Bower, G., Athanasiou, T., Isla, A., Harling, L., Li, J., Holmes, E., Efthimiou, E., Darzi, A., & Ashrafian, H. (2015). *Bariatric surgery and nonalcoholic fatty liver disease. European Journal of Gastroenterology & Hepatology, 27*, 755–768.

Brethauer, S., Aminian, A., Romero-Talamás, H., Batayyah, E., Mackey, J. E., Kennedy, L., Kashyap, S., Kirwan, J., Rogula, T., Kroh, M., Chand, B., & Schauer, P. (2013). *Can diabetes be surgically cured? Long-term metabolic effects of bariatric surgery in obese patients with type 2 diabetes mellitus. Annals of Surgery, 258*(4), 628–637.

Budny, A., Janczy, A., Szymański, M., & Mika, A. (2024). *Long-term follow-up after bariatric surgery: Key to successful outcomes in obesity management. Nutrients, 16*(24), 4399.

Camastra, S., Palumbo, M., & Santini, F. (2021). *Nutrients handling after bariatric surgery: The role of gastrointestinal adaptation. Eating and Weight Disorders, 27,* 449–461.

Cengiz Açıl, H., Çelik Yılmaz, A., & Aygin, D. (2024). *Post-bariatric surgery nursing care. İzmir Kâtip Çelebi University Journal of Health Sciences*, 11(1).

Ceriani, V., Pinna, F., Galantino, A., Zakaria, A., Manfrini, R., Pontiroli, A., & Folli, F. (2021). *Biliopancreatic diversion, Roux-en-Y gastric bypass, and sleeve gastrectomy mediate differential changes in body weight and composition: A 5-year study. Acta Diabetologica, 59*(1), 39–48.

Chaim, É., Pareja, J., Gestic, M. A., Utrini, M. P., & Cazzo, E. (2017). *Preoperative multidisciplinary program for bariatric surgery: A proposal for the Brazilian Public Health System. Arquivos de Gastroenterologia, 54*(1), 70–74.

Chapela-Álvarez, C., Córdova, M., & Álvarez, D. (2025). *Neurobiological and microbiota alterations after bariatric surgery: Implications for hunger, appetite, taste, and long-term metabolic health. Brain Sciences, 15*(4), 363.

Charalampakis, V., Tahrani, A., Helmy, A., Gupta, J., & Singhal, R. (2016). *Polycystic ovary syndrome and endometrial hyperplasia: An overview of the role of bariatric surgery in female fertility. European Journal of Obstetrics, Gynecology, and Reproductive Biology, 207*, 220–226.

Chaturvedi, R. R., Gracner, T., Tysinger, B., Narain, K., Goldman, D., & Sturm, R. (2022). *The long-term value of bariatric surgery interventions for American adults with type 2 diabetes mellitus. Annals of Surgery, 275*(5), 864–874.

Cirocchi, R., Boselli, C., Santoro, A., Guarino, S., Covarelli, P., Renzi, C., et al. (2013). *Current status of robotic bariatric surgery: A systematic review. BMC Surgery, 13*(53), 53–53.

Côté, M., Pelletier, L., Nadeau, M., Bouvet-Bouchard, L., Julien, F., Michaud, A., Biertho, L., & Tchernof, A. (2024). *Micronutrient status two years after bariatric surgery: A prospective nutritional assessment. Frontiers in Nutrition, 11.*

Courcoulas, A., Yanovski, S., Bonds, D., Eggerman, T., Horlick, M., Staten, M., & Arterburn, D. (2014). *Long-term outcomes of bariatric surgery: A National Institutes of Health symposium. JAMA Surgery, 149*(12), 1323–1329.

Cummings, D., & Cohen, R. (2016). *Bariatric/metabolic surgery to treat type 2 diabetes in patients with a BMI <35 kg/m2. Diabetes Care, 39*(6), 924–933.

D’hoedt, A., & Vanuytsel, T. (2023). *Dumping syndrome after bariatric surgery: Prevalence, pathophysiology and role in weight reduction. Acta Gastro-Enterologica Belgica, 86*(3), 417–427.

Damaskos, C., Litos, A., Dimitroulis, D., Antoniou, E., Mantas, D., Kontzoglou, K., & Garmpis, N. (2020). *Cardiovascular effects of metabolic surgery on type 2 diabetes. Current Cardiology Reviews, 16*(4), 275–284.

Demir Gökmen, B., Yıldız, M., Güler, S., & Kayacık, A. D. (2024). *Investigation of the relationship between body image, orthorexia nervosa, and cyberchondria in pregnant women*. *Anatolian Journal of Health Research*. https://dx.doi.org/10.61534/anatoljhr.1435910.

Dirksen, C., Jørgensen, N. B., Bojsen-Møller, K. N., Jacobsen, S., Hansen, D. L., Worm, D., Holst, J. J., & Madsbad, S. (2012). *Mechanisms of improved glycaemic control after Roux-en-Y gastric bypass. Diabetologia, 55*(7), 1890–1901.

Drenth, J., Broek, R. P. G., & van Laarhoven, C. J. H. M. (2019). *Obesity and metabolic syndrome, too big of an enemy to be just fought with a scalpel. Obesity Surgery, 30*, 777–779.

Feris, F., McRae, A., Kellogg, T., McKenzie, T., Ghanem, O. M., & Acosta, A. (2022). *Mucosal and hormonal adaptations after Roux-en-Y gastric bypass. Surgery for Obesity and Related Diseases.*

Ferrannini, E., Camastra, S., Astiarraga, B., Nannipieri, M., Castro-Pérez, J., Xie, D., et al. (2015). *Increased bile acid synthesis and deconjugation after biliopancreatic diversion. Diabetes, 64*(10), 3377–3385.

Ferraro, D. R. (2014). *Telenutrition: An integrated approach to delivering medical nutrition therapy to bariatric surgery patients via synchronous teleconsultation. Clinical Scholars Review, 7*(2), 169–174.

Flore, G., Deledda, A., Fosci, M., Lombardo, M., Moroni, E., Pintus, S., Velluzzi, F., & Fantola, G. (2023). *Perioperative nutritional management in enhanced recovery after bariatric surgery. International Journal of Environmental Research and Public Health, 20*, 6899.

Garruti, G., Di Ciaula, A., Wang, H. H., Wang, D. Q., & Portincasa, P. (2017). *Cross-talk between bile acids and gastrointestinal hormones: Clues from bariatric surgery. Annals of Hepatology, 16*(Suppl 1), S68–S82.

Grindel, M. E., & Grindel, C. (2006). *Nursing care of the person having bariatric surgery. Medsurg Nursing, 15*(3), 129–145.

Hamamah, S., Hajnal, A., & Covasa, M. (2024). *Influence of bariatric surgery on gut microbiota composition and its implication on brain and peripheral targets. Nutrients, 16*(7), 1071.

Heber, D., Greenway, F., Kaplan, L., Livingston, E., Salvador, J., & Still, C. (2010). *Endocrine and nutritional management of the post-bariatric surgery patient: An Endocrine Society clinical practice* *guideline. The Journal of Clinical Endocrinology and Metabolism, 95*(11), 4823–4843.

Ji, Y., Lee, H., Kaura, S., Yip, J., Sun, H., Guan, L., Han, W., & Ding, Y. (2021). *Effect of bariatric surgery on metabolic diseases and underlying mechanisms. Biomolecules, 11*(11), Article 1582.

Jin, Z., & Liu, W. (2021). *Progress in treatment of type 2 diabetes by bariatric surgery. World Journal of Diabetes, 12*(8), 1187–1199.

Kafalı, M. E., Şahin, M., Ece, İ., Acar, F., Yılmaz, H., Alptekin, H., & Ateş, L. (2017). *The effects of bariatric surgical procedures on the improvement of metabolic syndrome in morbidly obese patients. Turkish Journal of Surgery, 33*(3), 142–146.

Kamal, F. A., Fernet, L. Y., Rodriguez, M., Kamal, F., Da Silva, N. K., Kamal, O. A., Aguilar, A. A., Arruarana, V. S., & Martinez Ramirez, M. (2024). *Nutritional deficiencies before and after bariatric surgery: Prevention and treatment. Cureus, 16,* e55062.

Kaouk, L., Hsu, A., Tanuseputro, P., & Jessri, M. (2019). *Modifiable factors associated with weight regain after bariatric surgery: A scoping review. F1000Research, 8*, 615.

Khaitan, M., Gadani, R., & Pokharel, K. (2021). *Evaluation of the effects of bariatric surgery in terms of weight loss and diabetes remission in the Indian population. Dubai Diabetes and Endocrinology Journal, 27*(3), 119–125.

Khee, G. Y., Lim, P. S., Chan, Y. L., & Lee, P. C. (2023). *Collaborative prescribing practice in managing patients post-bariatric surgery in a tertiary centre in Singapore. Pharmacy, 12*(1), 31.

Knop, F., & Taylor, R. (2013). *Mechanism of metabolic advantages after bariatric surgery. Diabetes Care, 36*(S2), S287–S291.

Kornyushin, O., Sakeian, I. S., Kravchuk, E., Vasilevsky, D. I., Danilov, I., & Neimark, A. (2021). *Prediction of remission of type 2 diabetes mellitus after bariatric surgery. Diabetes Mellitus, 24*(2), 120–128.

Kostecka, M., & Bojanowska, M. (2017). *Problems in bariatric patient care – challenges for dieticians. Videosurgery and Other Miniinvasive Techniques, 12*(2), 207–215.

Laferrère, B., & Pattou, F. (2018). *Weight-independent mechanisms of glucose control after Roux-en-Y gastric bypass. Frontiers in Endocrinology, 9,* 530.

Li, Y., & Zhang, T. (2025). *Advances in perioperative nutritional management in metabolic and bariatric surgery*. Diabetes, Metabolic Syndrome and Obesity, 18, 2191–2202. https://doi.org/10.2147/DMSO.S518912

Lupoli, R., Lembo, E., Saldalamacchia, G., Avola, C., Angrisani, L., & Capaldo, B. (2017). Bariatric surgery and long-term nutritional issues. World Journal of Diabetes, 8(11), 464–474.

Maciel, G. A., Maciel, D. P. A., Vieira, I. C. A., Silva, T. S., & Soares, P. D. P. S. (2024). *The importance of the multidisciplinary team in complex surgeries. International Seven Journal of Multidisciplinary, 3*(1), 23.

Mahawar, K., Clare, K., O'Kane, M., Graham, Y., Callejas-Diaz, L., & Carr, W. (2019). *Patient perspectives on adherence with micronutrient supplementation after bariatric surgery. Obesity Surgery, 29*(5), 1551–1556.

Maqueda-Martínez, M. A., Ferrer-Márquez, M., García-Redondo, M., Rubio-Gil, F., Reina-Duarte, Á., Granero-Molina, J., Correa-Casado, M., & Chica-Pérez, A. (2024). *Effectiveness of a nurse-led telecare programme in the postoperative follow-up of bariatric surgery patients. Healthcare, 12*(23), 2448.

Marin, R. C., Radu, A., Negru, P. A., Radu, A., & Bodog, T. M. (2024). *Integrated insights into metabolic and bariatric surgery: Improving life quality and reducing mortality in obesity. Medicina, 61*(10), 1014.

Marshall, S., Mackay, H., Matthews, C., Maimone, I. R., & Isenring, E. (2020). *Does intensive multidisciplinary intervention for adults who elect bariatric surgery improve postoperative weight loss, comorbidities, and quality of life? A systematic review and meta-analysis. Obesity Reviews, 21*(6), e13012.

Martínez-Ortega, A., Olveira, G., Pereira-Cunill, J. L., Arraiza-Irigoyen, C., García-Almeida, J. M., & Vílches-López, F. J. (2020). *Evidence-based recommendations for the pre- and postoperative management of bariatric patients. Nutrients, 12,* 2002.

Mechanick, J., Youdim, A., Jones, D. B., Garvey, W., & Hurley, D. (2013). *Clinical practice guidelines for the perioperative nutritional, metabolic, and nonsurgical support of the bariatric surgery patient. Endocrine Practice, 19*(2), 337–372.

Meira, I., Menino, J., Ferreira, P., Leite, A. R., Gonçalves, J., Ferreira, H., Ribeiro, S., Moreno, T., Silva, D., Pedro, J., Varela, A., Souto, S. B., Freitas, P., Lima da Costa, E., Queirós, J., & Group, C. (2024). *Diabetes remission after bariatric surgery: A 10-year follow-up study. Obesity Surgery, 35*(2), 161–169.

Mendes, C., Carvalho, M., Oliveira, L., Rodrigues, L. M., & Gregório, J. (2023). *Nurse-led intervention for the management of bariatric surgery patients: A systematic review. Obesity Reviews, 24*(1), e13614.

Mohammed, N., & Shahin, M. (2025). *Pre- and postoperative care for bariatric surgery patients: The impact of a designed reference guide on nurses' awareness and patient satisfaction. Healthcare, 13*(9), 1023.

Moizé, V., Laferrère, B., & Shapses, S. (2024). Nutritional challenges and treatment after bariatric surgery. Annual Review of Nutrition, 44.

Montastier, E., Chalret du Rieu, M., Tuyeras, G., & Ritz, P. (2018). *Long-term nutritional follow-up post bariatric surgery. Current Opinion in Clinical Nutrition and Metabolic Care, 21*(5), 388–393.

Morales, C., Alexandre, J. G., Prim, S., & Amante, L. (2014). *Perioperative communication from the perspective of patients undergoing bariatric surgery. Texto & Contexto Enfermagem, 23*(2), 347–355.

Mulla, C. M., Middelbeek, R. J., & Patti, M. E. (2018). *Mechanisms of weight loss and improved metabolism following bariatric surgery. Annals of the New York Academy of Sciences, 1411*, 53–64.

Nett, P., Borbély, Y., & Kröll, D. (2016). *Micronutrient supplementation after biliopancreatic diversion with duodenal switch in the long term. Obesity Surgery, 26,* 2469–2474.

Nguyen, K., & Korner, J. (2014). *The sum of many parts: Potential mechanisms for improvement in glucose homeostasis after bariatric surgery. Current Diabetes Reports, 14*(5), 481.

Nuzzo, A., Czernichow, S., Hertig, A., Ledoux, S., Poghosyan, T., Quilliot, D., Le Gall, M., Bado, A., & Joly, F. (2021). Prevention and treatment of nutritional complications after bariatric surgery. The Lancet Gastroenterology & Hepatology, 6(3), 238–251.

O'Brien, R., Johnson, E. S., Haneuse, S., Coleman, K., O'Connor, P., Fisher, D. P., Sidney, S., Bogart, A., Theis, M., Anau, J., Schroeder, E., & Arterburn, D. (2018). *Microvascular outcomes in patients with diabetes after bariatric surgery versus usual care. Annals of Internal Medicine, 169*(5), 300–310.

O’Kane, M., Parretti, H., Pinkney, J., Welbourn, R., Hughes, C., Mok, J., Walker, N., Thomas, D., Devin, J., Coulman, K., Pinnock, G. L., Batterham, R., Mahawar, K., Sharma, M., Blakemore, A., McMillan, I., & Barth, J. (2020). *British Obesity and Metabolic Surgery Society Guidelines on perioperative and postoperative biochemical monitoring and micronutrient replacement-2020 update. Obesity Reviews, 21.*

Ochner, C., Gibson, C., Shanik, M., Goel, V., & Geliebter, A. (2011). *Changes in neurohormonal gut peptides following bariatric surgery. International Journal of Obesity, 35*(2), 153–166.

Osland, E., Powlesland, H., Guthrie, T., Lewis, C.-A., & Memon, M. (2020). *Micronutrient management following bariatric surgery: The role of the dietitian in the postoperative period. Annals of Translational Medicine, 8,* 119.

Pappachan, J. M., & Viswanath, A. (2015). *Metabolic surgery: A paradigm shift in type 2 diabetes management. World Journal of Diabetes, 6*(8), 990–998.

Pereira, S., Guimarães, M., Almeida, R., Pereira, A. M., Lobato, C., Hartmann, B., Hilsted, L., Holst, J., Nora, M., & Monteiro, M. (2018). *Biliopancreatic diversion with duodenal switch (BPD-DS) and single-anastomosis duodeno-ileal bypass with sleeve gastrectomy (SADI-S) result in distinct post-prandial hormone profiles. International Journal of Obesity.*

Peterli, R., Steinert, R., Woelnerhanssen, B., Peters, T., Christoffel-Courtin, C., Gass, M., Kern, B., von Fluee, M., & Beglinger, C. (2012). *Metabolic and hormonal changes after laparoscopic Roux-en-Y gastric bypass and sleeve gastrectomy: A randomized, prospective trial. Obesity Surgery, 22*(5), 740–748.

Pinnock, G. L. (2021). *Nutritional management after bariatric surgery.* In *Obesity, Bariatric and Metabolic Surgery*. Springer.

Pop, L., Mari, A., Zhao, T. J., Mitchell, L., Burgess, S., Li, X., Adams-Huet, B., & Lingvay, I. (2018). *Roux-en-Y gastric bypass compared with equivalent diet restriction: Mechanistic insights into diabetes remission. Diabetes, 67*(10), 1710–1721.

Pucci, A., & Batterham, R. (2018). *Mechanisms underlying the weight loss effects of RYGB and SG: Similar, yet different. Journal of Endocrinological Investigation, 42*(2), 117–128.

Puplampu, T., & Simpson, S. (2016). *Nursing care of the bariatric surgery patient.* In *Bariatric Surgery Handbook* (pp. 147–154). Springer.

Purnell, J., Dewey, E., Laferrère, B., Selzer, F., Flum, D., Mitchell, J. E., Pomp, A., Pories, W., Inge, T., Courcoulas, A., & Wolfe, B. (2020). *Diabetes remission status during seven-year follow-up of the longitudinal assessment of bariatric surgery study. The Journal of Clinical Endocrinology & Metabolism, 105*(3), 850–862.

Rajabi, M., Rezaei, M., Abdollahi, A., Gholi, Z., Mokhber, S., Mohammadi-Farsani, G., Abdoli, D., Mousavi, S. D., Amini, H., & Ghandchi, M. (2024). *Long-term systemic effects of metabolic bariatric surgery: A multidisciplinary perspective. Heliyon, 10,* e34339.

Ramasamy, I. (2024). *Physiological appetite regulation and bariatric surgery. Journal of Clinical Medicine, 13*(5), 1347.

Ratcliffe, D., & Banting, E. (2023). *What is the role of psychology in bariatric surgery? A survey of the differing views of psychologists, the multidisciplinary team, and patients in the UK. Clinical Obesity, 13*(3), e12612.

Reytor-González, C., Frías-Toral, E., Nuñez-Vásquez, C., Parise-Vasco, J. M., Zambrano-Villacres, R., Simancas-Racines, D., & Schiavo, L. (2025). *Preventing and managing pre- and* *postoperative micronutrient deficiencies: A vital component of long-term success in bariatric surgery. Nutrients, 17.*

Sandoval, D., & Patti, M. (2022). *Glucose metabolism after bariatric surgery: Implications for T2DM remission and hypoglycaemia. Nature Reviews Endocrinology, 19,* 164–176.

Scarpellini, E., Arts, J., Karamanolis, G., Laurenius, A., Siquini, W., Suzuki, H., Ukleja, A., Vanuytsel, T., & Tack, J. (2020). *International consensus on the diagnosis and management of dumping syndrome. Nature Reviews Endocrinology, 16*(7), 448–466.

Sherf Dagan, S., Goldenshluger, A., Globus, I., Schweiger, C., Kessler, Y., Kowen Sandbank, G., Ben-Porat, T., & Sinai, T. (2017). *Nutritional recommendations for adult bariatric surgery patients: Clinical practice. Advances in Nutrition, 8*(2), 382–394.

Sherf-Dagan, S., Biton, R., Ribeiro, R., Kessler, Y., Raziel, A., Rossoni, C., Santos, Z., Bragança, R., Goitein, D., Viveiros, O., Graham, Y., Mahawar, K., Sakran, N., & Ben-Porat, T. (2023). *Nutritional and lifestyle behaviors reported following one anastomosis gastric bypass based on a multicenter study. Nutrients, 15*(6), 1515.

Sinclair, P., Docherty, N., & le Roux, C. L. (2018). *Metabolic effects of bariatric surgery. Clinical Chemistry, 64*(1), 72–81.

Singhal, R., Kitchen, M., Bridgwater, S., & Super, P. (2010). *Dietetic-led management of patients undergoing laparoscopic gastric banding: Early results. Surgical Endoscopy, 24*(6), 1268–1273.

Soliman, A., Mattar, A., et al. (2025). *Optimizing nutrition interventions: Recommendations for pre- and post-bariatric adult patients to achieve long-term success. The Egyptian Journal of Internal Medicine, 37*(2), 112–128.

Spetz, K., Svedjeholm, S., Roos, S., Grehn, S., Olbers, T., & Andersson, E. (2022). *Adherence to vitamin and mineral supplementation after bariatric surgery: A two-year cohort study. Obesity Research & Clinical Practice, 16*(5), 431–440.

Steenackers, N., Van der Schueren, B., Augustijns, P., Vanuytsel, T., & Matthys, C. (2022). Development and complications of nutritional deficiencies after bariatric surgery. Nutrition Research Reviews, 35(1), 1–36.

Svane, M., Bojsen-Møller, K. N., Martinussen, C., Dirksen, C., Madsen, J., Reitelseder, S., Holm, L., Kristiansen, V., van Hall, G., Holst, J. J., & Madsbad, S. (2019). *Postprandial nutrient handling and gastrointestinal hormone secretion after Roux-en-Y gastric bypass vs sleeve gastrectomy. Gastroenterology, 156*(6), 1627–1641.

Tan, M. M. C., Jin, X., Taylor, C., Low, A., Le Page, P., Martin, D., Li, A., Joseph, D. J., & Kormas, N. (2022). *Long-term trajectories in weight and health outcomes following multidisciplinary publicly funded bariatric surgery in patients with clinically severe obesity. Journal of Clinical Medicine, 11*(15), 4466.

Taselaar, M., Boes, S., van den Berg, J., & Boer, H. (2023). *PROMISE: Effect of protein supplementation on fat-free mass preservation after bariatric surgery. Trials, 24.*

Tsenteradze, T., Fayyaz, F., Ekhator, C., Ahmed, I., Lima, S. R. O. S., Daher, O. A., Bakht, D., et al. (2023). Navigating bariatric surgery: Understanding and managing short-term and long-term complications. Cureus, 15, e48580.

Vennapusa, A., Panchangam, R., Kesara, C., & Chivukula, T. (2020). *Factors predicting weight loss after sleeve gastrectomy with loop duodenojejunal bypass surgery for obesity. Journal of Obesity & Metabolic Syndrome, 29*(3), 208–214.

Wang, L., Zhang, Z., Wang, Z., & Jiang, T. (2023). *First study on the outcomes of biliopancreatic diversion with duodenal switch in Chinese patients with obesity. Frontiers in Surgery, 9.*

Widjaja, J., Chu, Y., Yang, J., Wang, J., & Gu, Y. (2022). *Can we abandon foregut exclusion for an ideal and safe metabolic surgery? Frontiers in Endocrinology, 13,* 1014901.

Wilbrink, J. A., van Avesaat, M., Nienhuijs, S., Stronkhorst, A., & Masclee, A. (2024). *Changes in gastrointestinal motility and gut hormone secretion after Roux-en-Y gastric bypass and sleeve gastrectomy for individuals with severe obesity. Clinical Obesity, e12721.*

Xu, G., & Song, M. (2020). *Recent advances in the mechanisms underlying the beneficial effects of bariatric and metabolic surgery. Surgery for Obesity and Related Diseases, 16*(8), 1205–1214.

Uçak, Ş., Gökmen, V., & Demir Gökmen, B. (2025). *Yatan hastalarda anksiyete, depresyon ve sıkıntı-stres arasındaki ilişkinin incelenmesi: Ağrı ili örneği*. Current Research in Health Sciences. https://doi.org/10.62425/crihs.1730232.

Yildirim, M. S., Firat, M. Ö., Atay, M. E., & Others. (2025). *Effects of demographic characteristics on burnout, psychological resilience, and family functioning in parents of children with disabilities*. BMC Psychology, 13, 872. https://doi.org/10.1186/s40359-025-03238-2.

Yildiz, M., Yildirim, M. S., Sarpdagi, Y., Solak, T. K., Kaplan, E., & Atay, M. E. (2023). *Investigation of the relationship between tiger-based nursing informatics competencies and digital literacy levels in nurses: Analysis with machine learning approach*. Fenerbahçe Üniversitesi Sağlık Bilimleri Dergisi. https://dx.doi.org/10.56061/fbujohs.1252026

Zambrano, A., Paz-Cruz, E., Ruiz-Pozo, V. A., Cadena-Ullauri, S., Tamayo-Trujillo, R., Guevara-Ramírez, P., et al. (2024). *Microbiota dynamics preceding bariatric surgery as obesity treatment: A comprehensive review. Frontiers in Nutrition, 11*.

Zarshenas, N., Tapsell, L., Batterham, M., Neale, E., & Talbot, M. (2022). *Investigating the prevalence of nutritional abnormalities in patients prior to and following bariatric surgery. Nutrition & Dietetics, 79*(5), 590–601.

Zhang, L., Yu, S., Wei, X., Wu, L., & Gao, L. (2020). *Application of medical nursing integrated nursing mode in patients undergoing laparoscopic Roux-en-Y gastric bypass bariatric surgery. American Journal of Nursing Science, 9*(4), 220–226.

Ziegler, O., Sirveaux, M., Brunaud, L., Reibel, N., & Quilliot, D. (2009). *Medical follow-up after bariatric surgery: Nutritional and drug issues-General recommendations for the prevention and treatment of nutritional deficiencies. Diabetes & Metabolism, 35*(6 Pt 2), 544–557.

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