

## ORIGINAL RESEARCH

# The Impact of Bariatric Surgery on Men's Reproductive Health: Hormonal, Semen, and Fertility Outcomes

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Received: November 2024; Accepted: December 2024; Published online: January 2025

**Abstract:** **Background:** Obesity has a growing global prevalence and is closely associated with impaired male reproductive health, including hormonal imbalances and subfertility. Bariatric surgery is the most effective intervention for sustained weight loss in morbidly obese individuals, but its impact on reproductive outcomes in men remains unclear. **Methods:** We performed a narrative review of studies published between 2005 and 2025 that examined the effects of bariatric surgery on hormonal profiles, semen quality, and fertility outcomes in men. Literature was identified through PubMed, with additional targeted searches in Embase and Cochrane. Studies were included if they evaluated male reproductive parameters before and after bariatric surgery. **Results:** Evidence consistently demonstrates significant increases in testosterone levels post-surgery. However, semen quality outcomes are variable, with some studies showing improvements in sperm motility and morphology, while others report reductions in semen volume and concentration, particularly after malabsorptive procedures. Data on fertility outcomes, including in vitro fertilization (IVF) success rates, are limited and based on small sample sizes. Nutritional deficiencies are a frequent complication and may contribute to negative reproductive outcomes. **Conclusion:** Bariatric surgery restores hormonal balance in obese men but has heterogeneous effects on semen parameters and fertility. Long-term, large-scale studies are needed to clarify reproductive risks and optimize perioperative fertility care.

**Keywords:** Bariatric Surgery, Obesity, Male Infertility, Semen, Fertility, Micronutrient Deficiencies

Cite this article as: Nicknama R, Karimi K, Abedi A, Samenezhad S. The Impact of Bariatric Surgery on Men's Reproductive Health: Hormonal, Semen, and Fertility Outcomes. Archives of Men's Health. 2025; 9(1): e1.

## 1. Introduction

Obesity has tripled in prevalence worldwide over the past three decades, affecting over 650 million adults [1]. Its detrimental effects extend beyond cardio metabolic health, contributing significantly to male infertility through hormonal imbalances, testicular dysfunction, and epigenetic alterations [2–4]. Epidemiological studies indicate that obese men are more likely to experience reduced sperm concentration, erectile dysfunction, and hypogonadism [5]. Lifestyle interventions are first-line treatments; however, bariatric surgery offers the most effective and sustained weight loss for morbidly obese individuals [6–7]. While hormonal recovery post-surgery is well-documented, evidence on semen qual-

ity and fertility outcomes is conflicting.

This review aims to synthesize available evidence on the effects of bariatric surgery on male reproductive health, including hormonal changes, semen parameters, and fertility outcomes, while highlighting gaps for future research.

## 2. Methods

We performed a narrative review of English-language articles published between January 2005 and March 2025. PubMed was the primary database searched, supplemented by targeted searches in Embase and Cochrane Library to ensure comprehensive coverage. Keywords and MeSH terms included: "Bariatric Surgery," "Male Infertility," "Semen," "Fertility," and "Micronutrient Deficiencies."

Inclusion criteria: (1) studies involving adult men undergoing bariatric surgery; (2) pre- and post-operative hormonal or semen analyses; (3) reports on fertility outcomes (natural conception or assisted reproduction). The exclusion criteria

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were studies that were not original or lacked primary data, animal studies, and those that did not report reproductive outcome measures.

The search identified 112 articles, of which 28 met the inclusion criteria. Both observational and interventional studies were included to provide a broad overview of outcomes. Limitations include language restrictions and reliance on studies indexed in major databases.

### **2.1. Evidence**

Bariatric surgery procedures, including Roux-en-Y gastric bypass (RYGB), sleeve gastrectomy (SG), and adjustable gastric banding (AGB), achieve substantial and durable weight loss through restrictive and/or malabsorptive mechanisms. Beyond their metabolic benefits, these procedures exert significant physiological effects on the male reproductive axis. Although weight loss is generally linked to hormonal and metabolic improvements, reproductive outcomes after bariatric surgery remain variable. The following section summarizes current evidence on hormonal recovery, semen quality, fertility outcomes, and nutritional factors following bariatric procedures.

### **2.2. Hormonal Changes**

Across all bariatric techniques, studies consistently report significant elevations in total and free testosterone levels, accompanied by reductions in estradiol concentrations and improvements in gonadotropin secretion. These findings indicate a reversal of obesity-related hypogonadism. The mechanisms underlying this hormonal normalization include decreased adipose-derived aromatase activity, which limits peripheral conversion of testosterone to estradiol, and restoration of the hypothalamic–pituitary–gonadal (HPG) axis function through improved insulin sensitivity and decreased systemic inflammation [8–10].

### **2.3. Semen Quality**

In contrast to hormonal outcomes, the effects of bariatric surgery on semen parameters remain inconsistent. Some prospective cohorts have documented improvements in sperm motility, morphology, and total motile count within one year after SG or RYGB [11]. These improvements are often attributed to reduced oxidative stress, normalization of scrotal thermoregulation, and enhanced testicular endocrine support following weight loss. Conversely, several other investigations report no improvement or even deterioration in semen volume, sperm concentration, and total sperm count after surgery, particularly in cases involving malabsorptive procedures. Such declines have been linked to postoperative micronutrient deficiencies—especially in zinc, selenium, folate, and vitamin B12 as well as to increased oxidative stress during rapid fat mobilization [12–14].

### **2.4. Fertility Outcomes**

Evidence regarding fertility outcomes after bariatric surgery remains limited but promising. Several small studies and case reports describe spontaneous conceptions in previously infertile men following substantial postoperative weight loss. Improvements have also been noted in assisted reproductive settings, where postoperative patients, particularly those undergoing SG, demonstrated higher in-vitro fertilization (IVF) fertilization rates and better embryo quality [15].

### **2.5. Nutritional Complications**

Postoperative nutritional deficiencies are among the most well-documented sequelae of bariatric surgery. Deficiencies in iron, folate, vitamins A, D, and B12, and essential trace elements such as zinc and selenium occur frequently and can directly compromise spermatogenesis, sperm motility, and DNA stability [16]. A summary of key findings and clinical implications across hormonal, seminal, and nutritional domains is presented in Table 1.

Additionally, rapid postoperative fat mobilization increases circulating free fatty acids and reactive oxygen species, creating a transient state of oxidative stress. Such oxidative imbalance may damage sperm membranes and nuclear DNA, leading to increased sperm DNA fragmentation. Because sperm DNA integrity is now recognized as a vital determinant of male fertility, routine postoperative assessment of the DNA fragmentation index (DFI) could provide valuable prognostic information regarding reproductive outcomes. Integrating DFI evaluation into postoperative care may allow clinicians to identify at-risk patients early and implement antioxidant or nutritional interventions to preserve fertility potential [17,18].

Collectively, current evidence indicates that bariatric surgery consistently restores hormonal balance in obese men but yields variable effects on semen quality and fertility outcomes. The type of procedure, postoperative nutritional management, oxidative stress levels, and duration of follow-up are key factors influencing reproductive recovery. Comprehensive perioperative care that integrates endocrinological, nutritional, and andrological expertise is essential for optimizing reproductive outcomes. Future research should prioritize standardized reporting of semen quality and DNA integrity parameters, extended follow-up periods, and the creation of fertility-focused management protocols tailored to male bariatric patients.

## **3. Conclusion**

Bariatric surgery is a powerful intervention for obesity-related hypogonadism in men, with robust evidence supporting hormonal normalization. However, its impact on semen quality and fertility is variable and influenced by sur-

gical type, follow-up duration, and nutritional status. Comprehensive pre- and postoperative reproductive counseling, alongside close nutritional monitoring, is crucial to optimizing reproductive outcomes. Future large-scale, multi-center trials are necessary to clarify these effects.

## 4. Appendix

### 4.1. Acknowledgment

The authors have no acknowledgments to declare.

### 4.2. Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

### 4.3. Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

### 4.4. Author's contributions

All authors were involved in the conception, drafting, and revision of the manuscript. All authors read and approved the final version of the manuscript.

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**Table 1:** Summary of Evidence on Male Reproductive Outcomes After Bariatric Surgery

Parameter	Post-Surgical Findings	Key Mechanisms	Clinical Notes
Hormonal profile	↑ Testosterone, ↓ Estradiol, normalized LH/FSH	Reduced adipose aromatase activity; restored HPG-axis	Reversal of hypogonadism and improved sexual function
Semen quality	Mixed results Some motility/morphology, others ↓ count/volume	Oxidative stress fluctuations; micronutrient deficits (Zn, Se, B12, folate)	Monitor semen over 12 months; ensure nutritional repletion.
Fertility outcomes	Limited evidence of improved natural conception and IVF success	Hormonal recovery, reduced metabolic inflammation	Larger, long-term studies are needed for confirmation
Nutritional status	Frequent deficiencies in Fe, folate, vitamins A/D/B12	Malabsorption, reduced intake	Routine supplementation and laboratory monitoring are essential
Oxidative stress / DNA integrity	Transient rise in oxidative markers; possible ↑ DFI	Rapid fat mobilization, ROS generation	Antioxidant support may help preserve sperm DNA quality
Procedure influence	SG = steadier recovery; RYGB = greater nutritional risk	The degree of restriction/malabsorption varies	Choose a procedure considering reproductive goals
Overall effect	Consistent hormonal benefit; variable semen and fertility outcomes	Multifactorial—hormonal, metabolic, oxidative	Multidisciplinary peri-/post-operative care is recommended