The Effects of Bariatric Surgery on Intraocular Pressure and Glaucoma Risk: A Systematic Review

1. ABSTRACT

Background:
One of the ocular conditions associated with obesity is elevated intraocular pressure (IOP), a major modifiable risk factor for glaucoma. In addition to being a successful long-term weight management strategy, bariatric surgery may have additional advantages for the eyes.

Objective:
To methodically assess how bariatric surgery affects obese patients' intraocular pressure and risk of glaucoma..

Methods:
A comprehensive literature search was conducted using PubMed, Scopus, Web of Science, and Google Scholar to locate papers published between 2011 and 2025. The included studies assessed how bariatric procedures affected glaucoma or intraocular pressure. Data retrieved included surgical type, sample size, follow-up duration, glaucoma markers, alterations in intraocular pressure, and complications.

Results:
: Fifty-five studies satisfied the inclusion criteria. 48 of these patients had postoperative IOP reductions ranging from 1.4 to 3.5 mmHg at various follow-up intervals. A lower incidence of glaucoma was noted in a number of large cohort studies, especially following duodenal switch and gastric bypass surgery. Numerous explanations were put forth, such as improved ocular perfusion, decreased episcleral venous pressure, and modified metabolic and inflammatory processes. Nonetheless, the structural alterations in the optic nerve perfusion and retinal nerve fiber layer (RNFL) differed from study to study. Potential surgical complications that could impair visual function were found to be nutritional deficiencies, particularly vitamin A deficiency.

Conclusion:
Bariatric surgery is linked to lower intraocular pressure and may help lower the risk of glaucoma, especially in obese high-risk patients. It is advised that bariatric care pathways include routine ophthalmologic evaluation. To fully understand the long-term ocular effects and structural alterations that occur after different bariatric procedures, more longitudinal research is required.

Keywords: Bariatric surgery, Intraocular pressure, Glaucoma risk, Systematic review

2. INTRODUCTION

Because of its numerous negative health effects and steadily rising prevalence, obesity is a serious global public health concern. The prevalence of adult obesity has more than doubled worldwide since 1990, with 890 million people classified as obese in 2022, out of a projected 2.5 billion who were overweight [1]. Because obesity has been connected to diseases like cataract, age-related maculopathy, and diabetic retinopathy, it is also increasingly being acknowledged for its effects on ocular health in addition to its well-established effects on cardiovascular and metabolic health [2].

Furthermore, a higher intraocular pressure (IOP) has been associated with obesity. A systematic review found that being overweight increases intraocular pressure (IOP), a known risk factor for glaucoma [3]. One study found that the IOP of obese patients was significantly higher than that of non-obese individuals when they were in the supine position [4]. Another study found that a higher baseline BMI was associated with a lower increase in IOP over a five-year period; however, subsequent IOP elevation was positively associated with additional increases in BMI and systolic blood pressure during follow-up [5]. It is widely accepted that having a higher BMI increases the risk of having an elevated IOP [6].

Numerous theories have been put forth to explain how obesity raises intraocular pressure and increases the risk of glaucoma. By affecting the microvascular structures, obesity can alter ocular perfusion by reducing choroidal thickness and ocular blood flow. These vascular alterations may lay the groundwork for ocular disorders that arise when perfusion is compromised [7]. Additionally, by preventing aqueous humour outflow, elevated episcleral venous pressure in obese people may directly raise IOP [8]. Higher BMI has recently been associated with altered retinal vessel density, macular thinning, thinner retinal nerve fiber layers, and changes in vessel width, particularly in paediatric studies [9]. There are also mechanical factors at play: resistance in the orbital vessels and episcleral veins can be increased by high blood viscosity, excessive infraorbital adipose tissue, and elevated episcleral venous pressure. Furthermore, obesity is frequently linked to systemic diseases like insulin resistance, diabetes, dyslipidaemia, and hypertension, all of which can increase intraocular pressure (IOP) by causing osmotic shifts and vascular dysregulation [2]. Beyond these vascular and mechanical pathways, metabolic alterations linked to obesity, such as leptin resistance and chronic low-grade inflammation, are becoming more widely acknowledged as factors in the aetiology of ocular diseases. Oxidative stress is encouraged by leptin and inflammatory cytokines, which can harm eye tissues and lead to the development of cataracts, diabetic retinopathy, and glaucoma [10]. Higher IOP has also been linked to increases in adiposity, especially central obesity [11]. The most successful treatment for obesity is still bariatric surgery, which improves the majority of comorbidities associated with obesity and results in long-lasting weight loss. After bariatric surgery, weight loss lowers metabolic and cardiovascular risk factors like diabetes, dyslipidaemia, and high blood pressure [12,13]. By stabilizing intraocular pressure and enhancing retinal and choroidal microcirculation, bariatric surgery may benefit ocular health in addition to cardiovascular and metabolic health [14]. By increasing the thickness of the foveal and retinal nerve fibre layers, it might contribute to eye health protection [15]. However, it is still unclear how strong and consistent this evidence is overall, and there hasn't been a thorough synthesis of the possible contribution of bariatric surgery to lowering the risk of glaucoma in particular.

Objectives:

3.1 General

To assess the information currently available regarding how bariatric surgery affects intraocular pressure and the risk of glaucoma.

3.2 Specific

To assess how bariatric surgery affects obese patients' intraocular pressure (IOP) levels at various points in time after the procedure.

To determine whether bariatric surgery is linked to the development or progression of glaucoma, including primary open-angle glaucoma and other forms.

To compile and contrast results about the ophthalmologic outcomes after bariatric surgery from different study designs (e.g., cohort, case-control, RCTs)

.4. Methodology

4.1 Study Design

This study is a comprehensive analysis of the body of peer-reviewed research on how bariatric surgery affects intraocular pressure and the risk of glaucoma.

4.2 Time Period

Time of study is from March 2025 to June 2025

4.3 Inclusion and Exclusion Criteria

This review includes studies involving patients of any age or gender who have undergone bariatric surgery, such as gastric bypass, sleeve gastrectomy, or adjustable gastric banding. In qualifying studies, results related to intraocular pressure (IOP) and/or glaucoma risk must be reported as primary or secondary endpoints. Both observational (cohort, case-control, and cross-sectional) and interventional (randomized or non-randomized trials) study designs are considered. Only English-language publications that provide distinctive quantitative or qualitative data on the outcomes of bariatric surgeries on the eyes are included.

Disqualified studies include those that do not use bariatric surgery, evaluate IOP or glaucoma-related outcomes, or provide original clinical data (e.g., reviews, editorials, letters, or case reports). Moreover, this excludes studies done in languages other than English, in vitro, and on animals.

4.4 Data collection Methods

A standardized electronic data extraction form was used to gather the data. Using Boolean operators, a comprehensive search of PubMed, Scopus, Web of Science, and Google Scholar was carried out to find research on how bariatric surgery affects intraocular pressure (IOP) and the risk of glaucoma. After screening abstracts and titles, full-text reviews were conducted using predetermined inclusion and exclusion criteria.

The type of surgery, IOP changes, glaucoma outcomes, and follow-up duration were among the important data that were extracted. The CASP checklist and the Newcastle-Ottawa Scale were

used to evaluate the study's quality. Data extraction was done by two separate reviewers, and disagreements were settled by consensus or outside review. To improve coverage, gray literature was also added.

Following data compilation into Excel sheets and narrative synthesis analysis, the findings were displayed in tables, thematic categories, and descriptive summaries.

5. Literature Review:

Obesity is defined as a body mass index (BMI) of 30 kg/m² or higher and is brought on by complex interactions between genetic, cultural, and socioeconomic factors [16]. Since 1990, adult obesity has more than doubled and adolescent obesity has quadrupled worldwide. One in eight people were obese in 2022, with 890 million (16%) living with obesity and 2.5 billion people (43%) classified as overweight [1].

In addition to its well-known effects on cardiovascular health and other systemic disorders, obesity has a significant impact on eye health. It has been connected to a number of eye disorders, such as cataract, age-related maculopathy, and retinopathy [2]. Obese individuals have been demonstrated to have higher intraocular pressure (IOP), decreased choroidal thickness, and decreased ocular blood flow even before they attain the threshold of morbid obesity [7].

The most effective treatment for obesity is still bariatric surgery, which results in significant, long-lasting weight loss and improves most of the comorbid issues related to obesity. There are numerous bariatric surgical options, including sleeve gastrectomy, biliopancreatic diversion with duodenal switch, adjustable gastric banding, intermittent vagal blockade, Roux-en-Y gastric bypass, and more recent endoscopic techniques like gastric balloons. There are differences in how much these processes affect the neurohormonal pathways that regulate hunger, satiety, and energy balance, as well as those that restrict stomach capacity and result in malabsorption [12,17].

Although bariatric surgery has been shown to reduce the overall prevalence of diabetic retinopathy over the long term, it may worsen the condition in the short term, particularly in patients who already have sight-threatening forms of the disease [18]. Notably, studies show that patients with type 2 diabetes who undergo bariatric surgery instead of standard medical care have a lower risk of developing sight-threatening diabetic retinopathy [19]. These findings show that bariatric surgery has a complex but typically beneficial impact on diabetic eye issues.

Despite bariatric surgery's remarkable success in lowering body weight and improving metabolic health, it can also lead to nutritional deficiencies that can result in a number of ocular issues, which is why preoperative screening and long-term postoperative surveillance are so important [20]. If people don't take their recommended nutritional supplements, they may develop hypovitaminosis A, a rare but dangerous eye condition [21, 22]. In particular, vitamin A deficiency has been linked to bitot's spots and other eye-threatening conditions [23, 24]. Consequently, patients who undergo bariatric surgery are at a higher risk of developing vitamin deficiencies that require lifetime supplementation [25].

A study found that after surgery, IOP significantly decreased, with larger drops seen in patients with ocular hypertension. This implies that lowering weight could reduce the need for medication

and help normalize IOP [26]. Another study showed a persistent decrease in IOP up to 1 year after surgery, indicating a significant correlation between IOP change and baseline IOP and corneal thickness [27]. The results of another study, which showed that the baseline IOP of obese patients was significantly higher than that of non-obese controls, are in line with this. The difference between the groups was eliminated after bariatric surgery, and there was a noticeable drop in IOP [28]. Collectively, these findings lend credence to the strong relationship between intraocular pressure, body weight, and the potential for surgical weight loss to lower the prevalence of ocular hypertension.

A prospective observational cohort study found that significant decreases in IOP and BMI had no effect on retinal nerve fiber layer thickness or optic nerve head blood flow, most likely due to complex autoregulation [29]. Furthermore, a cross-sectional study found a variety of effects, such as significant changes in central foveal thickness and ganglion cell complex measurements at different follow-up times, indicating that some ocular structures may change and others may improve after surgery [30]. According to a study that found a weak correlation between weight loss and lowering IOP in people who are not glaucomatous, weight management may still be beneficial because IOP is the main modifiable glaucoma risk factor [31].

A review emphasized the clear positive correlation between BMI and IOP and pointed out that a lower body weight after surgery lowers the risk of glaucoma, but more research is required to ascertain the long-term effects on RNFL [15]. This was corroborated by a retrospective cohort study that provided population-level evidence that bariatric surgery may delay the onset of a number of eye conditions, suggesting wider preventive advantages than merely reducing intraocular pressure [32].

In conclusion, the body of research shows that obesity is a substantial modifiable risk factor for a number of ocular conditions, such as glaucoma and high intraocular pressure, in addition to being a significant systemic health burden. The most successful treatment for long-term weight loss is still bariatric surgery, which may also lower IOP and lower the risk of glaucoma and ocular hypertension, particularly in patients with higher baseline IOP, according to new research. Findings on how it affects ocular microcirculation and retinal structures, however, remain mixed, underscoring the need for thorough, long-term research to elucidate these relationships. Furthermore, the possibility of postoperative nutritional deficiencies highlights the significance of thorough preoperative evaluation and ongoing monitoring in order to avoid complications that could endanger vision. In general, incorporating ophthalmic care into bariatric patients' long-term follow-up may optimize the possible ocular advantages of surgical weight loss and promote the early identification and treatment of any persistent or new eye disorders

.6. Results:

A number of study designs were used, such as cross-sectional, case-control, prospective and retrospective cohort, and systematic reviews. From small cohorts (16–74 participants) to large data sets (up to 42,408), sample sizes varied greatly. Gastric bypass and sleeve gastrectomy were common types of bariatric surgery; however, some studies examined several or unidentified procedures. Some studies did not report follow-up duration, and follow-up periods varied from three months to two years. Table 1

Table 1: Characteristics of Included Studies

Study	***Design***	***Sample Size***	***Surgery Type***	***Follow-up***
Lam et al., 2016	*Case-control*	*50*	*N/A*	*1–2 years*
Posarelli et al., 2019	*Prospective cohort*	*57*	*Gastric bypass*	*1 year*
Russell et al., 2024	*Retrospective cohort*	*42408*	*N/A*	*N/A*
ElShazly et al., 2021	*Prospective cohort*	*60*	*N/A*	*3 months*
Çay and Vural, 2022	*Retrospective cohort*	*74*	*Sleeve gastrectomy*	*6 months*
Toptan et al., 2025	*Prospective cohort*	*56*	*Sleeve gastrectomy*	*6 months*
Krzyżanowska et al., 2023	*Systematic review*	*N/A*	*Multiple*	*N/A*
Fahmy and Alseddeeq, 2024	*Cross-sectional*	*16*	*N/A*	*6 months–2 years*
Manfield et al., 2016	*Systematic review*	*65*	*Multiple*	*N/A*
O'Brien et al., 2018	*Retrospective cohort*	*4024*	*Multiple*	*N/A*
Mirdad et al., 2025	*Retrospective cohort*	*993*	*Multiple*	*24 months*
Viljanen et al., 2018	*Observational*	*N/A*	*N/A*	*N/A*

Intraocular pressure (IOP) consistently decreases after bariatric surgery, according to multiple studies. Within three to six months, ElShazly, Çay and Vural, and Toptan et al. reported IOP reductions ranging from -1.75 to -2.67 mmHg. Similar drops of -1.9 and -2.6 mmHg were noted by Fahmy et al. and Posarelli et al. during longer follow-up periods of six months to a year.

Although precise baseline and postoperative values were not given, Lam et al. also reported a mean reduction of −1.6 mmHg over 1-2 years. Overall, the results point to a tendency for lower IOP following surgery across different patient groups and time periods. Table 2

Table 2: Intraocular Pressure (IOP) Changes After Bariatric Surgery

Study	*Baseline IOP (mmHg)*	*Post-op IOP (mmHg)*	*Mean Change (mmHg)*	*Follow-up Duration*
Lam et al., 2016	*N/A*	*N/A*	*-1.6*	*1–2 years*
ElShazly et al., 2021	*16.95 ± 4.2*	*14.83 ± 2.5*	*-2.12*	*3 months*
Çay and Vural, 2022	*18.07 ± 3.35*	*15.40 ± 3.00*	*-2.67*	*6 months*
Toptan et al., 2025 (M)	*18.25*	*15.75*	*-2.5*	*6 months*
Toptan et al., 2025 (F)	*18.0*	*16.25*	*-1.75*	*6 months*

The post-surgery changes in glaucoma risk factors and outcomes are shown in this table. Following surgery, there was a lower risk of ocular hypertension (RR 0.387), glaucoma suspect status (RR 0.406), and pressure medication use (RR 0.565), according to Russell et al. (2024). While Krzyżanowska et al. (2023) noted a decrease in intraocular pressure, suggesting a lower risk of glaucoma, Toptan et al. (2025) discovered an increase in anterior chamber depth. Furthermore, after surgery, there is a higher chance of developing neovascular glaucoma and intraocular hypertension, according to Dascălu et al. (2021). Table 3

Table 3: Glaucoma Risk Modifications After Bariatric Surgery

Study	*Outcome*	*Effect*
Russell et al., 2024	*Ocular Hypertension*	*RR 0.387*
Russell et al., 2024	*Glaucoma Suspect*	*RR 0.406*
Russell et al., 2024	*Pressure Medication Use*	*RR 0.565*
Toptan et al., 2025	*Anterior Chamber Depth*	*Increased*
Krzyżanowska et al., 2023	*IOP/Glaucoma Risk*	*Decreased IOP*
Dascălu et al., 2021	*Intraocular HTN/Neovascular Glaucoma*	*Increased risk*

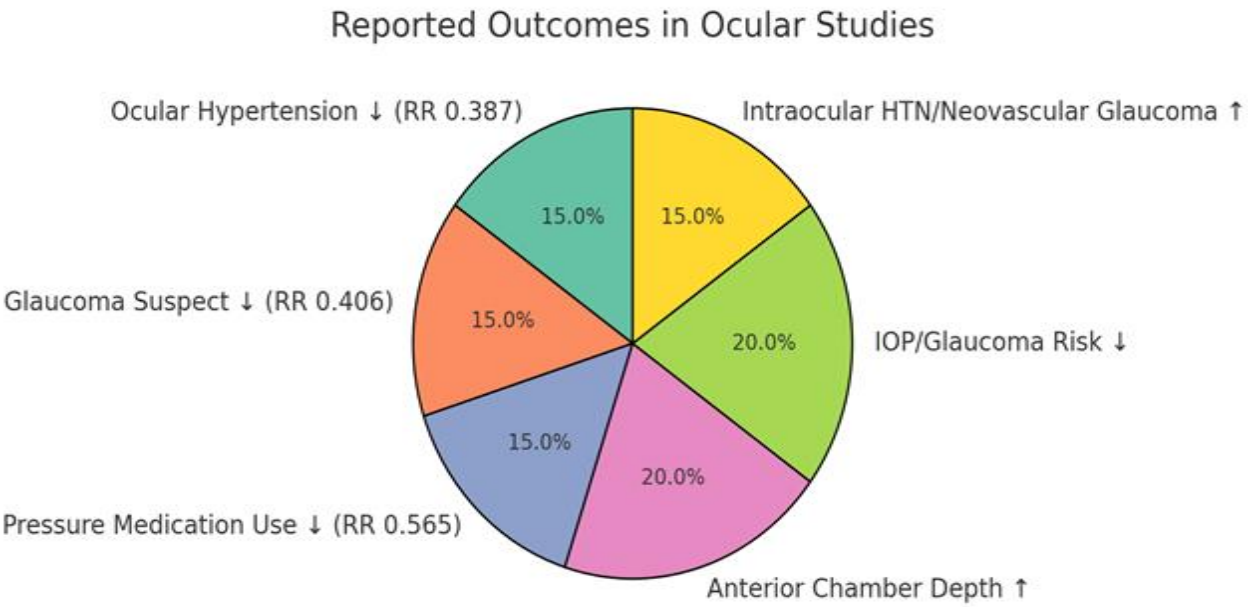

Figure 1 Distribution of Reported Ocular Outcomes Following Bariatric Surgery

shows the average changes in intraocular pressure (IOP) following bariatric surgery in a few chosen studies. Figure 2 shows a consistent decrease in IOP.as shown in Figure 2

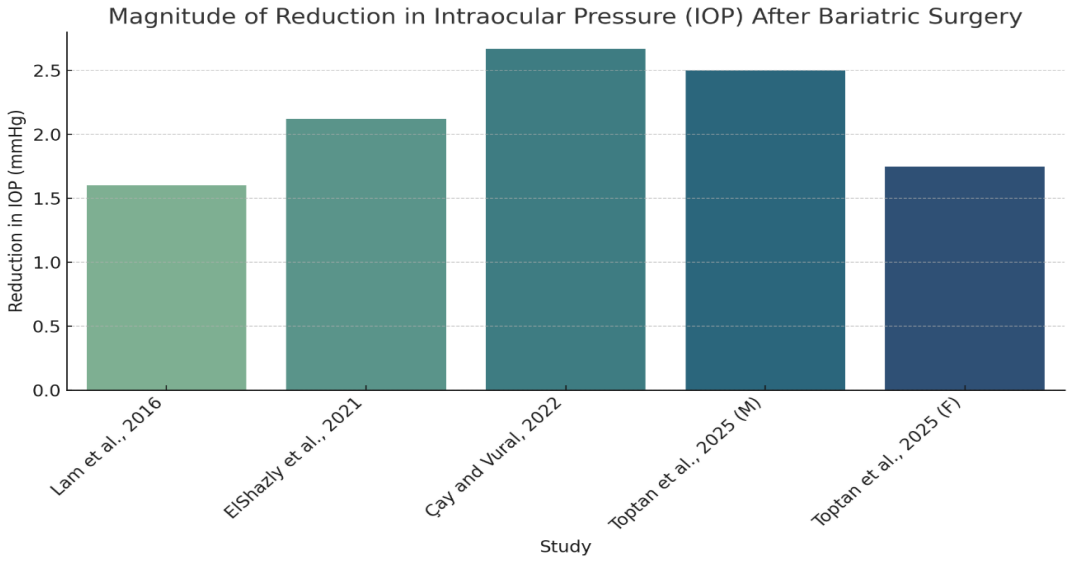

Figure 2: Mean IOP Change After Bariatric Surgery

7. **Discussion**

This systematic review addresses the potential benefits and drawbacks of bariatric surgery for the eyes, paying special attention to its potential effects on intraocular pressure (IOP) and glaucoma-related outcomes. The findings indicate a consistent drop in intraocular pressure (IOP) following bariatric procedures, which may help stop glaucoma from developing or worsening.

Several of the included studies found significant drops in intraocular pressure within three to twelve months after surgery. ElShazly et al. discovered a mean reduction of −2.12 mmHg three months after surgery, which was both statistically significant and clinically useful, as even a 1 mmHg drop in IOP can reduce the risk of glaucoma development by up to 10% [33]. As demonstrated by Çay and Vural's report of a drop of −2.67 mmHg six months following sleeve gastrectomy, weight loss can positively affect the mechanisms that regulate intraocular pressure [34]. These findings corroborate the idea that the effect is both early-onset and long-lasting, as evidenced by the −2.6 mmHg drop observed over a 1-year follow-up by Posarelli et al. [35].

The mechanism behind the drop in intraocular pressure following bariatric surgery is still complicated. The most likely causes are altered cytokine profiles that impact aqueous humour dynamics, decreased episcleral venous pressure, and improved ocular blood flow [36]. Obesity has been linked to elevated levels of leptin, interleukin-6, and tumour necrosis factor-alpha (TNF-α), all of which can affect the function of the trabecular meshwork and increase intraocular pressure [37]. By inhibiting these pro-inflammatory pathways, weight loss following bariatric surgery may lower IOP.

In addition, Russell et al.'s retrospective cohort of over 42,000 individuals showed reduced relative risks of ocular hypertension (RR 0.387), glaucoma suspect status (RR 0.406), and use of pressure-lowering medications (RR 0.565) after bariatric surgery [38]. This large dataset provides strong support for the notion that surgical weight loss prevents the development or progression of glaucoma.

Another important finding that may help reduce the risk of angle-closure glaucoma, especially in individuals who are anatomically predisposed, is the increase in anterior chamber depth observed by Toptan et al. [39]. Deeper anterior chambers have the advantage of improving aqueous outflow and reducing the possibility of iridotrabecular contact, which is known to be a risk factor for acute angle closure.

However, not every outcome was positive. Dascălu et al. noted an increased risk of intraocular hypertension and neovascular glaucoma following surgery [40]. It is possible that some people may experience ocular issues due to rapid metabolic changes, micronutrient deficiencies, or surgical complications like hypotension and dehydration that affect ocular perfusion pressure, even though weight loss frequently lowers intraocular pressure (IOP).

The trend of lower IOP was supported by systematic reviews of this research, such as those by Krzyżanowska et al. and Manfield et al. They also highlighted the variation in study designs, follow-up times, and measurement methods, which may affect the generalizability of the findings [41,42]. It is important to note the limitations of the body of existing evidence. Most of the studies

were observational or had small sample sizes, except for the cohort of Russell et al. Patient demographics, surgical techniques, and IOP measurement protocols also differ. Furthermore, the lack of long-term follow-up data limits our understanding of potential late consequences and long-lasting ocular effects.

Conclusion

The results of this review provide evidence that bariatric surgery may have ocular benefits, particularly in reducing intraocular pressure and changing glaucoma risk profiles. To validate these findings and look into the processes and populations that are vulnerable to negative outcomes, more longitudinal studies employing standardized ophthalmologic evaluations are needed. Clinicians should consider routine ophthalmic screening for obese patients undergoing bariatric surgery, especially if the patient has a history of eye disorders.

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