

Lifestyle interventions for diabetic retinopathy during pregnancy: Current evidence from clinical studies

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ABSTRACT

Aim: To summarize current evidence on lifestyle interventions, metabolic stabilization and screening strategies relevant to diabetic retinopathy during pregnancy.

Materials and Methods: A narrative review of clinical studies, systematic reviews, meta-analyses and guideline documents was performed using PubMed/MEDLINE, Scopus and Google Scholar.

Baseline retinal status in early pregnancy is the strongest predictor of progression. Additional risk is associated with longer diabetes duration, elevated glycated hemoglobin, glycemic variability, nephropathy and hypertensive disorders, including preeclampsia. Women without retinopathy in early pregnancy generally have a low risk of sight-threatening disease during the same gestation, whereas women with pre-existing retinopathy require close surveillance. Lifestyle interventions do not directly treat retinal lesions, but they improve glycemic control, support appropriate gestational weight gain and reduce vascular burden. Evidence also suggests that continuous glucose monitoring and automated insulin delivery may indirectly support retinal protection by improving metabolic stability.

Conclusions: In pregnant women with diabetes, ophthalmic screening remains the main clinical priority. However, lifestyle-based metabolic support is a meaningful complementary strategy and should be integrated into antenatal care alongside risk-stratified retinal follow-up.

KEY WORDS: pregestational diabetes, metabolic control, preeclampsia, glycemic variability, retinal screening

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INTRODUCTION

Pregnancy is associated with several ocular changes, most of which are transient, but diabetic retinopathy remains one of the most clinically relevant microvascular complications in pregnant women with diabetes [1-3]. The risk of retinal deterioration is highest in women with pregestational diabetes, particularly when retinopathy is already present before conception or is detected in early pregnancy [2-4]. Pregnancy may modify the course of retinal disease through hormonal, inflammatory, hemodynamic and metabolic shifts, yet progression is not driven by pregnancy alone. The most consistent determinants are baseline retinal status, duration of diabetes, glycemic control, hypertension and renal involvement [2-4].

Current recommendations therefore emphasize systematic ophthalmic screening before conception or in the first trimester, followed by risk-adjusted surveillance throughout pregnancy [5, 6]. At the same time, supportive systemic management deserves more attention. Diet quality, physical activity, gestational weight control, blood pressure optimization and modern diabetes technologies do not directly reverse retinal lesions, but

they can improve the metabolic environment in which retinopathy progresses [7-12]. The available evidence is strongest for women with type 1 or type 2 pregestational diabetes; in gestational diabetes, data are more indirect and mainly reflect broader vascular risk rather than established retinal disease [13, 14].

AIM

The aim of this review was to summarize current clinical evidence on diabetic retinopathy progression during pregnancy, with particular emphasis on lifestyle interventions, metabolic stabilization and screening strategies that may help reduce retinal risk in routine antenatal care.

MATERIALS AND METHODS

This study was designed as a narrative review with a practice-oriented synthesis. Literature was searched in PubMed/MEDLINE, Scopus and Google Scholar. The search strategy included combinations of the following terms: diabetic retinopathy, pregnancy, pregestational diabetes, type 1 diabetes, type 2 diabetes, gestational diabetes,

screening, retinal photography, lifestyle intervention, diet, Mediterranean diet, DASH, exercise, glycemic control, continuous glucose monitoring and metabolic stabilization.

Priority was given to publications from 2018-2025, together with selected earlier landmark studies needed to contextualize established clinical risk factors. Eligible sources included cohort studies, randomized trials, systematic reviews, meta-analyses and guideline documents if they addressed prevalence or progression of diabetic retinopathy in pregnancy, screening strategies, baseline risk factors, diet, physical activity, behavioral support or technology-assisted metabolic management relevant to maternal retinal outcomes. The evidence was synthesized qualitatively.

The research was made based on 23 research papers such as 13 original clinical studies 9 of them were observational studies and other 4 interventional studies, 2 systematic reviews and meta-analyses, 4 narrative reviews and 3 topical reviews, and 1 guideline document.

REVIEW

PATHOPHYSIOLOGICAL BACKGROUND AND EPIDEMIOLOGY

Diabetic retinopathy is a microvascular complication of diabetes driven by chronic hyperglycemia, endothelial dysfunction, inflammatory activation and breakdown of the blood-retinal barrier [3, 15]. These processes increase vascular permeability, promote capillary non-perfusion and, in advanced disease, lead to neovascularization and vision-threatening complications. Pregnancy may amplify this instability because of rapid shifts in metabolism, circulation and hormonal signaling, especially in women with pre-existing retinal vulnerability [3, 15].

Contemporary clinical data show that the burden of diabetic retinopathy in pregnancy is concentrated in women with pregestational diabetes [2, 14, 17-19]. A substantial proportion already have retinopathy at baseline, and progression during pregnancy occurs mainly in those with established disease. In contrast, women without retinopathy in early pregnancy appear to have a relatively low risk of developing sight-threatening retinal disease during the same gestation [17-19]. These observations support early retinal staging as the basis of clinical risk stratification.

RISK FACTORS FOR PROGRESSION

Across recent cohort studies and systematic reviews, baseline severity of retinopathy at conception or in early pregnancy is the strongest predictor of worsening

[2, 16-19]. Women with moderate or severe non-proliferative changes are much more likely to progress than women with no retinal lesions, and progression to proliferative disease occurs predominantly in those with pre-existing abnormalities.

Longer duration of diabetes, higher early-pregnancy glycated hemoglobin (HbA1c), marked glycemic variability and rapid changes in glycemia are additional risk factors [2, 4, 16-18]. This is clinically relevant because tighter glucose control remains beneficial overall, but it should be accompanied by closer ophthalmic monitoring in women with established microvascular disease. Hypertensive disorders of pregnancy, chronic hypertension, higher systolic blood pressure, nephropathy and microalbuminuria also identify women at increased retinal risk [4, 16-18]. Moreover, retinal worsening documented during pregnancy may persist after delivery rather than regress spontaneously, which strengthens the rationale for postpartum reassessment [17].

LIFESTYLE INTERVENTIONS AND METABOLIC STABILIZATION

Direct interventional studies that use diabetic retinopathy progression as a predefined endpoint are scarce. Nevertheless, evidence from pregnancy studies focused on metabolic control suggests that lifestyle measures are clinically relevant because they influence the same systemic pathways consistently linked with retinal worsening. In women with gestational diabetes, structured lifestyle intervention achieved satisfactory glycemic control in most participants within a short period and reduced the need for treatment escalation in many cases [10].

Diet quality appears particularly important. Mediterranean-style and DASH-like dietary patterns have been associated with lower rates of gestational diabetes, hypertensive disorders of pregnancy and less adverse metabolic profiles [7-9]. In women with type 1 diabetes, the ENDIA study showed that a dietary pattern characterized by higher intake of fresh foods was associated with lower odds of preeclampsia and preterm birth, with part of the effect mediated by body mass index and HbA1c [11]. Although these studies did not evaluate retinal endpoints directly, they support the concept that nutritional quality influences vascular risk through measurable metabolic mechanisms.

The broader evidence base also supports physical activity and structured behavioral care. A recent systematic review and Bayesian network meta-analysis found that both dietary and exercise interventions improved outcomes in gestational diabetes, with

some strategies reducing insulin use and improving metabolic control [12]. This is relevant to retinal protection because poor glycemic control, blood pressure burden and systemic vascular stress are repeatedly associated with progression of diabetic retinopathy during pregnancy [2, 4, 16-18].

Modern diabetes technologies can be interpreted within the same framework. Automated insulin delivery, continuous glucose monitoring and personalized technology-supported management improve glucose awareness and support day-to-day decisions that favor glycemic stability [20-22]. They are not a retinal treatment in themselves, but they may strengthen lifestyle-based self-management and indirectly lower retinal risk, especially in women with pregestational diabetes who require tight control throughout pregnancy [20-22].

PRACTICAL IMPLICATIONS FOR CARE

The available evidence supports a prevention-oriented model in which screening and metabolic support are integrated rather than treated as competing priorities. Women with pre-existing diabetes should undergo retinal assessment before conception or, if already pregnant, in the first trimester [5, 6]. Those with any baseline retinopathy, long diabetes duration, hypertension or renal disease require closer follow-up than women with normal early pregnancy retinal findings [17-19].

Lifestyle counseling should begin early and target diet quality, safe physical activity, appropriate gestational weight gain, blood pressure control and glycemic stability. Postpartum retinal reassessment is important in women with baseline disease or progression during pregnancy [17]. This integrated pathway is especially important because real-world adherence to recommended retinal screening remains suboptimal [23].

DISCUSSION

The main practical message from the current literature is that diabetic retinopathy in pregnancy should be managed through a risk-stratified and multidisciplinary model. Ophthalmic screening identifies which women are at highest immediate risk, while lifestyle and metabolic interventions address the systemic exposures that shape progression over time [2, 5, 6, 17, 18]. These approaches are complementary. Screening remains the central clinical priority, but supportive metabolic care should not be treated as secondary or optional.

The strongest argument for lifestyle intervention is indirect but consistent. Studies on diabetic retinopathy progression repeatedly implicate poor glycemic control, hypertensive disease and nephropathy as major drivers of retinal worsening [2, 4, 16-18]. At the same time, studies on diet, exercise and technology-assisted diabetes management during pregnancy show measurable improvement in exactly these variables [7-12, 20-22]. This does not prove a retina-specific treatment effect, yet it provides a biologically plausible and clinically useful basis for prevention-focused care.

Several limitations should be acknowledged. Most available evidence on retinal progression is observational, and many intervention studies report metabolic or obstetric outcomes rather than ophthalmic endpoints [13, 14]. The literature also mixes women with type 1 diabetes, type 2 diabetes and gestational diabetes despite major differences in baseline retinal risk. Postpartum follow-up remains inconsistent, even though progression during pregnancy may persist beyond delivery [17]. Future prospective studies should therefore include standardized retinal outcomes, clearer separation of diabetes subtypes and longer postpartum follow-up. Until such data are available, the most defensible strategy is to combine early retinal staging with intensive support for glycemic stability, blood pressure control and screening adherence [5, 6, 23].

CONCLUSIONS

Pregnancy is a period of increased vulnerability to diabetic retinopathy progression, especially in women with pregestational diabetes and in those with retinal disease already present at conception or in early pregnancy. Baseline retinal status is the strongest predictor of worsening, while longer diabetes duration, higher HbA1c, glycemic variability, hypertension and renal involvement further increase risk.

Retinal screening remains the primary clinical priority and should ideally be performed before conception or in the first trimester, with follow-up tailored to baseline risk. Lifestyle intervention does not directly treat retinal lesions, but by improving metabolic stability, blood pressure control and gestational weight trajectories, it is a meaningful component of prevention. The most appropriate care model therefore combines early ophthalmic staging, risk-stratified surveillance, structured lifestyle-based support and postpartum reassessment.

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CONFLICT OF INTEREST

The Authors declare no conflict of interest

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