



Pregnancy After Bariatric Surgery: A Narrative Review of Nutritional Surveillance and Fetal Growth

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Abstract

Bariatric surgery before pregnancy does not make pregnancy safer in a simple sense; it exchanges one set of risks for another. Rates of gestational diabetes, pregnancy-induced hypertension, pre-eclampsia and large-for-gestational-age birth fall, while small-for-gestational-age birth, preterm delivery and micronutrient deficiency rise. Meta-analysis of observational studies reports that infants born after bariatric surgery weigh a mean of 242 g less than those born to women without prior surgery (95% CI -307 to -177, $p < 0.001$). The most uncomfortable finding concerns surveillance. In a cohort of 57 pregnancies in 48 women, small-for-gestational-age neonates occurred in 36.0 per cent, and although supplement uptake rose from 56.8 per cent before conception to 100 per cent in the third trimester, third-trimester deficiency was still present for vitamin C in 83.3 per cent, selenium in 50.0 per cent and vitamin A in 40.0 per cent. Supplementation as delivered did not prevent deficiency. This review sets out what is measured, what is recommended and where the two diverge.

Keywords: Bariatric surgery; Pregnancy; Small for gestational age; Micronutrient deficiency; Nutritional surveillance

Introduction

Bariatric surgery is increasingly performed in women of reproductive age, and obesity in pregnancy carries well-established risks to mother and infant [1,2,3]. Surgery before conception reduces several of them, and fertility frequently improves, so the number of pregnancies following surgery continues to rise [4,5].

The procedures achieve weight loss by restricting intake, reducing absorption, or both, and the same mechanisms reduce the absorption of micronutrients required for fetal development [6,7]. Pregnancy raises the requirement for several of those nutrients at precisely the point when the capacity to absorb them is reduced [8].

This review examines what the perinatal outcome data show, what nutritional surveillance achieves in practice, and how far the evidence supports the recommendations built on it.

Material and Methods

Search strategy: PubMed and the archives of the major obstetric, bariatric surgery and clinical nutrition journals were searched for studies of pregnancy following bariatric surgery. Search terms combined bariatric surgery and gastric bypass with pregnancy, perinatal outcome, small for gestational age, micronutrient deficiency and supplementation. Reference lists of the principal meta-analysis [9] and narrative reviews [7,10] were screened by hand for primary sources.

Eligibility: Studies were included if they reported perinatal or nutritional outcomes in pregnancies after bariatric surgery against a defined comparator or reference range, or synthesised such studies. Guidance documents are cited for the recommendations they contain and are identified as such.

Data extraction and handling: Design, population, the surgical procedure where reported, the comparator and the reported estimate were extracted as published. This review reports published findings and the content of existing guidance;

it does not constitute nutritional advice and makes no dietary, caloric, supplementation or exercise recommendations. No pooling or re-analysis was performed. Figures 1 to 6 and Tables 1 to 3 reproduce published values only. This is a narrative synthesis and was not registered as a systematic review.

Results

The direction of the trade: Systematic review evidence is consistent about which risks move in which direction. Surgery before pregnancy is associated with reduced rates of gestational diabetes, pregnancy-induced hypertension, pre-eclampsia and large-for-gestational-age birth, and with increased rates of small-for-gestational-age birth and preterm delivery (Figure 2) [9,11,12,17]. Nationwide register and matched cohort studies report the same direction [20,21,34], as do earlier meta-analyses [18,19,33]. Higher rates of stillbirth have also been reported, and the mechanism is not established [10].

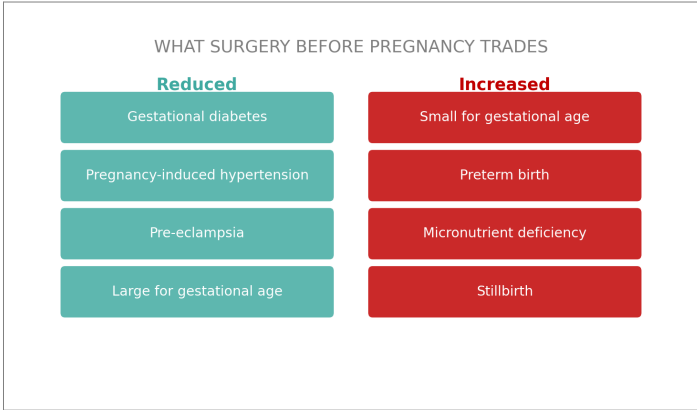


Figure 2: Risks reduced and increased by bariatric surgery before pregnancy [9,10,11,12]

Birthweight: Meta-analysis of observational studies found that infants born after bariatric surgery of all types weighed a mean of 242.42 g less than those born to women without prior surgery (weighted mean difference -242.42 g, 95% CI -307.43 to -177.40, $p < 0.001$) (Figure 1). The association with adverse perinatal outcomes was reported as strongest for gastric bypass [9]. Centre-based series examining growth restriction directly reach compatible conclusions, and one compared bypass with sleeve gastrectomy against maternal nutritional status [22,23].

What that means at the level of individual pregnancies: A retrospective cohort examined 57 singleton pregnancies in 48 women who had undergone bariatric surgery between 2011 and 2016. Small-for-gestational-age neonates were identified in 36.0 per cent of pregnancies (Figure 3) [13].

Table 1: Prevalence of deficiency by trimester in 57 pregnancies, all women supplemented by the third trimester [13]

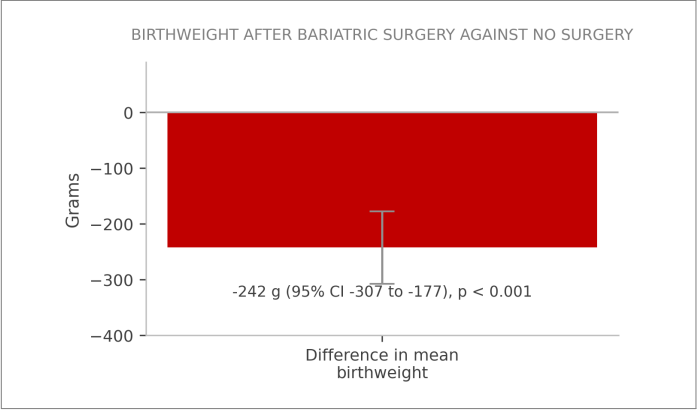


Figure 1: Difference in mean birthweight after bariatric surgery [9]

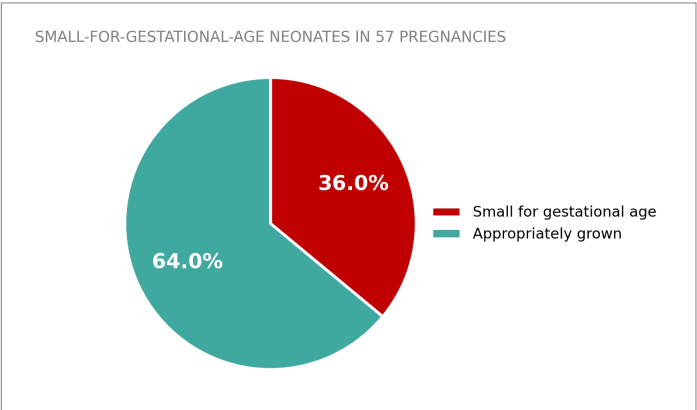


Figure 3: Small-for-gestational-age neonates in 57 pregnancies after bariatric surgery [13]

Supplementation as delivered: In that cohort, supplement uptake rose steadily through pregnancy: 56.8 per cent in the periconceptional period, 77.8 per cent in the first trimester, 96.3 per cent in the second and 100 per cent in the third (Figure 4) [13].

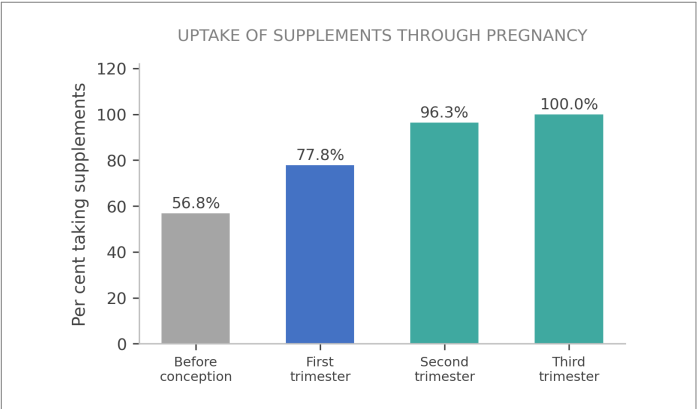


Figure 4: Uptake of supplements through pregnancy in the same cohort [13]

What supplementation did not prevent: Deficiencies persisted throughout. In the third trimester, with every woman taking supplements, deficiency was present for vitamin C in 83.3 per cent, selenium in 50.0 per cent, vitamin A in 40.0 per cent, vitamin B1 in 20.0 per cent, folate in 9.1 per cent and vitamin D in 8.3 per cent (Figure 5). Earlier in pregnancy the pattern differed by nutrient, with vitamin A deficiency in 36.4 per cent

and selenium in 77.8 per cent during the first trimester [13]. The investigators found no significant difference in the prevalence of deficiencies or complications by surgical procedure, by body mass index at the start of pregnancy, or by the interval between surgery and conception [13]. Prospective cohorts elsewhere have measured micronutrient levels and supplement intake serially through pregnancy [24,29,30], systematic review has linked maternal deficiency to neonatal outcomes [25,27], nutritional indices have been compared across three procedures at one institution [26], and low birth weight examined against neonatal micronutrient status [28].

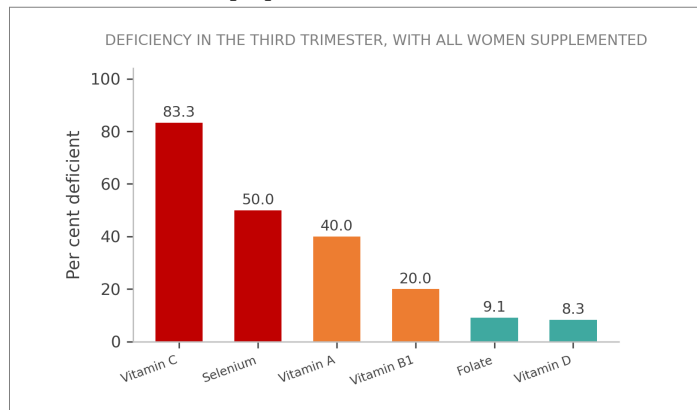


Figure 5: Third-trimester deficiency with all women taking supplements [13]

Nutrient	First trimester	Third trimester
Vitamin C	66.7%	83.3%
Selenium	77.8%	50.0%
Vitamin A	36.4%	40.0%
Vitamin B1	45.5%	20.0%
Folate	14.3%	9.1%
Vitamin D	33.3%	8.3%

What guidance recommends: Reviews and guidance converge on preconception assessment of micronutrient status, regular specialist dietetic input through pregnancy, and increased monitoring of fetal growth [7,9,14]. Consensus recommendations covering periconception, antenatal and postnatal care exist [15,31], alongside practical guidance for post-surgical medical management generally [32]. A delay of at least 12 months between surgery and conception is commonly advised, on the reasoning that conception during the phase of rapid weight loss risks insufficient gestational weight gain [10,15]. Guidance also notes that glucose tolerance testing performs differently after bypass procedures, which affects how gestational diabetes is screened for [14,16].

Recommendation	Stated rationale
Preconception micronutrient assessment	Deficiencies precede pregnancy [7,14]
Delay conception at least 12 months	Avoid the rapid weight-loss phase [10,15]
Specialist dietetic review in pregnancy	Requirements rise as absorption falls [7,8]
Increased fetal growth monitoring	Raised risk of growth restriction [9,13]

Recommendation	Stated rationale
Modified screening for gestational diabetes	Tolerance testing performs differently [14,16]

Table 2: Recommendations found in guidance and the reasoning given for each

The quality of the evidence: A systematic review of maternal nutrition in this population judged that 61 per cent of included studies, 14 of 23, did not use valid or reliable outcome measures, through omitting diagnostic criteria for gestational diabetes or for micronutrient deficiency, or through failing to account for confounders of micronutrient concentrations such as gestation and inflammation (Figure 6) [12]. Studies reporting dietary intake omitted quality control information including how portion sizes were estimated and how self-reported intake was validated [12].

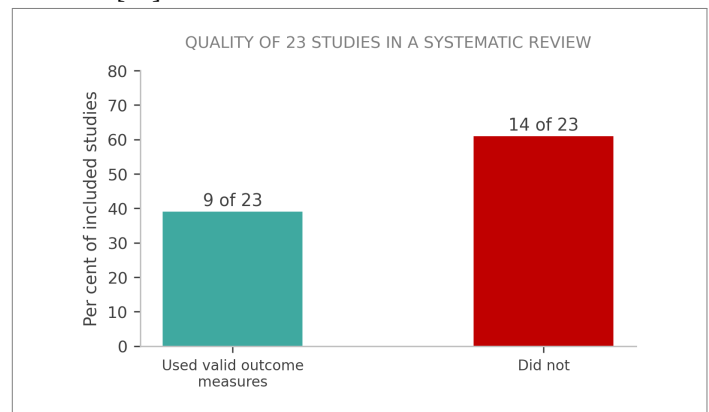


Figure 6: Quality assessment of 23 studies in a systematic review [12]

Issue	Consequence for interpretation
Observational designs only	Confounding by indication cannot be excluded [9]
Deficiency criteria vary	Prevalence not comparable across studies [12]
Inflammation alters micronutrient levels	Some deficiency may be apparent only [12]
Procedures grouped together	Malabsorptive and restrictive differ [9]
Small single-centre cohorts	Wide confidence around every estimate [13]

Table 3: Methodological issues in this literature and what each limits

Screening for gestational diabetes after bypass: The oral glucose tolerance test performs differently in women who have had a gastric bypass, because rapid transit of a glucose load into the small bowel produces an exaggerated early rise followed by reactive hypoglycaemia [16]. Altered glucose profiles and a risk of hypoglycaemia during testing have been documented directly in this population, which is why guidance suggests alternative approaches to diagnosing gestational diabetes after bypass procedures [14,16]. The paradox is that surgery lowers the incidence of gestational diabetes while making it harder to detect when it occurs.

What population studies add: Nationwide matched cohort studies in Nordic registers, which avoid some of the selection

problems of clinic series by comparing against women matched on pre-surgery characteristics, report the same pattern of reduced gestational diabetes and large-for-gestational-age birth alongside increased small-for-gestational-age birth and preterm delivery [11,21,34]. That consistency across designs strengthens the direction of the finding even though none of the studies is randomised [9,18,19].

Discussion

The trade is the finding. Surgery before pregnancy reduces gestational diabetes, hypertensive disorders and macrosomia, and increases growth restriction and preterm birth [9,11,12]. Describing it as making pregnancy safer is therefore incomplete: it substitutes a set of risks associated with maternal obesity for a set associated with restricted nutrient supply, and which exchange is favourable will depend on the individual.

The birthweight figure gives the effect a scale. A mean reduction of 242 g across all procedures is not trivial at a population level, and the association was strongest for gastric bypass, the procedure that combines restriction with malabsorption [9]. That gradient is the clearest evidence that the mechanism is nutritional rather than an artefact of the population selected for surgery, though it does not exclude confounding.

The supplementation result is the one that should change practice, and it is easy to miss because it looks like a compliance success. Uptake rose from 56.8 per cent before conception to 100 per cent by the third trimester, and yet third-trimester deficiency was present for vitamin C in more than four fifths of women and for selenium in half [13]. Supplementation as delivered did not achieve nutritional adequacy. Whether that reflects insufficient doses, poor absorption of standard preparations, or the wrong nutrients being supplemented cannot be determined from these data, but the assumption that a prescribed supplement resolves the problem is not supported.

A second finding from the same cohort cuts against standard advice and deserves flagging rather than adopting. The investigators found no significant difference in deficiencies or complications by the interval between surgery and conception [13]. That is the variable on which the common recommendation to wait 12 months rests [10,15]. With 57 pregnancies the study is far too small to overturn that guidance, and a null result in a small sample is weak evidence, but it does indicate that the interval recommendation is less firmly grounded than its ubiquity suggests.

The methodological assessment sets a limit on all of the above. If 14 of 23 studies in a systematic review lacked valid outcome measures, then the pooled picture is built substantially on estimates whose definitions are unclear [12]. Micronutrient concentrations in particular fall during inflammation and change across gestation independently of nutritional status, so a proportion of the reported deficiency may be apparent rather than real. That does not explain a figure of 83.3 per cent, but it

should temper precision.

A practical question follows from the supplementation finding and is not answered by the literature. If standard preparations do not achieve adequacy in this population, the possibilities are that doses are too low, that absorption of the preparation is itself impaired by the surgery, or that monitoring is too infrequent to detect shortfalls while they can still be corrected [6,24,30]. These call for different responses, and distinguishing between them would require serial measurement against defined thresholds, which most of the reviewed studies did not do [12].

It is also worth being clear about what the growth findings do not establish. A mean birthweight 242 g lower is a shift in a distribution, not a diagnosis, and a proportion of those infants are appropriately grown for mothers who are no longer obese [9,22]. Whether the excess of small-for-gestational-age births reflects pathological restriction of fetal growth or a downward shift in a healthy range cannot be resolved from birthweight alone, and the reported excess of stillbirth suggests it is not entirely benign [10,21].

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Study limitations

The limitations belong to the underlying literature. All perinatal evidence is observational, and women who undergo bariatric surgery differ systematically from those who do not in ways that also predict perinatal outcome, so confounding by indication cannot be excluded [9,11]. The nutritional cohort comprises 57 pregnancies in 48 women at a single centre, and subgroup comparisons within it are underpowered [13]. Diagnostic thresholds for micronutrient deficiency differ between studies and laboratories, and concentrations are altered by gestation and inflammation independently of intake [12]. Surgical procedures are frequently grouped together despite differing mechanisms, and the balance of procedures differs between regions [9,14]. Supplement composition and dose are inconsistently reported, so the finding that supplementation did not prevent deficiency cannot be attributed to a specific regimen [12,13]. The mechanism linking surgery to growth restriction and stillbirth is not established [10]. And no randomised evidence exists, nor could it ethically be generated for the comparison of principal interest [9,12].

Conclusion

Pregnancy after bariatric surgery carries less gestational diabetes, hypertension and macrosomia, and more growth restriction and preterm birth, with infants weighing a mean of 242 g less than those of women without prior surgery. That is an exchange of risks rather than a reduction in them. The finding most relevant to how these pregnancies are managed is that supplementation as currently delivered does not close the nutritional gap: in one cohort every woman was taking supplements by the third trimester while more than four fifths remained vitamin C deficient. Increased fetal growth monitoring is well justified by the outcome data. Confidence that a prescribed supplement has solved the underlying problem is not.

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Conflict of Interest

The authors declare no competing interests.

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Ethics Statement

This article reviews previously published studies only. No new patient data were collected and no participants were recruited, so ethical approval was not required.

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