

Original article

# Risk of low birth weight and micronutrient deficiencies in neonates from mothers after gastric bypass: a case control study

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## Abstract

**Background:** An increased risk of small-for-gestational-age infants after maternal bariatric surgery has been shown. The risk of micronutrient deficiencies in these neonates is unclear.

**Objective:** To screen for micronutrient deficiencies in newborns of mothers with gastric bypass.

**Settings:** University hospital in Angers, France.

**Methods:** This study compared the clinical and cord blood biological characteristics of 56 newborns of mothers with prior Roux-en-Y gastric bypass (RYGB) and 56 newborns of nonobese healthy mothers after normal pregnancy (controls), followed between January 3, 2008 and October 31, 2012. Cord blood micronutrient concentrations from controls were used for establishing normative data. After RYGB, the women took daily micronutrient supplements.

**Results:** RYGB mothers lost  $18.1 \pm 6.3$  kg/m<sup>2</sup> of body mass index (BMI) in the 11–69 months between surgery and pregnancy onset (percentage of excess weight loss  $79 \pm 20\%$ ), reaching BMI of  $30.1 \pm 6.0$  kg/m<sup>2</sup> compared with  $22.3 \pm 4.0$  kg/m<sup>2</sup> in the controls ( $P < .05$ ). Neonates born to RYGB mothers were small-for-gestational-age in 23% of cases versus 3.6% in the control group ( $P < .01$ ). A higher percentage of RYGB neonates had cord blood concentrations below the 2.5 percentile for calcium (19% versus 2%), zinc (13% versus 3%), iron (19% versus 2%), and vitamin A (13% versus 3%), and over the 97.5 percentile for magnesium (13% versus 3%), vitamin E (16% versus 3%), 25-hydroxy-vitamin D (13% versus 2%), and vitamin B12 (14% versus 2%) ( $P < .05$  for all comparisons).

**Conclusion:** Neonates from RYGB mothers showed cord blood micronutrient differences compared with neonates from healthy mothers. The comparison with neonates from morbidly obese women is still to be done. (Surg Obes Relat Dis 2017;13:1384–1391.) © 2017 American Society for Metabolic and Bariatric Surgery. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

## Keywords:

Newborn; Severe obesity; Vitamin; Trace element; Micronutrient; Bariatric; Gastric bypass; Morbid obesity; Pregnancy; Neonate

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Obese pregnant mothers have shown higher frequencies of morbidities as well as mortality, with these complications tending to be more frequent in those with the highest body mass indexes (BMI) [1]. Their offspring have shown higher

frequencies of stillbirth, neonatal death, congenital anomalies, and macrosomia, and in later life, these children more frequently developed obesity, insulin resistance, and cardiovascular disease [2–4]. These findings suggest that the nutritional stress associated with maternal obesity has an effect on the short- and long-term health of the offspring, in agreement with the developmental origins of health and disease hypothesis [5].

Morbid obesity (BMI >40 kg/m<sup>2</sup>) has been estimated to affect 1%–3% of pregnant women [1]. Bariatric surgery for morbid obesity is considered when the response to other treatments is considered inadequate, with greater improvement in weight loss outcomes and weight-associated comorbidities compared with nonsurgical interventions [6]. Approximately half of all bariatric procedures are performed in women of reproductive age [7]. Observational studies of the effect of bariatric surgery on pregnancy outcomes suggest that obstetric outcome is improved [7–9]; however, nutritional deficiencies in the mothers are common despite dietary guidance and micronutrient supplementation [10–12]. Neonatal outcome was first assumed to be comparable with that of normal pregnancy [9]. The improved outcome after bariatric surgery has recently been challenged, with large studies showing an increased risk of preterm and small-for-gestational-age births [7,13–16]. Neonatal evaluation has been limited to clinical assessment, and no systematic biological evaluation of potential micronutrient deficiencies has been reported, despite occasional reports of adverse neonatal outcomes related to vitamin A, K, B9, and B12 deficiencies [17].

The aim of this prospective study was to compare the clinical characteristics as well as the micronutrient profiles in the cord blood of 56 newborns born to mothers after Roux-en-Y gastric bypass (RYGB) and 56 newborns born to nonobese mothers after a normal pregnancy, in the Obstetrics Department of Angers University Hospital between March 1, 2008 and October 31, 2012.

## Methods

### Study participants and setting

All women who had given birth after RYGB for severe obesity at the Obesity Specialized Care Center in Angers, France were eligible for the present study. The surgery had been performed between October 2005 and July 2008 (Fig. 1), and 56 RYGB women gave birth to a single newborn between March 1, 2008, and October 31, 2012, in the Obstetrics Department of Angers University Hospital. During the same period, healthy nonobese pregnant women with normal pregnancies followed in the Obstetrics Department were matched for age, parity, and smoking habits and were asked to participate in the study, on the basis of 1 control per patient: 56 who had also given birth to a single newborn. Matched controls had no complications during

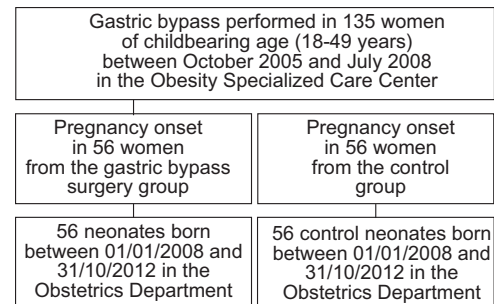


Fig. 1. Recruitment of the patients: 135 women of childbearing age underwent gastric bypass surgery in our specialized care center between 2005 and 2008, 56 of whom eventually became pregnant and gave birth. All of these women agreed to participate in the study.

pregnancy or labor and denied the use of any illegal substances.

This study was approved by Angers University Hospital Ethics Committee, and written informed consent was obtained from the parents.

### Study design

After surgery, the women were followed in the Nutrition Unit of Angers University Hospital every 6 months. They all took daily micronutrient supplements containing vitamin A (1200 µg), vitamin B1 (1.6 mg), vitamin B2 (1.8 mg), vitamin B5 (10 mg), vitamin B6 (2.6 mg), vitamin B8 (200 µg), vitamin B9 (800 µg), vitamin B12 (4 µg daily and 1000 µg monthly), vitamin C (100 mg), vitamin D3 (500 UI daily and 100,000 UI monthly), vitamin E (15 mg), vitamin PP (19 mg), calcium (125 mg), magnesium (100 mg), phosphorus (125 mg), iron (190 mg), manganese (1 mg), copper (1 mg), and zinc (45 mg). They were advised to use efficient contraception and postpone pregnancy for 12 to 18 months after surgery [18] and to contact the nutrition unit at the onset of an eventual pregnancy. None of them underwent fertility treatment. Monthly follow-up was then initiated, including an interview, physical examination (weight, height, blood pressure measurement), and biological measurements (see maternal and neonatal biological assessments for further detail). At each visit, the women were asked about micronutrient supplement intake and tolerance.

Healthy mothers were followed at 3 months, 6 months, and 8 months of gestation in the Obstetrics Department of Angers University Hospital. All received vitamin D3 100,000 IU at 6 months' gestation.

### Data collection

**Clinical data.** BMI at surgery and 6 months before the onset of pregnancy, and timing between surgery and pregnancy were recorded for the women who had had bariatric surgery. Maternal age at birth, BMI at the onset of pregnancy, total weight gain during pregnancy, tobacco

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