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Gestational weight gain and postpartum weight retention after bariatric surgery: data from a prospective cohort study

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Gestational weight gain in women after bariatric surgery

Abstract

Background:

It is unknown whether international guidelines on gestational weight gain can be used in pregnancies after bariatric surgery.

5 Objectives:

To investigate gestational weight gain, intra-uterine growth and postpartum weight retention in post-bariatric women.

Setting:

8 Belgian hospitals.

10 Methods:

Prospective data from 127 post-bariatric pregnancies from September 2014 through October 2018. Patients were grouped according to achievement of 2009 IOM-guidelines.

Results

In 127 patients, aged 30.2 years (SD, 4.7), mean gestational weight gain was 12.5 kg (SD, 6.7). 24% (30/127) of patients showed insufficient weight gain, 20% (26/127) adequate weight gain and 56% (71/127) excessive weight gain. 21% of patients (27/127) had small-for-gestational-age infants. This peaked in the insufficient weight gain group (47%, 95% CI 29% - 65%; $p < 0.001$). Prevalence of large-for-gestational-age was comparable between groups, although highest in the excessive group (0 vs. 4 vs 8%). Preterm birth was recorded more in patients with insufficient weight gain (23%, 95% CI 8% - 38%, $p = 0.048$). Mean postpartum weight retention was 4.0 kg (SD 7.4) at 6 weeks and 3.0 kg (SD 9.1) at 6 months. Weight

retention at 6 weeks (7.1 kg, 95% CI 5.5 – 8.7, $p<0.001$) and 6 months (8.3 kg, 95% CI 4.5 – 12.2, $p<0.001$) was highest in women gaining excessive weight.

Conclusions:

- 25 Achievement of IOM guidelines is low in post-bariatric pregnancies. Insufficient weight gain increases the risk for small-for-gestational-age babies. Excessive weight gain increases weight retention after delivery and could precipitate weight regain. Women after bariatric surgery should be encouraged to achieve IOM recommendations.

Keywords

- 30 IUGR, gastric bypass, sleeve gastrectomy, gastric banding; BPD; biliopancreatic diversion

1. Introduction

As the worldwide prevalence of obesity continues to rise, an increasing number of patients choose to undergo bariatric surgery (BS). Around 80% of these patients are female and many of them are of reproductive age.⁽¹⁾ Studies on the effects of BS on pregnancy outcomes show

a reduced incidence of gestational diabetes, macrosomia and hypertensive complications.⁽²⁻⁴⁾

However, pregnant women with a history of BS are at risk for other adverse outcomes, such as surgical complications, congenital malformations, micronutrient deficiencies, preterm delivery and intrauterine growth restriction (IUGR).^(2, 5-7)

The Institute of Medicine (IOM) has released guidelines regarding the optimal gestational weight gain (GWG) during pregnancy, which are summarized in Table 1.⁽⁸⁾ Excessive GWG has been associated with increased risk for large-for-gestational-age (LGA) infants, macrosomia, caesarean delivery and gestational diabetes mellitus (GDM). Insufficient GWG on the other hand, is correlated to IUGR, small-for-gestational-age (SGA) infants, preterm birth and more NICU admissions.⁽⁹⁾

It remains unclear whether the IOM guidelines for GWG can be used safely in a post-bariatric population. On one hand, weight regain is an important complication in post-bariatric patients,^(3, 10, 11) and limiting GWG and postpartum weight retention is therefore important.

On the other hand, pregnant post-bariatric patients are at an increased risk of IUGR and SGA infants, which might also be triggered by insufficient weight gain. To study this we evaluated

GWG, attaining to IOM guideline, pregnancy outcomes and postpartum weight retention using data from a prospective cohort study (AURORA).⁽¹²⁾

2. Materials and methods

2.1 Data collection

55 Data was used from the AURORA study, an ongoing multicentre prospective cohort study, examining the reproductive outcomes of female patients after BS. The study protocol has been described in detail elsewhere.⁽¹²⁾ In short, women aged 18 to 45 years who are planned for or who have undergone BS are recruited. Patients should have a working internet connection and an email address. Infertile women (e.g. women with a hysterectomy or
60 already in menopause) are excluded. Data from patients included before surgery is gathered completely prospectively. Data of those who are included after surgery is gathered partially retrospectively for the measurements before surgery. Inclusion is possible until the end of the first trimester of pregnancy (14+6 weeks). Several forms of BS were included in the analysis and the choice of the type of surgery depended on Body Mass Index (BMI),
65 comorbidities and the expertise of the surgeon. The study was approved by the local ethical committees of the participating hospitals and informed consent was obtained from each of the participants. The trial is registered on ClinicalTrials.gov (NCT02515214).

For this study, we selected all patients in the AURORA cohort (total inclusions, N=396) for which data on at least one completed pregnancy was available (N=127). Women were
70 weighed wearing indoor clothing without shoes using calibrated scales. Height was only measured once at inclusion. Preconception weight was self-administered. Twin gestations were excluded from the analysis.

2.2 Data analysis

Statistical analysis was performed using R statistical software (version 3.5.1, <http://www.r-project.org>). GWG was defined as the difference between measured weight at time of child
75

birth and the self-reported preconception weight. Patients were grouped according to their achievement of the 2009 IOM-guidelines.⁽⁸⁾ An overview of these recommendations is provided in Table 1. Patients gaining less weight than recommended were considered having insufficient weight gain. Patients who gained more than the recommended weight were defined as having excessive GWG. Pregnancy outcomes were compared between groups. Primary outcomes studied were the prevalence of LGA or SGA, and postpartum weight retention at 6 weeks and 6 months after delivery. Birth weight was compared to the general population of the region of Flanders using data from the Centre of Perinatal Epidemiology (SPE),⁽¹³⁾ taking into account the neonatal sex, gestational age and parity. SGA and LGA infants were defined as birth weight below the 10th percentile or above the 90th percentile respectively. Macrosomia was defined as a birth weight >4000g. Postpartum weight retention was calculated as the difference between the maternal weight at six weeks and six months after delivery and preconception weight. Delivery prior to 34 and 37 weeks of pregnancy was defined as early and late preterm birth respectively. The definition of gestational hypertension was blood pressure >140 mmHg systolic or >90 mmHg diastolic, in patients with no known hypertension prior to pregnancy. Pre-eclampsia was defined as new-onset hypertension with signs of significant end-organ dysfunction (e.g. proteinuria, IUGR, etc.). Plots correlating birth weight, gestational age, parity, child sex and attainment to IOM guidelines were constructed. Boxplots on postpartum weight retention at 6 weeks and 6 months postpartum were also created. The Shapiro-Wilk test was used to determine if variables were normally distributed. One-way ANOVA was used to examine differences in continuous variables between groups. Chi-square or Fisher's exact test was used to compare prevalence of comorbidities and other variables between groups. A p-value of <0.05 was considered statistically significant.

3. Results

3.1 Patient Characteristics

One hundred and twenty-seven patients were included in the analysis. Seventy-four percent (94/127) of patients underwent a Roux-en-Y Gastric bypass (RYGB), 17% Laparoscopic adjustable Gastric Banding (LAGB) (21/127), 7% (9/127) Sleeve Gastrectomy (SG) and 2% (3/127) biliopancreatic diversion (BPD).

3.2 Gestational weight gain and pregnancy outcomes

Overall, mean GWG was 12.5 kg (SD, 6.7). Thirty patients (24%) had a lower than recommended GWG (insufficient), twenty-six (20%) gained weight within recommended range (adequate) and seventy-one (56%) gained more than recommended by the IOM (excessive). These data are detailed in Table 2. One patient lost weight during pregnancy (-0.7 kg).

Pregnancy outcomes according to achievement of IOM-guidelines are shown in Table 3. There was no statistical difference between groups in regard to age, smoking status, type of surgery, parity, BMI at conception and surgery-to-conception interval.

Gestational age at delivery was also comparable, but late preterm birth was more frequent in those patients who gained insufficient weight (23% (7/30) in the lower than IOM-guidelines group vs. 8% (2/23) and 7% (5/71) in the normal weight gain group and the excessive weight gain group respectively, $p < 0.05$). Only one patient delivered prior to 34 weeks of gestation. Overall, there were 14 preterm births (11%). We found no difference in outcomes regarding method delivery, neonatal sex, incidence of gestational hypertension and gestational diabetes. Birth weight however did differ significantly between GWG-groups, with the lowest mean birth weight being found in the lower-than-recommended weight gain

group (2838 g, 95% CI 2672 – 3005, $p < 0.001$). Concordantly, we also found a significant difference in the prevalence of SGA-infants with 47% (14/30) in patients with lower-than-recommended weight gain vs. 15% (4/26) and 13% (9/71) in normal weight gain and excessive weight gain patients respectively ($p < 0.001$). The patient who lost weight during pregnancy delivered an SGA infant (2230 g at 38w AD). The prevalence of LGA was comparable between all groups. Overall, twenty-seven patients delivered an SGA infant (21%), ninety-three had a normal weight child (73%) and there were seven LGA neonates (6%). Figure 1 shows the relationship between birth weight and gestational age for the complete group of patients. Table 3 shows the achievement of IOM guidelines per type of surgery. Although patients with malabsorptive surgery types (RYGB or BPD) seemed to have an increased risk of gaining insufficient weight compared to restrictive types (LAGB or GS), this finding failed to reach significance ($p=0.08$).

3.3 Gestational weight gain and postpartum weight retention

Data on postpartum weight retention at 6 weeks and 6 months was available in 75 and 32 patients respectively. Patients with excessive GWG retained significantly more weight at 6 weeks postpartum (7.1 kg, 95% CI 5.5 – 8.7, $p < 0.001$) and these patients even gained weight at 6 months postpartum (8.3 kg, 95% CI 4.5 – 12.2, $p < 0.001$). Patients with insufficient weight gain lost weight at 6 weeks and 6 months postpartum, when compared to their preconception weight (-3.3 kg, 95% CI -6.3 - -0.3, and -5.5 kg, 95% CI -9.6 - -1.5, respectively), whereas patients with normal GWG returned to their preconception weight (3.2 kg, 95% CI -1.4 – 7.7, and 0.1 kg, 95% CI -2.6 – 2.8). These data are presented in Table 3 and Figure 2.

4. Discussion

145 In this prospective multicentre study, we show that only 20% of bariatric patients attained to international GWG-guidelines, and that achievement of the guidelines is associated with the lowest rate of complications. Attainment of the guidelines is substantially lower than in the general population of Flanders (28% with insufficient GWG, 38% with normal GWG and 34% with excessive GWG) or in a comparable population with obesity.^(14, 15) The overall risk of
150 having an SGA-infant after BS was increased when compared to the general population in Belgium and was alarmingly high in patients who gained below recommendations. These patients were also at an increased risk of delivering preterm. Excessive GWG on the other hand was associated with a significant amount (8kg) of weight retention after birth and could precipitate weight regain in post-BS women.

155 Overall, GWG was 12.5 kg in our study, with one patient losing weight during pregnancy. Few other studies have reported on GWG in postsurgical mothers. Our findings are in line with those of Hammeken *et al.*,⁽¹⁶⁾ who compared 151 RYGB-patients to 151 non-RYGB-patients in a retrospective matched cohort study. GWG in the RYGB-group was 11.5 kg $\pm$ 9.9. 15.2% of these patients had lower than recommended GWG, 25.8% gained adequate weight
160 and 39.7% gained more weight than recommended. When compared to the control population, there was no significant difference in attainment to the guidelines between the two groups. They reported a large number of missing data in regard to achievement of the guidelines, with 19.2% of data missing from the study population and 13.9% missing from the control group.

165 Stentebjerg *et al.*⁽¹⁷⁾ reported pregnancy outcomes from 71 RYGB-patients. Data on GWG was available from only 54 women. They found a much higher (42.6%) rate of insufficient

weight gain in their study, when compared to our data. However, a higher percentage of patients in their study presented with obesity, which influences GWG. Another explanation could be the fact that in general the surgery-to-conception interval was shorter in their study. As such, more patients would still be in the catabolic state after surgery, leading to lesser weight gain. This is further suggested by the fact that in their population the mean GWG was higher in those patients who conceived more than 18 months after surgery. Patients who conceived more than 18 months after surgery also had lower rates of insufficient GWG (28.6%) and higher rates of excessive GWG (47.6%), which is more in line with our findings.

Finally, in a retrospective analyses of 337 pregnancies after BS, Grandfils *et al.* reported that 27% of patients achieved GWG guidelines, 35% had insufficient GWG and 38% gained excessive weight.⁽¹⁸⁾ Women with insufficient GWG had a higher pre-pregnancy weight and BMI when compared to those with adequate or excessive GWG, something we did not find in our data.

In our study, there was an increased risk for delivering an SGA-infant, when compared to the general population of Flanders (21% vs. 10%).⁽¹⁵⁾ In this recent analysis of GWG and various pregnancy outcomes, the risk for SGA was highest in patients with insufficient GWG, at 15%. This is still substantially lower than the reported 47% in our dataset. Furthermore, when comparing the prevalence of SGA to that in mothers in varying BMI-categories, a persistently increased risk is noticed in patients after bariatric surgery. For instance, in this analysis in non-bariatric patients the prevalence of SGA was highest in those patients with underweight and insufficient GWG, but increased only to 24%, whereas non-bariatric patients with obesity and insufficient GWG had a risk of 10%. This dropped even further in patients with

190 class III obesity (8.5%). On the other hand, patients with bariatric surgery saw a decrease in the risk of having an LGA-infant, with only 6% of patients delivering an LGA-infant. These data suggest that bariatric surgery is an independent risk factor for SGA, regardless of BMI-category, with the risk for SGA increasing even further if GWG-guidelines are not achieved. The link between BS and low birth weights has already been described.⁽²⁾ Studies by Kjaer *et al.*⁽¹⁹⁾ and Roos *et al.*⁽²⁰⁾ found an increased incidence of SGA, but did not relate it to GWG. In the study by Hammeken *et al.*,⁽¹⁶⁾ SGA, defined as a birthweight 22% below the average in the normal population, had a prevalence of 10.6% in the RYGB-group, vs. 4.0% in the control group ($p = 0.040$). LGA (birthweight 22% above the average in the normal population) was present in 0.7% of the study population and 4.6% of the control population ($p = 0.069$). As mentioned earlier, they did not examine the relationship between the prevalence of SGA and achievement of the IOM-guidelines. Stentebjerg *et al.*⁽¹⁷⁾ also defined SGA and LGA as a <22% or >22% deviation from the mean. In their study they only found 1 case of SGA and LGA each, both of which were found in the insufficient GWG-group. Similar to our own findings, Grandfils *et al.*⁽¹⁸⁾ found insufficient GWG to increase the risk for SGA (34% in the insufficient GWG-group versus 27% in the adequate GWG-group and 19% in the excessive GWG-group).

In general, our findings support the evidence surrounding the increased risk for SGA-infants after BS. Further follow-up of these infants is necessary to investigate the long-term effect of BS on the offspring, as IUGR is associated with the development of metabolic syndrome later in life.^(21, 22)

Although gestational age at delivery was comparable between the three GWG-groups, more patients with insufficient weight gain delivered prior to 37 weeks. Overall 11% of patients delivered preterm. In contrast, according to SPE, the global prevalence of preterm birth in

Flanders is 7.4%.⁽¹³⁾ It is unknown if the preterm deliveries in our study were spontaneous
labours or not. It could be possible that patients with IUGR were induced prior to 37 weeks,
thus explaining this difference. Furthermore, patients who delivered preterm also had less
time to gain weight, which would make it more likely that they were classified as having
insufficient weight gain. Grandfils *et al.*⁽¹⁸⁾ found patients with insufficient GWG to be at an
increased risk for preterm labour, and more specifically when compared to those patients
with excessive GWG. Stentebjerg *et al.*⁽¹⁷⁾ found no difference in the prevalence of preterm
deliveries between groups. In the review by Guelinckx *et al.*⁽²⁾, there also was no difference
in the prematurity rate in pregnancies after BS. Sheiner *et al.*⁽²³⁾ reported an increased risk
for premature rupture of the membranes.

37% of our patients were still considered overweight and 32% had residual levels of obesity,
despite having undergone BS. As weight regain is an important complication after BS,^(3, 10, 11)
focussing on possible precipitating factors is important. In our study we found patients with
excessive GWG to be at risk for additional weight gain in the postpartum period. However, in
a retrospective observational cohort of 232 women by Alatische *et al.*,⁽²⁴⁾ 24 women became
pregnant. At 30 months follow-up there was no difference in weight loss outcomes between
pregnant and non-pregnant patients. Similar data were found by Quynh Pham *et al.*⁽²⁵⁾ in
their retrospective cohort of 591 women, of whom 84 became pregnant. They found that in
general, pregnancy slows down postoperative weight loss, but does not affect weight results
at 5-years of follow-up. It should be noted that neither of these studies related their findings
to achieving the GWG-guidelines. As such it is possible that a subgroup of patients who did
gain weight are missed.

Our study represents obvious limitations. While this is to the best of our knowledge the largest reported prospective study in post-BS women, the sample size is too small to make definitive conclusions regarding guidelines to follow in this specific population as many factors like post-surgery BMI, type of surgery and surgery-pregnancy interval appear to also play a role. It is also not known if the weight gain existed primarily of muscle or fat mass. Despite this, our study shows convincing data on the association between insufficient GWG and poor outcome, including SGA. This is very useful information for care providers and patients. It should be recommended that weight is monitored at each antenatal visit in these patients. Also, intra-uterine growth scans should be part of antenatal care, especially in mothers gaining insufficient weight⁽²⁶⁾.

A third possible bias could be that the study took place over the course of several years. As such, possible changes in guidelines might influence pregnancy outcomes. However, all patients in this study are being monitored in line with the protocol of the study. No difference in follow-up of the patients was noticed over the time of recruitment.

5. Conclusion

Patients who get pregnant after BS only seldom achieve GWG within the recommendations of the IOM. Insufficient weight gain should be avoided as it increased the risk for SGA. Excessive weight gain is frequent and associated with postpartum weight retention and weight regain. Therefore, attaining the IOM guidelines appears to be the best recommendation in this group of patients for now. Gestational weight gain should be monitored during pregnancy, especially to detect insufficient weight gain or weight loss. Estimations of fetal weight should be used to detect IUGR and specialized follow-up should be provided for these patients. A multidisciplinary follow-up with specialized midwives,

dieticians and specialized obstetricians could be proposed to keep GWG within normal
 260 ranges.

6. Conflicts of Interest

The authors declare no conflicts of interest.

7. Legend

Abbreviations:

BMI	Body Mass Index
BPD	Biliopancreatic diversion
BS	Bariatric Surgery
GDM	Gestational diabetes mellitus
GWG	Gestational Weight Gain
IOM	Institute of Medicine
IUGR	Intrauterine growth restriction
LAGB	Laparoscopic adjustable Gastric Banding
LGA	Large-for-gestational-age
NICU	Neonatal Intensive Care Unit
PPWR	Postpartum Weight Retention
RYGB	Roux-en-Y Gastric bypass
SG	Sleeve Gastrectomy
SGA	Small-for-gestational-age
SPE	Centre for Perinatal Epidemiology

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Weight category	Recommended gestational weight gain
Underweight (BMI <18.5 kg/m ²)	12.5 – 18 kg
Normal weight (BMI 18.5 – 25 kg/m ²)	11.5 – 16 kg
Overweight (BMI 25 – 30 kg/m ²)	7 – 11 kg
Obese (BMI > 30 kg/m ²)	5 – 9 kg

Table 1: Institute of Medicine guidelines on gestational weight gain.⁽⁹⁾ Abbreviations: Body Mass Index (BMI)

	Underweight (BMI <18.5 kg/m²) (n = 1)	Normal weight (BMI 18.5-25 kg/m²) (n = 38)	Overweight (BMI 25-30 kg/m²) (n = 47)	Obese (BMI >30 kg/m²) (n = 41)	Total (n = 127)
GWG lower than IOM, n (%)	0 (0%)	14 (37%)	9 (19%)	7 (17%)	30 (24%)
GWG according to IOM, n (%)	0 (0%)	9 (24%)	9 (19%)	8 (20%)	26 (20%)
GWG higher than IOM, n (%)	1 (100%)	15 (39%)	29 (62%)	26 (63%)	71 (56%)

Table 1: Overview of adherence to Institute of Medicine guidelines per BMI category. Abbreviations: Body Mass Index (BMI); Gestational Weight Gain (GWG); Institute of Medicine (IOM).

		Lower than IOM (n=30)	According to IOM (n=26)	Higher than IOM (n=71)	p-value*
Age, years (SD)		29 (4)	29 (4)	30 (4)	0.14
Smoking, n (%)	NA = 7	6 (21%)	4 (16%)	12 (18%)	0.91
Type of surgery, n (%)	LAGB	4 (13%)	2 (8%)	15 (21%)	0.09**
	RYGB	26 (87%)	21 (81%)	47 (66%)	
	BPD	0 (0%)	1 (4%)	2 (3%)	
	SG	0 (0%)	2 (8%)	7 (10%)	
Nulliparous, n (%)		10 (33%)	9 (35%)	23 (32%)	0.98
Presurgery BMI, kg/m ² (SD)		41 (6)	42 (8)	44 (8)	0.20
Maximum weight loss, kg (SD)		40 (10)	47 (15)	47 (18)	0.09
Preconception BMI, kg/m ² (SD)		28 (7)	28 (5)	29 (5)	0.40
% Excess weight loss at conception		90 (28)	81 (34)	80 (25)	0.26
% Total body weight loss at conception		33 (10)	33 (14)	33 (11)	0.98
Weight category at conception, n (%)	Underweight	0 (0%)	0 (0%)	1 (1%)	0.28
	Normal weight	14 (47%)	9 (35%)	15 (21%)	
	Overweight	9 (30%)	9 (35%)	29 (41%)	
	Obese	7 (23%)	8 (31%)	26 (37%)	
Surgery-to-conception interval	Months (SD) NA = 2	47 (40)	47 (35)	57 (41)	0.34
	>18 months (%)	19 (63%)	20 (77%)	57 (80%)	0.19
GWG, kg (SD)		5 (4)	10 (3)	17 (5)	<0.001

PPWR at 6 weeks, kg (SD, n)	NA = 33	-3 (6, n=17)	3 (8, n=15)	7 (5, n=43)	<0.001
PPWR at 6 months, kg (SD, n)	NA = 95	-6 (6, n=10)	0 (2, n=5)	8 (8, n=17)	<0.001
Gestational age at delivery, weeks (SD)		38 (2)	39 (1)	39 (2)	0.20
Preterm delivery <37w, n (%)		7 (23%)	2 (8%)	5 (7%)	0.048
Preterm delivery <34w, n (%)		0 (0%)	0 (0%)	1 (1%)	0.67
Delivery method, n (%)	Uncomplicated vaginal	24 (80%)	21 (81%)	47 (66%)	0.68
	Assisted vaginal	2 (7%)	2 (8%)	8 (11%)	
	Primary caesarean	2 (7%)	1 (4%)	10 (14%)	
	Secondary caesarean	2 (7%)	2 (8%)	6 (8%)	
Birth weight, g (SD)		2838 (446)	3189 (402)	3328 (489)	<0.001
SGA, n (%)		14 (47%)	4 (15%)	9 (13%)	<0.001
LGA, n (%)		0 (0%)	1 (4%)	6 (8%)	0.21
Macrosomia, n (%)		0 (0%)	1 (4%)	7 (10%)	0.15
Male sex, n (%)		12 (40%)	15 (58%)	42 (59%)	0.20
Gestational diabetes, n (%)	NA = 6	8 (31%)	6 (24%)	15 (21%)	0.64
Gestational hypertension, n (%)	NA = 2	1 (3%)	2 (8%)	4 (6%)	0.77

Table 1: Pregnancy outcomes according to adherence to Institute of Medicine-guidelines. Values presented as mean (SD), or n (%). Abbreviations: Institute of Medicine (IOM); Standard deviation (SD); Laparoscopic adjustable gastric banding (LAGB); Roux-en-Y gastric bypass (RYGB); Billiopancreatic Diversion (BPD); Sleeve Gastrectomy (SG); Body Mass Index (BMI); Gestational Weight Gain (GWG); Postpartum Weight Retention (PPWR); Small for Gestational Age (SGA); Large for Gestational Age (LGA). *values in bold are deemed significant after correction for multiple comparisons ($p < 0.002$). **Result of chi-squared test comparing RYGB and BPD vs. SG and LAGB. Surgery types were grouped due to small numbers in the BPD-group.

Figure 1: Birth weight in relation to gestational age at delivery. The solid lines represent cut-offs for the 10th and 90th percentile of the SPE data. The symbols describe the relationship to Institute of Medicine-guidelines (IOM), with circles (●) representing lower-than-recommended weight gain, triangles (▲) represent normal weight gain and squares (■) representing higher-than recommended weight gain.

Figure 1: Postpartum weight retention (PPWR) at 6 weeks and 6 months in patients grouped according to adherence to Institute of Medicine-guidelines (IOM)

Highlights

- Adherence to IOM guidelines is low in post-bariatric pregnant women
- Insufficient weight gain increases the risks for small-for-gestational-age infants
- Excessive weight gain could precipitate weight retention