



Published in final edited form as:

*Int J Eat Disord.* 2011 July ; 44(5): 428–434. doi:10.1002/eat.20835.

## Gestational Weight Gain of Women with Eating Disorders in the Norwegian Pregnancy Cohort

Anna Maria Siega-Riz<sup>1,2</sup>, Ann Von Holle<sup>4</sup>, Margaretha Haugen<sup>5</sup>, Helle Margrete Meltzer<sup>5</sup>, Robert Hamer<sup>3,4</sup>, Leila Torgersen<sup>6</sup>, Cecilie Knoph Berg<sup>6</sup>, Ted Reichborn-Kjennerud<sup>6,7,8</sup>, and Cynthia M Bulik<sup>2,4</sup>

<sup>1</sup>Department of Epidemiology, Gillings School of Global Public Health, The University of North Carolina at Chapel Hill, North Carolina

<sup>2</sup>Department of Nutrition, Gillings School of Global Public Health, The University of North Carolina at Chapel Hill, North Carolina

<sup>3</sup>Department of Biostatistics, Gillings School of Global Public Health, The University of North Carolina at Chapel Hill, North Carolina

<sup>4</sup>Department of Psychiatry, School of Medicine, The University of North Carolina at Chapel Hill, North Carolina

<sup>5</sup>Division of Environmental Medicine, Norwegian Institute of Public Health, Norway

<sup>6</sup>Division of Mental Health, Norwegian Institute of Public Health, Norway

<sup>7</sup>Institute of Psychiatry, University of Oslo, Norway

<sup>8</sup>Department of Epidemiology, Columbia University, New York

### Abstract

**Objective**—To examine the amount of weight women with eating disorders (anorexia nervosa (AN), bulimia nervosa (BN), and binge eating disorder (BED)) gained during pregnancy and to evaluate the adequacy of total weight gain.

**Methods**—Data from the Norwegian Mother and Child Cohort Study were used in a cross-sectional manner,  $n=35,148$ . Descriptive statistics and Generalized Estimating Equations to calculate the relative risk estimates were employed.

**Results**—Mean gestational weight gain for the entire sample was 2.5 kg at 17.0–20.1 weeks gestation, 9.3 kg at 27.4–29.7 weeks gestation and 15.0 kg at delivery. Women with BN and BED gained significantly more weight on average than those with no eating disorders at each time point. Women with AN had a lower risk (AOR= 0.65 (0.24, 1.72) of gaining inadequately while women with BN and BED were more likely to gain excessively, AOR=1.09 (1.01, 1.18) and 1.11 (1.08, 1.14) respectively.

**Discussion**—The pattern of weight gain identified for each eating disorder subtype may help explain the birth outcomes of women with eating disorders.

---

Pregnancy is a time period of many physiological and metabolic changes which usually ensures that a woman gains weight during gestation. How much weight is gained has been noted to vary by not only biological factors such as pregravid weight status and amount and type of food ingested, but also by cultural norms and psychological factors.<sup>1-7</sup> Most women have a positive attitude about gaining weight during pregnancy<sup>8,9</sup> but for some, a negative weight gain attitude has been associated with inadequate weight gain during pregnancy.<sup>10</sup> By virtue of their illness, women with eating disorders are preoccupied with their weight status. The pregnancy state can exacerbate these preoccupations as inevitable changes in body shape and weight may intensify the pathognomonic fear of weight gain.<sup>11</sup>

Both low and high gestational weight gain during pregnancy have been associated with several adverse pregnancy outcomes. A recent systematic evidence based review concluded that there was strong to moderate evidence for the association between low gestational weight gain and low birth weight, small-for-gestational age, and preterm birth, while high weight gain was associated with macrosomia, large-for-gestational age, cesarean delivery, and postpartum weight retention.<sup>12</sup> A few of these same outcomes have been associated with women with eating disorders (i.e., cesarean delivery, low birth weight, small for gestational age, and preterm birth).<sup>13-17</sup>

There is a paucity of information on the amount of weight women with various eating disorders gain during pregnancy. Clinical practice guidelines focused on women with eating disorders suggest that weight gain may be inadequate for women with anorexia nervosa<sup>18</sup> but to date there is no population based study demonstrating the amount of weight gained by women with eating disorders compared to women with none. The Avon Longitudinal Study of Parents and Children reported on behaviors and attitudes of women with eating disorders.<sup>19</sup> The authors showed that women with a past history and recent episode of eating disorders had higher use of laxatives and self-induced vomiting during the first half of pregnancy compared to normal weight non-eating disordered women, and at 32 weeks gestation, women with eating disorders were more likely to report dieting for weight loss which could influence weight gain; however, no information on weight gain was provided.<sup>19</sup>

This study sought to examine the amount of weight women with eating disorders, specifically anorexia nervosa (AN), bulimia nervosa (BN), eating disorders not otherwise specified purging subtype (EDNOS-P), and binge eating disorder (BED) gained during pregnancy at various gestational ages and to evaluate the adequacy of total weight gain using the 1990 Institute of Medicine (IOM)<sup>20</sup> guidelines for weight gain (12–18 kg for underweight, 11.3–16 kg for normal weight, 6.8–11.3 kg for overweight, and at least 6.8 kg for obese women) compared to women with no eating disorders in a population based study conducted in Norway. There is no global recommendation for weight gain during pregnancy and in Norway, women are told to gain approximately 10 to 15 kg (22 to 33 lbs) with overweight and obese women instructed to gain at the lower end of the range.<sup>21</sup> Since the IOM guidelines are more specific to pregravid weight status and the definition of eating

disorders is dependent on weight status, we felt it was appropriate to use these guidelines in evaluating adequacy of weight gain.

## Methods

### Design

The data collection was conducted as part of the Norwegian Mother and Child Cohort Study (MoBa) at the Norwegian Institute of Public Health.<sup>22</sup> MoBa is population-based cohort study in which pregnant women are recruited to the study by postal invitation after they have signed up for the routine ultrasound examination in their local hospital, usually around 18 weeks gestation. Participants are asked to provide biological samples and to answer questionnaires covering a wide range of information; three questionnaires during pregnancy (Questionnaire #1–3) and four during the infant's early childhood (Questionnaire #4–7). The cohort database is linked to the Medical Birth Registry of Norway (MBRN) in order to obtain information on the course and outcome of the pregnancy.<sup>23</sup>

The study has been approved by the University of North Carolina, School of Medicine Institutional Review Board, the appropriate regional committees for ethics in medical research and the Norwegian National Data Inspectorate.

### Subjects

This analysis is based on version 3 of the quality-assured data files released in 2007. Overall, from 1999–2006, the participation rate in MoBa was approximately 43%. Our sample included MoBa participants who: a) had a pregnancy identifier from MoBa Questionnaires 1, 3, and 4 and the MBRN, b) had a gestational age between 20 and 44 weeks, c) had a gestational weight change between –10 and 50 kg for Questionnaires 3 and 4, d) had weight values between 30 and 300 kg for Questionnaires 3 and 4, e) did not complete an early pilot version of Questionnaire 1 (n=2,599), f) had valid pre-pregnancy values for self-reported age, weight, and height, g) returned Questionnaire 1 before delivery, h) had a singleton live birth, and i) had a non-missing eating disorder subtype and self-reported age before pregnancy. If a woman enrolled in MoBa more than once (due to additional pregnancies), only the first pregnancy was included. Of the initial 74,200 mother-child records reported in MoBa, 35,148 (47.3%) met the criteria above and were included in this analysis.

### Definition and Classification of Eating Disorder Groups

Information for the categorization of women into eating disorders subtypes came from Questionnaire 1 and included items that were previously used for studies of eating disorders in the Norwegian Institute of Public Health Twin Panel<sup>24–27</sup> and were designed in accordance with the Diagnostic and Statistical Manual of Mental Disorders, 4<sup>th</sup> edition (DSM-IV).<sup>28</sup> Diagnostic algorithms and hierarchies were constructed from the questionnaire items to define the presence of eating disorders in the six months prior to pregnancy and/or during pregnancy. Our final categories included: broadly defined AN, defined as meeting DSM-IV criteria for AN (with the exception of amenorrhea); broadly defined BN, endorsing at least weekly frequency of binge eating and either purging (vomiting, laxatives) or non-

Author Manuscript  
Author Manuscript  
Author Manuscript

purging (exercise, fasting) compensatory behaviors; EDNOS-P, purging at least weekly in the absence of binge eating, and broadly defined BED, at least weekly frequency of binge eating in the absence of compensatory behaviors. Questions for binge eating included both eating an unusually large amount of food and the feeling of loss of control. Purging was assessed specifically to be differentiated from nausea and vomiting of pregnancy. As the symptom picture for many women changed in the interval before pregnancy and during pregnancy, the order for our diagnostic hierarchy was: AN, BN, EDNOS-P, BED, and no eating disorder. All individuals who met AN criteria before pregnancy were categorized as AN regardless of presentation during pregnancy. Those who met BN criteria either before or during pregnancy and who did not meet AN criteria prior to pregnancy were categorized as BN. If not classified as AN or BN, those who met criteria for EDNOS-P before or during pregnancy *and* did not endorse binge eating at either time were categorized as EDNOS-P. Similarly, individuals who endorsed BED and did not endorse purging during or before pregnancy were included in the BED group. Group assignment was consistent with previous reports from this cohort and was only made when all responses were available to ensure accurate classification.<sup>29</sup>

### Collection and Classification of Gestational Weight Gain

Women self-reported their pregravid weight and height at Questionnaire 1 and then weight during pregnancy at Questionnaire 3 and total weight gained at Questionnaire 4 which were administered around the beginning of the third trimester and 6 months postpartum respectively. The information from Questionnaire 1 was used to calculate pregravid body mass index (BMI, kg/m<sup>2</sup>). Women were categorized into BMI categories based on the World Health Organization (WHO) cut points: BMI <18.5 kg/m<sup>2</sup> (underweight); 18.5–24.99 kg/m<sup>2</sup> (normal weight); 25.0–29.99 kg/m<sup>2</sup> (overweight); and ≥30 kg/m<sup>2</sup> (obese).<sup>30</sup> Weight gain during pregnancy was calculated using maternal reported weight before pregnancy from Questionnaire 1 subtracted from the weight reported at Questionnaires 3 and 4.

Weight gain ratio, according to pregravid BMI status, was calculated as a ratio of observed weight gain over expected weight gain up until the time of completion of the questionnaire or the date of delivery for questionnaire 4 using the weight gain recommendations from the 1990 IOM report as previously described.<sup>5,31</sup> The 1990 IOM guidelines were used since they were in existence at the time and by combining them with the WHO BMI cut points they are similar to the new recommendations with the exception of the range for obese women.<sup>32</sup> This methodology adjusts for the differences in gestational age at the time the weight was self-reported or of delivery. A categorical variable of inadequate, adequate, or excessive weight gain was then created with adequacy defined based on predetermined ranges specific to prepregnancy BMI weight status groupings.<sup>5,31</sup>

Covariates included self-reported smoking during pregnancy (coded as a dichotomous yes/no variable), household income, education, parity (defined as total number of live births), maternal age, gestational diabetes, pregnancy induced hypertension and hyperemesis. With the exception of maternal age, gestational diabetes, pregnancy induced hypertension and hyperemesis which were from the MBRN all other covariates originated

from the first MoBa maternal questionnaire. Detailed descriptions on how the information on the covariates was obtained can be found in previous publications.<sup>22, 23</sup>

### Statistical Analysis

Data from the MoBa cohort for these analyses are used in a cross-sectional manner. Analysis included generation of study sample descriptive statistics; means, standard errors and frequencies were calculated for the entire sample and by eating disorder categories. For the analysis involving weight gain at time of Questionnaire 1 and 3, we limited the data to women who had an observation in the inter-quartile range of gestational age. For Questionnaire 1 this pertained to 17.0 to 20.1 weeks' gestation and for Questionnaire 3, 27.4 to 29.7 weeks' gestation. Lastly, for Questionnaire 4 which asked the women to report the total amount of weight gained during the pregnancy, we included values for gestational age greater than or equal to 33 weeks at birth. Statistical tests of weight gain differences, at each gestational time point for the eating disordered women (BN and BED) versus the no eating disorder group, were done using an analysis of covariance. The model included weight at the time point of interest as the response variable and pre-pregnancy BMI and eating disorder groups as covariates.<sup>33</sup> We did not perform testing for the AN or EDNOS-P groups because of their small sample size (ranging from 15 to 30 women). We then created models for total weight gain using Poisson regression and Generalized Estimating Equations with robust variance estimation to calculate the relative risk of gaining inadequate and excessive separately, compared to non-eating disordered women who gained adequately. Confounders considered in the models included pre-pregnancy BMI, maternal age at delivery, education, income, pregnancy induced hypertension, and gestational diabetes. We adjusted for confounding using the 10% criteria for a change in the estimate. If a confounder was found to change the estimate for any of the eating disorder variables by 10 percent or more then it was retained for the final model. Data analysis was done using SAS/STAT® software for Windows and AIX (Version 9. Cary, NC: SAS Institute, Inc 2004).

### Results

The sample represented in this analysis (n=35,148 ) includes pregnant women with a mean age of 30 years (SE= 0.024) at the time of delivery, 50.6% were primiparous, 50.1% reported being married, 95.3% spoke Norwegian as their native language, 56.9 % had a combined minimum income of EUR \$21–52,500 for the mother and father (if present) and 8.2% <EUR \$21,000, and 37.7% had less than or equal to a high school education, 42.4% 13–16 years of education, and 19.9% >16 years of education. Eighty-five percent reported being employed in the private or public sectors, 6% reported being at home, and 9% indicated “other” for their employment status. Using the WHO guidelines to define pregravid weight status, 3.0% of the women were classified as underweight, 65.3% as normal, 22.3% as overweight, and 9.4% as obese. Almost half of the women reported any lifetime smoking, with 9.4% reporting smoking during pregnancy. Ninety-four percent of the women were classified as having no eating disorders either prior to or during pregnancy, while 0.1%, 0.8%, 0.1%, and 5.1% were classified as having AN, BN, EDNOS-P, and BED respectively.

Compared to women who gave birth in Norway during this same time period,<sup>34</sup> we find that our sample of 35,148 has a higher percent of women age >34 (21.8% vs 16.3%), more primiparous (49.6% vs 40.9%), smaller percent of preterm deliveries (5.2% vs 7.5%), smaller percent of LBW (3.1% vs 5.1) and a higher mean birthweight (3603 vs 3528 gms).

Mean gestational weight gain at the time of Questionnaire 1, 3 and at delivery for the entire sample and by eating disorder group is shown in Table 1. Mean gestational weight gain for the entire sample was 2.5 kg at 17.0–20.1 weeks' gestation, 9.3 kg at 27.4–29.7 weeks' gestation and 15.0 kg at delivery. Women with BN and BED gained significantly more weight on average than those with no eating disorders at each time point. While it appears that AN women gain the most we were not able to test for significance due to the small sample size.

Results for adequacy of total weight gain by eating disorder group showed that in the no eating disorder referent group, 24.0% of the women gained inadequately, a quarter gained adequately, and the remaining 50.3% gained excessively. For women with AN, 21.9% gained inadequately, while 28.1% gained adequately, and 50% gained excessively. Among women classified as BN, 20.0% gained inadequately, 20.4% adequately, and 59.7% excessively. For women with EDNOS-P, 19.4% gained inadequately, 25.8% gained adequately, and slightly more than half of the women gained excessively. For women with BED, 17.6% gained inadequately, 17.1% adequately, and a 65.3% gained excessively.

Table 2 presents the results of our modeling for the effect of eating disorders on adequacy of weight gain. Two models were built independently, one for inadequate compared to adequate and the other for excessive compared to adequate. In both models women with no eating disorders were the referent category. Women with AN had a 35% lower risk of gaining inadequately during pregnancy controlling for pre-pregnancy BMI; however, given the sparse number of women with this eating disorder, the confidence intervals are wide and included the null. A similar pattern was seen for women the EDNOS-P; while there appeared to be no association with inadequate weight gain for women with BN and BED. In contrast, women with BN and BED were 9% and 11%, respectively, more likely to gain excessively compared to women with no eating disorders controlling for pre-pregnancy BMI and maternal income.

## Discussion

In this population based sample from Norway, women with eating disorders gained on average more weight than those with no eating disorders with significant differences existing for BN and BED women relative to women without eating disorders. When evaluating adequacy of weight gain, women with BN and BED were at a greater risk of gaining excessively compared to those with no eating disorders. In contrast to what was expected, women with AN were less likely to gain inadequately although this finding was not statistically significant. Overall, the proportion of women gaining adequately among those with no eating disorder was lower than that seen in the US published literature (25% vs 33%) while the proportion gaining excessively (49.2%) was similar in this Norwegian cohort.<sup>12,35</sup>

It is important to note that women with AN started at a lower pre-pregnancy weight and therefore are expected to gain more weight during pregnancy. Thus, the fact that they had a high percentage of excessive weight gain and the trend of a lower risk of inadequate weight gain relative to the referent may be appropriate and protective. In a previous analysis we did not find an effect of AN on birth outcomes adjusting for several factors including pre-pregnancy BMI and gestational weight gain.<sup>29</sup> This lack of an effect may also be explained by the inclusion of individuals with less severe AN in this population.

On the other hand, women with BED started pregnancy at a higher pre-pregnancy weight compared to non-eating disordered women and they were at greater risk of gaining excessively. These two risk factors puts them at higher risk of having a cesarean delivery and a large for gestational age infant as well as a lower risk of having a small for gestational age infant as previously shown.<sup>29</sup> In contrast women with BN had a pre-pregnancy BMI similar to that of non eating disordered women but they gained more weight and had a small increased risk of gaining excessively. This higher weight gain by women with BED and BN may be the result of their eating pathology; we have previously shown that binge eating persists in many women with BED and BN during pregnancy<sup>36</sup> and, that they had higher intakes of total energy and higher total mono-saturated and saturated fat than women without eating disorders.<sup>37</sup> Other pregnancy cohort studies not related to eating disorders have also shown higher weight gains being associated with higher energy density in the diet<sup>5</sup>, higher total calories as well as milk and sugar intake.<sup>6</sup> In addition, normal, overweight and obese women who can be characterized as restrained eaters prior to becoming pregnant have also been shown to gain more weight during pregnancy than those who are not characterized as such.<sup>38</sup>

The findings of this study must be taken into account within the context of its strengths and limitations. First, our diagnostic questions and questions about weight gain during pregnancy and pre-pregnancy BMI were based on maternal self-report. Although we used questions that reflected DSM-IV criteria, direct interviews may have yielded richer diagnostic information. In addition, while self-reported weights have been shown to be reliable, there is a tendency for overweight and obese women to underestimate their weights<sup>39-41</sup> and inaccurate estimation may be even more problematic among women with eating disorders.<sup>42</sup> This underestimation if operative both for pregravid weight and weight at each survey time including that associated with delivery, would not have resulted in the overestimation of total weight gain. It would have only biased the results if women under-reported their pregravid weight but then over-estimated the weight at each survey or at the end of pregnancy. We do not have information to sort out if this bias existed. Second, we employed frequency criteria for binge eating and purging which differ from current DSM-IV criteria; however, the established criteria have not been empirically supported and continue to be questioned.<sup>43</sup> Third, 43% of women invited agreed to participate in MoBa and although this response rate is low, it is typical for large epidemiologic studies and recent analysis has shown that while prevalence estimates of exposures and outcomes may be biased, estimates of exposure-outcome associations are not.<sup>34</sup> Moreover, given the considerable effort required to participate in the various waves of the MoBa protocol, the women with eating disorders who participate may represent the healthier end of the eating disorder severity spectrum. An alternative explanation could also be, that those women with

eating disorders, who have live births, and choose to participate in MoBa may be particularly motivated to adequately nourish their unborn child contributing to excess weight gain in bulimia nervosa and binge eating disorder and adequate weight gain in anorexia nervosa.

Nevertheless, there are many strengths of this study including the prospective and longitudinal study design which collected information on many potential confounders; the large sample size that is needed to study rare diseases such as eating disorders; the ability to link with the Norwegian Birth Registry data, and lastly the high retention rate of mothers across waves of assessment (85%) that yields low drop-out rates for the cohort and reduces potential sources of participant bias.

In summary, in the Norwegian Mother and Child Cohort, women with BN and BED gained more weight during pregnancy than non-eating disordered women and this weight gain is excessive when using the IOM guidelines to define adequacy of weight gain which may explain their increased risk of having adverse birth outcomes such as cesarean deliveries and large-for-gestational age infants. Women with AN tended to gain more weight as would be expected given their lower pre-pregnancy weight, and this adequate gain appears to be protective against adverse birth outcomes.

## Acknowledgments

This research was supported by the National Institutes of Health Grants (HD047186, NIDDK56350) and the MoBa study is supported by the Norwegian Ministry of Health, NIH/NIEHS (N01 - ES - 85433), NIH/NINDS (1 UO1 NS 047537-01) and Norwegian Research Council/FUGE (151918/S10).

## References

1. Siega-Riz AM, Evenson KR, Dole N. Pregnancy-related weight gain--a link to obesity? *Nutrition Reviews*. 2004; 62:S105–11. [PubMed: 15387475]
2. Stotland NE, Haas JS, Brawarsky P, Jackson RA, Fuentes-Afflick E, Escobar GJ. Body Mass Index, Provider Advice, and Target Gestational Weight Gain. *Obstet Gynecol*. 2005; 105:633–638. [PubMed: 15738036]
3. Strychar IM, Chabot C, Champagne F, et al. Psychosocial and lifestyle factors associated with insufficient and excessive maternal weight gain during pregnancy. *J Am Diet Assoc*. 2000; 100(3): 353–356. [PubMed: 10719411]
4. Olson CM, Strawderman MS. Modifiable behavioral factors in a biopsychosocial model predict inadequate and excessive gestational weight gain. *J Am Diet Assoc*. 2003; 103:48–54. [PubMed: 12525793]
5. Deierlein A, Siega-Riz AM, Herring A. Dietary energy density but not glycemic load is associated with gestational weight gain. *Am J Clin Nutri*. 2008; 88(3):693–9.
6. Olafsdottir AS, Skuladottir GV, Thorsdottir I, Hauksson A, Steingrimsdottir L. Maternal diet in early and late pregnancy in relation to weight gain. *Int J Obes*. 2006; 30(3):492–499.
7. Ohlin A, Rossner S. Factors related to body weight changes during and after pregnancy: the Stockholm Pregnancy and Weight Development Study. *Obes Res*. 1996; 4(3):271–276. [PubMed: 8732961]
8. Dipietro JA, Millet S, Costigan KA, Gurewitsch E, Caulfield LE. Psychosocial influences on weight gain attitudes and behaviors during pregnancy. *J Am Diet Assoc*. 2003; 103(10):1314–9. [PubMed: 14520249]
9. Stevens-Simon C, Nakashima I, Andrews D. Weight gain attitudes among pregnant adolescents. *J Adolesc Health*. 1993; 14(5):369–72. [PubMed: 8399248]



10. Palmer JL, Jennings GE, Massey L. Development of an assessment form: attitude toward weight gain during pregnancy. *J Am Diet Assoc.* 1985; 85(8):946–9. [PubMed: 4019986]
11. Ward VB. Eating Disorders in Pregnancy. *BMJ.* 2008; 336:93–96. [PubMed: 18187726]
12. Viswanathan, M.; Siega-Riz, AM.; Moos, M-K.; Deierlein, A.; Mumford, S.; Knaack, J.; Thieda, P.; Lux, LJ.; Lohr, KN. Outcomes of Maternal Weight Gain. RTI International–University of North Carolina Evidence-based Practice Center; Contract No. 290–02–0016
13. Bulik C, Sullivan P, Fear J, Pickering A, Dawn A, McCullin M. Fertility and reproduction in women with a history of anorexia nervosa: a controlled study. *J Clin Psychiatry.* 1999; 60:130–5. [PubMed: 10084645]
14. Treasure JL, Russell GFM. Intrauterine growth and neonatal weight gain in babies of women with anorexia nervosa. *BMJ.* 1988; 296:1038. [PubMed: 3130128]
15. Conti J, Abraham S, Taylor A. Eating behavior and pregnancy outcome. *J Psychosom Res.* 1998; 44:465–77. [PubMed: 9587889]
16. Kouba S, Hallstrom T, Lindholm C, Hirschberg A. Pregnancy and neonatal outcomes in women with eating disorders. *Obst Gynecol.* 2005; 105:255–60. [PubMed: 15684148]
17. Sollid CP, Wisborg K, Hjort J, Secher NJ. Eating disorder that was diagnosed before pregnancy and pregnancy outcome. *Am J Obstet Gynecol.* 2004; 190:206–10. [PubMed: 14749661]
18. Franko DL, Spurrell EB. Detection and management of eating disorders during pregnancy. *Obstet Gynecol.* 2000; 95:942–46. [PubMed: 10831998]
19. Micali N, Treasure J, Simonoff E. Eating disorders symptoms in pregnancy: A longitudinal study of women with recent and past eating disorders and obesity. *J Psychosomatic Res.* 2007; 63:297–303.
20. Institute of Medicine. Part I Weight gain. Washington, DC: National Academy Press; 1990. Nutrition during pregnancy.
21. A National Clinical Guideline for Antenatal Care. Directorate for Health and Social Affairs; Norway: [http://www.shdir.no/vp/multimedia/archive/00016/IS-1339\\_Engelsk\\_16536a.pdf](http://www.shdir.no/vp/multimedia/archive/00016/IS-1339_Engelsk_16536a.pdf)
22. Magnus P, Irgens LM, Haug K, Nystad W, Skjærven R, Stoltenberg C, et al. Cohort profile: The Norwegian Mother and Child Cohort Study (MoBa). *Int J Epidemiol.* 2006
23. Irgens LM. The Medical Birth Registry of Norway. Epidemiological research and surveillance throughout 30 years. *Acta Obstet Gynecol Scand.* 2000; 79:435–39. [PubMed: 10857866]
24. Harris J, Magnus P, Tambs K. The Norwegian Institute of Public Health Twin Panel: a description of the sample and program of research. *Twin Res.* 2002; 5:415–23. [PubMed: 12613498]
25. Reichborn-Kjennerud T, Bulik C, Kendler K, Maes H, Roysamb E, Tambs K, Harris J. Gender differences in binge-eating: A population-based twin study. *Acta Psychiatr Scand.* 2003; 108:196–202. [PubMed: 12890274]
26. Reichborn-Kjennerud T, Bulik C, Kendler K, Roysamb E, Tambs K, Harris J, Torgeson S. Influence of weight on self-evaluation: A population-based study of gender differences. *Intern J of Eat Disord.* 2004; 35:123–32.
27. Reichborn-Kjennerud T, Bulik C, Tambs K, Harris J. Genetic and environmental influences on binge eating in the absence of compensatory behaviours: a population-based twin study. *Intern J of Eat Disord.* 2004; 36:307–314.
28. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders. 4. Washington, D.C: American Psychiatric Association Press; 1994.
29. Bulik C, Von Holle A, Siega-Riz AM, Lie KK, Torgersen L, Hammer R, Berg CK, Sullivan P, Reichborn-Kjennerud T. Birth Outcomes in Women with Eating Disorders in the Norwegian Mother and Child Cohort Study(MoBa). *Intern J of Eat Disord.* 2009; 42(1):9–18.
30. World Health Organization. Obesity: preventing and managing the global epidemic. Geneva, Switzerland: World Health Organization; 2000. WHO technical report series 894
31. Siega-Riz AM, Adair LS, Hobel CJ. Institute of Medicine maternal weight gain recommendations and pregnancy outcome in a predominantly Hispanic population. *Obstet Gynecol.* 1994; 84(4): 565–73. [PubMed: 8090394]
32. IOM (Institute of Medicine). Weight Gain During Pregnancy: Reexamining the Guidelines. Washington, DC: The National Academies Press; 2009.

33. Fitzmaurice G. A conundrum in the analysis of change. *Nutrition*. 2001; 17:360–361. [PubMed: 11369183]
34. Nilsen RM, Vollset SE, Gjessing HK, Skjaeven R, Melve KK, Schreuder P, et al. Self-selection and bias in a large prospective pregnancy cohort in Norway. *Paed Perinat Epidemiol*. 2009; 23:597–608.
35. Institute of Medicine. *Influence of Pregnancy Weight on Maternal and Child Health: Workshop Report Committee on the Impact of Pregnancy Weight on Maternal and Child Health*. Washington, DC: National Academy Press; 2007.
36. Bulik C, Von Holle A, Hammer R, Berg CK, Torgersen L, Magnus P, Stoltenberg C, Siega-Riz AM, Sullivan P, Reichborn-Kjennerud T. Patterns of remission, continuation, and incidence of eating disorders during early pregnancy in the Norwegian Mother and Child Cohort Study (MoBa). *Psychological Medicine*. 2007 Aug; 37(8):1109–18. [PubMed: 17493296]
37. Siega-Riz A, Haugen M, Meltzer HM, Von Holle A, RMH, Torgersen L, et al. Nutrient and food group intakes of women with and without bulimia nervosa and binge eating disorder during pregnancy. *Am J Clin Nutr*. 2008; 87:1346–55. [PubMed: 18469258]
38. Mumford S, Siega-Riz AM, Herring A, Evenson K. Dietary Restraint and Gestational Weight Gain. *J Am Diet Assoc*. 2008; 108(10):1646–53. [PubMed: 18926129]
39. Brunner Huber LR. Validity of self-reported height and weight in women of reproductive age. *Matern Child Health J*. 2007; 11:137–144. [PubMed: 17066316]
40. Engstrom JL, Paterson SA, Doherty A, Trabulsi M, Speer KL. Accuracy of self reported height and weight in women: An integrative review of the literature. *J Midwifery and Women's Health*. 2003; 48(5):338–345. [PubMed: 14526347]
41. Rowland ML. Self Reported weight and height. *Am J Clin Nutr*. 1990; 52:1125–1133. [PubMed: 2239790]
42. Conley A, Boardman JD. Weight overestimation as an indicator of disordered eating behaviors among young women in the United States. *Int J Eat Disord*. 2007 Jul; 40(5):441–5. [PubMed: 17497706]
43. Sullivan PF, Bulik CM, Kendler KS. The epidemiology and classification of bulimia nervosa. *Psychol Med*. 1998; 28:599–610. [PubMed: 9626716]

Maternal pre-pregnancy BMI and weight gain at Questionnaire 1 (range 17.1–20.1 gestational weeks), Questionnaire 3 (range 27.4–29.7 gestational weeks), and at delivery for women in the Norwegian Mother and Child Cohort by eating disorder group.

**Table 1**

| Eating Disorder Category           | Pre-pregnancy BMI (weight, kg/<br>height, m <sup>2</sup> ) | Weight gain at 17.0–20.1 weeks (kg) | Weight gain at 27.4–29.7 weeks (kg) | Total weight gain for deliveries >33<br>weeks gestational age (kg) |           |
|------------------------------------|--|-------------------------------------|-------------------------------------|--|-----------|
| N                                  | Mean (SE)  | N                                   | Mean (SE)                           | N  | Mean (SE) |
| Anorexia Nervosa                   | 32<br>18.1 (0.1)   | 15<br>5.5 (1.0)                     | 15<br>12.6 (1.4)                    | 30<br>17.3 (1.0)   |           |
| Bulimia Nervosa <sup>a</sup>       | 275<br>24.3 (0.3)  | 118<br>3.9 (0.3)                    | 143<br>10.9 (0.3)                   | 265<br>16.6 (0.4)  |           |
| EDNOS-P <sup>b</sup>               | 31<br>24.0 (0.9)   | 15<br>2.9 (0.9)                     | 17<br>11.1 (1.6)                    | 29<br>17.0 (1.3)   |           |
| Binge Eating Disorder <sup>d</sup> | 1,737<br>26.0 (0.1)  | 816<br>3.2 (0.1)                    | 863<br>10.2 (0.2)                   | 1,647<br>16.6 (0.2)  |           |
| No Eating Disorder                 | 32,311<br>24.0 (0.02)                                      | 15,743<br>2.5 (0.02)                | 15,636<br>9.3 (0.03)                | 30,804<br>14.9 (0.03)  |           |
| All women                          | 34,386<br>24.1 (0.02)                                      | 16,707<br>2.5 (0.02)                | 16,674<br>9.3 (0.03)                | 32,775<br>15.0 (0.03)  |           |

<sup>a</sup> Statistical tests of weight gain differences at each time point in BN and BED groups versus the no eating disorder group were done using an analysis of covariance controlling for pre-pregnancy BMI. All differences are significant at  $P < 0.0001$ .

<sup>b</sup> EDNOS-P= Eating Disorder Not Otherwise Specified, Purging Subtype

**Table 2**

Relative Risks and 95% Confidence Interval for adequacy of weight gain for women with eating disorders compared to women with no eating disorder.

| <b>Weight Gain Outcome</b>          | <b>Anorexia Nervosa</b> | <b>Bulimia Nervosa</b> | <b>EDNOS-p<sup>c</sup></b> | <b>Binge Eating Disorder</b> |
|-------------------------------------|-------------------------|------------------------|----------------------------|------------------------------|
| Inadequate vs adequate <sup>a</sup> | 0.65 (0.24, 1.72)       | 1.07 (0.88, 1.31)      | 0.75 (0.39, 1.45)          | 0.94 (0.87, 1.03)            |
| Excessive vs adequate <sup>b</sup>  | 1.24 (0.93, 1.65)       | 1.09 (1.01, 1.18)      | 0.99 (0.72, 1.37)          | 1.11 (1.08, 1.14)            |

<sup>a</sup> Controlled for pre-pregnancy BMI.

<sup>b</sup> Controlled for pre-pregnancy BMI and maternal income.

<sup>c</sup> EDNOS-P= Eating Disorder Not Otherwise Specified, Purging Subtype.