

Achieving the Recommended Gestational Weight Gain in High-Risk Versus Low-Risk Pregnancies

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ABSTRACT: **Background:** Abnormal gestational weight gain (GWG) has been associated with adverse outcomes for mothers and their offspring. **Objectives:** To compare the achievement of recommended GWG and lifestyle factors in women with high-risk versus normal-risk pregnancies. **Methods:** Pregnant women hospitalized in a gynecological and obstetrics department and pregnant women who arrived at a community clinic for a routine checkup were interviewed and completed questionnaires relating to weight gain and lifestyle factors (e.g., smoking, diet, exercise). Recommended GWG was defined by the American Congress of Obstetricians and Gynecologists (ACOG). **Results:** GWG higher than ACOG recommendations was reported by 52/92 women (57%) with normal pregnancies and by 43/86 (50%) with high-risk pregnancies. On univariate analysis, characteristics associated with greater GWG were: current or past smoking, age > 40 years, pre-gestational body mass index (BMI) > 25 kg/m², low fruit intake, and high snack intake. High-risk pregnancies were associated with pre-gestational BMI > 25 kg/m² (48% vs. 27%, *P* = 0.012), consumption of vitamins (84% vs. 63%, *P* = 0.001), avoidance of certain foods (54% vs. 21%, *P* = 0.015), receiving professional nutritionist consultation (65% vs. 11%, *P* = 0.001), and less physical activity (9% vs. 24%, *P* = 0.01). **Conclusions:** A minority of pregnant women met the recommended GWG. No difference was noted between normal and high-risk pregnancies. High-risk population tended to have a less healthy lifestyle. Counseling to follow a healthy, balanced diet should be recommended, regardless of pregnancy risk, with particular attention to women at high risk of extra weight gain.

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KEY WORDS: body mass index (BMI), exercise, gestational weight gain (GWG), nutrition, pregnancy

betes, and Cesarean delivery, as well as risks for offspring such as early mortality and morbidity, and obesity, and cardiovascular disease in adulthood [1-5]. Weight gain below the recommendation is associated with preterm birth, low birth weight, and growth restriction [5]. Recommendations for GWG published by the Israeli Ministry of Health (MOH) [1] are similar to those published by the U.S. Institute of Medicine (IOM) and the American College of Obstetricians and Gynecology [2]. The guidelines recommend weight gain during pregnancy based on pre-gestational body mass index (BMI): 11.5–17.0 kg if pre-gestational BMI is within the normal range (≥ 18.5 and ≤ 25 kg/m²), 12.5–18.0 kg if pre-gestational BMI is low (< 18.5 kg/m²), 7.0–11.5 kg/m² if pre-gestational BMI is high (> 25 and ≤ 30 kg/m²), and 5.0–9.0 kg/m² if pre-gestational BMI is very high (> 30 kg/m²). Many pregnant women do not reach the recommended weight gain [1,6-9].

The aim of this study was to compare weight gain during pregnancy of women with high-risk versus normal pregnancy. There can also be differences because of unhealthy lifestyle or due to the woman's health prior to pregnancy. We also investigated differences according to weight gain and according to pregnancy risk in characteristics of maternal lifestyle: smoking habits, exercise, diet, nutritional counseling, and alcohol consumption in addition to pregnancy factors: abortions, drugs, gestational diabetes, and hypertension.

PATIENTS AND METHODS

This study was approved by the ethics committees at Rambam Medical Center and Leumit Health Services. The study presents self-reported weight gain during pregnancy of two populations of pregnant women. The first population consists of pregnant women hospitalized in the obstetrics department of Rambam Medical Center. Most of these pregnancies were classified as high risk. The second population comprised pregnant women who attended a routine follow-up in a community outpatient clinic. Most of these pregnancies were classified as normal.

High-risk pregnancy was defined as the presence of one or more of the following conditions: diabetes, hypertension, bleeding, hyperemesis gravidarum, and preeclampsia [10]. For

Abnormal gestational weight gain (GWG) increases the risks for unfavorable pregnancy outcomes [1-4] such as preeclampsia, large for gestational age infants, gestational dia-

analysis, women were grouped according to high- and normal-risk pregnancy and not according to the clinic they attended. The women who participated in this study were in the third trimester at the time of the interview (2012–2015). They all gave written informed consent prior to participation. Women with missing information regarding their last menstruation, height, and weight were excluded from the study.

Participants were interviewed and completed a questionnaire that assessed information about GWG, BMI, age, chronic diseases including diabetes and hypertension, medications, smoking and alcohol consumption, exercise, and nutritional counseling during pregnancy. We also double checked the collected data in electronic charts. If a discrepancy was discovered, the woman was interviewed again.

STATISTICAL ANALYSIS

Data were analyzed for the cohort as a whole, according to GWG (as recommended, below recommendation, and above recommendation) and according to pregnancy risk (normal vs. high). Data were examined for normal distribution, and the appropriate statistical test was selected accordingly. Continuous and categorical parameters were compared between independent groups, using the independent Student's *t*-test and chi-square test, respectively. Correlations between continuous variables were tested using Spearman's correlation. $P < 0.05$ was considered statistically significant.

Pre-gestational BMI was defined as: normal range (18.5–25 kg/m²), low range (< 18.5 kg/m²), high range (>25 kg/m²), and very high range (> 30 kg/m²) [1-2]. The recommendations of the U.S. IOM and the Israeli MOH served to define recommended weight gain [1-2].

RESULTS

Overall, 269 women participated in the study. After excluding 91 women (31 high-risk, 60 normal pregnancy) for whom main data were missing (last menstruation, height, and weight), 178 were included in the analysis: 86 women in the high-risk group and 92 in the normal pregnancy group. The power analysis for 796 women in each group is 80. The age range was 21–47 years, the BMI range 15.1–39.9 kg/m². Medical and lifestyle information reported by the study participants is presented in Table 1. Overall, more than half of the pregnant women gained weight above the recommendation, 73% reported taking vitamins before the pregnancy, 17% exercised during the pregnancy, and 52% consulted with a clinical dietitian.

HIGH-RISK PREGNANCY VERSUS NORMAL PREGNANCY

There was no statistically significant difference between the normal and high-risk pregnancy groups in the proportions that gained more than the recommended weight (57% vs. 50%, $P > 0.05$). The high-risk group comprised a higher proportion

of women with high pre-gestational BMI than did the normal pregnancy group (48% vs. 27%, $P = 0.012$). Regarding nutritional habits, more women in the high-risk group consumed vitamins (84% vs. 63%, $P = 0.001$); avoided certain foods such as dairy, meat, gluten, sweets, or carbohydrates (54% vs. 21%, $P = 0.0015$); and received professional nutritional counseling (65% vs. 11%, $P = 0.001$). A smaller proportion of women in the high-risk group were engaged in physical activity before the pregnancy (9% vs. 24%, $P = 0.01$) [Figure 1].

GESTATIONAL WEIGHT GAIN AND BMI

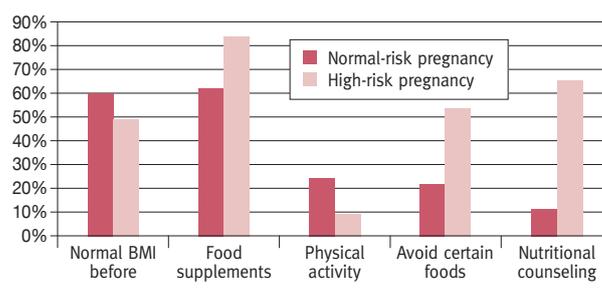
Table 2 displays weight gain according to pre-gestational BMI. Women with normal pre-gestational BMI tended to gain a weight according to recommendations compared to those with abnormal pre-gestational BMI ($P = 0.008$).

Table 1. Medical and lifestyle information reported by the study participants. Data are presented as mean \pm SD or as percentages (numbers)

	Total cohort	Normal pregnancy (N=92)	High-risk pregnancy (N=86)	P value (high-risk vs. normal pregnancy)
Age, years	31.7 \pm 5	30.8 \pm 7.7	31.5 \pm 5.3	–
BMI, kg/m ²	24.3 \pm 5.21	22.9 \pm 6.2	25.1 \pm 5.5	–
Vitamin consumption	73% (130)	63% (58)	84% (72)	0.001
Current/past smoking	31% (55)	45% (41)	17% (14)	0.001
Consumption of alcohol	34% (60)	40% (36)	30% (25)	0.261
Artificial abortion	17% (29)	22% (19)	12% (10)	0.215
Avoided certain foods	37% (65)	21% (19)	54% (46)	0.0015
Recommended weight gain	20% (36)	16% (15)	24% (21)	0.195
Weight gain above the recommendation	53% (95)	57% (52)	50% (43)	0.398
Professional nutritional consulting by nutritionist	27% (24)	11% (7)	65% (17)	0.001

BMI = body mass index

Figure 1. High-risk vs. normal pregnancy. Lifestyle factors are compared between women with high-risk and those with normal-risk pregnancies. Data are presented as percentages



BMI = body mass index

WEIGHT GAIN ACCORDING TO INTAKE OF FRUITS AND SNACKS

Of the entire cohort, 102 (61%) women reported consuming two or more fruits per day during the pregnancy. Data for fruit consumption were missing for 11 participants. A higher proportion of women who consumed two fruits daily gained the recommended weight than did women who consumed no or one fruit daily [Figure 2] ($P = 0.045$). Most (92, 58%) of the women reported not consuming snacks during the pregnancy, 67 (42%) reported consuming one or more snacks per day, and data were missing for 19. Consumption of snacks was associated with abnormal weight gain during pregnancy, $P = 0.025$ [Figure 2].

WEIGHT GAIN ACCORDING TO ARTIFICIAL ABORTION

A higher proportion of women who did not have artificial abortions, compared to women who had abortions, gained weight as recommended, 80% vs. 20% ($P = 0.029$).

WEIGHT GAIN ACCORDING TO AGE AND SMOKING

A higher proportion of women aged < 40 years gained weight as recommended than did women aged 40 years or above ($P = 0.015$).

Fifty-five (32%) women were current smokers or smoked in the past. Among women who gained weight as recommended, a higher proportion were non-smokers than smokers ($P = 0.014$).

DISCUSSION

This study showed associations of high-risk pregnancy with abnormal high BMI before pregnancy, consumption of vitamins, less exercise, avoidance of certain foods, and professional nutritional counseling. There was no difference between women with high- and normal-risk pregnancies, in achieving recommended weight gain.

Altogether, more than half of the participants in this study gained more than the recommended weight during pregnancy, and most were not involved in physical activity. In previous research [11], we reported associations of high weight gain during pregnancy with smoking (present or past), age above 40 years, and high pre-gestational BMI. In the current study we report additional factors that were associated with high weight gain, namely the lack of consumption of fruits and eating more snacks as well as artificial abortion. To the best of our knowledge, this is the first study to investigate these factors in Israel.

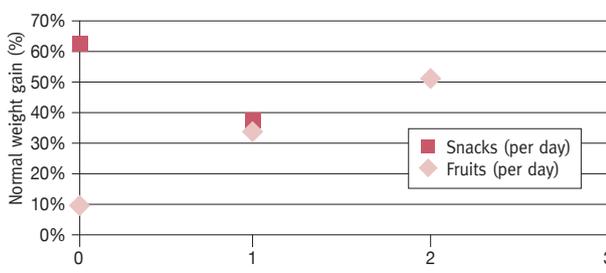
Others studies have reported more than the recommended weight gain during pregnancy for high proportions of women [1,7,9,12]. Moreover, our findings of associations of high-risk pregnancy with abnormal BMI values before pregnancy – consuming food supplements, engaging in less exercise, and avoiding certain foods – concur with other publications [13-16]. Our findings of less weight gain among younger pregnant women are also in agreement with other investigations [11,17]; as are our findings of abnormal BMI at baseline [11,13,18-21]

Table 2. BMI and weight gain. Data are presented as percentages (numbers)

Weight gain	Total	High-risk	Normal pregnancy	Pre-gestational BMI (kg/m ²)			
				< 18.5	18.5–24.9	25–29.9	30–39.9
Above the recommendations	53% (95)	50% (43)	57% (52)	6% (6)	46% (44)	32% (30)	16% (15)
As recommended	20% (36)	24% (21)	16% (15)	8% (3)	24% (23)	8% (3)	19% (7)
Below the recommendations	26% (47)	26% (22)	27% (25)	13% (6)	64% (30)	6% (3)	17% (8)

BMI = body mass index

Figure 2. Normal weight gain according to snack and fruit consumption. The proportions of pregnant women with normal weight gain are shown according to consumption of snacks and fruits: 0, 1, and 2 portions daily



and a history of smoking as factors associated with weight gain [11] exceeding the recommendations.

Although we did not find differences in achieving recommended weight gain between women with normal and high-risk pregnancies, we emphasize that women with high-risk pregnancies started with higher pre-gestational BMI values and also tended to lead a more sedentary life [22-23]. High-risk pregnancy may be more likely to develop in women with pathological behavior prior to the pregnancy, which can also lead to an abnormal increase in weight during the pregnancy. An example of this finding is the relationship between obesity and diabetes. It is also possible that women with high pre-gestational BMI and smokers may have less awareness of healthy lifestyle habits and may therefore gain more weight during pregnancy. However, in this study, women with high-risk pregnancies tended to receive more professional nutritional counseling. Women with gestational diabetes are expected to seek professional nutritionist counseling; however, it is unclear the degree to which such recommendation affected the seeking of nutritional counseling among the participants in the current study.

This study had some limitations due to its cross-sectional design. Since women were interviewed during the third trimester or after their pregnancies, recall bias may have affected their responses. They might not have reported accurately or remembered their weight before the pregnancy. Although the participants of this study were from two sources, the differences in demographic characteristics in the groups were not statistically or clinically significant.

CONCLUSIONS

Women with high-risk pregnancies tend to have a higher BMI and consume more food supplements prior to their pregnancies. They also exercise less and avoid certain foods. Only a minority of women, both with normal- and high-risk pregnancies, gained the recommended amount of weight during pregnancy. High BMI, a history of smoking, older age, low fruit intake, and high snack intake were associated with weight gain above recommendations. Dietary counseling and educating women about healthy behavior is important to increase their compliance to dietary recommendations during pregnancy.

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Capsule**Nociceptor sensory neurons suppress neutrophil and $\gamma\delta$ T cell responses in bacterial lung infections and lethal pneumonia**

Lung-innervating nociceptor sensory neurons detect noxious or harmful stimuli and consequently protect organisms by mediating coughing, pain, and bronchoconstriction. However, the role of sensory neurons in pulmonary host defense is unclear. Baral and co-authors found that TRPV1⁺ nociceptors suppressed protective immunity against lethal *Staphylococcus aureus* pneumonia. Targeted TRPV1⁺-neuron ablation increased survival, cytokine induction, and lung bacterial clearance. Nociceptors suppressed the recruitment and surveillance

of neutrophils, and altered lung $\gamma\delta$ T cell numbers, which are necessary for immunity. Vagal ganglia TRPV1⁺ afferents mediated immunosuppression through release of the neuropeptide calcitonin gene-related peptide (CGRP). Targeting neuroimmunological signaling may be an effective approach to treat lung infections and bacterial pneumonia.

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