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Original Article

Correlates of Absolute and Excessive Weight Gain During Pregnancy

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Abstract

Objective: Factors associated with weight gain during pregnancy that may be linked to maternal overweight and obesity were examined.
Methods: In this observational study, 144 women reported on demographics, (prepregnancy) body weight, and lifestyles in self-reported questionnaires at 30 weeks gestation. Body weight at the end of pregnancy (self-reported at 6 weeks postpartum) was used to determine total gestational weight gain. Multivariate prediction models were developed to identify factors associated with total gestational weight gain and excessive gestational weight gain (i.e., higher weight gain than recommended by the Institute of Medicine).
Results: Women gained 14.4 (±5.0) kg during pregnancy. Obese women gained almost 4 kg less than normal weight women. Pregnant women judging themselves to be less physically active or women who reported increased food intakes during pregnancy gained significantly more weight. Over one third of women (38%) gained more weight than recommended. Being overweight, judging yourself to be less physically active than others, and a perceived elevated food intake during pregnancy were significantly associated with excessive weight gain (odds ratio [OR] = 6.33, 95% confidence interval [CI]: 2.01–19.32; OR = 3.96, 95% CI: 1.55l, 10.15; and OR = 3.14, 95% CI: 1.18, 8.36, respectively). A higher age at menarche and hours of sleep reduced the odds for excessive weight gain (OR = 0.75, 95% CI: 0.57, 0.99; and OR = 0.35, 95% CI: 0.57, 0.93, respectively).
Conclusions: Mean hours of sleep, perceived physical activity, and measures of food intake at 30 weeks gestation were identified as modifiable behavioral correlates for excessive gestational weight gain. Strategies to optimize gestational weight gain need to be explored, with a focus on the identified factors.

Introduction

In developed countries, pregnant women constitute an important subpopulation with elevated risk for developing obesity, and hence obesity-related health problems.[1,2] Although the average weight increase after pregnancy is modest, ranging from 0.5 to 3 kg, this weight retention heightens the risk of maternal obesity.[3,4] Numerous studies have shown that weight gain during pregnancy accounts for a large part of the variability in postpartum weight change.[5–9] To tackle maternal obesity, insight in factors related to gestational weight gain is required, as this provides essential information for the development of possible effective intervention strategies.

In 1990, the U.S. Institute of Medicine (IOM) released a report stressing the importance of optimizing weight gain during pregnancy, as the impact of gestational weight gain on pregnancy outcome for mother and child is considerable (e.g., with regard to gestational duration, course of delivery, and birth weight).[10] Moreover, weight gain guidelines based on pre-pregnant body size were formulated, and are now widely used. Researchers concerned with maternal obesity often apply these IOM guidelines to define *excessive gestational weight gain*, as gaining more weight than recommended by the IOM. Although the IOM did not address body weight changes of young mothers, current literature does link excessive gestational weight gain with maternal obesity.[1,4] Since the introduction of the IOM guidelines, most studies have concluded that over one third of pregnant women in developed countries cope with excessive gestational weight gain.[13] Altogether, these studies underline the considerable opportunity for improving adverse pregnancy outcomes, including maternal obesity.[13]

Previously identified correlates of excessive weight gain include ethnicity, socioeconomic status (SES), age, parity, body mass index (BMI) before conception, age at menarche,

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smoking, perceived change in physical activity (PA), and perceived increase of food intake.[9,14–18] As diet and PA constitute the scales of the energy balance, they are expected to affect weight development in a way similar to what occurs in the normal, non-pregnant population. However, most studies were not comprehensive in assessing diet or PA.[19] Consequently, the majority of the identified factors are demographic variables indirectly related to weight change. These factors are very difficult to influence and therefore less suitable for implementation in prevention programs. Understanding how different behavioral factors are associated independently with excessive gestational weight gain may enable us to develop effective preventive intervention programs that positively influence gestational weight gain.

In this observational study, we examined factors associated with absolute or excessive weight gain during pregnancy among a sample of pregnant women in the Netherlands. Our focus was on determining the relative importance of modifiable behavioral predictors for these two outcome measures.

Methods

Study design and participants

This article focuses on analysis of self-reported data of Dutch pregnant women in an observational setting. The association of several measures with total gestational weight gain was studied. The behavioral measures were assessed at 30 weeks pregnancy. Total gestational weight gain was the only measure which was based on a later report; at 6 weeks after delivery, we assessed self-reported end of pregnancy body weight.

The data collection was conducted from June 2003 to November 2004. The Municipal Health Services (MHS) of Amsterdam, which aims to register every pregnant woman in the Netherlands, cooperated in the recruitment phase. Initially, 550 women were randomly selected by the MHS to be invited to participate in our study. The selected women were 18 years or older, and living in Amsterdam or its surrounding communities. The MHS gave us permission to send an invitation together with the first questionnaire, and one reminder letter when the questionnaire was not returned. There was no telephone contact in the recruitment phase for privacy reasons. Only after individual consent, reminder phone calls were made to stimulate the response with regard to the questionnaires.

Written informed consent was obtained from every respondent. All data were collected by means of self-administered questionnaires, which included demographics, current and prepregnancy body weight, and certain lifestyle behaviors. The Medical Ethics Committee of the Vrije Universiteit (VU) Medical Center approved the study protocol.

Data

Study sample. Women who gave birth to live singleton infants after a minimal gestation of 36 weeks were included in the analyses of this study. Out of the 550 selected women, 168 (31%) were willing to participate and returned the first questionnaire. In total, 147/168 women returned the second questionnaire, which was needed to determine total gestational weight gain. Three women had a preterm delivery at less than 36 weeks of gestation and were excluded from this study, leaving 144 participants in the sample. Analyses showed that the drop out of 14% (24/168) was non-selective with regard to age, prepregnancy BMI, education, and ethnicity.

Outcome measures. In this study, two outcome measures were used in order to study gestational weight gain:

1. *Total gestational weight gain (kg), as a continuous variable.* This outcome measure was calculated by subtracting self-reported prepregnancy weight (at 30 weeks gestation) from self-reported end of pregnancy weight (at 6 weeks postpartum).
2. *Gaining more weight during pregnancy than recommended by the IOM (yes/no), as a dichotomous variable.* Based on the BMI group specific limits for gestational weight gain specified by the IOM (shown in Table 3 below), women were categorized as gaining less weight than recommended, gaining weight as recommended, or gaining more weight than recommended. As we were interested in excessive weight gain, the group of women who gained less than recommended was combined with the group that gained as recommended. Gestational weight gain was hereby defined dichotomously as gaining more weight than recommended or not. The IOM did not specify an upper weight gain limit for obese women. However, for this group the upper weight gain limit is expected not to be higher than the upper limit for overweight women, and therefore, the limit of 11.5 kg of weight gain was also used for obese women.

Behavioral covariates. Covariates were considered based on a review of literature on gestational weight gain and were all assessed at 30 weeks pregnancy. PA was assessed by means of the SQUASH,[20] the **S**hort **QU**estionnaire to **AS**sess **H**ealth-enhancing PA. This questionnaire covers 14 specified physical activities (e.g., walking to work or cycling in leisure time) and assesses minutes per day and number of days per week spent on activities in four domains: commuting, work, household work, and leisure time activities. Participants were asked to consider an average week in the past month. Collected data were used to determine whether or not a subject met the Dutch PA guideline for adults, of 30 min or more of moderate intense PA ($\geq$4 MET) on more than 5 and preferably all days of the week.[21] Covariates arising from the activity questionnaire were as follows: the number of minutes per day spent on light PA (2 to <4 metabolic equivalents [METs]), the number of minutes per day spent on at least moderate PA ($\geq$4 METs), and whether or not subjects met the Dutch guideline.

Moreover, time spent sitting, resting, and sleeping was assessed. This was determined for weekdays and weekend days separately, to reduce reporting bias due to divergent activities on week and weekend days that are common for working people. The following question was used: "How many hours do you . . . (sit/rest/sleep) during a 24-hour day from Monday to Friday/in the weekend?" Mean values for total hours per week for sitting, resting, and sleeping were computed.

Energy intake (kJ/day) and fat intake (g/day) were assessed by a validated Dutch food frequency questionnaire. This questionnaire is described extensively elsewhere.[22] Guidelines of the Dutch Health Counsel were used to determine whether or not participants met the guidelines for total

fat intake—less than 40% of the total energy intake (<40 E%)—and for saturated fatty acid intake—less than 10% of total energy intake (<10 E%).[23]

We assessed social comparison for PA to gain insight into how respondents judged their individual PA level when compared to others who were similar.[24] Respondents answered the question: "I think I am; a lot less/a little less/equally/a little more/a lot more, physically active than other women in a similar stage of pregnancy." Perceived overall change in PA and perceived overall change in food intake was assessed by questioning the extent to which personal behavior during pregnancy differed with regard to pre-pregnancy behavior, on 5-point Likert scales. Women stated: "I'm consuming a lot less/a lot more" and "I am a lot less/a lot more physically active." Hinton et al. found a similar measure on change in food intake following pregnancy to be significantly related to energy intake.[25] For analyses, the response categories of all these brief behavioral items were computed into tertiles.

Demographics and other covariates. Race/ethnicity was derived from the country of birth of the participant's parents. An individual was considered to be White/Caucasian when both parents were born in Europe (with the exception of Turkey and Morocco, two minority groups common in the Netherlands with a lower mean SES) or North America. Further, educational level was assessed as the highest level of education an individual reported to have achieved, which was then dichotomized into having finished post high school education or not. Moreover, participants were asked to report on their status of employment (y/n), their family (single or living alone/married or living together), smoking behavior (y/n), and their health (5-point Likert scale: excellent/rather well/good/moderate/bad).[26] Finally, it was assessed whether or not women had received personal advice on gestational weight gain from their health care professionals. If so, women were asked to report the amount of kilograms they were advised to gain during pregnancy. These data were reported as received advice on gestational weight gain under, within, or above IOM guidelines.

Statistical analysis

The analyses were conducted using SPSS 12.0.2 (SPSS Inc., Chicago, IL). All data were checked for normality. Univariate predictors were selected ($p < 0.2$) for both outcomes separately. Two multiple regression models, a linear and a logistic model, were developed by means of the stepwise forward method, using a significance level of $p < 0.05$. All analyses were adjusted for total weeks gestation. Finally, as a measure of model fit, the adjusted R-square was determined for the linear model.

Because of too few participants in some response categories, the variables social comparison for PA and perceived overall change in food intake were recoded into three categories ([a lot] less/not less or more/[a lot] more). Hours of sleep was categorized into tertiles (<8 h/8 to <9 h/≥9 h) to facilitate the interpretation of the results.

Results

Characteristics of the final study sample of 144 women are shown in Table 1. When compared to the general Dutch population of pregnant women, our study population had a comparable mean age, had a similar distribution of parity, but was represented by a higher percentage of White/Caucasian women (92% vs. 84%).[27]

Table 1. Population Characteristics ($N = 144$)

	Mean (SD)
Age, years	31.2 (4.7)
Height, cm	1.70 (0.07)
Age at menarche, years	13.2 (1.5)
Pre-pregnancy weight, kg	70.6 (12.2)
Pre-pregnancy BMI, kg/m^2	24.3 (3.9)
	% (n)
BMI categories (WHO)	
Underweight (<20)	12 (17)
Normal weight (20 to <25)	51 (74)
Overweight (25 to <30)	29 (42)
Obese (≥30)	8 (11)
Race/ethnicity	
White/Caucasian	92 (132)
Other	8 (12)
Educational level	
Lower	37 (53)
Higher	63 (91)
Employment status	
Employed, voluntary job	85 (121)
Unemployed	15 (23)
Marital status	
Single, or not living with partner	4 (5)
Married, or living with partner	96 (139)
Parity	
Nulliparous	51 (73)
Primiparous	37 (54)
Multiparous	12 (17)

BMI, body mass index; WHO, World Health Organization.

The participants had a mean gestation of 30.4 (±1.9) weeks while completing the first questionnaire. In Table 2a, characteristics of self-reported behavior at 30 weeks of pregnancy and their bivariate associations with both outcomes are shown. Table 2b shows the same data of the measures on perceived behavior during pregnancy. At 30 weeks gestation, 6% of the women reported smoking. Moreover, women perceived their own health as rather good: 2.3 (0.8) on a 5-point Likert scale.

The women had a mean total gestation of 39.7 (±1.4) weeks, which varied between 36 and 43 weeks. They reported having weighed themselves the last time during pregnancy on average at 39.2 (±1.5) weeks gestation. Data on gestational weight gain are described in Table 3: mean total weight gain during pregnancy and the percentages of the sample that gained less weight than recommended, as recommended, and more than recommended. Mean gestational weight gain was highly variable (3–27 kg), normally distributed, and varied by pre-pregnancy BMI group. There was a trend of less gestational weight gain with every successive BMI category. More than one third of women (38%) gained more weight than recommended by the IOM. Among overweight women, the majority exceeded the IOM guidelines (62%). The women exceeding the IOM guidelines did so with 4.8 kg on average

Table 2a. Behavioral Characteristics at 30 Weeks' Gestation ($N = 144$) and Their Bivariate Associations with Both Outcome Variables

		Gestational weight gain		*Excessive weight gain*	
		B	p	*OR*	p
Physical activity					
Light PA,[a] min/day, median (10–90th%)	306 (91–471)	−0.01	<0.2	1.00	0.6
At least moderate PA,[b] min/day, median (10–90th%)	25 (1–99)	0.00	0.5	0.99	<0.1
Meeting PA guideline,[c] % (*n*)	26 (37/144)	−1.05	0.3	0.52	<0.1
Sedentary behavior					
Sitting, h/day, mean (SD)	6.5 (3.2)	−0.05	0.7	1.08	<0.2
Resting, h/day, mean (SD)	1.4 (1.1)	0.07	0.8	1.08	0.6
Sleeping, h/day, mean (SD), $n = 122$	8.5 (1.1)	−0.37	0.4	0.61	<0.1
Food intake					
Energy intake, kJ/day, mean (SD)	9.4 (3.7)	0.00	0.3	1.00	0.3
Fat intake, E%, mean (SD)	33.9 (6.2)	−0.01	0.9	0.98	0.6
Meeting guidelines,[d] % (*n*)	85 (123/144)	0.46	0.7	0.97	0.9
Saturated fatty acid intake, E%, mean (SD)	12.5 (3.3)	0.02	0.9	0.98	0.7
Meeting guidelines,[e] % (*n*)	22 (32/144)	−0.12	0.9	1.18	0.7

[a]Light physical activity (PA) of 2 to <4 metabolic equivalents (METs).
[b]At least moderate PA; physical activity of ≥4 METs.
[c]PA guideline; moderate physical activity for at least 30 min on at least 5 days of the week.[19]
[d]Fat intake guideline: <40 E%.
[e]Saturated fatty acid intake guideline: <10 E%.
OR, odds ratio.

(underweight and obese women, +3.0 kg; normal weight women, +4.2 kg; overweight women, +6.9 kg).

The advice women received regarding gestational weight gain was considered as well. Twelve percent of the total study sample reported not having received any information on weight gain from their health care providers, 60% received advice in accordance with the IOM recommendations, 5% received advice which was lower than recommended by the IOM, and 23% received advice which was higher than recommended. When stratified for pre-pregnancy BMI, the majority of underweight and normal weight women reported having received advice within the IOM recommendations (75% and 88%, respectively), whereas the majority of overweight and obese women reported having received weight gain advice exceeding the IOM recommendations (76% and 78%, respectively).

Absolute gestational weight gain

Linear associations between demographic and lifestyle variables and absolute gestational weight gain were examined. Table 4 shows the final linear regression model ($p < 0.01$) explaining 21% of the variance in gestational weight gain. Obese status prior to pregnancy was associated with a lower weight gain of 4 kg when compared to gestational weight gain of normal weight women. Concerning social comparison on PA, we found that women who judged themselves to be less physically active than other pregnant women gained almost 2 kg more compared to women judging themselves equally physically active. Finally, women who perceived their food intake to have increased during pregnancy gained over 2 kg more compared to women who reported their food intake was stable before and during pregnancy.

Table 2b. Perceived Behavior ($N = 144$) and Bivariate Associations with Both Outcome Variables

		Gestational weight gain		*Excessive weight gain*	
	% (n)	*B*	p	*OR*	p
Social comparison, PA at 30 weeks pregnancy					
Equally active as others (reference)	35 (51)	–		1	
Less active than others	38 (54)	1.83	<0.1	3.15	<0.01
More active than others	27 (39)	−0.43	0.7	1.47	0.4
Perceived change in PA during pregnancy					
Same or more PA (reference)	16 (23)	–		1	
A lot less PA	42 (60)	0.24	0.8	0.81	0.7
A little less PA	42 (61)	0.31	0.8	1.03	0.9
Perceived change in food intake during pregnancy					
No change in food intake (reference)	28 (40)	–		1	
Less food intake	17 (25)	−1.87	0.1	1.25	0.7
More food intake	55 (70)	2.66	<0.01	2.10	<0.1

OR, odds ratio; PA, physical activity.

Table 3. Gestational Weight Gain Data: Stratified per Pre-Pregnancy BMI Group and for the Total Study Population ($N = 144$)

	IOM guideline	*Absolute weight gain, kg (SD)*	*Less than recommended*	*As recommended*	*More than recommended*
BMI group[a]					
<19.8 ($n = 8$)	12.5–18 kg	16.00 (4.5)	25% (2/8)	38% (3/8)	38% (3/8)
19.8 < 26 ($n = 99$)	11.5–16 kg	14.87 (4.6)	20% (20/99)	49% (48/99)	31% (31/99)
26 < 29 ($n = 24$)	7.0–11.5 kg	14.60 (6.1)	13% (3/24)	25% (6/24)	62% (15/24)
≥29 ($n = 13$)	>6 kg[b]	9.79 (4.2)	15% (2/13)	46% (6/13)	39% (5/13)
Total ($n = 144$)		14.39 (5.0)	19% (27/144)	44% (63/144)	38% (54/144)

[a]Body mass index (BMI) group ranges according to the U.S. Institute of Medicine (IOM).
[b]The recommended maximum weight gain for overweight women (11.5 kg) was used.

Excessive gestational weight gain

Furthermore, we were interested in determining factors associated with excessive weight gain during pregnancy, as determined by IOM parameters. The results of the final logistic regression model ($p < 0.01$) are shown in Table 5. Women who were overweight before pregnancy were six times more likely than normal weight women to gain more weight than is recommended by the IOM. Also, women who judged themselves less physically active than other pregnant women were four times as likely to gain excessive weight compared to women who judged themselves as active as others. Women reporting an elevated food intake during pregnancy were over three times as likely to gain more weight than recommended compared to women reporting a stable food intake. Participants who slept more than average had significantly lower odds than regular sleepers. The question on hours of sleep was not completed by 22 women. Analyses proved this was a random non-response. Finally, age at menarche was inversely associated with excessive weight gain.

Minutes of PA, energy intake, and meeting PA or nutritional guidelines did not appear in the end models. The sociodemographic variables ethnicity, education, health, parity, and smoking were not significantly associated with gestational weight gain either.

Table 4. Linear Regression Model with Factors Related to Absolute Gestational Weight Gain ($N = 144$)[a]

	B	*95% CI*
Normal weight (reference)	0	
Underweight	−0.24	−3.66; 3.19
Overweight	0.31	−1.79; 2.40
Obese (IOM)	−3.98**	−6.71; −1.25
Equally active as others (reference)	0	
Less active	1.97*	0.19; 3.75
More active	−0.03	−2.00; 1.94
No change in food intake (reference)	0	
Less food intake	−1.70	−4.08; 0.68
More food intake	2.15*	0.31; 3.98

[a]Adjusted for total weeks of gestation.
*$p < 0.05$; **$p < 0.01$.
CI, confidence interval; IOM, U.S. Institute of Medicine.

Discussion

The purpose of the current study was to determine the relative importance of diverse modifiable, behavioral correlates of absolute and excessive gestational weight gain. As the two described multivariate models represent similar findings, we can draw clear conclusions of relevance for researchers and clinicians in the field. Typically, over one third of women gained more weight than recommended by the IOM guidelines, illustrating that excessive gestational weight gain also affects a considerable part of the pregnant population in the Netherlands. However, it should be noted that the upper limit for the obese women is not defined optimally. The IOM concluded that evidence for such a limit in this subgroup was lacking. As in previous studies, we applied the upper threshold for the overweight group to the obese group, to estimate (ORs of predictors of) excessive gestational weight gain for obese women. Still, this threshold may be too high, as evidence suggests lower upper limits for every other successive BMI category. It is possible that a different operationalization would have modified the results. With stricter limits, the incidence of "over-gain" in the obese group would

Table 5. Logistic Regression Model with Factors Related to Excessive Gestational Weight Gain ($N = 122$)[a]

	OR	*95% CI*
Normal weight (reference)	1	
Underweight	0.78	0.13; 4.48
Overweight	6.33**	2.01; 19.32
Obese	2.24	0.56; 8.92
Equally active as others (reference)	1	
Less active	3.96**	1.55; 10.15
More active	1.70	0.61; 4.69
No change in food intake (reference)	1	
Less food intake	0.74	0.21; 2.63
More food intake	3.14*	1.18; 8.36
8 to <9 h of sleep (reference)	1	
<8 h sleep	1.20	0.46; 3.16
≥9 h of sleep	0.35*	0.13; 0.93
Age at menarche (years)	0.75*	0.57; 0.99

[a]Adjusted for total weeks of gestation.
*$p < 0.05$; **$p < 0.01$.
OR, odds ratio; CI, confidence interval.

be lower, probably also affecting the likelihood of excessive weight gain in obese women.

Correlates of absolute gestational weight gain

As expected, an obese status before pregnancy was associated with significantly less gestational weight gain. Of significance with regard to our search for modifiable behavioral factors is the finding that perceived increased food intake was associated with a higher gestational weight gain, confirming earlier findings of Olson et al.[18] Moreover, women who judged themselves to be less physically active than other pregnant women gained more weight during pregnancy compared to women judging themselves as active as others.

Correlates of excessive gestational weight gain

Overweight prior to pregnancy and early age at menarche were, as concluded in previous research, important maternal factors associated with excessive weight gain.[11,17,18,28] The behavioral factors associated with excessive gestational weight gain are of interest considering their modifiable character. Women who judged themselves less physically active at 30 weeks of pregnancy were more likely to gain excessive weight compared to women judging themselves as active as others. Two previous studies showed comparable correlations between excessive weight gain and exercise levels in the third trimester; however, these comprised univariate associations.[16,29] The association of perceived increase in food intake with excessive weight gain is concordant with findings from Olson et al. and Olafsdottir et al.[17,18] Interestingly, the protective association between more than 9 h of sleep and excessive gestational weight gain that we found has not been described before. Previous studies in the general population did describe a relationship linking sleep *reduction* with weight gain.[30] Sleep restriction in an experimental setting was proven to affect metabolism[31] and hormones that regulate appetite such as ghrelin and leptin,[32] and may hereby cause weight gain. Still, our finding could also be explained in the other direction, when higher gestational weight gain causes sleeping problems. Overall, more research is needed to improve the understanding of the influence of sleep on gestational weight change.

Receiving weight gain advice exceeding recommendations was univariately significantly associated with excessive weight gain. However, due to the high correlation with prepregnancy BMI, these two factors could not be included in the multivariate model simultaneously. We included prepregnancy BMI as it was a statistically stronger factor. Still, the quality of the received advice remains a point of concern. Over one third of women reported that they had not received any information on this topic at all or that they had received advice exceeding IOM recommendations. Strikingly, a clear majority of overweight and obese women reported having received personal advice that exceeded IOM recommendations.[18,33] Incorrect advice might be the result of health professionals not recognizing the pre-pregnant overweight status of their clients, possibly combined with a lack of knowledge of IOM guidelines.

The brief items social comparison for PA and perceived change in food intake were found to be statistically significant correlates in both end models, whereas more extensively assessed behavioral measures for PA and diet were not. The correlation between "social comparison for PA" and minutes spent on "at least moderate PA" derived from the SQUASH was $r = 0.41$ ($p = 0.00$), indicating that the brief item is a modest proxy of total time spent with PA. Altogether, it is most probable that different measures simply reflect different concepts of behavior, and that the brief items distinguished women better with regard to their gestational weight gain than the reported actual behavior.

Limitations

Several limitations are worth noting when interpreting our results. First, since our study was observational in nature, drawing inferences with regard to causal relationships is not possible. Second, self-administered questionnaires were used, whereas in most cases objective measurements would have been preferred. Measures such as body weight, food intake, and PA are known to be structurally under- and over-reported with increasing overweight.[34,35] Oken et al. validated self-reported prepregnancy weight with clinically measured weights and reported an overall underreport of 1 kg, which did not differ with weight itself.[36] Still, since both outcome variables are derived from change scores, and reporting bias often occurs in the same direction, reporting bias with regard to the outcome measures might not be significant. The lack of association between gestational weight gain and measures of self-reported actual behavior might be attributed to information bias, but also to insufficient accuracy of the questionnaires themselves. Moreover, the progressed pregnancy and individual weight gain until the time of measurement may have influenced the results. For example, data on the quality of the received advice with regard to gestational weight gain may be especially subject to such recall bias, as this topic is generally discussed earlier during pregnancy. Finally, it should be mentioned that the restricted recruitment conditions of the MHS had its limitations. Together with the use of lengthy questionnaires, this probably contributed to the relatively low response and the homogeneous study sample, undermining the generalizability of the results.

Implications for the future

Our findings indicate how different factors may contribute to both absolute and excessive weight gain, and indicate opportunities for future research in this field. Structural assessment of pre-pregnancy body weight and height, and implementation of IOM guidelines by health professionals, with a focus on the high-risk group of prepregnant overweight women might be beneficial. Earlier trials that primarily evaluated the impact of individual counseling on IOM guidelines and energy balance related behavior during pregnancy did not reduce overall excessive gestational weight gain, however.[37–40] It should be noted that inaccurate perceptions of healthy behavior during pregnancy are common. For example, the need for pregnant women to eat for two appears to be an outdated, but still influential misconception,[41–43] and exaggerated fears of adverse effects related to PA levels during pregnancy persist[44,45] Providing guidance may counteract these psychologically explicable but physiologically exaggerated changes in food intake or energy expenditure. Still, longitudinal studies or randomized controlled trials are necessary to assess true causal relationships, and future intervention programs should be evaluated in terms of outcomes.

Conclusions

Our study confirms earlier reports on prevalence rates of excessive gestational weight gain and shows that over one third of Dutch pregnant women gains more weight than recommended by the IOM. Intervention programs aiming to reduce these rates should be explored. PA, food intake, and sleep were associated with excessive gestational weight gain. Taking these modifiable behaviors into account may help to improve the effectiveness of tailored interventions in the future. Our results suggest that such interventions should specifically focus on preconception evaluation of overweight women.

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Disclosure Statement

No competing financial interests exist.

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