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Examination of Routine Use of Prenatal Weight Gain Charts as a Communication Tool for Providers

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Abstract *Objectives* In 2009 the IOM revised prenatal weight gain guidelines. The primary purpose of this pilot study was to assess if provider education and use of prenatal weight gain charts to track weight gain and counsel patients was associated with better patient and provider knowledge and communication about the guidelines. *Methods* A prospective non-randomized study conducted in four OB practices (two control, two intervention). Data sources included provider surveys (n = 16 intervention, 21 control), patient surveys (n = 332), and medical records. Intervention clinics received provider education on the IOM guidelines and used patient education materials and prenatal weight gain charts to track weight gain and as a counseling tool. Comparison clinics received no education and did not use the charts or patient education information. *Results* More patients at intervention clinics (92.3%) reported that a provider gave them advice about weight gain, compared to patients from comparison clinics (66.4%) ($p < 0.001$). Intervention patients were also more likely to report satisfaction discussions with their provider about weight gain (83.1 vs. 64.3%, $p = 0.007$). Intervention clinic patients were more likely to have knowledge of the guidelines indicated by 72.3% reporting a target weight gain amount within the guidelines versus 50.4% of comparison patients ($p < 0.001$). *Conclusion* Provider education and use of weight gain charts resulted in higher patient reported communication about weight gain from their provider, higher patient satisfaction with those discussions, and better knowledge of the appropriate target weight gain goals.

Keywords Prenatal weight gain · Patient education · Prenatal care · Provider communication

Significance

Excess and inadequate weight gain are established risks for poor perinatal and long-term health outcomes for mothers and infants. Despite IOM guidelines to address these health risks, a majority of women gain outside the weight range recommended. Communication for general health education messages and specifically for weight are documented barriers to addressing this problem.

This study found that the combination of provider education, integration of patient education materials and prenatal weight gain charts to track weight and guide counseling discussions resulted in a significantly higher proportion of patients with knowledge of the guidelines, reporting communication from their provider about weight gain, and patients more likely to be satisfied with weight gain discussions.

Introduction

Excess or inadequate weight gain during pregnancy is a growing public health concern (American College of Obstetricians and Gynecologists 2013; Chung et al. 2013; Stotland et al. 2006; Nehring et al. 2013; Heaman et al. 2013; Ferraro et al. 2012; Drehmer et al. 2013). As

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a result, the Institute of Medicine (IOM) developed new guidelines for gestational weight gain in 2009 (American College of Obstetricians and Gynecologists 2013; Institute of Medicine (US) and National Research Council 2009). Approximately 37–50% of women in the US gain more weight than recommended, while 19–21% of women gain less (Institute of Medicine (US) and National Research Council 2009), Siega-Riz and Gray (2013); Dalenius et al. (2012). Healthy People 2010 and 2020 both include a goal to increase the proportion of pregnant women who achieve the recommended amount of weight gain during pregnancy, demonstrating increased public health focus on prenatal weight gain (Healthy People 2020 2014).

Communication with patients about the guidelines is a necessary first step to achieve a change in prenatal weight gain trends. However there is incongruence between provider reporting and patient recollection of weight gain counseling (Lutsiv et al. 2012; Whitaker et al. 2016). While most providers report counseling their patients about weight gain during pregnancy (Lutsiv et al. 2012; Whitaker et al. 2016), far fewer patients (29%) report receiving any recommendation from their provider, and only 12% reported receiving advice that aligned with the IOM guidelines (McDonald et al. 2011). Additionally, advice may vary by BMI with overweight and obese women more likely to receive advice for weight gain amounts above the IOM recommended range (Waring et al. 2014). Written or visual information may help address gaps that spoken counseling leaves (Kessels 2003; Kominiarek et al. 2015; Overcash and Lacoursiere 2014). Research is mixed about impact of advice. Some authors find that women who report receiving advice about weight gain during pregnancy are more likely to stay within the recommended range, (Cogswell et al. 1999) while others find no association(Ferrari and Siega-Riz 2013) indicating the specific type or quality of advice may be important. Currently, there is no standard method of how to approach weight gain with pregnant patients. Providers report that discussions about weight gain are a source of discomfort and cite concerns about offending patients (Whitaker et al. 2016; Kominiarek et al. 2015; Knight-Agarwal et al. 2014), indicating an opportunity to provide resources to providers for weight gain related discussions.

The primary objective of this pilot study was to test if education of providers on the IOM guidelines combined with use of prenatal weight gain patient education materials and charts to track weight gain was associated with improved communication and knowledge about the guidelines among providers and patients. A secondary analysis was to assess if the intervention was associated with increased adherence to the guidelines.

Materials and Methods

Study Design Overview

This pilot study used a prospective, non-randomized group design with four obstetrics (OB) practices (two intervention, two control). The intervention clinics received provider education, incorporated basic patient education materials, and utilized prenatal weight gain charts during standard prenatal care practice. Comparison clinics received no education and did not use the patient education and weight gain chart materials. Data included provider surveys, patient surveys, and medical records. At baseline, provider surveys were conducted at all clinics. Intervention clinics recruited all new OB patients during a 6 month period and followed these patients throughout their pregnancy. All clinics conducted patient surveys during their third trimester. Provider follow-up surveys were conducted at all clinics after the intervention period was complete. The study ran from February 2014 through early 2015. This study was approved by Allina Health's appointed external Institutional Review Board, Schulman Associates IRB.

Study Context and Clinic Selection

The study took place in the context of Allina Health, a large health system within Minnesota and western Wisconsin. Two of the OB practices participating in the study are owned by Allina Health and two are private practices. Clinics were selected based on delivery location at either of Allina's two largest hospitals. Study groups were divided so that each contained one Allina owned and one private practice group. To assess baseline clinic education and weight gain tracking, researchers held conversations with clinic managers and providers. We confirmed that none of the clinics were systematically using any communication or tracking tools around prenatal weight gain beyond typical weight documentation.

Intervention Description

Intervention clinic providers received a training that included a review of the 2009 IOM guidelines (Institute of Medicine (US) and National Research Council 2009) review of the patient education materials, and instruction on the use of the prenatal weight gain charts. A one-page patient education document included information on the prenatal weight guidelines, risks of too little or too much weight gain, breakdown of weight gain (fetus, placenta, uterus, maternal stores, amniotic fluid, etc.), and basic nutrition information and exercise guidelines for pregnancy. Nutrition information focused on fluids without extra calories, gave examples of healthy snacks and proteins, and

suggested increasing fiber, whole grains, fruits and vegetables.. The sheet also discussed planning ahead to avoid unhealthy eating and referred to the choosemyplate.gov interactive food planning program. Exercise guidelines recommended 30 min a day as long as they were not experiencing complications and gave information about activities to avoid and when to talk with a provider or seek medical care. Clinics handed this out to patients at the first prenatal care appointment.

Intervention clinics used prenatal weight gain charts available online (N. C. Department of Health and Human Services 2013) (Fig. 1) that correspond with the 2009 IOM guidelines (Institute of Medicine (US) and National Research Council 2009) which specify recommended weight gain ranges for four body mass index (BMI) categories: underweight (<18.5), healthy weight (18.5–24.9), overweight (25.0–29.9), obese (≥30.0). At the first prenatal care appointment, clinic nurses identified the appropriate BMI category and chart based on a recent pre-pregnancy or early (<12 weeks) pregnancy BMI. Charts were updated at each prenatal care visit by nurses and left for the provider to review with the patient. Only patients starting prenatal care before 16 weeks were included. One of the intervention practice groups used a chart made available in the electronic health record (EHR) and then printed it at each visit to review. None of the other clinics had this electronic chart available.

Measures and Data Collection

Provider Surveys

Survey development was informed by prior provider surveys (Lutsiv et al. 2012; Wilkinson et al. 2013; Stewart et al. 2012). While specific survey questions were not always available in articles, we duplicated wording and response options when appropriate. Surveys were pretested and edited to address any confusing wording.

Provider baseline surveys assessed frequency of discussion of weight gain and related risks with patients, specific advice they gave patients, satisfaction with their ability to counsel patients about weight gain, satisfaction with their knowledge about the guidelines, how influential they felt their advice was, and how important they thought it was to discuss prenatal weight gain. The follow-up survey included the same questions as baseline with additional questions specific to the intervention experience and utility of the weight gain charts. Response options for survey questions were primarily in the form of Likert scale questions. In questions assessing specific weight gain advice, providers could respond with either a specific amount or a range (within each BMI category). The amount of weight gain recommended was coded two ways: first based on exact alignment with the IOM recommended ranges, and second whether the absolute or maximum weight amount (if a range) given by the provider was *under, over*, or the *within* the IOM guidelines. For a response to be coded as exactly aligned with the IOM guidelines they would have had to respond with the exact range recommend. For example, a response of "15–25 lbs" for the overweight category would be exactly aligned but a response of "20" would not. Both of these responses would have been coded as "within" for the second coding method. Additionally a response of "20–30" would have been categorized as over because if the woman gained the maximum amount advised by that provider (30 lbs), it would have been over the IOM recommended range.

Baseline surveys were collected at a staff meeting with one of the study authors present. Any physician, nurse practitioner, or nurse educator with a direct patient education role were asked to fill out the surveys. No provider names were collected on the survey; providers were only identified by their OB practice group. When providers were missing from the staff meeting, a clinic manager followed up to have those surveys completed when possible. Post-program surveys were collected by clinic managers or by the study investigators at staff meetings.

Patient Surveys

Patient surveys were handed out by clinic staff during a third trimester appointment. Clinics returned blank surveys for women who did not want to participate so the investigators would know that a woman had declined participation. No further data was collected on those who declined.

Survey development was informed by existing studies of weight gain among prenatal care patients using existing wording where available and appropriate, or modifying wording to fit the current study (McDonald et al. 2011, 2012; Phelan et al. 2011). Measures on the patient survey included whether a health care provider discussed prenatal weight gain, associated risks, patient understanding of how much weight they should gain, how important they thought it was to stay within the recommended weight range, and measures of satisfaction with provider communication about weight gain, perception of provider knowledge, and if they received enough information. The survey also collected race, ethnicity, and highest education level completed.

Women were asked how many total pounds they thought they should have gained from the beginning to end of their pregnancy. Responses were coded as being *within, over, or under* the IOM recommended amount for their BMI by looking first at the absolute amount if given and second at the maximum amount in a range response and comparing it to the maximum amount of the IOM guidelines.

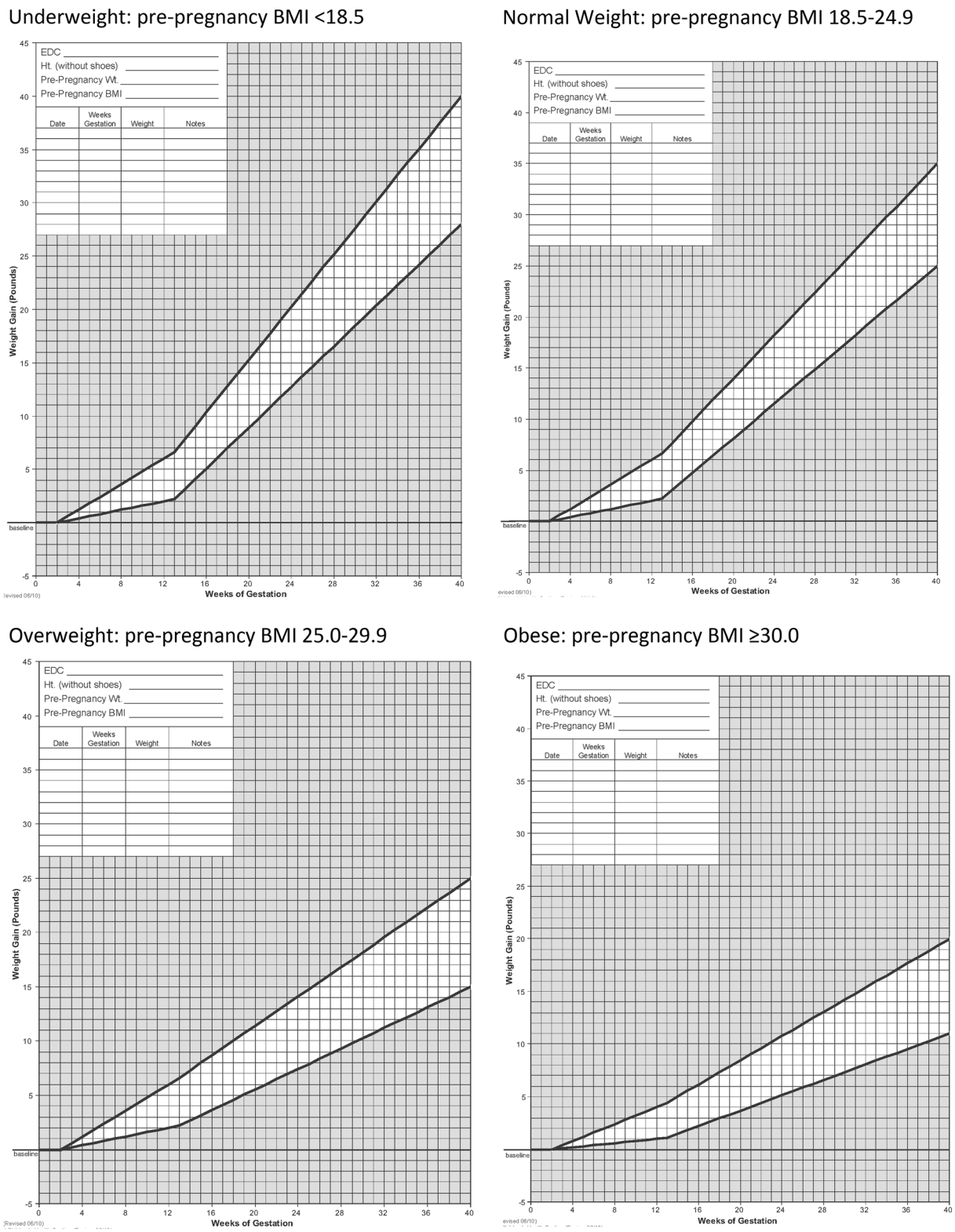

Fig. 1 Prenatal weight gain charts. Providers in the intervention practices used BMI prenatal weight gain charts to illustrate appropriate weight gain with their patients

Prenatal Weight Gain and Other Medical Record Data

Data collected from the medical record included age, marital status, parity, singleton or multiple gestation, pre-pregnancy BMI, first weight and BMI recorded during prenatal care, gestation of first prenatal weight measurement, final clinical pregnancy weight, gestation at final clinical weight visit, gestation at delivery, and delivery weight. Women were excluded if a survey was not available at intervention clinics. Women were also excluded from the study if they were pregnant with twins or triplets.

Baseline BMI category was determined using a prenatal value within the first trimester. Weight gain was coded as being *within, under*, or *over* the prenatal weight gain guidelines based on a comparison of weight gain at the time of the last prenatal care visit and the guideline recommended amount at the gestation of last weight measurement. This was done by using the prenatal weight gain charts (in intervention clinics) or by charting the weights for the patients at control clinics.

Analysis

Data analysis was conducted using SPSS version 18.0.2. Patient survey data was linked to medical record data using patient IDs. To compare responses from intervention and comparison clinics for patient and provider baseline surveys we used frequencies with Chi square tests for categorical variables and *t*-tests to compare mean patient age. Provider surveys were analyzed by study group. Statistical tests were conducted only on baseline tests to examine comparability of clinics in each group. No tests were conducted on the follow up surveys given the lower response rate.

Results

Provider Baseline Survey

Surveys were completed by 37 staff at the 4 practice groups (21 at control clinics, 16 at intervention clinics), which represents approximately 80% response rate. There were no differences between intervention and control clinics on most baseline measures (Table 1). Sixty-eight percent of respondents were physicians, 16% were nurse practitioners, and 16% were RN nurse educators. The majority of providers (86%) reported that they talk with every patient (43%) or most patients (43%) about the appropriate amount of weight gain. It was less common for providers to discuss risks of excess weight gain (51%), and even less common to discuss risks of inadequate weight gain (27%) with every or most patients.

Providers were asked about what types of advice they typically gave to patients about weight gain. They could report multiple types of advice. Most (87%) respondents reported recommending a range of weight, with 40% indicating they also referred patients to other educational resources. One difference in practice between the intervention and control groups was identified: no providers from the intervention group reported recommending to patients a specific amount of calories to consume each day, but 43% of control group providers (all from one clinic) indicated caloric advice was typical.

When provider reported advice about weight gain amounts (Table 1) was assessed for exact alignment with the IOM guidelines, 79% of providers reported advice exactly aligned for normal weight women, 44% reported advice aligned for overweight women, 6% of providers reported advice exactly aligned for underweight women, and no providers gave advice exactly aligned with the guidelines for obese women. When provider responses were coded as *within, under*, or *over*, only the obese category showed a different result between the study groups with 38% of intervention providers recommending values within range compared to none of the comparison clinics ($p = 0.015$). Providers were most likely to report advice within the guidelines for the normal weight BMI category (85%) and least likely to report advice within the guidelines for the obese category (18%).

There were no differences between intervention and control clinic providers with regard to feelings about communication. Half of providers (56%) were satisfied with their ability to discuss weight gain with patients but 35% also worried about making patients uncomfortable. While most (78%) felt they had sufficient knowledge, nearly half (49%) indicated they would like additional resources to help with weight gain discussions.

Provider Follow-up Survey

Response to the follow-up survey ($n = 22$) was lower than baseline ($n = 37$), with control clinic providers less likely to respond. One notable finding from the follow-up surveys (Table 1) is the increase among intervention providers reporting advice aligned with the IOM guidelines for the underweight and obese categories. Intervention providers were also more likely to report that they thought their advice was influential and to feel satisfied with their ability to discuss weight gain with patients.

Patient Survey Responses

Of the 375 patient surveys returned, 30 were left blank, an additional 13 were excluded because of multiple gestation,

Table 1 Provider baseline and follow-up surveys

	Baseline (n = 37)				Follow-up (n = 22)	
	Total (n = 37)	Control (n = 21)	Intervention (n = 16)	p-value*	Control (n = 11)	Intervention (n = 11)
	%	%	%		%	%
Role						
MD/DO	68	71	63	0.430	100	55
NP	16	10	25			36
RN	16	19	12			9
How often do you discuss the following topics with pregnant patients?						
The appropriate amount of weight to gain during pregnancy						
Always—every patient	43	33	56	0.454	46	73
Most of the time—with most patients	43	48	38		27	27
Sometimes—with some patients	11	14	6		27	0
Rarely—with few patients	3	5	0			
Never—with no patients	0	0	0			
Risks of inadequate weight gain						
Always—every patient	16	19	13	0.059	27	18
Most of the time—with most patients	11	5	19		18	36
Sometimes—with some patients	32	19	50		27	46
Rarely—with few patients	27	43	6		27	
Never—with no patients	14	14	13			
Risks of excess weight gain						
Always—every patient	19	14	25	0.227	18	36
Most of the time—with most patients	32	29	38		46	36
Sometimes—with some patients	30	38	19		36	27
Rarely—with few patients	14	19	6			
Never—with no patients	5	0	12			
When you talk about weight gain with patients do you						
Recommend a specific amount of weight	19	24	13	0.384	36	9
Recommend a range of weight to gain	87	81	94	0.259	100	100
Recommend a specific amount of calories to consume each day	24	43	0	0.003	36	0
Refer patients to other healthcare professionals for education	22	29	13	0.239	46	9
Refer patients to other educational resources (books, handouts)	40	43	38	0.742	46	55
How much weight gain do you recommend during pregnancy?						
Responses exactly aligned with IOM guidelines						
Underweight (BMI < 18.5)	6	0	13	0.110	0	27
Normal weight (BMI 18.5–24.9)	79	78	81	0.803	86	82
Overweight (BMI 25.0–29.9)	44	33	56	0.179	14	55
Obese (BMI ≥ 30.0)	0	0	0	NA	0	27
Responses categorized as within, below, or above IOM guidelines						
Underweight (BMI < 18.5)						
Within IOM range	42	31	53	0.412	14	100
Below IOM range	29	38	20		43	0
Above IOM range	29	31	27		43	0
Normal weight (BMI 18.5–24.9)						
Within IOM range	85	82	88	0.373	71	91
Below IOM range	12	18	6		29	9
Above IOM range	3	0	6		0	0

Table 1 (continued)

	Baseline (n = 37)				Follow-up (n = 22)	
	Total (n = 37)	Control (n = 21)	Intervention (n = 16)	p-value*	Control (n = 11)	Intervention (n = 11)
	%	%	%		%	%
Overweight (BMI 25.0–29.9)						
Within IOM range	59	50	69	0.491	57	64
Below IOM range	35	44	25		29	18
Above IOM range	6	6	6		14	18
Obese (BMI ≥ 30.0)						
Within IOM range	18	0	38	0.015	14	73
Below IOM range	76	94	56		71	18
Above IOM range	6	6	6		14	9
My advice influences how much weight my patients gain during pregnancy						
Strongly agree/agree	35	38	31	0.690	55	73
Undecided	41	43	38		27	0
Disagree/strongly disagree	24	19	31		18	27
I am very satisfied with my ability to discuss how much weight my patients should gain						
Strongly agree/agree	56	43	73	0.760	36	82
Undecided	31	33	27		27	18
Disagree/strongly disagree	14	24	0		36	0
I am very satisfied with my ability to discuss the risks associated with inappropriate weight gain						
Strongly agree/agree	69	57	86	0.202	91	82
Undecided	14	19	7		0	18
Disagree/strongly disagree	17	24	7		9	0
I have sufficient knowledge about gestational weight gain to counsel patients on weight gain topics						
Strongly agree/agree	78	76	80	0.416	82	91
Undecided	14	19	7		18	9
Disagree/strongly disagree	8	5	13			
I worry that discussing weight gain will make my patients uncomfortable						
Strongly agree/agree	35	29	44	0.590	36	36
Undecided	5	5	6		9	9
Disagree/strongly disagree	60	67	50		55	55
I think my patients do not understand the information I provide them about weight gain						
Strongly agree/agree	8	9	6	0.892	18	0
Undecided	27	29	25		9	18
Disagree/strongly disagree	65	62	69		73	82
I think my patients do not retain the information I provide them about weight gain						
Strongly agree/agree	30	29	31	0.785	36	9
Undecided	24	29	19		27	9
Disagree/strongly disagree	46	43	50		36	82
Additional resources are needed to assist me with weight gain discussions						
Strongly agree/agree	49	57	36	0.412	55	18
Undecided	26	24	29		27	27
Disagree/strongly disagree	26	19	36		18	55
In your opinion, how important is it to discuss gestational weight gain during pregnancy						
Very Important	68	71	63	0.565	73	64
Somewhat important	32	29	38		27	36
Neutral/not very important/not at all important	0	0	0		0	0

*p-value comparing baseline responses between intervention and control clinics

leaving a final sample of 332 (183 from intervention and 149 from comparison clinics).

Patients from the intervention and control clinics did not differ significantly with regard to age, marital status, race, ethnicity, education, parity, or baseline BMI category (Table 2). The majority of women (67%) were age 30 or older, married (79%), and white (74%). About half (53%) had BMI values in the healthy weight category, 25% were overweight, 21% were obese, and 1% were underweight.

Patients at intervention clinics were significantly more likely to indicate a provider gave them advice about weight gain over patients at control clinics (92 vs. 66%, $p < 0.001$) (Table 3). Of those who indicated a provider gave them advice, those at intervention clinics were significantly more likely to indicate that a provider also discussed the risks of gaining too much or not enough weight (64 vs. 52% $p = 0.040$), and to indicate that they were satisfied with the weight gain discussions they had with their provider (53 vs. 35% strongly agree, $p = 0.007$). Women's perceptions of how much weight they should gain were more likely to be aligned with the IOM guidelines if the woman was receiving care at an intervention clinic (72.7 vs. 50.4%, $p < 0.001$).

Secondary Analysis of Prenatal Weight Gain Outcomes

Data on patient weight gain was not available for 24 women, leaving 308 women with weight gain outcome data. There was no significant difference between intervention and control patients whether weight gain was within, over, or under the IOM guidelines (Table 3). There was also no significant difference in these measures when stratified by BMI category. Relative to the IOM guidelines, 36.7% gained within, 50.6% gained over, and 12.7% gained

Table 2 Comparison of patients from intervention and comparison clinics

	Control (n = 149) %	Intervention (n = 183) %	Total (n = 332) %	p-value
Age mean (SD)	31.3 (5.07)	31.9 (4.61)	31.6 (4.82)	0.254
Under 20	2.1	0.6	1.3	0.545
20–24 years	10.6	8.1	9.2	
25–29 years	21.8	23.7	22.9	
30+ years	65.5	67.6	66.7	
Marital status				
Single	21.1	20.3	20.7	0.866
Married	78.9	79.7	79.3	
Race/ethnicity				
Asian	13.7	6.7	9.8	0.133
Black/African American	9.6	12.8	11.3	
White	72.6	74.4	73.6	
American Indian/Alaska Native	0.7	0.6	0.6	
Native Hawaiian/Pacific Islander	0.7	0	0.3	
Other	1.4	5.0	3.4	
Multiple races selected	1.4	0.6	0.9	
Hispanic/Latino	3.4	4.5	4	0.601
Highest grade/education level completed				
Less than college degree	32.4	32.4	32.4	0.973
College degree	32.4	33.5	33.0	
Graduate or professional degree	35.1	34.1	34.6	
Parity				
No prior deliveries	55.2	53.7	54.4	0.794
1 or more prior deliveries	44.8	46.3	45.6	
BMI category	(n = 141)	(n = 167)	(n = 308)[a]	0.672
Underweight (BMI < 18.5)	1.4	0.6	1.0	
Healthy weight (BMI 18.5–24.9)	49.6	55.7	52.9	
Overweight (BMI 25.0-29.9)	27.0	23.4	25.0	
Obese (BMI ≥ 30)	22.0	20.4	21.1	

[a] 24 excluded because first weight was after first trimester or no weight data available in record

Table 3 Patient survey responses and weight gain outcomes from EHR data at intervention and control clinics

Patient responses (%)	Total (n = 332)	Control (n = 149)	Intervention (n = 183)	p-value
Did a healthcare provider give you advice about how much weight you should gain this pregnancy?				
Yes	80.7	66.4	92.3	< 0.001
No	19.3	33.6	7.7	
Of those who said yes …	(n = 271)	(n = 100)	(n = 171)	
How important is it to stay within weight range advised?				
Very important	42.1	40.0	43.3	0.952
Somewhat important	42.1	43	41.5	
Neutral	12.9	14	12.3	
Not very important	3.0	3	2.9	
Did a provider discuss risks of gaining too much or not enough?				
Yes	59.6	51.5	64.3	0.040
No/don't know	40.4	48.5	35.7	
Thinking about the healthcare provider who discussed weight gain with you the most, how much do you agree with the following				
I am very satisfied with the weight gain discussions				
Strongly agree	46.2	34.7	53.0	0.007
Somewhat agree	29.9	29.6	30.1	
Neutral	20.5	30.6	14.5	
Somewhat disagree	2.7	3.1	2.4	
Strongly disagree	0.4	1	0	
Don't know or NA	0.4	1	0	
The healthcare provider is very knowledgeable about weight gain during pregnancy				
Strongly agree	60.0	55.1	62.9	0.151
Somewhat agree	19.6	20.4	19.2	
Neutral	15.8	19.4	13.8	
Somewhat disagree	1.5	0	2.4	
Strongly disagree	0.8	2	0	
Don't know or NA	2.3	3.1	1.8	
I felt comfortable with the weight gain discussions				
Strongly agree	62.0	59.6	63.5	0.490
Somewhat agree	22.6	24.2	21.6	
Neutral	11.7	14.1	10.2	
Somewhat disagree	3.0	1	4.2	
Strongly disagree	0.8	1	0.6	
I was given as much information as I wanted about weight gain				
Strongly agree	62.0	56.6	65.3	0.300
Somewhat agree	20.3	20.2	20.4	
Neutral	12.0	16.2	9.6	
Somewhat disagree	3.8	6.1	2.4	
Strongly disagree	0.4	0	0.6	
Don't know or NA	1.5	1	1.8	
I was not judged when talking about weight gain				
Strongly agree	73.1	73.5	72.9	0.825
Somewhat agree	15.9	13.3	17.5	
Neutral	7.2	8.2	6.6	
Somewhat disagree	1.1	1	1.2	
Strongly disagree	0.8	1	0.6	
Don't know or NA	1.9	3.1	1.2	

Table 3 (continued)

Patient responses (%)	Total (n = 332)	Control (n = 149)	Intervention (n = 183)	p-value
How many total pounds do you think you ideally should have gained from the beginning to the end of this pregnancy? (total or range allowed)				
Target within IOM recommendations	62.4	50.4	72.7	< 0.001
Target over IOM recommendations	30.7	39.8	22.7	
Target under IOM recommendations	7	9.8	4.5	
Prenatal weight gain in relation to guidelines (from EHR data)		(n = 141)	(n = 167)	
Within	36.7	36.9	36.5	0.909
Over	50.6	49.6	51.5	
Under	12.7	13.5	12.0	
Stratified by baseline BMI category				
Healthy weight (BMI 18.5–24.9)		(n = 70)	(n = 93)	
Within	53.4	57.1	50.5	0.528
Over	31.9	27.1	35.5	
Under	14.7	15.7	14.0	
Overweight (BMI 25.0-29.9)		(n = 38)	(n = 39)	
Within	16.9	18.4	15.4	0.762
Over	79.2	76.3	82.1	
Under	3.9	5.3	2.6	
Obese (BMI ≥ 30)		(n = 31)	(n = 34)	
Within	18.5	16.1	20.6	0.734
Over	66.2	71.0	61.8	
Under	15.4	12.9	17.6	

less weight than recommended. Staying within the guidelines was most common among those in the healthy weight category (53.4%). Gaining over the guidelines was most common among those in the overweight category (79.2%).

Discussion

Improved patient education and communication surrounding gestational weight gain is imperative, yet a standard and consistent method is lacking. There is often considerable disconnect between provider perception of counseling and patient recollection. Our findings demonstrate that the combination of provider education, routine use of a prenatal weight gain chart, and basic patient education materials resulted in a higher proportion of both patients and providers at intervention clinics reporting communication about weight gain and knowledge of the guidelines. At baseline provider survey responses to typical advised amounts of weight gain recommended by BMI category indicate that providers were not all knowledgeable of the 2009 guidelines. Baseline provider responses found that only 43% reported talking with every patient about gestational weight gain recommendations. Furthermore, only 35% of all providers in our study felt like their advice influenced patients, yet consistent guideline congruent provider advice has in fact been positively associated with patients staying within IOM guidelines (Cogswell et al. 1999; Stotland et al. 2005). Accordingly, post-surveys identified that 73% of intervention providers felt like their advice now influenced patients.

We also found that intervention patients reported higher satisfaction with the weight gain discussions compared to control clinic patients. Previous studies support the notion that weight gain is perceived as a sensitive topic; many providers avoid counseling or feel uncomfortable bringing it up and patients can feel offended if the method of counseling is inconsistent (Waring et al. 2014; Kominiarek et al. 2015; Chang 2013; Oken et al. 2013). A weight gain chart is an objective tool and routine use allows providers to counsel on gestational weight gain similar to other vital signs. Apart from its usefulness in initiating counseling, visual aids have also been shown effective in providing medical information, of which 40–80% is otherwise immediately forgotten (Kessels 2003). In parallel with our findings, prior authors have suggested the chart as a useful method for counseling (Chang 2013; Oken et al. 2013; Olson et al. 2004). The prenatal weight gain charts for the IOM guidelines are now available in the EHR system (Epic) and may be incorporated into other electronic health

record systems making the tool readily available for providers at no extra investment.

While the perception of weight gain was more likely to be aligned with the IOM recommendations among women in the intervention clinics, there was no significant difference in actual weight gain. We found that 36.7% of women gained within the guidelines while 50.6 and 12.7% gained above or below, respectively. These findings are similar to general weight gain patterns (Institute of Medicine (US) and National Research Council 2009; Siega-Riz and Gray 2013); Dalenius et al. 2012). While this finding is discouraging, our study was designed as a pilot study focused on communication tools. These findings are also similar to a similar intervention study by Olson et al. (2004), which examined the use of a gestational weight gain grid in addition to patient education tools. Their study found no difference in weight gain outcomes between the intervention group and a historic comparison group. Identified barriers to appropriate gestational weight gain include financial concerns, family and time constraints, and misconceptions regarding appropriate weight gain. A recent study (Kominiarek et al. 2015) found that the concept of "eating for two" was still prevalent among elder support persons. Patients need a consistent message and increased involvement from their providers.

Pregnancy is a time when women are motivated to adopt healthy behaviors, and providers have the opportunity to influence change (Chang 2013; Oken et al. 2013; Adamo et al. 2013). Striking evidence linking maternal obesity and excess gestational weight gain to childhood obesity has made this issue a public health priority (Adamo et al. 2013). Moreover, excessive weight gain in the first half of pregnancy has been shown to affect neonatal body fat more than total excess weight gain (Davenport et al. 2013). Meta-analyses and systematic reviews have previously reported that dietary intervention reduced total gestational weight gain, weight retention postpartum, and importantly, the incidence of cesarean delivery (Muktabhant et al. 2012; Thangaratinam et al. 2012; Tanentsapf et al. 2011). Initiating counseling is a vital first step, and counseling must begin early in pregnancy, when there is an opportunity to identify a trend towards excess weight gain. However, our study would suggest that counseling alone may not affect maternal weight gain. Future strategies may incorporate behavioral counseling in addition to diet and exercise management. Efforts should utilize dietitians who can provide tailored advice and planning specific to the needs of each woman based on weight, income, cultural background to find healthy choices that are feasible and desirable. Other prospective steps include group prenatal care, which is increasingly more prevalent. Particularly among young and minority women, group prenatal care has the potential to impact weight gain in addition to psychosocial aspects of pregnancy. Continuing counseling and education in the postpartum period is also imperative.

Our study followed two groups prospectively and baseline provider surveys did not differ in important responses. We implemented use of a prenatal weight gain chart into routine care with success. Provider feedback was positive in regards to their feelings on weight gain discussions and their influence on patients. Because of the small provider sample size and missing follow-up data, investigators acknowledge the possibility of bias in the follow-up provider survey data. The lower response at follow-up in the control clinics was likely due to the change from collection of surveys by the investigator at a staff meeting at baseline to the collection by the clinic manager at follow-up at two clinics. Another notable limitation of our study was that a few providers in one of the control clinics were found to have utilized the weight gain chart (after hearing of the study's purpose). This was not discovered until the study was completed. Utilizing this tool during the study may have altered results. Despite this limitation, we still found a significant difference in patients reporting increased counseling and satisfaction. An additional limitation is that we are unable to quantify the total response rate among patients. While clinics were instructed to return refused surveys as blank, we only received 30 blank surveys out of 375. We are unsure if this 8% represents the full set of refusals or if clinic staff did not always return the surveys of refusals.

In summary, we found that routine use of a prenatal weight gain chart resulted in higher provider and patient reported knowledge and communication about weight gain. Importantly, more patients reported feeling satisfied with their discussion utilizing this objective tool. Patient counseling may be insufficient to impact the number of patients that stay within guidelines for recommended gestational weight gain. However, patient counseling coupled with intervention may have a greater impact. Consistent and objective patient counseling is the first step to towards this goal.

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Compliance with Ethical Standards

Conflict of interest All authors declare that they have no conflict of interest.

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