ORIGINAL ARTICLE

Preconception and antenatal knowledge and beliefs about gestational weight gain

Short title: Gestational weight gain knowledge and beliefs

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Abstract

Background: Prevention of excessive gestational weight gain during pregnancy is difficult; targeting women before pregnancy may be more effective.

Aims: In order to generate knowledge that may influence the development of effective interventions to promote healthy weight in reproductive-aged women, this study aimed to explore knowledge and belief formation regarding gestational weight gain for preconception and pregnant women.

Materials and Methods: Women ≥ 18 years (preconception $n = 265$; pregnant women at 16 weeks gestation $n = 271$) completed questionnaires assessing knowledge and beliefs about gestational weight gain. Responses were categorised according to the 2009 Institute of Medicine gestational weight gain recommendations.

Results: Preconception women exhibited poorer gestational weight gain knowledge than pregnant women, yet only half of pregnant women reported accurate gestational weight gain knowledge within the Institute of Medicine recommendations. Beliefs about gestational weight gain were also inaccurate for both preconception and pregnant women, with 34.1% of pregnant and 44.6% of preconception women expecting to gain less than recommendations. Gestational weight gain knowledge accounted for about half of the variance in GWG beliefs.

Conclusions: Overall, the large inaccuracies in gestational weight gain knowledge and beliefs reported by both preconception and pregnant women suggest significant gaps in dissemination of gestational weight gain advice throughout the reproductive life phase. Knowledge is an important part of belief formation that can lead to appropriate weight gain. Hence, health professionals and policy makers should actively pursue opportunities to improve gestational weight gain knowledge in reproductive-aged women.

Introduction

Rising rates of overweight and obesity in women of childbearing age and excessive gestational weight gain (GWG) present a significant issue for the provision of appropriate perinatal care¹. Approximately 50% of women in Australia² and other developed nations gain excessive weight during pregnancy, defined as weight gain exceeding the range recommended by the United States Institute of Medicine (IOM) based on pre-pregnancy body mass index (BMI)¹. Excessive GWG is associated with increased risk of pregnancy and delivery complications such as caesarean delivery and infant macrosomia^{3,4} and increased risk of short- and long-term weight retention⁵.

Knowledge of GWG recommendations has been shown to be associated with lower GWG in pregnant women⁶. Previous research has shown that expectations to gain more gestational weight are associated with higher GWG⁷. A potential mechanism to explain the links between GWG advice, expectations and weight gain is that knowledge about GWG influences the formation of beliefs. The Theory of Planned Behaviour explores behaviour change in relation to the development of beliefs and attitudes towards behaviours, where these beliefs are acquired through a range of factors, including knowledge about the behaviour⁸. Conceptualised simply, knowledge of GWG influences the development of beliefs about GWG, which affect actual GWG.

Knowledge provision can be a key component of pregnancy-based lifestyle interventions designed to prevent excessive GWG⁹. However, a key challenge for the promotion of healthy GWG is that such interventions have only modest success^{9, 10}. Once pregnancy has occurred, it may be too late to influence many of the factors that contribute to the mother's health¹¹. For instance, habit formation to attain and maintain healthy lifestyle behaviours is a long-term process and change can be difficult to achieve during the gestational time-span. Physical symptoms, financial stress, and contrasting social norms experienced during pregnancy also make change more difficult. Moreover, many women reach or exceed their total recommended GWG for their BMI category before antenatal care has commenced, limiting opportunity for prenatal intervention¹².

A strategic avenue for the prevention of excessive GWG may be to address the issue of weight prior to conception¹³. This approach has multiple benefits, including the promotion of healthy preconception BMI as well as the ability to target women with planned or unplanned pregnancies. Fifty percent of pregnancies are unplanned¹⁴, and unplanned pregnancies are associated with negative outcomes such as poor maternal psychosocial wellbeing¹⁵, delayed initiation of prenatal care¹⁶, and preterm birth¹⁷. Ensuring all women of reproductive age have appropriate knowledge and beliefs around pregnancy facilitates equality in the face of unplanned pregnancies. A recent Lancet series on preconception health identified the importance of broad, public health level initiatives to reduce risk behaviours at a population level¹⁸.

To our knowledge, there is no research characterising women's knowledge or beliefs of appropriate GWG before pregnancy, nor any research contrasting the GWG knowledge and beliefs of preconception and pregnant women. Understanding differences between preconception and pregnant women's knowledge and beliefs and

how these beliefs are formed is essential to developing effective and appropriately targeted interventions. Hence, the aim of this study was to explore the GWG knowledge and beliefs of preconception and pregnant women. Specifically, we aimed to investigate the: [1] differences in accuracy of knowledge about GWG (i.e., GWG for their own or baby's health) between preconception and pregnant women; [2] differences in accuracy of beliefs about GWG (i.e., GWG expectations and desires) between preconception and pregnant women; and [3] contribution of GWG knowledge to the development of GWG beliefs.

Materials and Methods

Participant Recruitment, Enrolment, and Procedure

For the preconception sample, 269 women residing in Australia were recruited throughout 2012 for a study investigating the wellbeing of non-pregnant women who had never been pregnant (i.e., nulligravid women). Women over the age of 18 years were invited to take part through advertisements on a social media (i.e., Facebook) page, in a sporting club newsletter, and via a link posted on an undergraduate student online web forum. Women were provided with a web address to the survey. Completion of the 20-minute, online survey implied consent. Ethics approval was obtained from XXXXX <<details provided upon acceptance>>.

For the pregnant sample, 274 women participated in a prospective study examining psychosocial wellbeing during pregnancy and the first 12-months postpartum. Women were recruited between February 2010 and July 2012 through advertisements in pregnancy and parenting magazines and on Australian pregnancy online forums. Pregnant women over 18 years and between 10 and 16 weeks gestation were invited to participate. Twin/multiple pregnancies were excluded. Interested women contacted the researchers and were given a participant information sheet. After providing written informed consent, pregnant women completed questionnaires at approximately 16 weeks gestation. The postal survey took approximately 45 minutes to complete. Of 446 pregnant women interested in participation, 274 (61.4%) consented and provided data for the study. Ethics approval was obtained from XXXXX <<details provided upon acceptance>>.

Measures

Demographic information. Date of birth, occupation, and socio-economic status (SES) were collected via the questionnaires. Participants' postcode was converted into a disadvantage index score using the Australian Bureau of Statistics' (ABS) Socio-

Economic Indexes for Areas (SEIFA)¹⁹. Information regarding parity and gravidity was collected from women in the pregnant sample.

Body mass index (BMI). Questionnaires included current self-reported height and weight for preconception women, and self-reported height and pre-pregnancy weight for pregnant women. Body-mass-index was classified as underweight ($<18.5 \text{ kg/m}^2$), normal weight ($18.5\text{-}24.9 \text{ kg/m}^2$), overweight ($25.0\text{-}29.9 \text{ kg/m}^2$), and obese ($\geq 30.0 \text{ kg/m}^2$). These categories align with the 2009 IOM recommendations for GWG entering pregnancy: underweight women should gain 12.5 to 18 kg, normal pre-pregnancy BMI between 11.5 and 16 kg, overweight women between 7 and 11 kg, and women who are obese should gain 5 to 9 kg throughout their entire pregnancy¹.

Knowledge of GWG. Women were asked to freely report (kg) how much GWG they thought would be best for their baby's health (GWG baby) and would be best for their own health (GWG own; see Table 1). This dichotomy may reflect how a woman may perceive and rank the risks, for instance women readily prioritise behaviours that have impact on their future baby's health rather than their own²⁰. Furthermore, evidence for the impact of optimal GWG on maternal outcomes is predominately supported by meta-analyses of randomised evidence. Indeed, intervention studies have shown that reducing weight gain can lower risks for maternal outcomes such as caesarean section¹⁰ and preeclampsia²¹ and may reduce risks for gestational diabetes, gestational hypertension and preterm birth²¹. Meta-analyses of observational studies generally support these findings and also indicate that higher GWG is associated with higher short- and long-term weight retention⁵. On the other hand, our knowledge of the impact of healthy GWG on optimising infant outcomes is based primarily on meta-analyses of observational studies, indicating that GWG below IOM recommendations is associated with increased risk of preterm birth and small-for-gestational-age infants, whilst GWG above recommendations is associated with increased risk of large-for-gestational-age infants and macrosomia³. These findings are supported by research indicating that there appears to be no public health level harm when IOM GWG recommendations are prescribed¹⁰.

Beliefs about GWG. Women were asked to freely report (kg), how much GWG they expect to gain (GWG expect) and how much they would like to gain (GWG like) during pregnancy (see Table 1). Preconception women were asked to answer according to their beliefs for any future pregnancies they may have. Pregnant women were asked to answer according to their general GWG beliefs.

Responses to each of the GWG knowledge and beliefs items were categorised as below, within, or exceeding GWG guidelines. The category was determined by comparing a participant's response to the 2009 IOM GWG guidelines for their current BMI (for preconception women) or their pre-pregnancy BMI (for pregnant women).

Statistical Analysis

Analyses were performed using SPSS (version 22.0). Seven women were multivariate outliers (defined as Mahalanobis distance greater than the critical value of 18.47, $df = 4$, $p < .001$) and excluded from analyses²². Paired t-test and chi-square tests were used to compare between groups. Linear regression was conducted to examine whether GWG beliefs (i.e., GWG expect and like) could be explained by knowledge of overall GWG for optimal maternal health when controlling for age, BMI, and parity. Knowledge of optimal GWG for baby's health (GWG baby) was not included in multivariable analyses due to issues of multi-collinearity. Significance was set at $\alpha = .05$ (two-tailed).

Results

Sample Characteristics

Sample characteristics are described in Table 2. Mean age of preconception and pregnant women was 23 years and 32 years, respectively. Of the pregnant women, 55% were primiparous (having their first baby). Socio-economic status (SEIFA) did not differ between the two groups. Preconception women reported significantly lower mean BMI than pregnant women ($p < .001$).

GWG Knowledge

Means and standard deviations (kg) for GWG knowledge for preconception and pregnant women are presented in Table 3a. On average, participants estimated 0.56 kg heavier what they thought would be best for the baby's health, than what they thought would be best for their own health ($p < .001$, moderate effect size ($\eta^2 = .05$)). This difference was significant for pregnant women (0.73 kg difference, $p < .001$, large effect size ($\eta^2 = .12$)) and marginally significant for preconception women (0.40 kg difference, $p = .020$, small effect size ($\eta^2 = .02$)).

Preconception and pregnant women's GWG knowledge categories are presented in Table 4. Pregnant women were more likely to estimate a GWG range for themselves (GWG own) within IOM guidelines (54.5%) than preconception women (31.1%; $p < .001$). Specifically, preconception women were more likely to under-report the amount of weight they should gain for their own health (55.8%), than pregnant women

(20.8%). The percentage of women overestimating their own GWG was similar between preconception (13.1%) and pregnant women (13.9%). Results were similar for estimating GWG weight gain for the infant (GWG baby) as for estimating GWG for themselves.

Beliefs about GWG

Means and standard deviations (kg) for GWG beliefs for preconception and pregnant women are presented in Table 3b. On average, women expected to gain 3.65 kg more than they would like to gain ($p < .001$). This result was significant for preconception women (4.13 kg, $p < .001$, very large effect size ($\eta^2 = .48$)) and pregnant women (3.17 kg, $p < .001$, very large effect size ($\eta^2 = .51$)).

The proportions of women reporting GWG beliefs fitting each IOM category are presented in Table 4. Expected GWG below IOM recommendations was 27.8% higher in preconception women (40.2%) than in pregnant women (12.4%). Expected GWG higher than IOM recommendations was 17.3% lower in preconception women (25.8%) than in pregnant women (43.1%). Less than half the sample expected to gain the recommended IOM GWG (preconception women, 34.1%; pregnant women, 44.6%). Two-thirds of preconception women (68.2%) stated that they would like to gain below IOM GWG recommendations, compared to 33.7% of pregnant women ($p < .001$). Only 20.1% of preconception women stated that the amount of weight they would like to gain during pregnancy was within IOM recommendations, compared to almost half of pregnant women (48.7%, $p < .001$).

Knowledge as a Predictor of Beliefs about Gestational Weight Gain

Two models were constructed to determine how much GWG knowledge for maternal health (GWG own) predicted GWG beliefs of how much weight women would expect to gain during pregnancy (GWG expect), and the amount of weight they would like to gain during pregnancy (GWG like), as presented in Table 5. Covariates entered into the model were age, BMI, socio-economic status (SEIFA) and gravidity (preconception or pregnant).

GWG Expect. The model accounted for 45.8% of the variance in GWG expect ($F(5, 503) = 85.06$, $p < .001$; $R^2 = .458$). Four variables significantly contributed to GWG expectations: age ($\beta = -.141$, $p = .004$), BMI ($\beta = .116$, $p = .001$), gravidity ($\beta = .157$, $p = .001$), and GWG own ($\beta = .676$, $p < .001$). Gestational weight gain knowledge (GWG own) was the largest predictor of GWG expectations.

GWG Like. The model accounted for 53.0% of the variance in GWG like ($F(5, 501) = 112.81, p < .001; R^2 = .530$). Three variables significantly contributed to GWG like: BMI ($\beta = -.085, p = .010$), gravidity ($\beta = .220, p < .001$), and GWG own ($\beta = .648, p < .001$). Knowledge (GWG own) was the largest predictor of GWG like.

Discussion

To our knowledge, this is the first study to explore the GWG knowledge and beliefs of preconception women, contrast them with pregnant women's knowledge and beliefs about GWG, and explore the contribution of knowledge to the development of GWG beliefs. No previous studies have compared preconception and pregnant women's knowledge and beliefs about GWG. When looking only at pregnant women, our findings are consistent with the literature that a significant proportion of women report GWG knowledge that does not conform with recommendations^{6, 23}. Furthermore, our findings indicated that GWG knowledge contributed significantly to the development of GWG beliefs, even after accounting for gravidity group, reflective of research that shows women who receive appropriate GWG advice are more likely to gain within GWG recommendations²⁴. This finding reiterates the importance of providing BMI-appropriate GWG recommendations to all women of reproductive age so that women have accurate knowledge on which to base their beliefs. Barriers to the provision of GWG advice exist for both women as patients (e.g., perception that GWG is not a high priority during pregnancy²⁵) and for their practitioners (e.g., lack of confidence and skills in raising weight-related topics during consultations, or lack of time to devote to lifestyle management with pregnant clients²⁶). A significant barrier to provision of GWG advice is the fact that women not planning a pregnancy are not likely to seek out or be receptive to preconception advice²⁷.

Pregnant women exhibited more accurate GWG knowledge than preconception women, which may be a function of exposure to GWG recommendations, for example through midwife/obstetric care consultations²⁴. At 16 weeks gestation, it is likely that most of the pregnant participants had attended at least one antenatal appointment; in Australia, it is recommended that healthcare professionals provide advice regarding GWG recommendations appropriate to the woman's pre-pregnancy BMI²⁸. In contrast, attendance at preconception appointments is low and weight concerns are not often broached²⁹. Hence, opportunities to provide GWG advice to preconception women using this strategy are limited.

In terms of GWG beliefs, pregnant women were more likely to expect and like to gain more gestational weight overall than preconception women. Our findings suggest these beliefs are influenced by GWG knowledge, after accounting for BMI, age, and socio-economic status. However, GWG beliefs are also likely to be dependent on other preconception or early pregnancy experiences, such as early GWG or psychosocial concerns that arise during pregnancy^{12, 30}. The preconception window may be particularly salient for the development of GWG knowledge and beliefs because women are not overwhelmed by the many changes accompanying pregnancy³¹.

Limitations

Whilst BMI was assessed via self-report, subjective weight and height measures are generally accurate and valid in adult non-pregnant and pregnant women³². Gestational weight gain beliefs of pregnant women were assessed once, and may change through pregnancy. This study relied on relatively narrow criteria when assessing GWG knowledge: explicit knowledge of IOM recommendations was not assessed. Women in both groups were not asked about prior knowledge of GWG recommendations and therefore we cannot discern the source of the GWG knowledge reported herein. Seven women were excluded from the analyses due to being identified as multivariate outliers. However, a sensitivity analysis was conducted to check whether the exclusion of these participants altered the findings, and there were no differences in results (data not shown). Generalisability of results should be kept in mind considering the relatively homogenous socio-economic status of this sample.

Conclusions

Our findings revealed GWG knowledge was an important determinant in the development of beliefs around GWG, yet suggest significant room for improvement for disseminating GWG advice throughout the reproductive life-phase. This is an important public health goal, as this issue affects a majority of women of reproductive age and has consequences for women's preconception and antenatal care. Thus, policy and/or cultural changes in the delivery of preconception care must be considered in order to effectively convey GWG advice to all preconception women, including the 50% of women with unplanned pregnancies¹⁴. This call reiterates that reported in a 2018 Lancet series on preconception health that population-level initiatives to reduce the determinants of preconception risks are essential to improving health outcomes for women¹⁸. Notwithstanding the scope for obstetricians and gynaecologists to impart GWG knowledge during preconception and antenatal care, further research, exploration,

and development may include provision of GWG advice during school sexual education classes and fiscal rewards for healthcare providers that initiate preconception care during opportunistic visits.

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Table 1.

Terms Used for GWG Knowledge and Beliefs Measures

Measure	Nomenclature
Knowledge of GWG	
How much GWG would be best for the baby's health	GWG baby
How much GWG would be best for a woman's own health	GWG own
Beliefs about GWG	
How much GWG a woman expects to gain	GWG expect
How much GWG a woman would like to gain	GWG like

Table 2

Participant Characteristics and Group Comparisons (N=536)

Demographic characteristics	Preconception Women n = 265	Pregnant Women n = 271	p
Age, mean (SD), y	22.8 (3.94)	31.5 (4.34)	<.001
SEIFA, mean (SD), decile	6.8 (2.19)	6.9 (2.66)	.761
BMI, mean (SD), kg/m ²	23.8 (4.72)	25.3 (5.17)	<.001
BMI Category, n (%)			.006
Underweight (<18.5)	13 (4.9)	5 (1.8)	
Normal Weight (18.5-24.9)	179 (67.5)	158 (58.3)	
Overweight (25.0-29.9)	50 (18.9)	66 (24.4)	
Obese (≥30.0)	23 (8.7)	42 (15.5)	
Parity, n (%)			<.001
No children	265 (100)	0 (0.0)	
Pregnant with first child	0 (0.0)	148 (54.6)	
Pregnant and has one or more other children	0 (0.0)	123 (45.4)	

Table 3a

Means, Standard Deviations and Paired t-test Results for Preconception, Pregnant and All Women Comparing GWG baby to GWG own (Knowledge)

	GWG baby M (sd)	GWG own M (sd)	Mean diff	t	df	p	Eta ² †
Preconception	10.51 (4.84)	10.11 (4.82)	0.40	2.35	263	.020	.02
Pregnancy	11.89 (2.92)	11.16 (2.92)	0.73	5.91	264	<.001	.12
Total	11.20 (4.22)	10.64 (4.36)	0.56	5.34	528	<.001	.05

† Eta-squared interpretation guidelines (Cohen, 1988): .01 = small effect, .06= moderate effect, .14 = large effect

Table 3b

Means, Standard Deviations and Paired t-test Results for Preconception, Pregnant and All Women Comparing GWG expect to GWG like (Beliefs)

	GWG expect M (sd)	GWG like M (sd)	Mean diff	t	df	p	Eta ² †
Preconception	12.35 (5.27)	8.22 (4.59)	4.13	15.66	263	<.001	.48
Pregnancy	13.79 (3.94)	10.62 (3.38)	3.17	16.38	263	<.001	.51
Total	13.07 (4.70)	9.42 (4.20)	3.65	22.15	527	<.001	.48

† Eta-squared interpretation guidelines (Cohen, 1988): .01 = small effect, .06= moderate effect, .14 = large effect

Table 4

GWG Knowledge and Beliefs for Preconception and Pregnant Women According to Whether They Report Values Below, Within, or Above the IOM GWG Recommendations, and Chi-square Test Results.

Construct	Preconception Women, n (%)			Pregnant Women, n (%)			χ^2	df	p
	Below IOM	Within IOM	Above IOM	Below IOM	Within IOM	Above IOM			
Knowledge									
GWG own	140 (55.8)	78 (31.1)	33 (13.1)	77 (31.6)	133 (54.5)	34 (13.9)	32.71	2	<.001
GWG baby	138 (52.3)	76 (28.8)	50 (18.9)	55 (20.8)	144 (54.5)	65 (24.6)	59.21	2	<.001
Beliefs									
GWG expect	106 (40.2)	90 (34.1)	68 (25.8)	33 (12.4)	119 (44.6)	115 (43.1)	54.05	2	<.001
GWG like	180 (68.2)	53 (20.1)	31 (11.7)	90 (33.7)	130 (48.7)	47 (17.6)	65.62	2	<.001

Table 5.

R^2 change, Unstandardised B weights, Standard Errors, Standardised Betas (β), p -values for linear regression analyses of GWG beliefs (expect and like)

	GWG Expect $R^2 = 45.8\%$, $p < .001$				GWG Like $R^2 = 53.0\%$, $p < .001$			
	B	SE for B	β	p	B	SE for B	β	p
Age	-0.110	.038	-.141	.004	.001	.031	.001	.983
BMI	0.109	.033	.116	.001	-.071	.027	-.085	.010
SEIFA	0.016	.064	.008	.801	.023	.054	.013	.670
Gravidity*	1.470	.450	.157	.001	1.851	.377	.220	<.001
GWG own (knowledge)	0.727	.037	.676	<.001	.625	.031	.648	<.001

*Gravidity (preconception, pregnant)

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