

# Is Gestational Weight Gain and Early Postpartum Weight Retention Associated with Clinician Advice in First Time Mothers?

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Received date: February 20, 2017; Accepted date: February 25, 2017; Published date: February 28, 2017

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## Abstract

**Objective:** Excess gestational weight gain (GWG) and postpartum weight retention increase risk for multiple maternal and child health complications. It is necessary to determine factors which influence maternal weight across the perinatal period. The aim of this study was to describe change in maternal body mass index (BMI) from pre-pregnancy to early postpartum, document weight advice provided by clinicians and assess associations of advice received with maternal weight gain during and following pregnancy.

**Methods:** First-time mothers (n=448) and their newborns who attended first-time parent groups at their local Maternal and Child Health Centres were recruited to the InFANT Extend cluster randomised controlled trial. Baseline data collection occurred when women were approximately three months postpartum. Women completed a written questionnaire assessing their own health and the provision of weight-related advice received by clinicians. Pre-pregnancy weight and GWG were self-reported. Postpartum height and weight were objectively measured.

**Results:** Mean GWG was  $14.0 \pm 6.08$  kg and 41.0% of women experienced excess GWG. Mean PPWR was  $4.3 \pm 5.75$  kg and mean BMI increased from  $24.8 \pm 4.9$  kg/m<sup>2</sup> pre-pregnancy to  $26.2 \pm 4.9$  kg/m<sup>2</sup> at three months postpartum. The proportion of women classified obese (BMI  $\geq 30$ kg/m<sup>2</sup>) almost doubled from pre-pregnancy (11.8%) to three months postpartum (21.7%) ( $p < 0.001$ ). 54.4% of all women reported receiving advice regarding how much weight to gain during pregnancy and 42.6% reported receiving advice to avoid excess GWG. During the postpartum period, just 5.8% of women reported receiving advice about how much they should weigh and 8.3% reported receiving advice about programs to support weight loss. No associations were found between provision of clinician advice with GWG or postpartum weight retention.

**Conclusion:** More intensive approaches are required, opposed to provision of advice alone, to influence healthy maternal weight across the perinatal period in the interest of best maternal and child health outcomes.

**Keywords:** Clinician; Gestational weight gain; Postpartum; Weight; Maternal; Obesity; Body mass index; Perinatal; Pregnancy

## Introduction

The US Institute of Medicine (IOM) 2009 guidelines [1,2] provide clinical guidance as to the amount of weight women should gain during pregnancy and have been adopted in the absence of country specific gestational weight gain (GWG) guidelines (Figure 1) [3,4]. Women who gain within these recommendations have been shown to have better perinatal outcomes than women who exceed them [5].

Excess GWG places the mother and child at increased risk of multiple pregnancy complications [1,6-12] and has been shown to adversely impact offspring birth weight (both large for gestational age and small for gestational age [13,14] and higher long term BMI [13]. Postpartum weight retention (PPWR) has been associated with an increased risk for complications during subsequent pregnancies [15], the development of maternal overweight and obesity [16,17] and future cardiovascular disease [16,18].

Moreover, a 20-40% increased risk for babies being born large for gestational age, has been shown to exist, with an increase of 1-2 maternal BMI units between pregnancies [19].

Advice provided by antenatal clinicians may be an effective means to assist women to achieve best maternal weight outcomes. Women are in frequent contact with a wide range of health professionals during the antenatal period [20-22].

This study aimed to assess change in maternal BMI from pre-pregnancy to the postpartum period, document weight advice provided by clinicians during and following pregnancy, and assess associations of the advice received with maternal GWG, PPWR and postpartum BMI.

Pre pregnancy weight category	Pre pregnancy BMI	Recommended total weight gain Range (kg)	Recommended rate of weight gain* 2 <sup>nd</sup> and 3 <sup>rd</sup> Trimester Range (kg/week)
Underweight	<18.5kg/m <sup>2</sup>	12.5 – 18kg	0.51 (0.44 – 0.58)
Normal weight	18.5 – 24.9kg/m <sup>2</sup>	11.5 – 16kg	0.42 (0.35 – 0.50)
Overweight	25 – 29.9kg/m <sup>2</sup>	7 – 11.5kg	0.28 (0.23 – 0.33)
Obese	≥30kg/m <sup>2</sup>	5 – 9kg	0.22 (0.17 – 0.27)

**Figure 1:** Institute of Medicine (IOM) 2009 guidelines for total gestational weight gain<sup>^</sup> (\* Calculations assume a 0.5-2 kg weight gain during the first trimester, <sup>^</sup>Adapted from the IOM's 2009 report Weight Gain During Pregnancy: Re-examining the Guidelines).

## Materials and Methods

Participants were from the three year, extended Melbourne Infant Feeding Activity and Nutrition Trial Program (InFANT Extend) (Trial registration: (InFANT Extend) Australian New Zealand Clinical Trials Registry (ACTRN12611000386932 13/04/2011)), a cluster-randomised controlled intervention trial which recruited first-time mothers who attended first-time parent groups at their local Maternal and Child Health Centres in Victoria, Australia [23]. The InFANT Extend trial was a community based, early obesity prevention program whereby first-time parent groups received 6x2 hour sessions, delivered quarterly from when infants were three months of age up until 18 months [24]. Sessions were based on anticipatory guidance and were focussed on child feeding, active play, screen time alternatives, parent modelling, physical activity and sedentary behaviours [24].

Women allocated to the control group received usual care as part of the Maternal and Child Health system and mailed newsletters regarding general information (e.g. dental health and sun protection) [24]. A two-stage random sampling design was used to select first-time parent groups across all socio-economic areas [23].

As described elsewhere, [23] to ensure inclusion of a broad representation of socio-economic areas, each Local Government Area (LGA) was classified by socio-economic position (SEP) classified by the Australian Bureau of Statistics Socio-Economic Indices for Areas (SIEFA). Local Government areas with SEIFAs in the lowest quintile throughout the state of Victoria were eligible for selection. Firstly, nine LGAs met criteria to be approached for recruitment and seven LGAs agreed to take part. Secondly, 62 first-time parent groups were selected from the seven LGAs.

To be eligible, parents needed to be English literate. A minimum of eight participants per group needed to consent within mid and higher SEP LGAs and six participants per group were required to consent within the lower SEP LGAs. This lower number required for lower SEP areas was because participation rates tend to be low in health behaviour interventions for vulnerable population groups or low socio-economic areas [25]. Groups that provided written consent, administered by trained researchers at the recruitment visit were then randomly allocated to intervention or control arms.

The InFANT Extend trial was approved by the Deakin University Human Research Ethics Committee (2011-029) (2007-175)

(11/02/2011) and the Victorian Government Department of Human Services, Office for Children Research Co-ordinating Committee.

Questionnaires including demographic information and questions regarding practitioner advice were distributed to all mothers when they were approximately three months postpartum at the recruitment visit. Surveys were completed prior to women being allocated to either the control or interventions groups. Postpartum weight was measured by trained research staff when women were approximately three months postpartum. As detailed in a previously published study [23], weight in light clothing and without shoes was measured once using Tanita digital scales (Model 1582) and recorded to the nearest 0.01 kg.

Height was measured using a Victar stadiometer. Two measurements were taken separately and were recorded to the nearest 0.1cm. If the two measurements disagreed by 0.5cm or more, a third measurement was taken. The average of the height measurements was used to calculate maternal pre-pregnancy BMI and postpartum BMI (weight (kg)/height (m<sup>2</sup>)). Body Mass Index classification was according to World Health Organization criteria [26].

Excess GWG was defined as weight gain exceeding the 2009 IOM recommendations [2], a universally used reference for multiple studies which have assessed pregnancy weight gain [12,27-30]. Postpartum weight retention was calculated as the difference between objectively measured weight at three months postpartum and self-reported pre-pregnancy weight. While this method does not take into account the possibility of maternal weight gain during the first few months following childbirth [31], this method has been used for calculating PPWR in multiple studies of varying design assessing maternal PPWR [17,32-35], as well as a recent, large, Norwegian, prospective cohort pregnancy study which assessed PPWR of approximately 95, 200 women [36]. This method is considered a standard method for calculating PPWR [2].

Provision of advice given by clinicians during pregnancy was measured by two items requiring a yes/no response which asked women if during their pregnancy, a doctor, nurse or other healthcare practitioner talked with them about weight advice: 'how much weight you should gain during pregnancy' and 'avoiding gaining too much weight during pregnancy'.

Provision of advice given by clinicians during the postpartum period was measured by two items requiring a yes/no response which asked women if, since delivering their baby, they had they received advice from their doctor, nurse or other healthcare worker about 'how much you should now weigh' and 'programs or resources to help you lose weight after pregnancy'.

Data were analysed using SPSS statistical package version 21, and for regression analyses assessing associations of clinician advice with maternal weight, Stata Version 12 was used to allow controlling for clustering. Adjustment for clustering within the analysis is necessary when assessing a cluster-randomised trial such as the Melbourne InFANT RCT [37] and accounts for the design effect and expected intra-cluster correlations of maternal characteristics within a first-time parent group.

Analyses included descriptive statistics to characterize the sample and distributions of key variables. The change in the proportion women classified as overweight/obese and underweight/healthy weight was assessed via paired t-tests. Chi square tests were conducted to detect differences in the proportion of women who reported receiving advice during pregnancy compared to during the postpartum period.

For associations of clinician advice with maternal weight both during and following pregnancy, linear regression was conducted for these continuous outcomes. Such outcome measures were checked for normality and when found to be non-normally distributed, were transformed using root or log transformations. Binomial or multinomial logistic regression analyses were conducted for categorical outcomes.

Statistical significance was set as  $p < 0.05$  for all analyses and maternal age, education, income and BMI or GWG were adjusted for in the analyses. The rationale for adjusting for various confounding factors in the analyses was based on previously established predictors of the outcome variables. Pre-pregnancy BMI has been frequently associated with GWG [38-40] and GWG has consistently been shown to be the strongest predictor of PPWR [2,41-45]. In addition and consistent with other studies which have previously assessed maternal weight both during and following pregnancy, age, education, and income were also adjusted for [46-51].

## Results

A total of 477 women from 62 first-time parent groups were recruited to the InFANT Extend RCT from 531 women approached (90%). Of the 62 groups, 28 were classified as low SEP, 20 were medium and 14 were high SEP. The present analysis excluded mothers with non-singleton pregnancies ( $n=6$ ) and those who did not provide detail regarding parity ( $n=6$ ).

Those women who were not first-time mothers ( $n=15$ ) were also excluded and survey data were missing for two women. Data for 448 women were included in the analysis. Sample characteristics are presented in Table 1.

Variables	Mean $\pm$ SD	Range
Maternal age (years)	31.9 $\pm$ 4.25	19.3-43.5
Pre-pregnancy weight (kg) (n=445)	67.1 $\pm$ 14.34	35.0-155.0
Pre-pregnancy BMI (kg/m <sup>2</sup> ) (n=430)	24.8 $\pm$ 4.88	16.3-55.0
Postpartum BMI (kg/m <sup>2</sup> ) (n=416)	26.2 $\pm$ 5.00	17.1-46.8
	<b>Percentage (%)</b>	
Marital status		
Married	74.1	
De facto	22.3	
Separated/Divorced	1.3	
Never married	2.2	
Birth country		
Australia	75.9	
UK	3.3	
New Zealand	2.2	
Other	18.5	
Weekly household income (n=433)		

\$1-1499	36.7
\$1500-1999	22
\$2000 or more	29.7
Unsure/Don't want to answer	11.6
Education (n=447)	
No qualification/up to year 12	11.6
Trade/apprenticeship/certificate/diploma	30
University degree/Higher degree	58.4
Employment status (n=446)	
Full time work	3.4
Part time work	6.3
Keeping house/raising children full time	88.6
Studying full time/Unemployed	1.8
Smoking during pregnancy	
Yes	3.8
No	96.2
Smoking currently	
Yes	5.4
No	94.7
Breastfeeding	
Exclusive breastfeeding	49.6
Combined breastfeeding	28.1
Formula feeding only	22.3

**Table 1:** Maternal weight status across the perinatal period and characteristics at 3 months Postpartum ( $n=448$  unless otherwise stated).

Two thirds (60.0%) of women had a healthy pre-pregnancy BMI. Just over one third of women were classified as either overweight or obese pre-pregnancy (37.7%) (Table 2). The proportion of women classified as overweight and obese (combined) women increased significantly from pre-pregnancy to three months postpartum by 30%. Mean GWG was  $14.0 \pm 6.08$  kg.

Overall, 41.0% of women exceeded IOM recommendations. Compared with healthy women ( $n=258$ ), those who were overweight ( $n=110$ ) or obese ( $n=52$ ) pre-pregnancy, were more likely to exceed IOM recommendations for weight gain during pregnancy (OR=4.3, 95% CI=2.7, 7.0 and OR=3.2, 95% CI=1.7, 6.0 respectively). Mean PPWR was  $4.3 \pm 5.75$  kg.

Women who were obese pre-pregnancy retained significantly less weight, on average ( $1.9 \pm 6.41$  kg) compared to women with a healthy BMI ( $4.4 \pm 5.51$ ) and women who were overweight ( $5.0 \pm 5.84$ ) ( $p=0.023$  and  $p=0.009$  respectively) (Table 2).

BMI category	Pre-Pregnancy (n=430)		3 months postpartum (n=416)		Combined BMI category	Change pre-pregnancy to 3 months postpartum (+/-n)	p-value
	n	%	n	%			
Underweight	10	2.3	5	1.2	Underweight/Healthy*	-63 (-24%)	<0.001
Healthy	258	60	200	48.1			
Overweight	110	25.6	121	29.1	Overweight/ Obese*	+49 (+30%)	<0.001
Obese	52	12.1	90	21.6			
<b>GWG (kg)~</b>	<b>n</b>				<b>%</b>		
Below recommendations	88				21.1		
Within recommendations	158				37.9		
Exceeded recommendations	171				41		
	<b>Mean ± SD</b>				<b>Range</b>		<b>p-value^</b>
GWG (kg) (n=434)	14.0 ± 6.08				-11.0-47.0		
Underweight	14.8 ± 7.40				4.5-30.0		0.217^
Healthy	14.4 ± 5.07				2.0-40.0		0.001^
Overweight	14.4 ± 6.50				0.0-47.0		0.003^
Obese	10.9 ± 7.54				-7.0-30.0		
PPWR (kg) (n=415)	4.3 ± 5.75				-12.0-32.9		
Underweight	4.9 ± 4.91				-2.3-12.5		0.994^
Healthy	4.4 ± 5.51				-6.7-32.9		0.023^
Overweight	5.0 ± 5.84				-8.2 ± 26.9		0.009^
Obese	1.9 ± 6.41				-12.0-16.8		

**Table 2:** Change in maternal BMI, gestational weight gain and postpartum weight retention across the perinatal period (\*change in number of women in the combined underweight/healthy weight BMI category and overweight/obese category from pre-pregnancy to three months postpartum, ^the difference in GWG (kg) and PPWR (kg) when 'obese' was used as the reference category, ~ GWG compared to IOM recommendations based on pre-pregnancy BMI).

Approximately half (54.4%) of all women reported receiving advice regarding how much weight to gain during pregnancy, while 42.6% reported receiving advice to avoid excess GWG (Table 3). During the postpartum period, just 5.8% of women reported that they had received advice about how much they should now weigh and 8.3% reported receiving advice about programs to support weight loss, during the postpartum period.

There were no significant associations found between clinician advice regarding how much weight to gain or how to avoid excess weight gain received during pregnancy, and either GWG (kg) or gaining weight within IOM recommendations (Table 3).

During pregnancy (#) did a doctor, nurse, or other health care worker talk with you about?		n	%	Gestational Weight Gain (n=448)	β-coef (95%CI)	p-value	OR/RRR (95%CI)	p-value
How much weight you should gain during pregnancy?	Yes	244	54.5	GWG (kg)	-0.17 (-1.30, 0.97)	0.765		
	No	204	45.5	GWG within IOM recommendations			0.87 (0.57, 1.33)	0.506

Avoiding gaining too much weight during pregnancy?	Yes	191	42.6	GWG (kg)	-0.48 (-1.63, 0.67)	0.405		
	No	257	57.4	GWG within IOM recommendations			0.91 (0.57, 1.44)	0.679
<b>Since delivering this baby (##) Has a doctor, nurse, or other health care worker talked with you about:</b>		<b>n</b>	<b>%</b>	<b>Postpartum Weight (n=448)</b>	<b>β-coef (95%CI)</b>	<b>p-value</b>	<b>OR/RRR (95%CI)</b>	<b>p-value</b>
How much you should now weigh?	Yes	26	5.8	PPWR (kg)	0.81 (-0.47, 2.08)	0.21		
	No	422	94.2	Postpartum BMI				
				Overweight			1.67^ (0.66, 4.23)	0.278
				Obese			2.46^ (1.00, 6.06)	0.049
Programs or resources to help you lose weight after pregnancy?	Yes	37	8.3	PPWR (kg)	1.12 (-1.05, 3.29)	0.306		
	No	411	91.7	Postpartum BMI				
				Overweight			0.93^ (0.34, 2.56)	0.887
				Obese			1.01^ (0.43-2.36)	0.983

**Table 3:** Associations of weight advice received by mothers with gestational weight gain and postpartum weight retention (#Analyses controlled for maternal age, education, income, pre-pregnancy BMI and/or GWG and clustering by first-time mother's group, ##Analyses controlled for maternal age, education, income, postpartum BMI and/or GWG and clustering by first-time mother's group, ^where healthy weight was used as the reference category; OR (odds ratio); RRR (relative risk ratio) for measures of association from regression analyses).

## Discussion

This study showed a shift in maternal weight across the perinatal period, whereby mean BMI increased by over one whole unit from pre-pregnancy to three months postpartum. Moreover, the proportion of women who were classified as either overweight or obese increased by roughly 30%, both likely explained by a combination of excess GWG and/or PPWR experienced by many women. Furthermore, while a much higher proportion of women reported having received weight related advice from antenatal clinicians during pregnancy, compared to the postpartum period, provision of advice did not appear to influence weight outcomes.

Nearly half of all women exceeded IOM recommendations for GWG. These results are consistent with findings from other studies [5,52]. Interestingly, overweight and obese women in this study were more likely to experience excess GWG. Considering almost half of all women enter pregnancy already overweight or obese [53,54] and that excess GWG is the strongest predictor of PPWR [55,56], the need to focus on the promotion of healthy weight gain for women with high BMIs is further highlighted.

Despite the high rate of women experiencing excess GWG in this study, less than half of all women reported receiving advice to avoid excess GWG. While detail of the advice provided to women regarding recommendations for GWG was not assessed, it might be reasonable to assume that advice was varied among healthcare providers as there are no formal guidelines in Australia to advise targets for GWG. This could promote inconsistent advice being given; a hypothesis supported by the results of other studies assessing management of GWG [38,57]. This is an important consideration, as when healthcare practitioners do use target GWG as part of their practice, women have been shown to adhere to guidelines [58].

Of the few studies that have assessed postpartum weight management provided by healthcare practitioners, provision of maternal weight advice does not appear to be a priority [59]. For example, in North Carolina, as part of a prospective cohort study, Ferrari et al. (2010) assessed clinician advice regarding postpartum weight-loss in women (n=688) at three months postpartum [59]. The majority of women in that study (89%) reported receiving no weight-loss advice during the postpartum period. Likewise, results of this study showed that weight was not a focus of care received in the postpartum period, whereby less than one in ten women reported receiving advice regarding suitable weight loss programs and even fewer women reported receiving advice about how much they should weigh.

The lack of advice received during the postpartum period may not necessarily reflect a new mother's level of interest or motivation in wanting to lose weight. For example, in a study of 179 women at four months postpartum, approximately half (53%) of normal weight women, 79% of overweight women and 81% of obese women reported plans to seek weight-loss information, despite the fact that 85% of the women received no such information from healthcare providers [60]. Moreover, many women have been found to report that they perceived their weight as less important during pregnancy compared with following childbirth [45,61].

However, provision of advice alone may not be sufficiently rigorous to influence maternal weight as suggested by our results. Implementation of alternate support strategies such as healthy lifestyle intervention programs may be promising approaches to assist women. To date, successful lifestyle programs which have been shown to reduce excess GWG [43,57,62,63] and limit PPWR [64-67] have included more than provision of education or information alone. It is encouraging that healthcare practitioners themselves have previously acknowledged the need for lifestyle interventions to assist in promoting healthy maternal weight gain during pregnancy and

following childbirth [68,69] and future work should aim to further identify healthy weight strategies while being conducive to the unique life stage encountered by women both during and following pregnancy.

A strength of this study was the assessment and comparison of frequency of advice both during pregnancy and following childbirth. This comparison enabled identification of gaps in current management strategies to be identified, and showed that the postpartum period can be considered a missed opportunity at present, for provision of healthy weight advice, thereby supporting the need for greater provision of support in the months following childbirth. This study was limited by the inability to determine what specific advice regarding weight was provided to women. This is an important consideration as if women were following advice received from clinicians, differences in the type of advice given may account for variations in weight gain or weight loss and the lack of associations observed in this study. Further, the type of advice provided may have influenced maternal weight, yet this is unable to be determined.

Further, this sample of women were predominately highly educated and over half of the sample of women had moderate to high household income therefore limiting the generalizability of the results. Future research would ideally consider advice provided to low income women to enable specific delivery of support amongst different population groups across the perinatal period. A final limitation was the method of self-reported pre-pregnancy weight used in this study.

Yet with studies having previously shown that under-reporting of weight and BMI tends to be common amongst overweight adults [70,71], rather than weight overestimations, expected inaccuracies in self-reported data in this study would have been towards more favourable outcomes (under-reporting of body weight). It could be possible that rate of excess GWG and maternal obesity have been underestimated or that if overweight or obese women were misclassified at pre-pregnancy, the increased rates of obesity from pre-pregnancy to three months postpartum could have been less.

With the many adverse health implications resulting from excess GWG, PPWR and maternal overweight and obesity, there is a need to better influence women to attain and maintain a healthy weight status across the perinatal period. Future work should seek to identify strategies which are most likely to be successful in promoting healthy maternal weight.

This study has provided valuable insight into maternal weight change across the perinatal period and the potential for BMI to increase significantly in first time mothers as a result of weight gained during pregnancy. As it stands, provision of advice alone may be inadequate for promoting healthy maternal weight during a period whereby many women are vulnerable to weight gain. The findings from this study have raised the importance of exploring alternate strategies (e.g. behavioral interventions) to assist in facilitating healthy maternal weight across the perinatal period. Successful approaches should be embedded in the current antenatal system, which at present, seemingly does not sufficiently support many women to attain a healthy weight both during and following childbirth. With the many adverse health implications resulting from excess GWG, PPWR and maternal overweight and obesity, there is a need to better influence women to attain and maintain a healthy weight status across the perinatal period.

## Acknowledgements

The InFANT-Extend study, within which this study was nested, was funded by a World Cancer 452 Research Fund grant (2010/244). PV was funded by a National Health and Medical Research Council (NHMRC) Postgraduate Scholarship at the time of drafting this paper; KB is supported by a NHMRC Principal Research Fellowship, ID 1042442 (the contents of this work are the responsibility of the authors and do not reflect the views of NHMRC); KDH is supported by an Australian Research Council Future Fellowship (FT130100637) and Honorary National Heart Foundation of Australia Future Leader Fellowship (100370). We would like to thank Dr Gavin Abbott for his expertise and assistance with the statistical analysis conducted in formulating this paper. Thank you to all staff who worked on the InFANT Extend RCT.

## Authors' Contributions

PV and KC conceived this study and KC, KB, KH, MT and DC advised on the study design. PV assisted with study recruitment, data collection and conducted the statistical analysis. PV drafted the manuscript together with JD. All authors contributed to the critical revision of the paper and approved the final manuscript. All authors have approved the final manuscript.

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