A mixed method study evaluating the integration of pregnancy weight gain charts into antenatal care

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Abstract

Monitoring pregnancy weight can reduce excess gestational weight gain (GWG), and is recommended in clinical practice guidelines as part of routine care. This study aimed to evaluate the implementation of routine weight monitoring using a pregnancy weight gain chart (PWGC), and assess health care professionals (HCPs) and pregnant women's attitudes and practices around its use. A semiquantitative survey was conducted with a consecutive sample of antenatal women at 16 and 36 weeks gestation. Women were weighed, and a PWGC audit done at 36 weeks gestation to assess adherence to chart use and GWG. A cross-sectional survey of antenatal HCPs at the Australian facility assessed staff attitudes and practices relating to weight monitoring and PWGC use. Of the 291 women surveyed, 68% reported being given a PWGC. Of the audited PWGCs ($n = 258$), 54% had less than three weights recorded, 36% had errors, and 3% were unused. All HCPs surveyed ($n = 42$) were aware of the PWGC, 63% reported using it to track GWG regularly and 26% believed it to be only the woman's responsibility (i.e., not the midwife's role) to complete it. Seventy-six percent reported they needed more training in counselling pregnant women, and insufficient time was a main barrier to weighing and conversing with women. It is feasible to implement a PWGC into routine antenatal care. Clarity over women's and HCPs responsibility for monitoring GWG and completion of the PWGC is needed. Training on correct PWGC use and counselling and workforce engagement are required to overcome barriers and support healthy GWG.

KEYWORDS

implementation, obesity, pregnancy weight gain, weight gain chart, weight monitoring

1 | INTRODUCTION

The prevalence of weight gain outside of recommendations during pregnancy is high, with around half of women gaining too much and a quarter not enough. (de Jersey, Nicholson, Callaway, & Daniels, 2012; Goldstein et al., 2017) Inadequate gestational weight gain (GWG) is associated with an increased risk of small for gestational age babies, preterm birth, and subsequent chronic disease, whereas excess GWG is associated with an increased risk of instrumental and caesarean birth, macrosomia, large for gestational age babies, and

subsequent obesity in mothers and offspring. (Goldstein et al., 2017; Institute of Medicine and National Research Council, 2009) In recent years, there has been increasing attention on strategies to promote healthy GWG to not only optimise pregnancy outcomes but also prevent rising obesity in women of reproductive age and their children.

Interventions designed to influence GWG predominately focus on diet and physical activity counselling, combined with weight monitoring. (Muktabhant, Lawrie, Lumbiganon, & Laopaiboon, 2015) Although it is accepted that provision of such advice and support services should form part of good clinical practice, access to specialist staff

and services to support this type of intervention is poor outside of trial settings. (Heslehurst et al., 2014; Wilkinson & Tolcher, 2010) Furthermore, it is likely that multilevel strategies are needed to provide low intensity interventions for those at lower risk and more intensive interventions support those at higher risk. (de Jersey, Mallan, Callaway, Daniels, & Nicholson, 2017a, 2017b) Routine weight monitoring as a stand-alone intervention in antenatal care remains controversial, with limited evidence to support its use in routine antenatal care. (Fealy et al., 2017) However the two trials examined in this meta-analysis included little information for participants to track their weight in the context of where they should be in relation to gestation, rather relying on the total Institute of Medicine (IOM) pregnancy weight gain range as a basis for discussion at routine visits (Brownfoot, Davey, & Kornman, 2016; Jeffries, Shub, Walker, Hiscock, & Permezel, 2009). Little information was available on the intervention fidelity (the extent to which the routine weight monitoring occurred) of these trials. (Brownfoot et al., 2016; Jeffries et al., 2009) To determine the value of routine weight monitoring it is important to ascertain the extent to which it can be implemented into routine care outside of trial conditions and the impact this has on outcomes. Communication between pregnant women and their health care professionals (HCPs), in relation to GWG, is a key barrier to the delivery of appropriate advice (Heslehurst et al., 2014; Wilkinson, Poad, & Stapleton, 2013). However, it is clear that pregnant women want to be provided with advice about weight gain in pregnancy (de Jersey, Nicholson, Callaway, & Daniels, 2013; Nikolopoulos, Mayan, MacIsaac, Miller, & Bell, 2017). HCPs find conversations about weight and weight gain challenging (Wilkinson et al., 2013), advice is rarely provided (de Jersey et al., 2012), often incorrect (Wrotniak et al., 2015), and when a discussion on weight does occur, some women report experiences that are stigmatising, judgemental, or unhelpful (Mulherin, Miller, Barlow, Diedrichs, & Thompson, 2013; Nikolopoulos et al., 2017). Using an objective visual record to plot weight in the context of gestation may support the discussion between women and their HCP that allows for ongoing conversations about weight at each antenatal visit.

A small number of studies have sought to examine the use of a handheld weight gain tracking tool to track GWG and serve as a tool to guide communication between an HCP and a pregnant woman (Aguilera, Sidebottom, & McCool, 2017; Daley et al., 2015; Olson, Strawderman, & Graham, 2017). These studies conducted under trial conditions suggest that discussion about weight gain and advice accuracy is enhanced between women and their HCP (Aguilera et al., 2017) when both find the tools acceptable and feasible to use (Daley et al., 2015) and there are positive outcomes on GWG in some groups of women (Aguilera et al., 2017; Daley et al., 2015; Olson et al., 2017). A qualitative evaluation of HCPs' perceptions of using a weight tracker in routine care, found a consensus that the tool allowed women to be more proactive in keeping within recommended ranges and made it easier to discuss weight with women (Hasted, Stapleton, Beckmann, & Wilkinson, 2016). However, this study did indicate that some HCPs and women were not using the tool (Hasted et al., 2016), highlighting the importance of clarifying the role between HCPs and a woman in using a weight monitoring resource.

Implementation of these research findings into routine practice, including the examination of barriers to penetration of routine weight monitoring coupled with a weight monitoring tool to guide communication, is necessary to inform public health policy and practice

Key messages

- Despite substantial preimplementation training and support, the introduction of a pregnancy weight gain chart into routine care does not lead to optimal usage by women or health care professionals
- Pregnant women predominantly found the use of a pregnancy weight gain chart positive and welcomed its use
- Sustained implementation strategies are required to overcome barriers, normalise the use of the weight gain chart, and encourage conversations between women and their health care professionals

(Harrison, Skouteris, Boyle, & Teede, 2017). The aim of this study was to examine the implementation of a pregnancy weight gain chart (PWGC) into routine antenatal care in a large metropolitan birthing facility, including HCPs and pregnant women's perceptions of its use.

2 | METHODS

2.1 | Study design

This was a prospective observational study, with two components examining the implementation of a low intensity consumer handheld resource to support routine weight monitoring in antenatal care. Low intensity, in this context, refers to a resource utilised by pregnant women and their HCP to guide brief intervention conversations that support healthy GWG in routine antenatal care without the need for additional appointments or specialist services. The components are first, an evaluation from the perspective of pregnant woman and the use of the weight monitoring resource; and second, an evaluation of HCPs attitudes and practices, following implementation of the resource.

This study was approved by the Royal Brisbane and Women's Hospital Human Research Ethics Committee on November 10th 2014, approval number HREC/14/QRBW/491 and Queensland University of Technology Human Research Ethics Committee (1500000362) on June 6th 2015.

2.2 | Implementation of the pregnancy weight gain charts

An existing IOM PWGC (Institute of Medicine and National Research Council, 2009) was adapted with permission for use in Australia. HCP and consumer feedback was gathered and amendments made as appropriate. Two resources were created, one for women commencing pregnancy with a BMI < 25 kg/m², and one for women commencing pregnancy with a BMI ≥ 25 kg/m². The charts provided guidance on the upper and lower range of healthy GWG for each prepregnancy BMI category. The resources provided detailed instructions for use and strategies to support a healthy GWG (See Data S1). It was expected that all women with a singleton pregnancy would have a chart established by the midwife conducting the initial hospital

assessment, and that weight would be measured and plotted on the chart throughout pregnancy. The implementation of the charts was supported by mandatory training for midwives (de Jersey et al., 2018), and a 15 min voice over PowerPoint presentation, available to all health professionals on computers in all work areas, provided guidance on the use of the charts and tips to support women achieve a healthy weight gain in pregnancy. The training addressed key barriers to routine weight monitoring and communicating with women about weight identified by midwives in a series of focus groups. The training content has been described in detail previously (de Jersey et al., 2018). Emails were disseminated through midwifery and medical leads to inform HCPs of the availability of the training in addition to in-services in outpatient work areas. General practitioners (GP) participating in the hospital alignment program were provided with face to face training and a practical skills session on the use of the charts. Medical and Obstetric doctors were provided with a face to face in-service on utilising the charts. The PWGCs were introduced in May 2015 with training commencing in January 2015 and continued on an ongoing basis.

2.3 | Study population—pregnant women

The first evaluation component involved a cohort of pregnant women recruited 6 months following introduction of the PWGC in November 2015, continuing until January 2016. A consecutive, unselected sample of pregnant women who were less than 20 weeks gestation were approached in the waiting room of the antenatal clinic by a research staff member at their “first visit” appointment and asked if they would like to participate in a study evaluating the provision of health advice and weight monitoring during pregnancy. Exclusion criteria included insufficient English language skills to complete questionnaires and preexisting Type 1 or 2 diabetes. Women who had preexisting diabetes were provided with intensive dietetic intervention throughout their pregnancy, impacting on the level of detailed counselling regarding gestational weight gain. Completion of the PWGC for these women was undertaken by the dietitian, and therefore, inclusion of these women would introduce a level of bias with their level of care not representative of the general obstetric population. All women provided written informed consent to participate. Women completed a questionnaire and had their weight measured on their first visit and at 36–38 weeks gestation. The questionnaire, following the first appointment, assessed prepregnancy weight, whether a PWGC was provided at this visit and demographic characteristics. The second questionnaire assessed antenatal model of care, provision of the PWGC, and experience using the chart. At 36–38 weeks gestation at a routine hospital visit, women were weighed and a copy of each woman's PWGC was taken to assess its use. Independent research staff recruited women and collected data but were not involved in clinical care delivery. Study sample size was established based on categorical variables to demonstrate a lower proportion of excess GWG than population estimates. The estimated population prevalence of excess GWG was 40%, based on previous work (de Jersey et al., 2012). It was anticipated that this low intensity intervention would result in a 10% reduction in excess GWG. A sample of 440 pregnant women needed to be recruited to account for a 40% attrition, with

80% confidence and a 0.05 significance level to detect this difference in excess GWG.

2.3.1 | Experiences and usability

Qualitative responses to an open-ended survey question (provided as part of the questionnaire at 36–38 week visit) about women's experience using the chart and any changes to better meet their needs were thematically analysed. Responses were arranged by two authors separately into themes according to aspects of the PWGC, who later met to negotiate key themes (Gale, Heath, Cameron, Rashid, & Redwood, 2013). Additional comments that were not relevant to the question, were blank or not legible, were excluded.

2.3.2 | Pregnancy weight gain chart audit

Each copy of the PWGC taken at 36–38 weeks gestation was audited by a research dietitian trained in the auditing protocol. A priori criteria of which chart was provided, whether the chart was established correctly, specific errors identified, number of weight measures recorded, gestation first weight was recorded (weeks), tracking within recommendations (no/yes/partial), and specific tracking outside targets (within range/above target/below target/mixed-above, below, and/or within), were used. A composite score for “optimal PWGC usage” was calculated based on (a) the correct chart being given and no errors in establishment, (b) first weight recorded at 20 weeks gestation or less, and (c) three or more weight measures plotted.

2.3.3 | Gestational weight gain

The difference between weight at 36–38 weeks gestation and self-reported prepregnancy weight determined overall GWG. Gestational weight gain was compared with IOM guidelines (Institute of Medicine and National Research Council, 2009) for each prepregnancy BMI category to determine the proportion of women with inadequate, healthy, and excess GWG.

2.4 | Study population- Health Care Professionals

The second evaluation component involved assessment of HCPs attitudes and practices in relation to PWGC usage and weight monitoring. Antenatal HCPs, including midwives, obstetricians, and registrars, working in the hospital were invited to participate in a semiquantitative survey. An email invitation that included a link to an online survey was sent to all relevant clinical HCPs via their respective Clinical Directors or Midwifery/Nurse Unit Managers. Paper-based surveys were also placed within clinical areas for HCPs who did not have ready access to email. The survey remained open for 4 weeks over July and August 2017; completion required approximately 15–20 min.

2.4.1 | Health care professional survey development

Survey items were sourced from preexisting tools (Wilkinson, Donaldson, Beckmann, & Stapleton, 2017; Wilkinson & Stapleton, 2012) and adapted for local use. Feedback on the constructed survey

was gathered from an expert advisory panel that consisted of a midwifery clinical academic, two senior dietetic clinician researchers experienced in survey development, and a service improvement clinical midwifery consultant and distributed to clinical leaders for feedback to assess content and face validity. Modifications were made to wording for clarity and a number of survey items deleted to reduce the participant burden of time to complete the questionnaire. The final survey consisted of 24 items, with 21 closed response option questions and 3 open-ended responses (See Data S2). Questions assessing participants' attitudes, practices, and possible barriers in offering GWG advice and weighing/monitoring the weight of women in their care were measured with a four-point Likert scale response dichotomised to "almost never/sometimes" and "usually/almost always". The options for "This is not appropriate" and "This isn't my job" was also available for questions assessing HCPs practices to accommodate those not working in outpatient areas such as birth suite.

Confidence in using the PWGC was assessed on a 10-point scale from 1 (*not at all confident*) to 10 (*very confident*), and was dichotomised as "not confident" (1–5) and "confident" (6–10) for data analysis purposes. Current practices in using and providing the PWGC during routine antenatal care were also assessed. Questions assessing opinion on the care they provided were measured on a four-point Likert scale from "Strongly disagree" to "Strongly agree," with the options of "I don't advise my patients about this" and "Don't know" available. Open-ended questions invited participants' commentary on (a) the usability of the PWGC, (b) preferred ways and timing in receiving training in supporting healthy GWG, and (c) other issues/comments on the resources/training implemented. Demographic characteristics were assessed, including gender, age, profession, years of practice, and primary work location.

This study was conducted in accordance with all necessary ethical principles and approved by the Human Research Ethics Committee of the birthing hospital (HREC/14/QRBW/491) and collaborating university (1500000362).

2.5 | Statistical analysis

Analyses were performed using the Statistical Package for Social Sciences (Version 23). Continuous variables were examined for normality, using descriptive statistics and histograms. Normality was established if the following criteria were met: mean within 10% of median; minimum and maximum approximately mean $\pm$ 3 standard deviations; skewness and kurtosis both within $\pm$ 3; and a roughly symmetrical histogram. Mean and standard deviation (mean [SD]) are reported for normally distributed data, and median and interquartile range (median [IQR]) for skewed data. Descriptive statistics were used to examine population characteristics and outcomes. Difference between groups used *t* tests or chi squared for continuous and categorical variables, respectively. Appropriate nonparametric tests were used for nonnormally distributed data. Logistic regression examined the association between optimal chart usage and excess compared with nonexcess GWG controlling for parity, prepregnancy BMI, and gestation at final weight measurement.

The criterion for statistical significance was set at the conventional level of $p < 0.05$ (two tailed) for all analyses. All available data were used in analysis, no data were imputed.

3 | RESULTS

A total of 478 women were recruited from the 590 approached (81% consent rate). The flow of participants through the study is outlined in Figure 1. One hundred and sixty-two (34%) women delivered their baby at the hospital but were missed at their final visit and therefore no weight was measured or questionnaire returned. Weight measurements at 36 weeks for 87/162 women missed were accessed through electronic medical records.

Characteristics of pregnant women and antenatal model of care are reported in Table 1. Prepregnancy BMI was 24.7 (5.4) kg/m², and 38% were in the preobese (24%) or obese (14%) categories. There was no statistically significant differences for prepregnancy BMI, age, or any other key demographic characteristics for those women who returned the first questionnaire but did not return the second questionnaire. Anthropometric and demographic characteristics were not available if the first questionnaire was not returned.

3.1 | Implementation of the pregnancy weight gain charts

Sixty eight percent of women (198/291) reported being given a PWGC at their first hospital visit, with 6% (18/291) unsure if they were given a chart. The incorrect chart based on prepregnancy BMI was given in 10% of cases (29/291). When charts were assessed, 36% had errors (93/258) and 3% (8/258) were completely blank. Specific errors were incorrect weights on the vertical (y axis) of the graph (43%, 40/93), incorrect prepregnancy BMI (10%, 9/93), no weights at all on the vertical y axis (8%, 7/93), the incorrect chart given (5%, 5/93), multiple errors (17%, 16/93), and other unclassified errors such as incorrect weight gain range identified (17%, 16/93).

Forty-six percent of women (119/258) who provided a copy of their pregnancy PWGC had 3 or more weights plotted on their chart. A greater proportion of women receiving hospital care compared with GP shared care had 3 or more weights recorded (34 vs 18%, $p = 0.07$). Eighty five percent (220/258) of women had their first weight recorded at 20 weeks gestation or less. Optimal PWGC usage was recorded in 33% (85/258) of charts audited.

3.2 | Women's perception on use of chart

From the 260 returned surveys, 176 comments were provided and 152 underwent thematic analysis ($n = 24$ excluded due to irrelevant or illegible responses). Major themes identified by the authors were (a) use of the tool for education and self-monitoring ($n = 87$ comments), (b) comments relating to women's experience using charts with health professionals ($n = 37$ comments), (c) comments relating to the principle of weight tracking ($n = 15$

FIGURE 1 Progression of participants through the Healthy Pregnancy Healthy Baby evaluation study time points from recruitment through to 36 week follow-up

TABLE 1 Characteristics of pregnant women participants in the Healthy Pregnancy Healthy Baby evaluation, $n = 290$

Characteristic	Mean (SD) or %
Age	31 (4.7) years
Married or defacto	94%
University education	54%
Nulliparous	55%
Full time work	52%
Hospital based model of care	60%

Within the theme relating to self-monitoring and education, the majority of responses were women reporting positive experiences using the resource to monitor and interpret their weight gain.

I really enjoyed being able to check my weight each week, it was reassuring to know that even though I felt huge, everything was normal. Participant ID003

Many women also reported that using the PWGC motivated or informed them about healthy lifestyles during pregnancy;

The chart was a useful tool in monitoring my weight gain throughout pregnancy & allowed me to adjust my diet accordingly. Participant ID206

comments), and (d) feedback for the chart design ($n = 23$ comments). It is worth noting that 12 comments fell across two separate themes.

There was a small proportion of women, however, who reported using the chart without relating this to lifestyle behaviours;

It was interesting to see, especially with gestational diabetes. It did not make me conscious about diet.
Participant ID130

There was a proportion of women who commented about not regularly using the weight monitoring chart and that it was not a high priority to address during their pregnancy;

[My experience was] positive but I wasn't too concerned about it, so I didn't watch it too closely Participant ID121

I didn't really use it. But initially it was helpful as it showed me that I had put on too much weight too quickly. Participant ID367

Comments relating to the implementation of the PWGC in practice by their midwives or other health professionals were more varied. Some women reported that the PWGC facilitated meaningful discussions with their midwife about their lifestyle behaviours;

I was about [half] way through my pregnancy and the midwife looked at my chart and said I was gaining weight maybe a little too quickly. It was good to have that comment said to me because from then on I was more observant of weight I was gaining. Participant ID066

Although many comments suggest that these conversations were lacking;

The midwife would weigh me but not share any details of my weight on the chart, just that everything was 'within range' Participant ID434

The chart is great to provide me a reference for my weight gain according to my BMI. However, there is no feedback from my midwife. Participant ID344

It is a great idea to educate me on normal weight gain—but what would I do if I am gaining excessive weight and my diet hasn't changed at all (which is the case)?
Participant ID166

Other comments related to inappropriate implementation by midwives that lead to women misunderstanding how to use the PWGC or the inappropriate chart being provided. This resulted in negative experiences for women;

I received the wrong chart, which caused me to think I gained way too much, which was not the case. I do feel it's a bit of a 'stress factor.' Participant ID312

I thought I had to stay on the blue line. Midwife did not explain it was between the blue lines. I also started to stress when I didn't gain any weight & lost weight for 2-3 weeks. Thought I was leaking amniotic fluid ...
Participant ID131

There were also a small number of women that reported inconsistent weight monitoring practices by health care professionals;

Sometimes midwives would plot it, others didn't. When they didn't, I did. It was good to know where I was and how I was tracking. Participant ID336

... Chart wasn't looked at every midwife appointment.
Participant ID043

A small proportion of the comments analysed fell into a theme relating to the principle of weight monitoring during pregnancy ($n = 15$). Majority of these comments described negative feelings about the use of weight and BMI in routine antenatal care;

Negative—following weight every week made me very anxious. Spacing out the weights (or only doing them at appointments) might have been better. Not thrilled with only BMI measure used—doesn't work for all patients.
Participant ID006

I have found it very stressful watching my weight as I am overweight to begin with so putting on weight was not a good thing in my head. Participant ID034

My experience was absolutely negative. Having the chart in my record book made me check my weight more often and every kilo made me worried. It spoilt my joy of being pregnant. I also do not think BMI as a reliable means of measurement. Participant ID139

Didn't really want to be reminded of my weight gain ... Made me feel very self-conscious when it was discussed ... Participant ID439

Very few comments reported negative experiences from the behaviour or discussions with antenatal health care professionals.

The final theme consisted of feedback from women about the design and readability of the PWGC. A large proportion of these comments were positive;

Good visual tool. Participant ID477

Everything was good! Easy enough to read and understand. Participant ID445

However, there was some constructive feedback on ways to improve readability and ease of use;

... On the chart itself, less text—it looks overwhelming.
Participant ID444

This included the addition of more space for weight loss to be tracked;

I couldn't use the chart properly as I lost weight rather than putting on, and have been under the lowest weight of the chart I received the whole time. Participant ID002

... I was 123 kg at conception. @ 36 weeks I'm 119, which means I am still not even on the chart at all.
Participant ID421

3.3 | Weight gain

Weight gain data were available for 347 women. Overall 37% ($n = 129$) of women gained weight within recommendations, with 36% ($n = 126$) gaining excess and 27% ($n = 92$) having inadequate weight gain by 36 weeks gestation. A higher proportion of women with a hospital-based model of care, compared with GP shared care, had healthy GWG (44% vs 29%; $p = 0.049$). Having a chart that was used “optimally” was not associated with a reduction in excess GWG when controlling for parity, prepregnancy BMI, or gestation at final weight measurement (0.8 [0.6–1.2] (95% CI) $p = 0.339$).

3.4 | Health care professionals survey

Forty-two HCPs, comprising of midwives (93%) and obstetricians (7%), completed the survey. Characteristics are outlined in Table 2. All respondents reported they were aware of the PWGC and 62% reported they had received specific training related to the recommended care of women to support healthy GWG.

Weighing women at every appointment was reported by 52%, and GWG advice was offered “usually/always” by 48% of respondents. The PWGC was used “usually/always” to track GWG by 52% of respondents. The majority of respondents (60%) reported it was the woman and her HCPs responsibility to monitor weight during pregnancy, however responsibility for completion of the PWGC was more varied (26% woman only, 38% all HCPs, 33% both the woman and HCP, and her midwife only 3%).

Respondents were very confident in all aspects of the PWGC as outlined in Table 3. HCPs perceived barriers and enablers to offering advice to women are outlined in Table 4. Ninety percent of staff perceived they had sufficient knowledge to counsel women in relation to healthy weight gain while having enough time to counsel women was reported by 41% of staff.

4 | DISCUSSION

This study demonstrated that the provision of a PWGC into routine antenatal care is feasible and well-received by the two thirds of pregnant women receiving the chart. However, optimal uptake and usage

TABLE 3 Health care professionals confidence^a with aspects of pregnancy weight gain chart use following implementation ($n = 42$)

Aspect of chart use	Median (IQR)	Proportion confident ^b (%)
Using the pregnancy weight gain chart yourself	10 (2)	88
Showing a pregnant woman how to use the pregnancy weight gain chart	10 (3)	83
Selecting the appropriate weight gain chart based on pre-pregnancy BMI	10 (2)	88

^arated on a 10-point scale from *not at all confident* to *extremely confident*.

^bresponding 6–10 on confidence scale.

of the chart was poor, indicating further implementation strategies are required to embed its use in practice. Women with a hospital model of care, which supported the use of the chart and targeted implementation strategies, were more likely to have a healthy GWG when compared with women who experienced GP shared care arrangements indicating the potential benefits of its use.

Just over two thirds of pregnant women reported being provided with a resource at their first hospital visit, and of these, a third had errors in chart establishment. Optimal usage was observed in only a third of all charts. Two recent studies examining the use of a PWGC in trial settings did not report on the fidelity of the intervention in relation to use of the charts (Aguilera et al., 2017; Daley et al., 2015). Not identifying the extent to which the charts were used by HCPs or pregnant women and the accuracy of use has the potential to confound the findings of the study and limits the ability to determine the practicality of this approach in routine care. It has been suggested that around half of the recommended health care practices are not implemented, with preventative and behaviour change interventions even less likely to be implemented (Glasgow & Emmons, 2007). In the current study, the correct introduction and use of the chart appeared poor with a third of charts recording errors. However the process of providing a chart to women was relatively high with two thirds of women receiving it and demonstrates promise in changing processes in antenatal care. Challenges identified through this evaluation include difficulties in distinguishing between the two PWGCs and the practicalities of commencing the chart based on prepregnancy weight rather than weight at first hospital visit. This information has been used to refine the PWGCs to provide more distinguishing features. During

TABLE 2 Characteristics of health care professionals completing the weight gain chart implementation evaluation ($n = 42$)

Characteristic		N value	Percentage
Age (years)	20–30	17	40
	31–40	10	24
	41–50	5	12
	51+	10	24
Years' experience	0–5	25	59
	6–10	7	17
	11–15	1	2
	16–20	3	7
	21+	6	14
Work area	Birth suite	10	24
	Maternity outpatients	9	21
	Inpatient ward	5	12
	Birth Centre and indigenous antenatal service	6	14
	Rotate through all work areas	12	41

TABLE 4 Proportion of health care professionals reporting they agree with perceived barriers and enablers to weight related counselling in pregnancy following implementation of PWGC ($n = 42$)

Perceived barrier or enabler to weight related counselling	Agree % (n)
Once an overweight/obese woman is already pregnant, there is not much that she can do to change the risks of pregnancy-related complications	10 (4)
I have enough time to counsel pregnant women in my care properly about the risks of unhealthy weight gain during pregnancy.	41 (17)
Pregnant women in my care are motivated to make changes to their health.	61 (25)
Pregnant women in my care have the resources they need to make the changes that I recommend.	68 (26)
Pregnant women in my care find my advice helpful regarding weight management during pregnancy.	73 (24)
My advice influences how much weight pregnant women in my care gain during pregnancy.	75 (30)
I would like more training to help me counsel pregnant women in my care to improve their pregnancy outcomes.	76 (29)
I have sufficient knowledge to counsel pregnant women in my care to improve their pregnancy outcomes.	90 (37)
Nutrition and dietetic referrals are available for pregnant women in my care.	97 (38)

ongoing HCP training common errors from the audit have been fed back with strategies to overcome these errors discussed. Enhanced implementation, accurate utilisation, and uptake of the resource may demonstrate improvements in healthy GWG by women in the service.

Despite nine out of 10 HCPs reporting they had sufficient knowledge to counsel women on the risks of unhealthy weight and over 80% reporting being confident in aspects of the PWGC use, three quarters wanted more training. At the time of this study, all midwives (the predominant respondents) within the service were provided with a minimum of 30 min of face to face training on healthy pregnancy weight gain annually (de Jersey et al., 2018). This training has been adapted annually, based on identified barriers to implementation of routine weight monitoring using PWGCs and brief intervention advice. Practical opportunities are provided to complete a case study using sensitive communication skills, identify common errors from PWGCs audited and discuss clinical guidelines and expectations for weight monitoring and completion of the charts. Knowledge and confidence of HCPs, in relation to pregnancy weight management, are consistently cited in the literature as barriers to addressing weight in routine care (Heslehurst et al., 2013; Wilkinson et al., 2013). However, it is also well documented that knowledge alone does not lead to changes in behaviour. (Aboud, 2010) There are complex factors that influence practices in relation to weight management. A recent metasynthesis of barriers and facilitators to implementation of weight management guidelines in pregnancy (Heslehurst et al., 2014) using the Theoretical Domains Framework (Cane, O'Connor, & Michie, 2012) found in addition to "knowledge," the domains of "beliefs about consequences" and "environmental context and resources" were the most frequently

identified influences of HCPs behaviours (Heslehurst et al., 2014). Thus, consideration of these influences and interactions between other domains is essential to enact lasting change in health care practices. Within the context of this implementation, there were modifications to the environmental context, with improved access to scales, the development of specific support resources, and a strong focus on discussing the consequences of supporting healthy weight gain or not. The findings of the current study indicate a need to provide ongoing opportunities for HCPs to engage in further professional development that includes skill acquisition, time for discussing solutions to identified barriers, and exploring attitudes that may hinder practice change. These opportunities are needed beyond the initial implementation phase if sustained implementation of weight management initiatives into routine antenatal care are to be achieved.

Time was a predominant perceived barrier to the use of the PWGC and discussing healthy GWG by HCPs in this study. This echoes concerns of doctors reported by Hasted et al. that they "would find it difficult to weigh women and then discuss" any deviations from the healthy trajectory in addition to other routine care (Hasted et al., 2016). However, when evaluating a weight monitoring intervention that involved a resource similar to the one evaluated in the present study, Daley et al. reported community midwives found the intervention could be done in 1 to 3 min, not adding significantly to a standard consultation (Daley et al., 2015). This inconsistency perhaps highlights some differences in the perceived time that an interaction may take rather than the reality. Providing practical opportunities within training sessions for HCPs to time, how long it takes to undertake the tasks required, how it can be incorporated into the flow of procedures, and how this may enhance their usual practice, may offer reinforcement that a brief intervention interaction need not add substantially to routine care.

An important finding in this research was a barrier to utilisation of the PWGC appeared to be a lack of clarity over whose responsibility it was to complete it. Although weight monitoring is considered a key component of supporting healthy pregnancy weight gain, there is insufficient evidence to suggest if this should be self-monitoring or by an HCP (Phelan, Jankovitz, Hagobian, & Abrams, 2011). The implementation of the PWGC promoted the resource as being carried by the woman in her handheld record, but the intended usage communicated to staff was that it was to be shared between a woman and her HCP. This lack of clarity in defining exactly who should plot weights and when, may have contributed to confusion and underutilisation of the chart, whereby women were waiting for HCPs to ask about the PWGCs, and HCPs assumed that if women did not use it, they didn't want to engage in a weight conversation. Changes to HCPs training and procedures have stipulated the expectations about chart use being the HCPs responsibility to complete at antenatal care visits and providing adequate education to women about monitoring and plotting weight so the woman can complete the chart between appointments. The preimplementation focus groups with midwives, where it was identified that a weight tracking resource would support raising the issue of weight with women and identify women's weight gain progress, was a catalyst to develop the weight gain charts. However, these focus groups did not explore who should complete the chart or how it might align with midwives' goals in supporting healthy

pregnancy weight gain. Further work is required to explore the goals of midwives around supporting healthy pregnancy weight gain and how the use of the PWGC aligns with these goals. This insight may guide future implementation strategies to help midwives in broaching the topic of weight and include a discussion in the consultation flow.

Routine weighing in antenatal care has in the past been considered unfashionable, unnecessary (Knight-Agarwal, Kaur, Williams, Davey, & Davis, 2014), and thought to increase anxiety in women. (Dawes & Grudzinskas, 1991) The review of the IOM weight gain guidelines in 2009 (Institute of Medicine and National Research Council, 2009) recognised the changing weight status characteristics of women of child-bearing age. The review identified maternal health consequences beyond birthweight and infant size that were related to GWG, such as postpartum weight retention and emergency primary caesarean sections (Institute of Medicine and National Research Council, 2009). This new evidence has seen a renewed emphasis on routine weighing in antenatal care. More recent research indicates women do believe weight monitoring should be part of routine care (Allen-Walker et al., 2017). The perspectives from women in the present study support this with predominantly positive reflections provided on experiences with using the PWGC. In particular, the use of the charts provided context for where women were for their gestation, instead of a weight measurement alone. A small proportion of women did report a negative experience with being weighed and the principle of the PWGC. This negativity may reflect previous challenges with weight management, confusing or judgemental communication, or stigmatising experiences, which are more commonly reported by women with obesity in antenatal care (Knight-Agarwal et al., 2016). It has been demonstrated in a largely female nonpregnant obese population that the predominant coping strategy used when faced with stigmatising experiences was heading off negative remarks and HCPs were rated as very high sources of stigma experiences (Puhl & Brownell, 2006). The negative experiences reported in the current study were potentially exacerbated by implementation errors and highlight the need to support HCPs with accurate implementation and usage of the charts, in addition to sensitive, individualised communication around weight. The findings of the current study are consistent with those of Daley et al., where the predominant perceptions of women were positive and provided motivation to focus on healthy lifestyle behaviours with only a small proportion of women reporting a negative experience (Daley et al., 2015).

This research needs to be considered in the context of limitations. First, the response rate from HCPs was relatively low and unable to be quantified. The small sample size of approximately 17% of the workforce and homogeneity of the respondents being predominantly midwives limits the ability to generalise findings to wider HCP groups, such as general practitioners and medical personnel. Workforce data indicate approximately 80% of staff are midwives and 20% are obstetricians or obstetric physicians, this indicates an underrepresentation of medical staff and overrepresentation of midwifery staff in the respondents to this survey. It is possible that HCPs completing the survey were more likely to be engaged with the weight monitoring resource and more positive about its use. These findings may not reflect the wider views of HCPs and may be more favourable than if

a more representative sample had been achieved. Furthermore, although a large number of pregnant women were recruited, the low response rate from women and lack of information on those that did not respond may limit the generalisability of these findings to others within the service or wider population. Over half of the pregnant women in this study population had a university education, likely reflecting a biased sample, which further limits the ability to generalise these results to less educated women. However, it is encouraging that respondents were broadly representative for weight status of the state from which participants were recruited. A key strength of this evaluation is the applied nature within routine antenatal care, reflecting real world conditions and the gathering of information from both HCPs and women.

5 | CONCLUSION

This implementation evaluation of a PWGC into routine antenatal care indicated the tool was positively received by the majority of women who received it. Although provision of the resource to women by HCPs was relatively high, a lack of clarity around responsibility for completion, time for discussion on weight, and a high number of errors in completion indicated the need for ongoing strategies to support uptake before normalisation of the practice is achieved.

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CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest

CONTRIBUTIONS

SdeJ conceived and designed the study with input from JT and KN, TG and HP assisted with development of data collection tools, data entry, and analysis. CB and WYL contributed to data collection and data analysis. All authors contributed to interpretation of results, drafting of the manuscript, and approved the final manuscript for submission.

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REFERENCES

- Aboud, F. E. (2010). Virtual special issue introduction: Health behaviour change. *Social Science and Medicine*, 71, 1897–1900. <https://doi.org/10.1016/j.socscimed.2010.09.002>
- Aguilera, M., Sidebottom, A. C., & McCool, B. R. (2017). Examination of routine use of prenatal weight gain charts as a communication tool for providers. *Maternal and Child Health Journal*, 21, 1927–1938. <https://doi.org/10.1007/s10995-017-2308-x>
- Allen-Walker, V., Mullaney, L., Turner, M. J., Woodside, J. V., Holmes, V. A., McCartney, D. M., & McKinley, M. C. (2017). How do women feel about being weighed during pregnancy? A qualitative exploration of the opinions and experiences of postnatal women. *Midwifery*, 49, 95–101. <https://doi.org/10.1016/j.midw.2016.12.006>
- Brownfoot, F., Davey, M. A., & Kornman, L. (2016). Routine weighing to reduce excessive antenatal weight gain: A randomised controlled trial. *BJOG: An International Journal of Obstetrics & Gynaecology*, 123, 254–261. <https://doi.org/10.1111/1471-0528.13735>
- Cane, J., O'Connor, D., & Michie, S. (2012). Validation of the theoretical domains framework for use in behaviour change and implementation research. *Implementation Science*, 7, 37. <https://doi.org/10.1186/1748-5908-7-37>
- Daley, A., Jolly, K., Jebb, S., Lewis, A., Clifford, S., Roalfe, A., ... Aveyard, P. (2015). Feasibility and acceptability of regular weighing, setting weight gain limits and providing feedback by community midwives to prevent excess weight gain during pregnancy: randomised controlled trial and qualitative study. *BMC Obesity*, 2, 35. <https://doi.org/10.1186/s40608-015-0061-5>
- Dawes, M., & Grudzinskas, J. (1991). Repeated measurement of maternal weight during pregnancy. Is this a useful practice? *BJOG: An International Journal of Obstetrics & Gynaecology*, 98, 189–194. <https://doi.org/10.1111/j.1471-0528.1991.tb13367.x>
- de Jersey, S. J., Mallan, K., Callaway, L. K., Daniels, L. A., & Nicholson, J. M. (2017a). A cross sectional comparison of predisposing, reinforcing and enabling factors for lifestyle health behaviours and weight gain in healthy and overweight pregnant women. *Maternal and Child Health Journal*, 21(3), 626–635. <https://doi.org/10.1007/s10995-016-2148-0>
- de Jersey, S. J., Mallan, K. M., Callaway, L. K., Daniels, L. A., & Nicholson, J. M. (2017b). Prospective relationships between health cognitions and excess gestational weight gain in a cohort of healthy and overweight pregnant women. *Journal of the Academy of Nutrition and Dietetics*, 117, 1198–1209. <https://doi.org/10.1016/j.jand.2016.12.011>
- de Jersey, S. J., Nicholson, J. M., Callaway, L. K., & Daniels, L. A. (2012). A prospective study of pregnancy weight gain in Australian women. *Australian and New Zealand Journal of Obstetrics and Gynaecology*, 52, 545–551. <https://doi.org/10.1111/ajo.12013>
- de Jersey, S. J., Nicholson, J. M., Callaway, L. K., & Daniels, L. A. (2013). An observational study of nutrition and physical activity behaviors, knowledge, and advice in pregnancy. *BMC Pregnancy and Childbirth*, 13, 115. <https://doi.org/10.1186/1471-2393-13-115>
- de Jersey, S. J. T. J., Guthrie, T., & New, K. (2018). Supporting healthy weight gain and management in pregnancy—does a mandatory training education session improve knowledge and confidence of midwives? *Midwifery* (under review), 65, 1–7. <https://doi.org/10.1016/j.midw.2018.06.025>
- Fealy, S. M., Taylor, R. M., Foureau, M., Attia, J., Ebert, L., Bisquera, A., & Hure, A. J. (2017). Weighing as a stand-alone intervention does not reduce excessive gestational weight gain compared to routine antenatal care: A systematic review and meta-analysis of randomised controlled trials. *BMC Pregnancy and Childbirth*, 17, 36. <https://doi.org/10.1186/s12884-016-1207-2>
- Gale, N. K., Heath, G., Cameron, E., Rashid, S., & Redwood, S. (2013). Using the framework method for the analysis of qualitative data in multi-disciplinary health research. *BMC Medical Research Methodology*, 13, 117. <https://doi.org/10.1186/1471-2288-13-117>
- Glasgow, R. E., & Emmons, K. M. (2007). How can we increase translation of research into practice? Types of evidence needed. *Annual Review of Public Health*, 28, 413–433. <https://doi.org/10.1146/annurev.publhealth.28.021406.144145>
- Goldstein, R. F., Abell, S. K., Ranasinha, S., Misso, M., Boyle, J. A., Black, M. H., ... Teede, H. J. (2017). Association of gestational weight gain with maternal and infant outcomes: A systematic review and meta-analysis. *JAMA*, 317, 2207–2225. <https://doi.org/10.1001/jama.2017.3635>
- Harrison, C. L., Skouteris, H., Boyle, J., & Teede, H. J. (2017). Preventing obesity across the preconception, pregnancy and postpartum cycle: Implementing research into practice. *Midwifery*, 52, 64–70. <https://doi.org/10.1016/j.midw.2017.06.003>
- Hasted, T., Stapleton, H., Beckmann, M. M., & Wilkinson, S. A. (2016). Clinician's attitudes to the introduction of routine weighing in pregnancy. *Journal of Pregnancy*, 2016, 1–9. <https://doi.org/10.1155/2016/2049673>
- Heslehurst, N., Newham, J., Maniopoulos, G., Fleetwood, C., Robalino, S., & Rankin, J. (2014). Implementation of pregnancy weight management and obesity guidelines: A meta-synthesis of healthcare professionals' barriers and facilitators using the Theoretical Domains Framework. *Obesity Reviews*, 15, 462–486. <https://doi.org/10.1111/obr.12160>
- Heslehurst, N., Russell, S., McCormack, S., Sedgewick, G., Bell, R., & Rankin, J. (2013). Midwives perspectives of their training and education requirements in maternal obesity: A qualitative study. *Midwifery*, 29, 736–744. <https://doi.org/10.1016/j.midw.2012.07.007>
- Institute of Medicine & National Research Council (2009). *Weight gain during pregnancy: Reexamining the guidelines* National Academies Press.
- Jeffries, K., Shub, A., Walker, S. P., Hiscock, R., & Permezel, M. (2009). Reducing excessive weight gain in pregnancy: A randomised controlled trial. *Medical Journal of Australia*, 191, 429–433.
- Knight-Agarwal, C. R., Kaur, M., Williams, L. T., Davey, R., & Davis, D. (2014). The views and attitudes of health professionals providing antenatal care to women with a high BMI: A qualitative research study. *Women and Birth*, 27, 138–144. <https://doi.org/10.1016/j.wombi.2013.11.002>
- Knight-Agarwal, C. R., Williams, L. T., Davis, D., Davey, R., Shepherd, R., Downing, A., & Lawson, K. (2016). The perspectives of obese women receiving antenatal care: A qualitative study of women's experiences. *Women and Birth*, 29, 189–195. <https://doi.org/10.1016/j.wombi.2015.10.008>
- Muktabhant, B., Lawrie, T. A., Lumbiganon, P., & Laopaiboon, M. (2015). Diet or exercise, or both, for preventing excessive weight gain in pregnancy. *Cochrane Database of Systematic Reviews*, 6.
- Mulherin, K., Miller, Y. D., Barlow, F. K., Diedrichs, P. C., & Thompson, R. (2013). Weight stigma in maternity care: Women's experiences and care providers' attitudes. *BMC Pregnancy and Childbirth*, 13, 19. <https://doi.org/10.1186/1471-2393-13-19>
- Nikolopoulos, H., Mayan, M., MacIsaac, J., Miller, T., & Bell, R. C. (2017). Women's perceptions of discussions about gestational weight gain with health care providers during pregnancy and postpartum: a qualitative study. *BMC Pregnancy and Childbirth*, 17, 97. <https://doi.org/10.1186/s12884-017-1257-0>
- Olson, C. M., Strawderman, M. S., & Graham, M. L. (2017). Association between consistent weight gain tracking and gestational weight gain: Secondary analysis of a randomized trial. *Obesity*, 25, 1217–1227. <https://doi.org/10.1002/oby.21873>
- Phelan, S., Jankovitz, K., Hagobian, T., & Abrams, B. (2011). Reducing excessive gestational weight gain: Lessons from the weight control literature and avenues for future research. *Women's Health*, 7, 641–661. <https://doi.org/10.2217/WHE.11.70>
- Puhl, R. M., & Brownell, K. D. (2006). Confronting and coping with weight stigma: An investigation of overweight and obese adults. *Obesity (Silver Spring)*, 14, 1802–1815. <https://doi.org/10.1038/oby.2006.208>
- Wilkinson, S. A., Donaldson, E., Beckmann, M., & Stapleton, H. (2017). Service-wide management of healthy gestational weight gain following

an implementation science approach. *Maternal & Child Nutrition*, 13. <https://doi.org/10.1111/mcn.12266>

Wilkinson, S. A., Poad, D., & Stapleton, H. (2013). Maternal overweight and obesity: A survey of clinicians' characteristics and attitudes, and their responses to their pregnant clients. *BMC Pregnancy and Childbirth*, 13, 117. <https://doi.org/10.1186/1471-2393-13-117>

Wilkinson, S. A., & Stapleton, H. (2012). Overweight and obesity in pregnancy: The evidence–practice gap in staff knowledge, attitudes and practices. *Australian and New Zealand Journal of Obstetrics and Gynaecology*, 52, 588–592. <https://doi.org/10.1111/ajo.12011>

Wilkinson, S. A., & Tolcher, D. (2010). Nutrition and maternal health: What women want and can we provide it? *Nutrition and Dietetics*, 67, 18–25. <https://doi.org/10.1111/j.1747-0080.2010.01404.x>

Wrotniak, B. H., Dentice, S., Mariano, K., Salaam, E. M., Cowley, A. E., & Mauro, E. M. (2015). Counseling about weight gain guidelines and

subsequent gestational weight gain. *Journal of Women's Health*, 24, 819–824. <https://doi.org/10.1089/jwh.2014.4984>

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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