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ORIGINAL RESEARCH

Re-evaluating the nutritional awareness, knowledge and eating behaviours of women attending a tertiary maternity hospital following iterative service redesign

Running head: Maternity service iterative service redesign

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Abstract

Aim: Since the opening of the new Mater Mothers' Hospital in 2008, innovative initiatives were developed, implemented, and evaluated to meet women's nutritional needs. This study evaluated changes in women's nutritional awareness, knowledge and behaviours and compared these data with our baseline survey.

Methods: During 2014-17, 421 postnatal women were surveyed across nine survey periods. Results were compared with those from our 2008 survey (n=102). Surveys assessed nutrition knowledge, attitudes, behaviour, education preferences, and dietetic service awareness and were distributed on meal trays.

Results: A greater proportion of women accessed the nutrition services in 2014-17 compared with 2008 (19.7% vs 9.9%) and rated the resources favourably (≥ 3.5 out of 5). A similar proportion rated the importance of eating well postnatally (83.1% vs 92.1%) and returning to their pre-pregnancy weight (62.4% vs 68.3%) as important/very important. In both periods, women had poor diet quality, despite identifying healthy eating as a high priority. A reduction in median gestational weight gain approached significance, 13.0kg (2014-17) versus 14.0kg (2008), $p = 0.055$. There was a significant association between gestational weight gain and cohort with an increase in the proportion of women

gaining within their correct guidelines (by 15.4%), a reduction of excessive gain (by 24.7%), $p < 0.001$) over time.

Conclusions: Evidence-based service changes made since 2008 have effected positive change in women's gestational weight gain, service preferences, and access. However, women still require awareness-raising and behaviour change programs to improve diet quality and gestational weight gain to ensure optimal pregnancy outcomes.

Key words: diet, gestational weight gain, health services research, maternal health, nutrition, pregnancy.

Introduction

Unhealthy pregnancy lifestyle behaviours and excessive gestational weight gain (GWG) are associated with negative pregnancy-related and long-term health outcomes for both mother and infant, including increased risk of caesarean sections,^{1,2} pre-term birth,^{1,2} and infant's risk of chronic disease in adult life.^{1,3-5} In Queensland (Australia), 30-100% (per body mass index (BMI) category) of women gain more weight than recommended during pregnancy.⁶⁻⁸ Thirty to 50% of women are overweight or obese at the beginning of pregnancy, placing them at increased risk of excessive GWG, with its associated complications.^{1,6-10} Very few women meet pregnancy fruit and vegetable guidelines (~10% and ~5%, respectively) or undertake sufficient physical activity (40%).^{7,11} A high BMI and a

poor lifestyle also increase a woman's risk of developing gestational diabetes mellitus (GDM).¹²

Since the opening of the new Mater Mothers' Hospital (MMH), South East Queensland, in 2008 a number of service delivery initiatives have been developed, implemented, and evaluated to meet the identified nutrition needs of women attending the publicly-funded service. Due to a lack of effective whole of maternity service models of care in the literature, we developed and tested our own⁷ using a Knowledge-to-Action (KTA) Framework, employing both the Knowledge Creation and Action Cycle¹³ Initiatives were informed by a survey of our postnatal patients in 2008⁷ as well as evidence and published literature regarding nutrition requirements during pregnancy,¹⁴⁻¹⁶ effective delivery of medical nutrition therapy for women with GDM,¹⁷ effective methods of education and methods of supporting behaviour change,¹⁸⁻²⁰ translating research into practice,²¹ evidence based methods of producing written health education material,²²⁻²⁴ and the most recent Institute of Medicine GWG recommendations.¹⁵ Our iterative process of health service redevelopment acknowledged that service improvements required a multi-strategy approach beyond attempting to solely obtain more resources for more dietitians. Short, medium, and long-term service development goals were set based on clinical priority areas. A pragmatic approach was used to achieve a balance between innovation, consumer needs, service practicalities, resource limitations and clinical expertise in the initial existing 1.0 full time equivalent (FTE) service.

Since 2008 the capacity and capability of the nutrition and dietetic department has grown through dedicated externally joint funded research positions, via partnerships and collaborations and subsequent re-orientation of existing resources to areas with demonstrated improvements in guideline adherence and subsequent health outcomes, as well as the acquisition of new resources and development of new patient tools in response to these outcomes. The current dietetic maternity team consists of 1.5 FTE delivering clinical care and an externally-funded grant/fellowship supported clinician-researcher (50-70% of FTE covered by grant) with a strategic development and evaluation role. The progressively evolving MMH nutrition and dietetic service has included a series of strategies and initiatives implemented and refined since 2008. These have included:

- improved promotion of the dietetic services and education around nutrition issues facing pregnant women to hospital staff and general practitioners who share maternity care with the MMH (commenced 2008),⁷
- a new nutrition in pregnancy booklet for midwives to distribute to all women at first booking visit ('Healthy eating during pregnancy')(commenced 2008),⁷
- an early pregnancy nutrition education workshop for patients ('Healthy Start to Pregnancy' (HSP) workshop)²⁵ (from 2011 initially as an evening group then from 2013 delivered within antenatal clinic, most days of the week),

- an outpatient postnatal program to support women's awareness of and ability to adopt healthy postnatal nutrition behaviours , 'Nutrition for New Mums'(commenced 2012),²⁶
- the translation of GDM nutrition practice guidelines into the antenatal clinic (from 2012),^{27,28}
- integration of the dietitian into the antenatal clinic on each day of the week, providing one on one appointments and the HSP group education sessions (from 2014),
- a service-wide implementation of GWG guidelines via addressing evidence-practice gaps in staff knowledge^{29,30} and including staff training, scale placement in every room, and a change to weight recording practice in the hospital's maternity database "Matrix"³¹ (from 2014),
- an integration of GWG management tool 'The Personalised Pregnancy Weight Tracker'³² (from 2008), and
- the development and implementation of 'Nine months of nutrition' resource as part of the addition to the suite of education and communication methods (from 2014) which is a series of seven web-based and USB-delivered, voice-over PowerPoint presentations disseminated via television screens throughout the MMH clinic waiting areas and also hosted on the hospital's website.^{32,33}

The aim of this study was to evaluate changes in the nutritional awareness, knowledge and eating behaviours of women who were inpatients in the MMH

postnatal ward following these service improvements and education initiatives within the MMH nutrition and dietetics maternity service. Specifically, we aimed to (i) evaluate women's levels of awareness of the dietetic services available at the MMH, (ii) evaluate women's perceptions of nutritional information available, (iii) compare women's dietary behaviours, and (iv) compare the GWG patterns with women who were surveyed as postnatal inpatients during 2008 to further assist with designing and planning future nutrition and dietetic services.

Methods

The population surveyed was a convenience sample of eligible women over the age of 18 years who were receiving postnatal care in the MMH public postnatal ward. Survey periods ran for approximately two weeks every four months from 2014 to 2017, commencing June 2014.

The survey was distributed daily on meal trays of women admitted to the MMH postnatal ward. Surveys were returned to Food Services in sealed envelopes that were collected by the dietitian. This distribution procedure differed from the 2008 procedure where surveys were distributed for a seven week period on one or two days across the week to prevent women being offered the survey more than once on account of the median length of stay being 2.0 days.

Approximately 5,000 women attend the MMH each year (approximately 100 women admitted to the postnatal ward each week). Based on an

anticipated response rate of 25-50%, we aimed to collect approximately 400 patient surveys per year (50-100 each survey period). The 2008 response rate was 17.4%.^{7,8} The current response rate was calculated from the number of women admitted to the postnatal ward during the survey periods.

The 3-page postnatal survey was based on the 2008 survey and took approximately five minutes to complete. The survey was self-report and collected women's demographics, anthropometric data (height, pre-pregnancy weight, current weight, and GWG), relevant pregnancy history, current breastfeeding behaviour, days since delivery, and history of GDM. Other data collected included dietary quality, opinions and knowledge, as well as women's awareness of, use of, and other needs that could be met by the MMH dietetic services. Dietary quality was assessed with a valid tool measuring number of serves of fruit, vegetables, and dairy products consumed per day.³⁴ Importance of healthy eating (during pregnancy; in the postnatal period) and returning to pre-pregnancy weight was rated on a Likert scale, with 1 being 'not important' to 5 being 'very important'. Surveys only differed in data gathered around service needs (2008) and service opinions (2014-17).

Completed surveys were scanned using 'Remark' services, producing raw data in Excel that was transferred to SPSS version 15 for analysis. STATA 15 was used for weight gain association analyses. Patient characteristics were summarised using frequencies and percentages for categorical variables and means and standard deviations (normal distributions) or medians and

interquartile ranges (IQR)(skewed) for continuous variables. Institute of Medicine GWG guidelines (2009) were used in analyses,¹⁵ including for multiple gestations. Postnatal women were considered to have similar diets as they had in late pregnancy, and therefore when assessing diet quality the Australian Guide to Healthy Eating¹⁴ recommendations for pregnancy were used. Between group differences were assessed with independent group t-tests (continuous variables) and independent group Chi-squared tests (categorical variables). BMI and gestational weight gain between two cohorts (2008 and 2014-2017) were compared using a Mann-Whitney U test. Association between categorical variable (BMI, gestational weight gain) and cohort was examined using Pearson's Chi-square test or Fisher's exact test where appropriate. The level of statistical significance was set at 0.05. The reporting of this study conforms to the STROBE (cross-sectional studies) statement.

Ethical approval was obtained from the hospital's Human Research Ethics Committee (HREC/14/MHS/89).

Results

A total of 421 surveys were returned from 1,080 surveys distributed (response rate (RR: 39.0%). During this period, 2,080 women were postnatal inpatients. The response rates from the individual survey periods were 46.7% (6/2014), 40.7% (10/2014), 41.7%(3/2015), 35.8%(7/2015), 40.8%(10/215),

38.3%(3/2016), 33.3%(6/2016), 30.0%(10/2016), and 41.4%(6/2017). In 2008, 101 postnatal surveys (17.4%) were collected.⁷

The study population in 2008 was a similar age to the hospital population and was slightly younger in 2014-2017, but had similar mean pre-pregnancy BMI (ppBMI). No differences in age or pre-pregnancy weight were found between the two survey periods. However, there was a greater proportion of women in the healthy weight range in the 2014-17 period and overweight in 2008,⁷ Table 1. Approximately half of the women had delivered their first baby (during the survey period) and over 92% were breastfeeding at both survey periods. One multiple pregnancy (triplets) was included in the cohort in 2008, two sets of triplets and 4 sets of twins were in the 2014-17 cohort.

In 2008, 54.5% (55) of postnatal women knew of the dietetic services, and of these women, 9.9% (n=10) accessed them. As shown in Table 2 there is now greater awareness of and engagement with the dietetic services. Across the different resources or services, between 47.0% to 88.8% of women received a resource or saw a dietitian. Furthermore of the women surveyed, 13.3% of women attended an individual appointment, 6.4% attended a group (HSP) and 90.9% of the women with GDM (10.5% of survey cohort) attended an individual appointment with a dietitian. Approximately 20% would have liked to have seen a dietitian but did not know the service was available.

Postnatal women were not surveyed about the resources in 2008. In 2014-17, between 40 -70% of women surveyed were aware of the healthy eating in

pregnancy booklet, weight tracker and the new nine months of nutrition resources (Table 2). A quarter to 40% rated them as useful/very useful, with ratings 3.5 or above out of 5 given. Only six women commented about extra services about which they would like information; five requested information about diet and breastfeeding, one requested information about weight loss postpartum and two commented they did not receive any dietary information. In addition to those who indicated they did not/would have liked to have received dietary information during pregnancy in Table 2, an additional two women noted they would have liked to have received information and support about healthy eating and weight gain during pregnancy.

Similar proportions of women reported having GDM at both survey periods (8.9% (2008) and 10.5% (2014-17)). No questions were asked of women about the GDM service and resources in 2008 due to a minimal service being offered. In 2014-17 of the women who reported having GDM (n=44), 40 of them reported having an individual appointment with a dietitian (3 missing). Most women with GDM (79%, 35) rated the booklet provided³⁵ as useful/very useful with a rating of 4.6 ± 0.7 out of 5. Only 9.1% (4) reported not receiving a booklet. The voice-over introductory GDM PowerPoint³³ was rated as useful/very useful by 50% (22) of the women, with 29.5% (13) reporting not having seen it. Women rated it 4.0 ± 1.1 out of 5.

A similar proportion rated the importance of eating well now as important or very important and this approached significance, being 9% less than in 2008

(92.1% (90) versus 83.1%(350), $p=0.055$). Similar proportions of women rated returning to their pre-pregnancy weight as important or very important at both survey periods (68.3% (69) in 2008 versus 62.4%(263) in 2014-2017, $p= 0.5$). A large proportion of women rated eating well in pregnancy as important or very important to them in 2014-17(80.1% (337)), with this question not asked in 2008.

No significant difference over time was observed in intake of fruit, vegetables or dairy products (Table 3). However, this approached significance for mean daily fruit intake (increase) and mean dairy intake per day (decrease). Hoerr *et al.* demonstrated in a US population that these food groups predict 62% of the variance of a person's diet.³⁴ Significantly more women met fruit guidelines in the second survey cohort; in 2008 women were recommended to consume 4 serves per day compared with 2 per day in 2014-17.^{14,16} The 9.5% increase in the proportion of women meeting dairy serves per day approached significance, $p=0.09$.

Median and IQR of GWG was 13.0 (10.0-16.0) in 2014-17 and 14.0 (10.0-19.0) in 2008; the difference approached significance, $p= 0.055$ (Table 1). Of patients with GWG and BMI available ($n=447$), there was a significant association between GWG and cohort ($p<0.001$) (3 categories i.e. correct vs insufficient vs excessive), $p=0.008$ (2 categories, correct vs outside guidelines) where a greater proportion of women had the correct weight gain in 2014-2017 (23.2% vs. 38.6%) (Table 1). Sub-group analyses suggested a significant

association between GWG and cohort among women with pre-pregnancy BMI 18.5-24.9 kg/m² (2008 vs 2014-17: Insufficient 33.3% vs 34.7%, Correct 21.4% vs 42.8%, Excessive 45.4% vs 22.5%, p=0.004). There was no significant association between GWG and cohort among women with each of the other ppBMI categories (Figure 1).

Discussion

This study has demonstrated greater nutritional service and resource awareness and ratings, as well as improved GWG patterns among MMH inpatients with nutrition and dietetics service improvements and education initiatives implemented in the MMH since the 2008 survey. However, only slight improvements have been observed in dietary patterns in women attending the MMH for maternity care.

Improvements in women's level of service awareness and access are potentially explained by the increased service capacity and the integration of this service into the antenatal clinic, the ongoing service promotion with women and staff, and the variety of resources available in numerous educational formats (booklet, videos, tracking resources). Over two thirds of the women surveyed were aware of these resources and a quarter had seen a dietitian in an individual or group setting, compared with less than 10% in 2008.⁷ Around a fifth would have like to have seen a dietitian but did not. Despite the importance of good dietary behaviours in pregnancy, particularly due to the effects of

epigenetics on long term chronic disease,³⁶ not all women will be able to, will want to, or will prioritise seeing a dietitian during pregnancy. Multiple, effective and accessible resources to inform and influence behaviour change are required in an effective maternity service. Referral pathways and prompts, ongoing service promotion, and service capacity should also be explored to ensure that women who do want to see a dietitian benefit from this service.

While no measure of the proportion of postnatal women receiving written information was documented in 2008, less than two-thirds of women surveyed during the antenatal period at the same time recorded having received written information. This shows our information distribution processes have improved.⁷ Between a quarter to just under a half of women rated the resources useful or very useful, and a large proportion of women rated GDM resources highly. While we did not examine the differences in ratings between women who were seen by a dietitian with those who were not, this might suggest women who had more passive exposure to the healthy eating booklet, weight tracker, and the voice over PowerPoints (nine months of nutrition) provided lower ratings. Bookari *et al.* demonstrated that while women predominantly prefer written information during pregnancy and almost all look for information as soon as they find out they are pregnant, they can become overwhelmed and confused and want constructive and interactive engagement from (all) health care professionals to support good nutrition behaviours.³⁷ Lucas *et al.* also highlighted that many health professionals cite barriers of time, resources, and

relevant training (lack of confidence) in providing or supporting nutritional changes in women.³⁸ The nine months of nutrition resource was constructed to act as an evidence-based tool that staff could direct women to when nutritional advice was required beyond their scope of practice. Similarly, the healthy eating booklet is a stand-alone, evidence based content and behaviour change resource that midwives distribute at women's first visit. Potentially more work needs to be done to flag women who would benefit from nutrition input and to improve staff's confidence in the use of these resources.

The importance of eating well in both pregnancy and the postnatal period received high scores in both cohorts. This has been documented in the literature with Szwajcer *et al.* showing that women prioritise the understanding and achieving of good nutrition in pregnancy compared with other times of their lives.³⁹ Surprisingly, fewer women in both cohorts rated returning to their pre-pregnancy weight as important to them (around two-thirds) compared with the ratings for eating well. Christensen *et al.* has noted that women perceived that their maternity health professionals seem unconcerned about their weight and postpartum weight loss, with little or no guidance being provided.⁴⁰ Women also had little knowledge of the risks of postpartum weight retention.⁴⁰ It has also been shown that the primary influence on women's pregnancy and postpartum attitudes towards weight is their pre-pregnancy orientation towards body weight;⁴¹ this lower rating may reflect an underlying dissatisfaction with their pre-pregnancy weight. However, women's responses also need to be

interpreted within the timeframe of questioning. This may not be of priority immediately after birth, but may be considered important once they feel they have some mastery over the many other new matters they need to deal with (lack of sleep, breastfeeding, new baby etc.).

Despite no significant changes in women's dietary intake, reflected by reported daily intake of fruit, vegetables or dairy products and the overall percentage of women meeting dietary guidelines for these food groups, women's intake in the 2014-17 cohort were higher than most recent Australian studies of dietary intake in pregnancy (note: proportion of women meeting fruit intake guidelines to be excluded due to change in guidelines from 4 to 2 serves per day).^{25,42-46} While this may be an artefact of measurement, a number of the studies used identical methodology.^{45,46}

Many barriers to consuming a healthy diet in pregnancy have been documented, including lack of availability of fruit and vegetables, convenience/time and effort to prepare fruit and vegetables,⁴⁷ and preference of other foods.⁴⁸ Few studies exist in the literature focused on improving diet quality during pregnancy, generally focusing on more specific conditions such as GDM or primarily influencing GWG.³⁹ When appropriate approaches are taken that provide information and strategies to support behaviour change/overcome barriers, significant improvements are observed in dietary behaviours as illustrated in our "Healthy Start to Pregnancy" low-intensity, dietitian-led behaviour change workshop.²⁵ Attendance at this workshop

resulted in significantly more women increasing their consumption of serves of fruit (+0.4 serves/day, $p = 0.004$), vegetables (+0.4 serves/day, $p = 0.006$), met fruit guidelines (+11.9%, $p < 0.001$), and had a higher diet quality score ($p = 0.027$) to those who only received our healthy eating in pregnancy booklet.²⁵ With less than 10% of women surveyed attending this program (Table 2) investigation into barriers to service access will be undertaken.

The significant increase in women gaining weight within the recommended IOM guideline ranges is a very promising outcome with only around 30% of women experiencing excessive GWG in the 2014-17 cohort. Whilst this is still a concern due to links with poor maternal and infant pregnancy and long term outcomes^{1,2} this is lower than many recent studies (E.g. 38%,⁶ 39%,⁴⁶ 42%,⁴⁵ 47%², and 52%.⁴⁹ It has been clearly demonstrated that interventions which include dietary advice, and physical activity, supported by ongoing weight monitoring can prevent excessive GWG and result in more women across all BMI categories achieving weight gain within correct ranges.⁵⁰⁻⁵³ It may be suggested that this increase in appropriate GWG is a result of service wide changes and support, including guidance provided by dietitians.³¹

Study strengths included the use of an implementation science framework (KTA Framework¹³) to guide service development and evaluation and our use of the same survey for both cohorts. The recruitment method and response rate are both a strength and a limitation. The recruitment rate was higher in 2014-17 (overall and at each collection point), potentially a reflection of shorter, more

targeted data collection periods. The overall number of women surveyed was also much larger, providing greater confidence in observations. The smaller sample size in 2008 may have reduced statistical power in comparisons undertaken. However, the cohorts' characteristics were similar to those of the wider hospital's population. The cross-sectional design provides data on health behaviours at two time points, rather than providing longitudinal information, although this was attempted to be circumvented by 'pulse' surveys over the longer time period for the second cohort. The dietary measures reported are subjective rather than objectively measured and the use of a longer dietary quality tool could be considered preferable, but the lack of availability of an affordable tool of a suitable length when the 2008 survey was distributed was a limitation. Physical activity data would also have added more information about women's lifestyle behaviours.

Priority areas for service redesign focus will continue to promote awareness and access to the suite of dietetic services, as well as strategies to improve diet quality and decrease excessive GWG. Exploration of the potential of broad reach/low intensity methods of delivery e.g. mHealth (mobile Health) approaches, such as the effective txt4two program⁵⁴ is planned, which may be able to integrate existing resources, and could be adapted to deliver our previously developed postnatal program to decrease postpartum weight retention.²⁶ This will also increase the capacity of the dietitian's clinic to accommodate women needing greater assistance and contact. Development

and evaluation of mHealth programs that are embedded in a maternity service, with functionality for tailoring 'push' messages that provide information and resources to facilitate knowledge acquisition AND behaviour change may help to overcome the complexity resulting from the 'noise' of social and traditional media with the trusted (but less accessible) health service evidence.^{37,55}

Other maternity services can learn from the processes undertaken and results obtained in this body of work⁷. Locally applying the KTA Framework¹³ would help to ensure a systematic approach to service assessment and redesign. This would begin with an understanding of the service and the women who use it, such as number of births, the proportion of women with higher needs (e.g. GDM, women with a ppBMI above 25kg/m², patterns of weight gain compared with guidelines etc.), to define the evidence-practice gap. Additionally, an assessment of barriers and enablers to delivering best practice care should be undertaken to allow prioritisation of changes required.^{56,57} It is widely recognised that translating research findings into clinical practice is a challenge for in health services and that many clinicians do not have the capacity, confidence, or expertise to realise change in their local settings. Parker *et al.* (2007) suggest a collaborative approach (a 'hybrid' model of facilitated implementation) to overcome such a problem.⁵⁸ This allows opportunities of 'local fit' and 'maximised buy-in' from sites to be balanced with tactical implementation decision and expertise from external facilitators from other clinical settings, health departments, and/or research institutes.⁵⁸ Benefits

could also be realised with co-funded (through external grants or partnerships) embedded clinician-researchers, such as in this body of work.

In conclusion, this maternity service review has demonstrated that the iterative, multi-strategy, evidence-based service changes made since 2008 have effected positive change in women's GWG, service preferences, and service access. However, it is also apparent that pregnant women require programs that provide greater awareness-raising and behaviour change support through targeted, tailored and frequent interventions to improve diet quality and manage GWG to ensure optimal pregnancy outcomes.

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Conflict of interest

No conflict of interest exists for any author.

Authorship

All authors have participated sufficiently in the article to take public responsibility for the content. Dr Shelley Wilkinson (corresponding author) was involved in the planning of this project, the analysis, and interpretation of data, and the writing of the paper. Elin Donaldson was involved in data collection, and Elin Donaldson and Sally McCray were involved in analysis and interpretation, as well as contributing to and reviewing the manuscript.

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