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EDITORIAL

The science and art of dietetics: Why science needs to underpin our practice

Dietetics is often described both as an art and a science;\textsuperscript{1–3} a science as it is derived from the science of nutrition and an art because of the translation of the science by practitioners into practice. The science of nutrition—the interaction of nutrients and other substances in food in relation to growth and health—draws from the foundational sciences of chemistry, biology, microbiology, physiology and biochemistry. Importantly, the science of food, the study of the chemical and physical properties of food and how composition may change with different levels of processing, is the conjugate of how nutrition is translated into dietetic practice. Each of these three pillars—nutrition, food and dietetics—are underpinned by science and this needs to be continually supported in practice. Here, the observation of a problem leads to the formation of a hypothesis. This hypothesis is then tested by conducting a fair and unbiased experiment, the data are analysed and a conclusion drawn—the whole process evaluated by submission of a manuscript for peer review. Dietitians are in a unique position to identify gaps in knowledge from their practice, to develop hypotheses and then collect and analyse the data and determine how they are translated into practice. Adherence to the scientific process and the use of well-developed and validated scientific methodologies is required to develop the evidence base that will help dietitians to continually improve the health of future generations and is critical in retaining the profession’s credibility.

Papers themed in this issue of Nutrition & Dietetics reflect the diversity of the different methodologies used to test their hypotheses within nutrition research, without the requirement for time intensive and costly traditional intervention studies such as randomised controlled trials (RCTs). These include systematic reviews,\textsuperscript{4} and qualitative methodologies such as online surveys\textsuperscript{5} and focus groups\textsuperscript{6} to monitor and assess efficacy. Also in this issue researchers have utilised existing RCTs to analyse secondary data,\textsuperscript{7} and report longitudinal observational studies\textsuperscript{8–10} to address existing gaps in the knowledge base in clinical dietetics.

A systematic review is a powerful research methodology that provides a structured framework to collect and analyse data from multiple studies, which provides high-level evidence to inform health-care practice. The nutritional intakes of children continue to be a strong research focus, especially given the long-standing understanding of the trajectory of poor diets in childhood and childhood obesity leading to an increased risk of poor metabolic outcomes in adulthood.\textsuperscript{11} With the awareness that grandparents are increasingly involved in the care of their grandchildren, the systematic review by Young et al. addresses a potentially important aspect of determinants of children’s dietary intakes.\textsuperscript{4} Studies where grandparents provided care to 2–12-year-olds were considered, excluding where grandparents were primary caregivers and studies from developing countries. Studies were eligible for inclusion if they had reported outcomes on the children’s dietary intake and weight, and the grandparent’s knowledge and beliefs on nutrition or their feeding practices. Three studies were identified in which grandparents had positive feeding behaviours towards their grandchildren, while nine studies identified that grandparents had negative impact on feeding attitudes and behaviours. Many of these included studies also reported qualitative data, providing a rich understanding of the influences and reasons behind their beliefs. Influences ranged from the negative in which grandparents actively undermine the parents—to the positive in which parents and grandparents worked together to ensure that traditional family recipes were passed down the younger generations. Importantly, this review of the evidence base highlights grandparental influence as another potential determinant of childhood obesity.

Monitoring nutritional status in health care has always been at the forefront of clinical dietetic practice. Aredes et al. addressed the critical question of how chemotherapy and radiotherapy affect nutritional status during therapy, specifically in the under-studied area of gynaecological cancer. A longitudinal prospective cohort study design was used to assess the influence of chemotherapy on the nutritional status, functional capacity and quality of life in women receiving treatment for cervical cancer in the National Institute of Cancer in Jose Alencar Gomes da Silva.\textsuperscript{10} One of the clinically significant findings of this manuscript was that the interruption of chemotherapy due to severe toxicity (either due to gastrointestinal, haematological or renal toxicity) was significantly associated with nutritional status prior to the commencement of chemotherapy. The cohort (20.4%) that suspended their chemotherapy had a significantly lower median skeletal muscle index. Furthermore, in the cohort that had treatment suspended, 83% had presented prior to treatment with cachexia and unintentional weight loss of more than 5%. It has been proposed that percentage weight loss is a better clinical indicator rather than body mass index in patients undergoing chemotherapy as a prognostic factor of quality of life, regardless of the type of cancer.\textsuperscript{12} This is an important consideration for clinical dietitians in ensuring weight maintenance (including fat-free mass) prior to chemotherapy treatment, forming part of the evidence base that will be incorporated into clinical practice.
The impact of and adherence to clinical practice guidelines in dietetic practice was also investigated in this issue by Bourne et al. Australian dietitians working with bariatric patients were surveyed for their adherence to the clinical practice guidelines for the nutritional, metabolic and non-surgical management of bariatric surgery patients in the pre-operative stage. This research employed a descriptive cross-sectional online survey to assess adherence to clinical practice guidelines. The proportion of dietitians reporting routine screening of at-risk micronutrients varied between 32 and 45% in the regional and remote areas, whilst in the metropolitan areas there was a higher proportion of screening with reports between 55 and 65%. This study demonstrates that all dietitians implemented some form of medical nutrition therapy to facilitate weight loss pre-operatively, but highlights the need of continued research into this area to determine the barriers to nutrient screening.

As reflected in the diversity of papers in this issue, dietitians practice in many different areas, and need to continually draw on the foundational sciences and the evidence base so that they can advocate, promote and provide the highest quality care, advice and education for our clients and community. Our ultimate goal has always been to improve the health of future generations, requiring continual professional development, remaining abreast of the literature and translating the evidence base into practice for the future generations. Yet arguably, the biggest challenge for those practising as dietetic and nutrition professionals may be to prove that nutrition is not a belief system, but a science.

The ‘art of dietetics’ has also become somewhat more difficult due to the growing number of ‘health practitioners’ who are providing ‘nutritional’ advice and who have mastered the ‘art’ of nutrition, without mastering the science that underpins it. Clearly their success has been facilitated by the widespread prevalence of social media, where everybody has a voice. This makes it a difficult space for the dietitians’ voice to compete, especially when the public perception is that nutrition is not science-based, but rather where the authenticity of the message is linked to the familiarity and popularity of the celebrities sprouting their message, often driven by significant conflicts of financial interest. This phenomenon continues to be fuelled by ‘hash-tag pop science’ terms such as ‘clean eating’, ‘detoxing’, ‘freedom’, ‘natural’ and ‘superfood’. This situation is perhaps further exacerbated with health professionals at the face of delivering health care who could provide basic nutrition knowledge but receive poor nutrition training, which denies them the foundational understanding that nutrition is a science.

The ‘art of dietetics’ should be more widely viewed as, perhaps, how dietitians communicate that nutrition is a science when advocating their message to improve the health of future generations. This highlights the importance for dietitians to have scientific literacy so that they understand the research process, including the strengths and limitations of different methodologies. This requires dietitians to become engaged in research in nutrition, food and dietetics. The dietitians’ voice is particularly important in food science principally because of their knowledge of nutrients, food components and the impact that changes in the food industry are likely to have in health and disease.

So, let us remember the quote from John Cleese “science—a method of investigation and not a belief system”. Dietetics is a science, in which dietitians with enquiring minds need to use and understand the methods of investigation with a non-biased mind to avoid investigator bias. To enable this scientific process, high level scientific literacy is required which needs to be heavily emphasised in undergraduate and post-graduate degrees, and in professional development. Adhering to these are critical for dietitians to maintain their credibility in the many areas that they practice in, from research, education, industry and of course all levels of health care to achieve their goal of improving nutritional status for people for better health outcomes.

Funding source

The author did not receive funding to write this Editorial.

Conflict of interest

The author has no conflicts of interest to declare.

Authorship

EM was the sole author of this manuscript.

References

ORIGINAL RESEARCH

Therapeutic alliance in dietetic practice for weight loss: Insights from health coaching

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Abstract
Aim: The psychological construct of 'therapeutic alliance' can be used to better understand the effectiveness of consultations, particularly goal setting for weight management. We analysed audio-recorded health coaching sessions during a weight loss trial to explore relationships between therapeutic alliance and various contextual factors.

Methods: Audio recordings of 50 health coaching sessions were analysed. After assessing fidelity to the protocol, therapeutic alliance was measured using an adapted Working Alliance Inventory Observer-rated Short Version (WAI-O-S), and examined by (i) identifying relationships between contextual factors and WAI-O-S scores (Spearman's coefficients); (ii) testing the impact of preparatory exercises and body mass index on WAI-O-S scores (one-way analysis of variance and least-squared differences tests) and (iii) comparing differences in WAI-O-S scores based on relationship status, gender and follow-up session completion (independent samples t-tests).

Results: Fidelity was high (mean 88%). WAI-O-S total scores ranged from 55 to 70 (out of 84). Session duration was significantly correlated with WAI-O-S component of 'Bond' (r = 0.42, P = 0.002). Those who completed preparatory exercises had significantly higher total WAI-O-S scores, 'Goal' and 'Task' scores. Participants who completed the follow-up session scored significantly higher for 'Goal' compared to no follow-up.

Conclusions: Spending more time in a session appears related to increased bonding, a key component of therapeutic alliance. Preparatory work may help build therapeutic alliance and agreement on goals appears to influence follow-up completion. These exploratory findings provide directions for research addressing the professional relationship in dietetic consultations for weight loss.

Key words: dietitian–patient relationship, health coaching, obesity, therapeutic alliance, weight loss.

Introduction

Obesity is a major health problem across the globe.1 In Australia, the latest national health survey reports nearly two-thirds (63%) of the adult population are either overweight or obese.7 Weight management is a major practice area for Accredited Practising Dietitians in Australia as poor diet can contribute to weight gain.3 The Dietitians Association of Australia Best Practice Guidelines for the Treatment and Management of Overweight and Obesity9 and 10-Point Plan5 are available to guide dietetic patient consultations for weight loss; however, little is known about how dietitians interact with patients to assist with sustained weight loss.

Within the discipline of psychology, 'therapeutic alliance' is a term that describes the practitioner–patient relationship. Bordin6 suggested a structured framework of therapeutic alliance, referred to as 'working alliance', breaking it down into 'Goal', 'Task' and 'Bond' components. 'Goal' refers to agreement on goals for therapy between practitioner and patient, 'Task' to the agreement on actions needed to achieve those goals and 'Bond' to the connection established between practitioner and patient.6 Therapeutic alliance has been researched extensively and found to be positively related to positive outcomes in psychotherapy and chronic disease.7–9 These findings were based on results of multiple, systematic tools for assessing therapeutic alliance, including the proven valid and reliable Working Alliance Inventory (WAI),10 which is based on Bordin’s framework. However unlike psychology, systematic and evidence-based assessment of the dietitian–patient relationship appears limited, particularly in relation to patient outcome. Despite variation in what comprises health coaching, it is broadly recognised as being patient-focused and aimed at enhancing motivation for behavioural changes.11–13 Research shows positive outcomes of health coaching within chronic disease and weight loss.11,15 Similarities are evident between health coaching and dietetic practice as both utilise a motivational counselling approach.11,13,16
The aim of this analysis was to explore relationships between therapeutic alliance and various contextual factors in health coaching sessions held within a weight loss trial.

Methods

This research utilised secondary data from a lifestyle intervention trial, the HealthTrack study (Australian New Zealand Clinical Trials registry number ACTRN126 14000581662).\textsuperscript{17} The HealthTrack study was a 12-month randomised controlled trial with three study arms: a control group who received usual care, intervention group A whose participants received multidisciplinary lifestyle support and intervention group B whose participants received multidisciplinary lifestyle support and 30 g of walnuts per day. Multidisciplinary support targeted diet, exercise and behaviour.

Ethics approval for the HealthTrack study was provided by University of Wollongong, Illawarra Shoalhaven Local Health District Human Research Ethics Committee (HE 13/189). Consent for secondary analysis of audio recordings of health coaching sessions and participant information was given by participants as part of the HealthTrack study.

Telephone health coaching sessions were based on acceptance commitment therapy.\textsuperscript{18} Two health coaches received training from psychologists prior to the study commencing. Both coaches were female and from a professional background involving dietetics or psychology. Participants received four telephone health coaching sessions, of approximately 15 minutes duration, over 12 months. Sessions were based on clarifying values underlying the desire to lose weight, increasing motivation, mindfulness and self-compassion. Participants received a booklet with information and exercises to complete for each session. A written script was developed for health coaches to follow throughout the sessions.\textsuperscript{17}

Digital audio recordings of the first telephone health coaching sessions were obtained for 50 participants, who were randomly selected from 205 participants who had completed the first health coaching session as part of the intervention arms of the HealthTrack study (groups A and B). Half (n = 25) were randomly selected from each of the two health coaches using simple random sampling\textsuperscript{19} generated by a web-based randomisation tool.\textsuperscript{20} Data from the first session only were used to determine the effect of early therapeutic alliance on completion of the follow-up session. Inclusion and exclusion criteria were determined by the HealthTrack study and have been published elsewhere.\textsuperscript{17}

Fidelity of participants’ first health coaching sessions to scripted content, outlined by the HealthTrack study protocol, was assessed. This was to ensure participants received the designed coaching intervention, and thus, there was no variation within session content that may influence results. A 3-point Likert scale was used to rate nine scripted session components. This method was tested for inter-rater reliability on a separate sample (n = 18). Two researchers rated fidelity independently and discussed discrepancies to reach an agreed rating.

An adapted version of the Working Alliance Inventory Observer-rated Short Version (WAI-O-S) was used to rate therapeutic alliance between health coaches and participants.\textsuperscript{21} Each of the 12 WAI-O-S items were rated using a 7-point Likert scale (1 = never, 7 = always), using an adapted version of the Manual for the WAI-O Revision IV.\textsuperscript{22} The tool and manual were adapted by altering wording and the scoring system to be relevant to health coaching. The adapted version of the WAI-O-S was tested for inter-rater reliability on a separate sample (n = 18). Given this was the first known time the WAI-O-S had been used within health coaching, certainty and relevance scores were added to each item.

The WAI-O-S has three subscales: Goal, Task and Bond. Each component comprises four items that were summed to obtain a subscale score (range of 4–28 based on four items on a 7-point Likert scale). The total WAI-O-S score for all 12 items was calculated (score range of 12–84). Example items of each component are as follows:\textsuperscript{21}

Goal: The health coach and participant are working on mutually agreed-upon goals for the session.

Task: There is agreement about the steps taken to help improve the participant’s situation.

Bond: The participant feels that the health coach appreciates them as a person.

Variables were assessed against WAI-O-S ratings to explore potential covariates of therapeutic alliance strength. Variables included the session duration, participant’s age, gender, body mass index (BMI) (actual and categorised) and relationship status (in relationship or not in relationship), participant completion of preparatory exercises for the first health coaching session (all exercises completed, some exercises completed or no exercises completed) and participant completion of the follow-up health coaching session (completed or not completed). The follow-up session was the second health coaching session within the HealthTrack study.

Duration of sessions was determined from the time displayed on the recording. Participants’ completion of preparatory exercises for the first health coaching session was determined from the review of the digital audio recordings between health coaches and participants, as this was one of the first items assessed during the interaction. Participant completion of the follow-up health coaching session was identified by completion records kept in the HealthTrack database.

SPSS software\textsuperscript{23} (IBM, Armonk, New York, USA) was used for statistical analysis. Descriptive statistics were applied to participant demographic data. Spearman’s coefficients were used to identify relationships between participants’ age and actual BMI, session duration and WAI-O-S scores. For further analysis, participants’ BMI was categorised into healthy, overweight and obese classes 1, 2 or 3, as outlined by the World Health Organisation.\textsuperscript{24} Participants’ relationship status was re-categorised into either ‘relationship’ or ‘no relationship’. One-way analysis of variance (ANOVA) was applied to groupings to test the impact of participants completing preparatory exercises (all exercises
completed, some exercises completed or no exercises completed) and their BMI category on WAI-O-S scores. If one-way ANOVA results were significant, step-down comparisons between groups were assessed using least-squared differences tests. Independent sample t-tests were applied to compare differences in WAI-O-S scores between groupings based on relationship status, gender and participants’ completion of the follow-up health coaching session (completed or not completed). Significance was set at $P < 0.05$ for all statistical analyses because of the exploratory nature of this research.

**Results**

Participants’ mean age was 45 years with a standard deviation of 7.8 years. The majority were female (66%), in obese BMI categories (76%) and in a relationship (80%).

The mean percentage of fidelity across all script components and health coaches was high (mean 88%). Adapted WAI-O-S scores ranged from 55 to 70 (out of 84). Inter-rater reliability results for assessing fidelity showed the average percentage of agreement across script components was 94% based on independent ratings. The range was 83–100%. Following independent ratings of the adapted WAI-O-S, the range of percentage raw agreement between raters across all 12 items was 61–100% and the kappa coefficients ranged from 0.20 to 0.90.

Table 1 shows relationships identified between the contextual factors of age, BMI and session duration with WAI-O-S scores. Session duration showed a significant positive correlation with WAI-O-S component ‘Bond’, $r(48) = 0.42$, $P = 0.002$. Participants’ age and actual BMI did not significantly correlate with WAI-O-S component or total scores.

<table>
<thead>
<tr>
<th>WAI-O-S component</th>
<th>Goal</th>
<th>Task</th>
<th>Bond</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>0.27 (0.06)</td>
<td>-0.03 (0.85)</td>
<td>0.18 (0.22)</td>
<td>0.09 (0.53)</td>
</tr>
<tr>
<td>Actual BMI</td>
<td>-0.20 (0.16)</td>
<td>-0.10 (0.50)</td>
<td>-0.21 (0.14)</td>
<td>-0.15 (0.29)</td>
</tr>
<tr>
<td>Session duration</td>
<td>0.17 (0.24)</td>
<td>0.12 (0.40)</td>
<td><strong>0.42 (0.002)</strong></td>
<td>0.27 (0.06)</td>
</tr>
</tbody>
</table>

BMI, body mass index; WAI-O-S, Working Alliance Inventory Observer-rated Short Version.

Correlation coefficients shown are Spearman’s coefficients. Bold value indicates significance at $P < 0.01$ (two-tailed).

There was a significant difference in WAI-O-S goal scores for those participants who completed the follow-up health coaching session compared to those who did not, $t(20.61) = 2.29$, $P = 0.03$ (see Table 3 for means).

**Discussion**

The present study explored relationships between therapeutic alliance and various contextual factors in health coaching sessions held within a weight loss trial. A significant finding of the present study was that the Goal component of therapeutic alliance was significantly related to participants’ completion of preparatory exercises for the first health coaching session (see Table 2). Similarly, Task and total WAI-O-S scores were also significantly related to participants’ completion of preparatory exercises. These results indicate that patients who have dedicated time to completing exercises in preparation for their health coaching session may develop a stronger therapeutic alliance with their health coach. Specifically, it appears they may be more likely to agree on their goals with their health coach and tasks they need to perform to achieve their goals.

From a dietetic practice perspective, this may mean patients who have dedicated time to completing work prior to a consultation, such as completing a food diary, may be able to develop a stronger therapeutic alliance with their diettitan, particularly around goals and tasks. A possible explanation may be that as a result of completing their food

**Table 2** Least-squared differences tests assessing difference in WAI-O-S scores between levels of participant completion of preparatory exercises (all, some and none)

<table>
<thead>
<tr>
<th></th>
<th>All (n = 14)</th>
<th>Some (n = 23)</th>
<th>None (n = 13)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal</td>
<td>5.09(a)</td>
<td>5.01(b)</td>
<td>4.87(a,b)</td>
</tr>
<tr>
<td>Task</td>
<td>5.39(a)</td>
<td>5.22</td>
<td>4.94(a)</td>
</tr>
<tr>
<td>Bond</td>
<td>5.39</td>
<td>5.30</td>
<td>5.10</td>
</tr>
<tr>
<td>Total</td>
<td>5.29(a)</td>
<td>5.18(b)</td>
<td>4.97(a,b)</td>
</tr>
</tbody>
</table>

M, mean; WAI-O-S, Working Alliance Inventory Observer-rated Short Version. Groups within rows that share a superscript are significantly different using least-squared differences tests at $P < 0.05$ (two-tailed).
diary, they have invested in the consultation, are better able to engage in discussion with their dietitian and consequently may be able to develop a more effective relationship.

Similarly, other significant findings suggest those participants who completed the follow-up health coaching session were also more likely to agree on their goals with their health coach in the first session. This finding supports similar results within health-related literature. A positive association between the agreement on patient’s goals and patient’s completion of subsequent therapy sessions has been commonly found within psychotherapy research.25 This association is also being increasingly found in treatments for physical health problems.7 The main implication from this is that early clarification and agreement around goals during health consultations are important in determining a patient’s completion of subsequent consultations. This may be an important finding for dietitians working with patients over multiple subsequent consultations, such as those patients seeking weight loss. Considering this, it appears there is a need for more research on what relationship-building and goal-planning skills are needed for effective dietetic practice. For dietitians, this may mean further articulation is required on specific skills to assist patients with goal setting and for planning changes patients can make to achieve their goals and improve their outcomes.

We found that the participants’ age had no apparent influence on therapeutic alliance scores. Our findings show within the telephone health coaching context, other participant demographics were also not significantly associated with therapeutic alliance. Studies in psychotherapy contexts have also reported mixed results between participant demographics and therapeutic alliance.26–28 Findings related to participants’ BMI may be of particular relevance to dietitians working within weight loss. BMI is an anthropometric measure directly related to weight, therefore is relevant to dietetic practice. Also, research shows a stigma exists towards overweight or obese people amongst health professionals that can negatively affect patients.29 Therefore, it was thought those patients within overweight or obese BMI categories may behave differently with a health professional and this may influence therapeutic alliance. However, we found participants’ BMI had no apparent influence on therapeutic alliance scores. This may be related to health coaching sessions taking place via telephone and therefore results may vary from this in a face-to-face context. Overall, these findings from health coaching sessions appear to provide some insight for dietitians regarding their therapeutic alliance with patients within weight loss practice, particularly in regard to factors that may influence effective therapeutic alliance development. In doing so, this research highlights how dietetic patient management may be enhanced to potentially benefit patient outcome.

Our findings highlight a multitude of research opportunities. More research on the goal-setting skills of dietitians may be necessary as part of building an effective dietitian–patient relationship. Research on communication skills such as active listening may also be important, as effective goal setting involves hearing what patients are saying and identifying their needs. Based on Cohen’s table of effect size magnitudes,30 our findings show a medium positive correlation between the duration of health coaching sessions and the bond developed between health coaches and participants (see Table 1). This indicates that research into how dietetic consultation times affect relationships with patients may also be needed, particularly as our findings are non-directional. Further research may be required to investigate whether a stronger bond allows for a longer consultation, or conversely whether a longer consultation allows for a stronger bond to form. Furthermore, given the therapeutic alliance construct appears useful within the present study and similarities exist between health coaching and dietetics, research into the role of this construct in assessing the dietitian–patient relationship appears important. Systematic and evidence-based assessment of the dietitian–patient relationship may also allow for further research into how the relationship influences patient outcome within dietetics.

Table 3 Independent samples t-tests between those who completed or did not complete the follow-up health coaching session and WAI-O-S scores

<table>
<thead>
<tr>
<th>Follow-up health coaching session completed</th>
<th>Yes (n = 35)</th>
<th>No (n = 15)</th>
<th>df</th>
<th>t</th>
<th>P</th>
<th>Cohen’s d</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>M SD</td>
<td>M SD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goal</td>
<td>5.04 0.15</td>
<td>4.90 0.21</td>
<td>20.61</td>
<td>2.29</td>
<td>0.03</td>
<td>0.75</td>
<td>0.01 to 0.26</td>
</tr>
<tr>
<td>Task</td>
<td>5.26 0.44</td>
<td>5.05 0.47</td>
<td>48</td>
<td>1.50</td>
<td>0.14</td>
<td>0.46</td>
<td>-0.07 to 0.48</td>
</tr>
<tr>
<td>Bond</td>
<td>5.30 0.36</td>
<td>5.22 0.40</td>
<td>48</td>
<td>0.73</td>
<td>0.47</td>
<td>0.22</td>
<td>-0.15 to 0.31</td>
</tr>
<tr>
<td>Total</td>
<td>5.20 0.28</td>
<td>5.06 0.31</td>
<td>48</td>
<td>1.60</td>
<td>0.12</td>
<td>0.48</td>
<td>-0.04 to 0.32</td>
</tr>
</tbody>
</table>

M, mean; WAI-O-S, Working Alliance Inventory Observer-rated Short Version. Bold value indicates significance at P < 0.05.
counselling approach. Health coaching differs from dietetics as coaches are not able to prescribe a specific treatment plan. Their role is to coach patients in making decisions and improving lifestyle-related choices. Dietitians working in the clinical domain develop ‘treatment’ in the form of a nutrition care plan. Similarities between health coaching and dietetics lie within the counselling aspect that is fundamental to each. It may be that these findings within a health coaching context have some relevance to dietetic practice given both services utilise a counselling approach. Thus, these findings within a health coaching context have some relevance to dietetic practice.

Consideration of the tool used to measure therapeutic alliance between health coaches and participants is important in light of findings. An adapted version of the WAI-O-S was used. The original 12-item tool is based on the longer, 36-item, WAI. A meta-analysis by Martin et al. suggests that for most research the WAI is a suitable method as it was developed to assess therapeutic alliance in all types of therapy. Validity and reliability of the tool is also supported. The original WAI and short version have shown to be interchangeable. Both versions of the tool have also been found to have consistently high reliability estimates, within standards of acceptability. These findings support the use of the WAI-O-S to measure therapeutic alliance developed between health coaches and participants within the present study.

Despite similarities being recognised between health coaching and dietetics, caution needs to be taken when considering applicability of findings. These relationships were only established with two health coaches and were not specific to dietetics. Furthermore, the small sample size of 50 participants limits interpretation and generalisability of results. Assessable variables were restricted as data collected were predetermined by the HealthTrack study. Also, as health coaching sessions were telephone-based, body language may have provided useful data but could not be assessed.

Within these health coaching sessions, spending more time in a session appears to help with bonding between the health coach and participant, which is recognised as a key component of therapeutic alliance. Participants completing exercises in preparation for their consultation may help to build their alliance with their health professional. Agreement on goals appears to influence completion of follow-up sessions. These exploratory findings provide directions for research addressing the professional relationship in dietetic consultations for weight loss.

**Funding source**

The Health Track study from which data were used for this analysis was funded by the Illawarra Health and Medical Research Institute with supplementary support from the California Walnut Commission. [Correction added on 03 July 2018, after first online publication: The funding information has been updated.]

**Conflict of interest**

The authors have no conflicts of interest to declare.

**Authorship**

AN contributed to the study design, completed data collection and analysis and wrote the main manuscript draft. AM and LT contributed to the study design and critically reviewed the manuscript prior to submission. FD contributed to the study design, completed data analysis and assisted with interpretation of results and critically reviewed the manuscript prior to submission. DA completed data collection to determine inter-rater reliability of methods. All authors are in agreement with the manuscript. The authors wish to declare the content of this paper has not been published or submitted for publication elsewhere.

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Weight cycling in adults with severe obesity: A longitudinal study

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Abstract
Aim: Although weight cycling is a common phenomenon in treatment-seeking patients with obesity, its consequences on health outcomes have not yet been completely clarified. We therefore aimed to investigate the effect of one cycle of intentional weight loss and regain on energy expenditure, body composition, cardiovascular risk factors and psychosocial variables in patients with severe obesity.

Methods: Clinical and psychosocial variables were measured in 38 adult patients with severe obesity (body mass index (BMI): 43.5 ± 7.2 kg/m²) consecutively readmitted to rehabilitative residential treatment (T1) for severe obesity after a cycle of weight loss (16.7 ± 7.7 kg) and regain (15.1 ± 11.3 kg), and compared with those recorded at a prior admission (T0).

Results: No significant differences were found between T0 and T1 values for weight, BMI, waist circumference, total body fat percentage, fat-free mass percentage, respiratory quotient, measured or predicted resting energy expenditure, metabolic adaptation, cardiovascular risk factors or psychosocial variables. However, younger patients (r = −0.38, P = 0.023) and those with higher historical weight (r = 0.43, P = 0.010) tended to regain more weight.

Conclusions: The absence of negative physical and psychological effects of weight cycling indicates that the risk of weight regain should not be a barrier to encouraging weight loss efforts in patients with severe obesity.

Key words: cardiovascular diseases, metabolic adaptation, obesity, weight cycling, weight regain.

Introduction
Obesity is a serious health problem associated with several medical and psychosocial comorbidities, not to mention a high rate of mortality. The international guidelines recommend a wide range of interventions, and nearly 70% of patients with obesity are currently undergoing some form of weight-loss treatment. However, it is widely known that although most weight-loss approaches are effective in the short term, and are usually accompanied by favourable medical and psychosocial improvements, weight regain is a common phenomenon in patients who have intentionally lost weight. Indeed, nearly 80% of patients return to their baseline weight within 3–5 years of follow-up.

Since the early 1980s, there has been a particular interest in the effects of repeated weight cycling in both rodents and humans, but such research has produced inconsistent evidence. While some studies have reported persistent improvements in several cardiovascular risk factors (e.g. HDL cholesterol) despite weight regain, others have shown that even modest weight regain leads to the loss of most of the health benefits achieved through weight loss, as well as a reversal toward baseline values of blood pressure and plasma glucose, insulin, total cholesterol, LDL cholesterol and triglyceride concentrations. Furthermore, some studies have even found that weight regain is associated with negative consequences on health, particularly on all-cause mortality. These conflicting results are likely because of methodological flaws, such as a cross-sectional design relying on self-reported weight-cycling history, the lack of distinction between intentional and unintentional weight loss, and the inclusion of normal-weight and overweight participants together with those with obesity. But, in light of these limitations to the current knowledge on the topic, the present longitudinal retrospective study was aimed at assessing the effect of one cycle of weight loss and regain in participants with severe obesity on resting energy expenditure (REE), metabolic adaptation, body composition, cardiovascular risk factors and psychosocial variables.

Methods
Participants were selected from a cohort of 1350 patients consecutively admitted to a rehabilitative residential treatment programme for severe obesity at the Villa Garda Hospital.
Hospital Department of Eating and Weight Disorders between January 2012 and July 2016. Patients were considered eligible if they were readmitted to the residential facility. A total of 38 (63.3%) of the 60 patients assessed for eligibility were included because they fulfilled all the following conditions: (i) they were aged between 20 and 80 years; (ii) the residential treatment was indicated by a global score of ≥25 on the Comprehensive Appropriateness Scale for the Care of Obesity in Rehabilitation (CASCO-R) scale; 10 (iii) they had achieved a significant weight loss (≥5%) after a prior treatment at the same facility and (iv) they were readmitted to the residential facility with a weight regain greater or equal to 30% of the weight lost after discharge from the first treatment programme (Figure 1). A weight-loss cut-off of 5% was chosen because it seems to improve metabolic function in multiple organs simultaneously, 20 and a 30% weight-regain cut-off was adopted to permit comparison with previous studies that used this percentage to define weight cycling. 21

All participants were referred to our department by general practitioners from all over Italy. Patients were excluded if they were taking medications affecting body weight, body composition or REE, or had any medical comorbidities associated with weight loss or regain.

As described in detail elsewhere, 22,23 the residential programme for severe obesity lasted 21 days, and included the following procedures: (i) a low-calorie diet (1200 kcal/day, 55% of which from carbohydrates, 30% from fat and 15% from proteins); (ii) 30 minutes indoor cycling per day and two 45-minute sessions of calisthenics per week and (iii) daily group cognitive behavioural treatment (CBT) sessions. After discharge from the first treatment, all participants were referred back to the care of their general practitioners, but encouraged to continue applying the procedures and strategies (e.g. self-monitoring, weekly weighing, meal planning, problem solving, cognitive restructuring) learned during their residential CBT programme.

The study design was reviewed and approved by the Institutional Review Board of Villa Garda Hospital, Verona. All participants gave informed written consent for the anonymous use of their personal information, and care was taken to adhere to STrengthening the Reporting of OBservational studies in Epidemiology in completion of the study.

Weight and height were measured on the first day of admission of the two successive residential treatment programmes (T0 and T1, respectively), and body mass index (BMI) was determined according to the standard formula: body weight in kilograms divided by height in metres squared. These were, respectively, measured using calibrated scales (Seca Digital Wheelchair Scale Model 664 [Seca, Hamburg, Germany]) and a stadiometer (Wall-Mounted Mechanical Height Rod Model 00051A; Wunder [Wunder, Milan, Italy]). During weighing and measuring, participants wore lightweight clothing and no shoes. Waist circumference was measured to the nearest 0.1 cm at the level of the iliac crest while the subject was breathing normally. 24 At admission to the second residential treatment, the lowest weight achieved after the first programme, minimum and maximum historical weight, and weight at the age of 20 were self-reported by patients.

The REE was measured on the morning of the day after admission to each treatment (day 2) using the Vmax Encore 229 Sensorsmedics system. This determines exhaled minute volume based on the air dilution method, and features variable flow that can be adjusted to maintain the fraction of expired carbon dioxide between 0.5 and 1.0%. An infrared gas analyser is used to measure carbon dioxide concentrations in expired and inspired air, while a galvanic fuel cell is used to measure oxygen concentrations. Gas sensors are calibrated with two gas mixtures, and the exhaled air is collected in a rigid plastic canopy. 25 Following a 12-hour fast, participants rested supine in a quiet, darkened room for 30 minutes before VO₂ and VCO₂ were measured for 20 minutes, the last 15 minutes of which were also used to determine REE.

Body composition was measured in the morning of the day after admission to each treatment (day 2) using a Tanita BC-418 body composition analyser (Tanita, Tokyo, Japan). This single-frequency device uses eight polar electrodes and a single-point load-cell weighing system in the scale platform; it can provide separate body mass readings for different segments of the body, and uses an algorithm incorporating impedance, age and height to estimate total body fat and fat-free mass percentages. 26

Fasting blood samples were obtained on the day of admission to each treatment (day 1). Plasma glucose, total cholesterol, HDL cholesterol and triglycerides were measured by common standard laboratory techniques (CHOL, HDL-C plus (2nd generation) and TG assays (Roche Diagnostics, Indianapolis, IN, USA). Insulin levels were measured using ADVIA Insulin Ready Pack 100 (Bayer Diagnostics s.r.l., Milan, Italy).

Fasting blood pressure was measured on the day of admission to each treatment following a 20-minute rest period (with the patient in a recumbent position) using an automated digital cuff (705IT; Omron, Vernon Hills, IL, USA); cuff size was chosen based on measured arm circumference.

Psychosocial measures were obtained on the second day after admission to each treatment (day 3) using the

Figure 1 Comprehensive Appropriateness Scale for the Care of Obesity in Rehabilitation scale.
The REE residuals were significantly different from zero. The differences between the measured and predicted REE is used to determine the magnitude of metabolic adaptation, which was considered to be present if the REE residuals were significantly different from zero. Repeated measures analysis of variance (ANOVA) was used to compare the differences between the first and the second treatment assessments in weight, BMI, waist circumference, metabolic adaptation, body composition, blood pressure, and blood test and psychosocial variables. Partial correlation analysis, controlling for both gender and baseline weight, was used to assess relationships between T0 data and: (i) the difference between the baseline weight (T0) and the lowest weight reached after the first assessment and (ii) the difference between the lowest weight reached after the first assessment and the weight at T1. Partial correlation analysis was also used to evaluate the relationships between T1 data and: (i) the difference between the baseline weight (T0) and the lowest weight reached after the first assessment and (ii) the difference between the lowest weight reached after the first assessment and the weight at T1, after controlling for T1 weight.

Table 1 shows the baseline characteristics of the sample (T0) and a comparison with the same variables at the second residential treatment assessment in the overall sample. The mean weight loss achieved from the first assessment (T0) to the lowest weight achieved after the first residential treatment was 16.7 kg (±7.7, F = 60.53, P < 0.001), and the mean weight regain from this lowest weight to the weight recorded at the second residential treatment assessment (T1) was 15.1 kg (±11.3, F = 20.36, P < 0.001). There was no significant difference between mean weight loss and mean weight regain (F = 1.11, P = 0.299).

Table 2 shows the baseline characteristics of the sample (T0) and a comparison with the same variables at the second residential treatment assessment (T1). No significant difference between T0 and T1 data was found for any of the variables measured. Similarly, Table 3 shows the differences between T0 and T1 assessments of blood pressure, blood values and psychosocial variables. No differences between T0 and T1 variables were significant.

Correlational analysis indicated that no baseline variable was significantly associated with the change in weight between T0 and the lowest weight reached after the first assessment, and that age measured at baseline (r = −0.38, P = 0.023), and maximum historical weight (r = 0.43, P = 0.010) were the only variables significantly associated with mean weight regain from the lowest weight reached after the first assessment.

**Discussion**

The present study aimed to investigate the effect of intentional weight loss followed by spontaneous weight regain on metabolic adaptation and REE, as well as body composition patterns, cardiovascular risk factors and psychosocial variables in patients with severe obesity. This yielded several major findings, the first being that weight cycling seems to have no adverse effect on the REE. This is in line with validated Italian versions of the following self-report questionnaires: the Binge Eating Scale (BES) to assess the severity of binge eating, and the Beck Depression Inventory (BDI) to assess the severity of depression.

The CASCO-R scale was used to assess the appropriateness of residential treatment. This scale has been proposed in a consensus report by the Italian Society of Obesity and the Italian Society for the Study of Eating Disorders as a valid suitability assessment for different settings of care in Italy (i.e. residential rehabilitation, intensive outpatient rehabilitation and outpatient treatment).

Categorical data are presented as n (percentage, %), and continuous data as mean (standard deviation, SD) or median (range). Baseline data from participants were used to generate a least-squares best-fit linear regression equation for REE, as a function of weight, height, age and sex (R² = 0.88), as follows:

\[
\text{REE} \text{ (kcal/day)} = 2286.60 - 1.56 \times \text{age} \text{ (years)} - 390.64 \times \text{sex} \text{ (M = 0, F = 1)} - 838.85 \times \text{weight} \text{ (m)} + 10.82 \times \text{weight} \text{ (kg)}.
\]

This equation was used to calculate the predicted REE based on each participant’s height, weight and age at both admission assessments. The differences between the measured and predicted REE is used to define the magnitude of metabolic adaptation, which was considered to be present if the REE residuals were significantly different from zero.

Repeated measures analysis of variance (ANOVA) was used to determine the significance of weight loss and weight regain. After controlling for gender and time between T0 and T1, repeated measures ANOVA was used to compare the differences between the first and the second treatment assessments in weight, BMI, waist circumference, metabolic adaptation, body composition, blood pressure, and blood test and psychosocial variables. Partial correlation analysis, controlling for both gender and baseline weight, was used to assess relationships between T0 data...
the majority of scientific literature on the topic, for example, findings by Wadden et al., who showed no association between reduction in REE in 12 females with obesity who had lost and regained an average of ~19 kg.30 It also mirrors findings by a study conducted on 11 women with obesity assessed through three consecutive cycles of two weeks of dieting followed by four weeks of unrestricted eating over a period of 18 months. These patients had an average weight loss and regain of ~6 kg, but their REE had returned to normal values by the end of the study.31 More recently, de Jonge et al., in a much larger sample of 800 participants in the overweight and obesity categories, reported no significant difference in REE between baseline and 24-month follow-up, during which participants lost a mean of 6.5 kg and partially regained a mean of 2.5 kg.32

We also found no significant difference in the degree of metabolic adaptation calculated before weight loss and after weight regain. This finding is in line with two recent studies. The first, conducted by Müller et al. on 32 healthy young men, demonstrated that metabolic adaptation occurs and is maintained during calorie restriction, something they reiterated in a recent review.33 but disappears with refeeding.34 The second, conducted by de Jonge et al. in participants in the overweight and obesity categories, showed that the adaptive metabolic response to calorie restriction and weight loss had disappeared after weight regain by 24-month follow up.32

However, these results contrast with those of one recent and widely publicised study by Fothergill et al., which found a persistence in the degree of metabolic adaptation over ~6 years.35 Nevertheless, that finding should be interpreted with caution, since the reason behind the discrepancy with our finding, namely the persistence of metabolic adaptation, may be attributable to the high rate of weight loss achieved during the “Biggest Loser” competition that the study entailed.35 Support for this hypothesis comes from the observation that changes in the magnitude of metabolic adaptation are influenced by the rate and type of weight-loss treatment undergone (i.e. diet, exercise, pharmacological or bariatric surgery).36 Furthermore, our results are

| Table 2 | Weight, body mass index, waist circumference, body composition and energy expenditure variables in 38 adult patients with severe obesity before and after one cycle of weight loss and regain |
|---------|-------------------------------------------------|---------------------------------|------------------------------|
| Variable     | T0, n = 38 | Mean (SD) | T1, n = 38 | Mean (SD) | F-test | P-value |
| Weight (kg)  | 118.0 (26.8) | 116.4 (28.7) | 2.81 | 0.103 |
| Body mass index (kg/m²) | 43.4 (8.2) | 42.7 (8.6) | 2.61 | 0.115 |
| Waist circumference | 132.0 (17.9) | 129.4 (17.8) | 3.47 | 0.071 |
| Total body fat (%) | 45.3 (7.2) | 44.5 (7.2) | 0.28 | 0.597 |
| Fat-free mass (%) | 54.4 (6.8) | 55.3 (6.9) | 0.16 | 0.690 |
| Respiratory quotient | 0.81 (0.06) | 0.81 (0.06) | 1.10 | 0.301 |
| Measured REE (kcal/day) | 1840.2 (397.9) | 1831.9 (408.9) | 0.07 | 0.892 |
| Predicted REE (kcal/day) | 1849.7 (367.0) | 1829.7 (378.2) | 2.79 | 0.104 |
| Metabolic adaptation (kcal/day) | 0.03 (139.1) | 8.3 (397.4) | 0.24 | 0.630 |

REE, resting energy expenditure; T0, admission at first residential treatment; T1, admission at second residential treatment. The analyses were controlled for time between the two assessments and gender.

| Table 3 | Blood pressure and laboratory values on the morning after overnight fasting, and psychological measures in 38 adult patients with severe obesity before and after weight regain |
|---------|-------------------------------------------------|------------------------------|
| Variable                     | T0 | Mean (SD) | T1 | Mean (SD) | F-test | P-value |
| Blood pressure and laboratory tests | | | | | | |
| Systolic blood pressure (mm Hg) | 132.4 (15.0) | 129.7 (14.1) | 0.69 | 0.413 |
| Diastolic blood pressure (mm Hg) | 82.5 (9.7) | 79.9 (8.3) | 1.06 | 0.311 |
| Glucose (mg/dL) | 113.3 (36.5) | 113.3 (33.0) | 3.60 | 0.062 |
| Insulin (μU/mL) | 14.4 (10.0) | 16.4 (17.7) | 0.04 | 0.844 |
| Triglycerides (mg/dL) | 148.5 (115.1) | 128.2 (77.3) | 0.02 | 0.892 |
| Total cholesterol (mg/dL) | 200.4 (36.2) | 197.3 (37.5) | 0.02 | 0.895 |
| HDL cholesterol (mg/dL) | 46.3 (12.8) | 49.4 (13.3) | 0.04 | 0.839 |
| LDL cholesterol (mg/dL) | 133.2 (32.9) | 125.7 (36.4) | 0.04 | 0.846 |
| Psychological measures | | | | | | |
| Beck Depression Inventory | 17.4 (10.8) | 17.2 (11.8) | 1.69 | 0.204 |
| Binge Eating Scale | 17.9 (8.7) | 17.5 (9.5) | 1.00 | 0.325 |

T0, admission at first residential treatment; T1, admission at second residential treatment. The analyses were controlled for time between the two assessments and gender.
partially in line with another finding by Fothergill et al. that the degree of metabolic adaptation measured after 6 years was not associated with the amount of weight regained.35

Another finding from the present study is that the weight regain that followed the period of intentional weight loss did not negatively change body composition (i.e. by increasing fat mass and/or decreasing fat-free mass). In fact, no significant differences were found in either total body fat or fat-free mass percentages between assessments conducted before and after weight cycling. This is in line with findings from four previous longitudinal studies.21,30,31,37

In contrast, however, Cereda et al.38 who investigated the relationship between weight cycling and abdominal fat accumulation, found an association between the two, and recommended adequate weight loss programs to achieve long-term weight maintenance to prevent unhealthy fat accumulation. Nonetheless, the cross-sectional design of that study means that no causal relationship between weight cycling and abdominal fat accumulation can be argued. Moreover, Cereda et al. did not rely on any objective measures of assessing either body composition (e.g. dual-energy x-ray absorptiometry or computed tomography) or abdominal visceral fat.38

Likewise, another study found that the greater the magnitude of weight cycling history the higher the percentage body fat.39 However, in this case too, the cross-sectional design of the study did not enable its authors to draw any conclusions about the causal relationship between the two variables.39

As far as cardiovascular risk factors are concerned, our data showed that there were no significant changes after weight cycling, that is, between the first and second assessments. This observation concords with the majority of studies previously conducted, none of which found any change associated with weight cycling in plasma total cholesterol or triglycerides,37,40 fasting plasma insulin,21,40 plasma glucose37,40 and blood pressure or risk of hypertension.37,40 In fact, only one cross-sectional study, based on self-reported weight-cycling history, has recorded an increase in blood pressure in women with obesity who weight cycled when compared to those who did not (matched by age and BMI).41 Nevertheless, the present study too was cross-sectional, and therefore the apparent correlation of weight cycling with blood pressure is not indicative of a causal link.41 Moreover, the definition of weight cycling in that study was arbitrary and self-reported—two limitations that may affect interpretation of results.41

Also in line with the previous literature, however, is our finding on the effect of weight cycling on psychological variables, specifically that there was no change in BDI or BES scores after weight regain. One prospective study examining weight cycling found no negative changes in mood or binge eating scores after an average weight loss of 20 kg and mean weight regain of +3.6 kg above the baseline weight after ~5 years of follow up.42 Similarly, another prospective study assessed changes in eating self-efficacy and BDI scores in a sample of patients with obesity treated via a multidisciplinary weight management programme after weight regain. This found no change in eating self-efficacy or BDI scores despite weight cycling.43

Our final finding was that younger patients and those with higher historical body weight regained more weight with respect to those who are older and have a relatively lower historical weight. This inverse correlation between age and weight regain may be related to several factors, including the higher weight loss expectations of younger patients,44 which may have led them to give up their attempt to control weight if they failed to reach their weight loss goals.45 It may also be related to the loss of appetite36 and awareness of health issues associated with obesity in older patients, which may have played a protective effect against weight regain. Multiple biological factors may also be implicated in the relationship between the maximum historical body weight and the magnitude of weight regain. For instance, adipose cellularity, endocrine function and energy metabolism may have been acting to promote weight regain to restore the highest historical body weight.47 That being said, we are not in a position to be able to confirm or refute any of these hypotheses.

Nonetheless, the present study does have several strengths. In particular, our design featured longitudinal assessment before and after weight loss and regain, and our sample comprising both women and men with severe obesity treated in a real-world clinical setting. Moreover, we assessed several clinical variables before intentional weight loss and after spontaneous weight regain as two separate phases.

However, the study has certain limitations. First, our results need to be interpreted with caution because they may not apply to patients treated in other settings (i.e. outpatient, pharmacotherapy or bariatric surgery). Second, our sample was small and participants lacked homogeneity in terms of the amount of weight lost and regained, and the absence of comparison with a stable-weight control group with obesity that did not undergo any intervention may bias interpretation of results. Third, we assessed body composition using the impedance analyser, which does not permit assessment of regional pattern measurements, and has not been accepted as a gold-standard technique for patients with obesity. Moreover, we did not assess metabolic, body composition, cardiovascular risk factors or psychosocial variables at the time of the lowest weight reached by patients after the first assessment. Finally, although we did measure a wide range of variables, we cannot rule out the existence of other factors, such as oral contraceptives, menstrual cycle status and/or biochemical make-up (i.e. adiponectin, leptin), which we did not measure but may be affected by weight cycling. Likewise, we performed no objective assessment of physical activity levels.

Although a recent study,35 which assessed participants in a “Biggest Loser” competition, has created a lot of debate and placed great emphasis on the persistence of metabolic adaptation as a potential factor behind weight regain, our findings were not able to provide evidence to support adaptive metabolic persistence as a consequence of weight cycling. In conclusion therefore, the absence of any detectable longitudinal association between weight cycling and adverse effects on body composition patterns,
cardiovascular risk factors or psychosocial variables, should encourage clinicians to motivate patients with severe obesity to persevere with weight loss efforts, even though the risk of weight regain is high.

Funding source

The authors received no funding for this study.

Conflict of interest

The authors have no conflict of interest to declare.

Authorship

RDG and MEG designed the study; MEG carried out the data assessment. SC performed the statistical analysis. RDG (MD), MEG (MD) and SC (PhD) co-wrote the manuscript and all have approved and made substantial contributions to the conception, drafting and final version of the manuscript. All authors are in agreement with the manuscript and declare that the content has not been published elsewhere.

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Influence of chemoradiotherapy on nutritional status, functional capacity, quality of life and toxicity of treatment for patients with cervical cancer

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Abstract

Aim: Assess the influence of chemoradiotherapy on the nutritional status, functional capacity and quality of life (QoL), associating these indicators at baseline with toxicity and interruption of oncologic treatment in women with cervical cancer.

Methods: Prospective cohort study performed on 49 women diagnosed with cervical cancer, who underwent treatment between August 2015 and January 2016. For data collection, two appointments were conducted by the lead researcher: the first occurred the day before the first chemotherapy session (T0) and the other at the end of chemotherapy session (T1). Nutritional status was measured by anthropometry (weight, height, mid-upper arm circumference and triceps skinfold thickness) and computed tomography (skeletal muscle index—SMI), functional capacity by handgrip strength (HGS) and Karnofsky Performance Status (KPS), and application of QoL questionnaire (EORTC QLQ-C30).

Results: The average age was 45.3 ± 13.8 years and 81.6% of the women were diagnosed in stages II and III. There was significant reduction in HGS, KPS and QoL between T0 and T1, in addition to a significant QoL reduction according to worsening nutritional status. The interruption of chemotherapy was significantly associated with the variables of nutritional status assessed at baseline. Women who interrupted treatment due to acute toxicity also had a significant lower median SMI than those who concluded the treatment and 83% of these patients presented cachexia.

Conclusions: Chemoradiotherapy treatment in patients with cervical cancer had changed negative nutritional parameters, function capacity and QoL, and poor nutritional status at baseline was associated with chemotherapy interruption.

Key words: cervical cancer, chemoradiotherapy, functional capacity, nutritional status, quality of life.

Introduction

Cervical cancer represents the fourth most common neoplasia in the female population and one of the main causes of death among women worldwide. Most instances of cervical cancer occur in developing countries, with close to 50% diagnosed in an advanced stage. Chemoradiotherapy is the most frequent treatment used for this type of cancer, being chosen for patients that had a tumour size exceeding 4 cm, when they are not indicated for surgery.

Cisplatin is the most effective cytotoxic agent against cervical cancer. The administration in combination with 25 fractions of daily pelvic radiotherapy is suggested as the first line of treatment for patients with locally advanced cervical cancer (stage II through stage IVa—local metastasis—according to the staging system of the International Federation of Gynaecology and Obstetrics). Chemotherapy enhances the effects of radiotherapy and provides greater efficiency against tumour cells; however, the combined use of these oncologic therapies attacks both neoplastic cells and normal cells, increasing the risk of toxicity. An elevated incidence of toxicity is described in chemoradiotherapy, with hematologic and gastrointestinal toxicity being the most commonly found in these cases. The presence of symptoms having a nutritional impact, such as nausea, vomiting and anorexia, can reduce nutritional intake and accelerate muscle loss, which results in impaired muscle function. This depletion may be reflected in different functional tests, such as hand grip strength.
The adverse effects provoked by antineoplastic therapy may aggravate pre-existing alterations of the nutritional status (NS), creating a vicious cycle. Therefore, degradation of the NS can result in a greater chance of toxicity due to the combined oncologic treatments and bring about other adverse consequences, such as a diminished response and tolerance of the treatment, and reduced quality of life (QoL). The NS has been described as a strong predictor of QoL in gynaecological cancer patients. On the other hand, the QoL has also been used for assessing the tolerance to oncologic treatment, and it is essential for measurement of the side effects of chemotherapy.19

Despite the limited literature, an increased frequency of malnutrition has been shown in patients with cervical cancer, especially among women diagnosed in an advanced stage (4–60% between the stages I and IV, respectively). However, the extent of oncological treatment impacts on nutritional status, QoL and functional capacity remain unknown. Therefore, the present study has two aims: to assess the influence of chemoradiotherapy on the nutritional status, functional capacity, and QoL in women with cervical cancer, and to evaluate if the patient’s baseline characteristics are related to chemotherapy toxicity and interruption of the oncologic treatment.

**Methods**

The present study is a prospective cohort, observational study, performed on women diagnosed with cervical cancer, registered in the National Institute of Cancer, Jose Alencar Gomes da Silva, who were proposed to undergo chemoradiotherapy. Inclusion criteria were all patients over 20 years old, who had never undergone prior treatment, had their diagnosis confirmed via a histopathology report and underwent treatment between August 2015 and January 2016. Patients with HIV virus, kidney disease under dialysis treatment, with oedema and/or ascites, as well as those with pacemaker or stent, were excluded, because these conditions influence nutritional status and/or the bioelectrical impedance measures.

Enrolment of the patients occurred during the pre-cancer treatment group counselling, which aims to provide group counselling before cancer treatment. All patients presenting nutritional risk or malnutrition are referred for an individual appointment with a registered dietitian. The eligible patients were instructed on the project and signed an informed consent form. The present study was approved by the Research Ethical Committee of the Brazilian National Cancer Institute—CEP/INCA under number 1.150.108/2015 and followed the Guidelines for Reporting Observational Studies (Strengthening the Reporting of Observational Studies in Epidemiology Statement—STROBE).22

Chemoradiotherapy treatment in the Brazilian National Institute of Cancer consisted of a weekly dose of cisplatin as the only type of chemotherapy, with a combination of daily doses of external-beam radiotherapy (25 fractions). All patients who met the inclusion criteria were invited to participate in the present study, of which only three women refused and five were subjected to exclusive radiotherapy because of poor performance status contraindicated for chemotherapy. Patients who did not complete the proposed treatment were not included in the post-treatment evaluation.

During the study period, 49 women diagnosed with cervical cancer and receiving chemoradiotherapy treatment were enrolled. Of this group, 10 patients did not conclude treatment due to elevated toxicity from chemotherapy, 1 patient interrupted her treatment due to being diagnosed with pulmonary metastasis and 4 other patients abandoned treatment by their own choice. Therefore, the number of patients that concluded the proposed treatment and underwent the evaluation at T1 was 34.

For data collection, two appointments were conducted by the lead researcher: the first one occurred the day before the first chemotherapy session (T0) and the second at the end of the last chemotherapy session (T1), roughly 35 days after T0. The research interview included personal data (age, ethnicity, marital status); clinical history (histological type, stage, comorbidities) and data related to the oncologic treatment (type of chemotherapy, number of sessions, duration of treatment, and clinical intercurrences)—obtained from medical records; nutritional status (anthropometric measures and body composition assessment); QoL and functional capacity assessments. All notes and assessments were performed by the same trained researcher.

At T0 and T1, the following anthropometric measurements were performed: weight, height, mid-upper arm circumference (MUAC) and triceps skinfold thickness (TSF). The patients were asked whether they had unintentional weight loss during the past 6 months. Calculation of the mid-arm muscle circumference (MUAMC) and corrected mid-arm muscle area (cMUAMA) was obtained using the MUAC and TSF values, by means of specific formulas, and classified according to Frisancho. The body mass index (BMI) was calculated using the actual weight and height (assessed in T0 and T1), and classified according to criteria of the World Health Organisation.24 The usual body weight was obtained from patient’s reports. Likewise, the percentage weight loss (%WL) between T0 and T1 was obtained using the following formula: Usual body weight × 100/usual body weight.

Cancer cachexia was diagnosed following the International Consensus of Cachexia that classifies cachexia into three stages: pre-cachexia, cachexia and refractory cachexia. Pre-cachexia is defined as unintentional weight loss of up to 5% in 6 months with the presence of anorexia. Cachexia is defined as greater than 5% weight loss during 6 months, or the combination of weight loss >2% with a BMI less than 20 kg/m². In refractory cachexia, patients do not present any response to antineoplastic therapy, with a limited functional capacity and life expectation of less than 3 months. The usual 6-month weight, referred by the patient, was used to calculate the percentage weight loss for cachexia diagnosis.
Skeletal muscle mass was assessed exclusively at T0, for patients who underwent computerised tomography (CT) up to 20 days before the first chemotherapy session. The CT assessment at T1 was not possible because this exam is not routinely performed after chemoradiotherapy. The skeletal muscle content for the diagnosis of sarcopenia was determined via analysis of a cross-sectional image of the third lumbar vertebrae (L3). The images were analysed using the software SliceOmatic 5.0 (Tomovision, Canada), allowing for specific demarcation of the skeletal musculature, expressed in Hounsfield Units (HU) in the range from −29 to +15.26 All images were analysed by a single trained researcher.

The skeletal muscle index (SMI), that corresponds to the area of muscle tissue obtained from the image of the L3, normalised to height and expressed in cm²/m², was used for sarcopenia classification, according to the cut-off established for women (≤38.9 cm²/m²).27 Functional capacity was assessed according to HGS using a dynamometer device (Jamar [Bolingbrook, IL, USA]), following the recommendations of the Brazilian Society of Hand Therapists.28 The patient was asked to squeeze the dynamometer with as much strength as possible and the result was registered in kilograms (kg). Before beginning, a pre-test was performed to familiarise the patient with the device. The test consisted of two measurements; performed with the patient’s dominant hand, with a 1-minute pause between each, and averages were used for analysis.

Furthermore, the Karnofsky performance scale (KPS) was applied by the same trained researcher and used for classifying the patients according to the degree of their functional disabilities, representing a general measurement of the independence of the individual to care for themselves and conduct their daily activities. The scale ranges between 0 and 100, where the higher the value obtained, the better the performance of daily functions.29 QoL assessment was performed using the questionnaire EORTC QLQ-C30, from the European Organisation of Research and Treatment of Cancer (EORTC), validated for the Brazilian population.30 The EORTC QLQ-C30 comprises 30 items, divided into three parts. The first part addresses questions related to cognitive, functional, emotional, social and physical performance. The second part reports the individual’s perception concerning overall health. In these two parts, a higher score indicated good development of daily capacities. The last part presents the scale of symptoms and a higher score obtained in this section of the questionnaire represents worsened symptoms. A summary score of the QoL is also obtained by the sum of the questionnaire’s scales.

For the evaluation of toxicity from radiotherapy and chemotherapy treatment, a specific questionnaire of the National Cancer Institute Common Toxicity Criteria for adverse events version 4.0 was used.31 The questionnaire determines the intensity of the symptoms presented, with a score ranging from 0 to 5. Interruptions or delay in chemotherapy treatment due to severe toxicity were classified as dose-limiting toxicity (DLT), according to institution protocol.

DLT variables were considered as follows: (i) gastrointestinal disorders—uncontrollable vomiting and diarrhoea with haemodynamic repercussions; (ii) haematologic disorders—febrile neutropenia requiring hospitalisation, thrombocytopenia (<50,000/mm³), or haemoglobin concentrations <6.5 g/dL; (iii) renal disorders—creatinine clearance <40 mL/min or patient requiring dialysis.

Statistical analysis was performed using version 2.0 of the SPSS statistical package for Windows (Chicago, IL, USA). Adherence to a normal curve was tested evaluate the symmetry of the distribution curve of the variables. A non-normal distribution of the variables was identified, except for age. Data were expressed as median (range) for numeric variables, and percentage for qualitative variables.

The difference between proportions was tested using the χ² test or Fisher’s exact test. The differences between the medians were assessed by the non-parametric Mann–Whitney (independent variables) or Wilcoxon tests (related variables) for two groups, and the ANOVA Kruskal–Wallis test for more than two groups. For all analysis, a P value of <0.05 was considered statistically significant.

Results

At baseline (n = 49), the average age of the study population was 45 ± 13.8 years, and 16.3% (8/49) were over 65 years. The majority of patients were single (25/49) and 38.8% (19/49) were housewives. Regarding race, 44.9% were pardo (mixed races), 42.9% white and 12.2% black. Almost 60% (29/49) of the women did not present associated comorbidities and arterial hypertension was the most prevalent comorbidity (14/49; 28.6%). Concerning cancer stage, 18.4% of the women were diagnosed with stage I, 55.1% with stage II and 26.5% with stage III. The most prevalent histological type was squamous cell carcinoma (85.7%), followed by adenocarcinoma (14.3%). Regarding the oncologic treatment, the median total treatment duration of patients who completed the treatment (n = 34) was 32 days (range: 26–47), and the average number of chemotherapy and radiotherapy sessions were 5 (range: 4–6) and 22 (range: 19–27), respectively. All patients received cisplatin as the only type of chemotherapy.

Table 1 shows the parameters used for the nutritional assessment, functional capacity and QoL questionnaire (EORTC QLQ-C30) separated into its specific scales, before and after treatment with chemoradiotherapy, among patients who concluded the oncologic treatment. There was a significant reduction in weight, BMI, handgrip strength and KPS between T0 and T1. Of the total population, 41.2% was diagnosed with pre-cachexia and cachexia at T0 and an increase in the frequency of pre-cachexia was observed after chemoradiotherapy (8.8–17.6%), although it was non-significant.

In relation to BMI classification before treatment, most of the patients had excess weight (overweight and obese).
However, a significant increase in the frequency of underweight individuals (BMI <18.5 kg/m²) was observed after the completion of chemoradiotherapy (0% vs 11.8%), as well as a reduction in frequency of those presenting healthy and excess body weight. No statistical difference was observed between T0 and T1 for the other anthropometric parameters (MUAC, TSF, MUAMC and cMUAMA) (Table 1).

When compared to the parameters assessed by the QoL questionnaire between T0 and T1, there was a significant reduction in physical capacity, role performance, social function and total functional scale. On the scale of symptoms, a significant increase was observed for the symptoms of nausea and vomiting, appetite loss and diarrhoea (Table 1).

Regarding the summary score of QoL, a significant reduction was found after the chemoradiotherapy treatment. At both evaluation times (T0 and T1), there was a significant reduction in the summary score according to the NS. Patients with pre-cachexia and cachexia had lower

Table 1 Nutritional assessment, functional capacity and quality of life questionnaire (EORTC QLQ-C30), separated into its specific scales, before and after treatment of women with cervical cancer who completed chemoradiotherapy

| Variables | Results (n = 34) | | P value |
|-----------|-----------------||----------------|
| Weight (kg) | 67.60 (44.5–100.2) | 65.86 (37.2–98.0) | 0.003 |
| BMI (kg/m²) | 27.19 (19.26–43.56) | 26.40 (16.10–41.78) | 0.002 |
| BMI classification | | | |
| Underweight | 0 (0) | 4 (11.8) | <0.001 |
| Healthy | 11 (32.4) | 10 (29.4) | |
| Overweight | 23 (67.6) | 20 (58.8) | |
| TSF (mm) | 25.0 (8–50) | 25.5 (6–48) | 0.936 |
| MUAC (cm) | 29.8 (22–44) | 30.0 (19.5–41.5) | 0.687 |
| MUAMC (cm²) | 22.58 (17.88–31.71) | 21.98 (17.51–27.52) | 0.374 |
| cMUAMA (cm²) | 34.09 (18.96–73.55) | 31.99 (17.91–53.81) | 0.437 |
| Cachexia stage | | | 0.767 |
| No cachexia | 20 (58.8) | 17 (50.0) | |
| Pre-cachexia | 3 (8.8) | 6 (17.6) | |
| Cachexia | 11 (32.4) | 11 (32.4) | |
| HGS | 24.25 (10–32.5) | 22.0 (12.5–33) | 0.050 |
| KPS (%) | 90 (60–100) | 80 (60–100) | 0.001 |
| Summary score of QoL | 80.60 (27.56–100) | 72.07 (30.13–97.78) | 0.004 |
| Global health status | 81.62 (17.26) | 82.11 (20.43) | 0.727 |
| Physical function | 78.24 (19.72) | 69.41 (24.73) | 0.037 |
| Role performance | 72.55 (34.30) | 53.92 (37.17) | 0.047 |
| Emotional function | 57.11 (30.09) | 62.25 (33.41) | 0.334 |
| Cognitive function | 83.82 (25.45) | 79.41 (29.60) | 0.384 |
| Social function | 78.92 (32.39) | 54.90 (38.82) | 0.001 |
| Total functional scale | 71.10 (18.97) | 64.84 (19.42) | 0.041 |
| Fatigue | 27.78 (26.84) | 37.91 (30.72) | 0.132 |
| Nausea and vomiting | 13.40 (22.06) | 27.94 (26.50) | 0.001 |
| Pain | 34.31 (31.50) | 23.53 (32.08) | 0.141 |
| Dyspnoea | 10.78 (25.99) | 10.78 (21.27) | 0.963 |
| Insomnia | 31.37 (38.44) | 26.47 (38.30) | 0.430 |
| Appetite loss | 12.74 (24.64) | 27.45 (37.13) | 0.048 |
| Constipation | 27.45 (40.59) | 18.63 (35.95) | 0.196 |
| Diarrhoea | 1.96 (7.96) | 40.20 (39.17) | 0.001 |
| Financial difficulties | 46.08 (41.86) | 44.15 (44.15) | 0.170 |
| Total symptom scale | 23.68 (17.32) | 28.81 (17.21) | 0.103 |

Values in bold present statistical significance (P < 0.05).
cMUAMA = corrected mid-upper arm muscle area; HGS = handgrip strength; KPS = Karnofsky performance scale; MUAC = mid-upper arm circumference; MUAMC = mid-arm muscle circumference; TSF = triceps skinfold thickness.

Summary score of QoL = (Physical Functioning + Role Functioning + Social Functioning + Emotional Functioning + Cognitive Functioning +100-Fatigue+100-Pain+100-Nausea_Vomiting+100-Dyspnoea+100-Sleeping Disturbances+100-Appetite Loss+100-Constipation+100-Diarrhoea)/13.

(a) Median (minimum – maximum), Mann-Whitney test.
(b) Absolute number (%), McNemar–Bowker test.
(c) Mean (SD), Wilcoxon test.
scores, reflecting the influence of NS on the individual’s perception of health (Table 2).

Concerning the oncologic treatment, 20.4% (n = 10) of the 49 patients enrolled in the present study discontinued chemotherapy due to severe toxicity, with the main causes being gastrointestinal (37.5%), hematologic (25%) and renal toxicity (25%). The interruption of radiotherapy occurred in only 8.2% of the patients in the present study. Even when chemotherapy was interrupted due to severe toxicity, radiotherapy was maintained as the exclusive treatment.

The interruption of chemotherapy was significantly associated with the variables of NS assessed at T0 (%WL, cachexia and sarcopenia). Age over 65 years, comorbidities and the stage of cancer showed no statistical difference, as well as the summary score of QoL and the performance status (KPS) (Table 3). Women that interrupted treatment due to acute toxicity from chemotherapy also had a significantly lower median SMI than those who concluded the treatment. It is important to note that roughly 83% of the patients that suspended their chemotherapy presented cachexia and %WL greater than 5%.

According to the Common Criteria of Toxicity (CCT), there was an incidence of symptoms related to chemoradiotherapy toxicity in 94% of the patients of the present study, and approximately 79% reported at least one symptom with severity greater than grade II. The most frequent symptoms were nausea (75.8%), fatigue (66.7%), diarrhoea

---

### Table 2 Summary score of quality of life obtained by the EORTC QLQ-C30 before and after chemoradiotherapy according to nutritional status

<table>
<thead>
<tr>
<th>Nutritional status variables</th>
<th>Summary score of QoL (EORTC QLQ-C30)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T0 Median (min–max)</td>
</tr>
<tr>
<td>Percentage weight loss</td>
<td></td>
</tr>
<tr>
<td>5%</td>
<td>81.32 (50.81–100)</td>
</tr>
<tr>
<td>≥5%</td>
<td>66.92 (27.56–93.08)</td>
</tr>
<tr>
<td>Cachexia diagnosis</td>
<td></td>
</tr>
<tr>
<td>No cachexia</td>
<td>81.85 (50.81–100)</td>
</tr>
<tr>
<td>Pre-cachexia</td>
<td>74.50 (57.52–87.39)</td>
</tr>
<tr>
<td>Cachexia</td>
<td>66.92 (27.56–93.08)</td>
</tr>
</tbody>
</table>

Values in bold present statistical significance (P < 0.05).

* Mann–Whitney test.

---

### Table 3 Association of clinical variables, nutritional status and quality of life with chemotherapy interruption

<table>
<thead>
<tr>
<th>Variables</th>
<th>Chemotherapy interruption (n = 49)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Age (n, %)</td>
<td></td>
</tr>
<tr>
<td>&lt;65 years</td>
<td>32 (86.5)</td>
</tr>
<tr>
<td>≥65 years</td>
<td>5 (13.5)</td>
</tr>
<tr>
<td>Comorbidities (n, %)</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>16 (59.3)</td>
</tr>
<tr>
<td>Yes</td>
<td>11 (40.7)</td>
</tr>
<tr>
<td>Cancer stage (n, %)</td>
<td></td>
</tr>
<tr>
<td>Stage I</td>
<td>7 (18.9)</td>
</tr>
<tr>
<td>Stage II</td>
<td>21 (56.8)</td>
</tr>
<tr>
<td>Stage III</td>
<td>9 (24.3)</td>
</tr>
<tr>
<td>KPS</td>
<td></td>
</tr>
<tr>
<td>Mean (SD)</td>
<td>87.30 (9.02)</td>
</tr>
<tr>
<td>Percentage weight loss(a) (n, %)</td>
<td></td>
</tr>
<tr>
<td>5&lt;% in 6 months</td>
<td>25 (69.4)</td>
</tr>
<tr>
<td>≥5% in 6 months</td>
<td>11 (30.6)</td>
</tr>
<tr>
<td>Cachexia (n, %)</td>
<td></td>
</tr>
<tr>
<td>No cachexia</td>
<td>23 (62.2)</td>
</tr>
<tr>
<td>Pre-cachexia</td>
<td>3 (8.1)</td>
</tr>
<tr>
<td>Cachexia</td>
<td>11 (29.7)</td>
</tr>
<tr>
<td>Sarcopenia(b),(c) (n, %)</td>
<td></td>
</tr>
<tr>
<td>No sarcopenia</td>
<td>28 (96.6)</td>
</tr>
<tr>
<td>Sarcopenia</td>
<td>1 (3.4)</td>
</tr>
<tr>
<td>SMI (cm²/m²)</td>
<td></td>
</tr>
<tr>
<td>Mean (SD)</td>
<td>47.11 (6.83)</td>
</tr>
<tr>
<td>Summary score of QoL</td>
<td></td>
</tr>
<tr>
<td>Mean (SD)</td>
<td>77.94 (14.23)</td>
</tr>
</tbody>
</table>

Values in bold present statistical significance (P < 0.05).

KPS = Karnofsky performance scale; SMI = skeletal muscle index.

Summary score of QoL = (Physical Functioning+ Role Functioning+ Social Functioning+ Emotional Functioning+ Cognitive Functioning +100-Fatigue+100-Pain+100-Nausea_Vomiting+100-Dyspnoea+100-Sleeping Disturbances+100-Appetite Loss+100-Constipation+100-Diarrhoea)/13.

*χ² test; ** Mann–Whitney test.

(a) Total number equal to 48 patients because one patient was unable to report the usual weight.

(b) Total number equal to 38 patients who had CT available at T0.

(c) Muscle area analysis in the image of the cross-section of the third lumbar (L3), and sarcopenia with SMI <= 38.9 cm²/m².

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(60.6%), xerostomia (60.6%), dysgeusia (48.5%), pain (42.4%), constipation (27.3%) and vomiting (24.2%). The tested variables in Table 1 (age exceeding 65 years, comorbidities, stage, KPS, %WL, sarcopenia and cachexia diagnosis) did not associate with the number or severity of symptoms outlined in the CCT (P > 0.05).

Discussion

There are few studies that describe the nutritional status of patients with gynaecological cancer. In the present study, the nutritional status of patients with cervical cancer was obtained via different methods of nutritional assessment. According to the BMI, 61.8% of the patients were overweight, a lower prevalence than reported (78.5%) in a study performed with cervical cancer patients eligible for surgical treatment, probably due to difference in the cancer stage.

Tartari et al., in a study with cancer patients of different tumour sites undergoing chemotherapy, also observed a high prevalence of excess weight according to BMI, especially in patients with gynaecologic tumours. However, the present study found a significant reduction in body weight and BMI, in addition to an increase in the frequency of underweight individuals after chemoradiotherapy treatment.

In the present study, despite of the low frequency of underweight individuals diagnosed by the BMI, roughly 33% of the patients had cachexia and/or weight loss greater than 5% before chemoradiotherapy. Other authors also reported a pre-treatment weight loss ranging from 26% to 40% among patients with gynaecological cancer. Weight loss and anorexia, present in cancer cachexia, can provoke a limitation in the doses of chemoradiotherapy, in addition to higher chances of treatment toxicity. It has been suggested that the %WL seems to be a better parameter than BMI in cancer patients undergoing chemotherapy and a good prognostic factor of QoL irrespective of the type of cancer.

Despite the wide use of anthropometric parameters for determination of the NS, the BMI has a limited value, because it is not capable of distinguishing the different body compartments. The relevance of the quantification of muscle mass in cancer patients submitted to chemotherapy has increased in recent years due to the correlation between skeletal muscle content and the occurrence of toxicity that can determine a dose reduction or chemotherapy interruption.

According to the QoL parameters assessed in the questionnaire, a significant reduction in physical capacity, social function, total scale function and the QoL summary score after treatment was observed. Osann et al., also showed that the application of radiotherapy associated with chemotherapy in patients with cervical cancer leads to a worsening of the NS. However, the perception of patients concerning their overall health before and after chemoradiotherapy is considered to be satisfactory when compared with the reference values of the EORTC for women with different cancer types and stages (Summary score of the present study: 77.94 ± 14.75 and 69.76 ± 15.55, before and after treatment respectively; Reference of EORTC: 59.3 ± 24.9).

The QoL summary score in the study population showed a positive association between NS at T0 and T1, with a significant reduction according to worsening of the NS. Data of the present study corroborate with recent literature, which has shown lower QoL scores among cancer patients presenting weight loss or malnutrition. Malnutrition is now considered an independent factor for the deterioration of QoL, and a recent systematic review concluded that poor NS is significantly associated with the QoL reduction in cancer patients, independently of the tumour site.

The present study, found DLT in roughly 80% of the sample. The gastrointestinal toxicities such as nausea and diarrhoea were the most common, corroborating with other studies that report an elevated incidence of toxicity in gynaecologic tumours, in addition to the association between severity and decline of the NS. The gastrointestinal symptoms can negatively impact the NS reducing of nutrient intake and accelerating muscular degradation, with worsened physical capacity and consequent QoL.

When analysing the variables related to cancer treatment interruption, one can observe that only those related to the NS presented a statistically significant association (diagnosis of cachexia and %WL). In addition, women that interrupted treatment had a median BMI significantly lower than those that did not interrupt treatment. Recognising the factors that can contribute to the reduction of toxicity risks is of utmost importance, and our results suggest that the NS before treatment should be taken into consideration by considering the body weight and %WL and, whenever possible, body composition evaluation. The lack of studies assessing the influence of chemoradiotherapy on NS and QoL of cervical cancer patients makes the present study an important contribution to the identification of variables related to unfavourable outcomes to cancer treatment for this group.

Some limitations of the present study should be pointed out. The small sample size limited a detailed statistical analysis, especially the analysis between different groups according to their NS. The inclusion of all cervical cancer patients who underwent chemoradiation therapy resulted in a sample with distinct stages of the disease, which may interfere with the different outcomes of oncologic therapy.

In addition, data on dietary intake were not collected, making it impossible to associate food intake with NS. A long-term follow up would be beneficial for a better understanding of the relationship between NS and chemoradiation therapy outcomes. Moreover, it was not possible to perform the CT scan after treatment to assess changes in the NS. In the clinical setting, body composition can be easily assessed using electrical bioimpedance; however, this technique has low accuracy in cancer patients, especially in advanced stage of the disease.

In accordance with our results, the combination of chemotherapy and radiotherapy for cervical cancer treatment caused a significant reduction in weight and an increase in the frequency of malnutrition. In addition, a significant
impairment in functional capacity and QoL were observed after the cancer therapy. The QoL summary score also demonstrated a significant reduction according to worsening of nutritional status. The vast majority of patients who interrupted chemotherapy treatment presented pre-cachexia/cachexia, as well as a significant pre-treatment weight loss.

The present study indicates the need to perform further studies on this target population, evaluating multimodal strategies, such as nutritional, physical activity and pharmacological interventions, in order to prevent or reduce treatment complications and consequently the optimisation of chemoradiotherapy. Moreover, determining and registering the risk factors for interrupting antineoplastic therapy should be considered prior to treatment.

**Funding source**

No funding was received for this manuscript.

**Conflict of interest**

The authors have no conflicts of interest to declare.

**Authorship**

MAA conducted the experimental and clinical work, data collection, data analysis and interpretation, prepared and revised the manuscript. MRG conducted the experimental and clinical work, data collection, prepared and revised the manuscript. GVC conceived and coordinated the study, conducted statistical analysis, prepared and revised the manuscript. The authors certify that the enclosed manuscript is original. All authors agree with the manuscript and declare that the content has not been published elsewhere.

**References**


Clinically relevant improvements achieved from a facilitated implementation of a gestational diabetes model of care

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Abstract

Aim: Medical nutrition therapy is a cornerstone treatment in gestational diabetes; however, most Australian women diagnosed with gestational diabetes do not receive this. The project evaluated adaptation of a successful evidence-based gestational diabetes model of care implementation from a tertiary centre into regional sites with varied demographics, population size and service capacity.

Methods: The project used a hub (project team)-spoke (sites) model in Far North Queensland (Site 1) and regional South-East Queensland (Site 2). Sites selected demonstrated strong gestational diabetes team cohesiveness and project commitment. The project phases were consultation, baseline, transition and implementation. A best practice decision tree tool was provided to assess/manage barriers to the model of care and clinical outcomes captured through a project database.

Results: Role clarification of site members, management engagement, site visits, decision tree and database refinement were completed in the project’s first phase. Unexpected organisational and team barriers prevented timeline implementation as planned. Sites negotiated relevant reallocation of resources to achieve project deliverables. The proportion of women seen according to best practice increased from 3.5 to 87.8% (P<0.001) (Site 1) and nil to 4.8% (P = 0.09) (Site 2), and those on medication dropped by 3.4 (Site 1) and 9.1% (Site 2).

Conclusions: This project demonstrates a successful implementation using a facilitated and rigorous approach. Support, engagement and tools at many levels were keys to success at both sites. The present study illustrates the opportunities and challenges of conducting implementation research within routine clinical care, particularly in resource-challenged sites.

Key words: gestational diabetes mellitus, health services research, implementation, medical nutrition therapy, model of care.

Introduction

Gestational diabetes mellitus (GDM) occurs in upwards of 5% of pregnancies. Elevated blood glucose levels in GDM can result in significant negative pregnancy, delivery and long-term outcomes, including an increased risk of type 2 diabetes mellitus, with associated personal, clinical and public health costs. Medical nutrition therapy (MNT) is a cornerstone treatment in GDM. American guidelines recommend women with GDM receive MNT according to an evidence-based appointment schedule with a dietitian, with a minimum of a one-hour individual initial counselling session and two review appointments, which has demonstrated reduction in medication requirements. While evidence-based nutrition practice guidelines (NPGs) exist, most women with GDM do not receive MNT according to these guidelines in many Australian centres, with a wide variety of time allocations and models of care (MOC) for delivering MNT to women with GDM. Across Australia, inadequate resourcing of dietitians in GDM clinics and unfamiliarity with NPGs are known barriers to guideline adherence. Additional barriers include poor integration of dietitians into clinic processes and lack of awareness by staff and women of the benefits of dietary intervention through regular dietetic contact for GDM management.
Implementation science (IS) recognises that to translate guidelines into practice a theory-driven approach to overcome barriers is required as dissemination of NPGs alone is not enough to result in service change.9–12 Numerous strategies facilitate guideline implementation, with multi-level (individual, team and organisation), multi-intervention approaches often being more successful.13,14 However, guideline adherence is also influenced by local factors that require development of site-specific strategies.13,14

An IS approach was undertaken at the Mater Mothers’ Hospital, a tertiary maternity GDM service in South-East Queensland (SEQ) (Australia) in 2013 to implement and evaluate an evidence-based MNT MOC in GDM. Following a barrier analysis7 and strategy selection using an evidence-based framework (i.e. the theoretical domains framework9 and behaviour change wheel10) interventions to overcome the identified barriers to guideline adherence included staff training, resources (clinic room space), workflow changes, feedback and audit and reallocation of staffing. This implementation resulted in improved outcomes for women with GDM with significantly more women receiving best practice care (<0.01% pre vs 50.6% post; P = 0.02).7 The MOC also saw non-significant decreases in GDM managed with medicines (31.1% (pre) to 26.9% (post)) that was more evident in those receiving best practice care ((27.2% (no) vs 25.0% (yes)), that is (number (1 new and 2+ reviews) and format (individual) of appointments). In addition, there was a clinically relevant increase in the amount of physical activity (+15.5 minutes (pre) vs +91.8 minutes per week (post)) undertaken by women, and positive trends observed in dietary quality (e.g. decrease in saturated fat, increase in healthy fats, modification of carbohydrate content), and a significant decrease in the glycaemic index of women’s diet (P = 0.014), particularly in women who received best practice care. There was a significant increase in staff’s satisfaction and women’s satisfaction remained high across the project.7

A systematic process that allows the application of evidence-based interventions to local barriers should facilitate local adoption of a MOC. Dissemination of the MNT MOC to other Queensland and Australian centres should enable dietitians to work to their full scope of practice and therefore, allow more women to benefit from best practice care. The aim of this project was to evaluate the process and clinical outcomes of the implementation of the MNT MOC from the Mater (tertiary site) at two regional sites (i.e. outside the metropolitan South-East of Queensland). Of specific interest was the identification and refinement of processes required to successfully embed the MOC locally and to determine whether the facilitated implementation of the MOC influenced (i) the elements of best practice (time from diagnosis to first appointment; number of dietitian visits per woman; the proportion of women receiving best practice care), and (ii) on the need for pharmacotherapy to manage GDM.

Methods

The project used a hub (project team)-spoke (sites) model15 in two centres: Site 1—Far North Queensland (FNQ) and Site 2—regional SEQ. Site 1 was 1800 km north of Brisbane with ~2700 births annually and a GDM prevalence of 8% and Site 2 was 130 km west of Brisbane with ~1200 births annually and a GDM prevalence of 9%. An IS approach was used to embed and facilitate the evidence-based MOC into practice at each site9–12 systematically applying the findings from the Mater Mothers’ Hospitals’ study’s systematic barrier analysis7 and tailored strategy selection approach.9,10

Sites were selected following an expression of interest (EOI) process distributed through a professional dietetic network (department managers) across Queensland. As part of the EOI process, sites were informed on each project phase in which they were required to participate (Appendix I). In addition, they were informed of benefits of participation and the resources available to assist them. These were improving patient outcomes, obtaining data about their service, participation in a multi-site trial with expert support and resources, evaluation of different models of care and associated outcomes and building implementation research capacity. The two sites were selected from four EOIs based on the greatest pre-project stakeholder engagement (as indicated by number of signatures obtained), hospital size, population and/or distance from SEQ. Sites were required to obtain support in writing from key stakeholders to participate in the study. In addition to being a regulatory step, this process was to assist selection of sites with effective team communication processes and to provide a formal mechanism to ensure key members of the multi-disciplinary team were aware of the project. Sites selected demonstrated strong GDM team culture, medical, dietetic, nursing management and research project support. Queensland Department of Health’s Chief Allied Health Officer joined the project team to ensure the project aligned with broader statewide strategic goals.

The project phases were consultation, baseline, transition and implementation. The baseline phase provided guidance to assess and overcome barriers to the local implementation of the MOC using a best practice decision tree tool (Figure 1). This was reviewed by sites and refined by the project team in the consultation phase as guidelines with greater familiarity and ease of use have a greater chance of implementation.14 The effective strategies from the (tertiary centre’s) project, were combined into this decision tree tool to allow the sites to assess their own barriers and select evidence-based interventions to overcome them.7,8 The decision tree tool was designed to facilitate team decision making around reallocation, realigning and planning of resources, and allowed identification of and links to evidence-based nutrition training and resources in preparation for the implementation. The decision tree tool was presented with literature underpinning the MOC, five barriers to the delivery of best practice nutrition and GDM care, and a reporting sheet to summarise barriers from their site and suggested action plan to overcome identified barriers (Appendix II). The five barriers were (i) gaps in dietetic staffing/resources; (ii) gaps in the delivery of MNT; (iii) lack of tailored individualised care; (iv) use of an integrated
Facilitated implementation of a GDM model of care

SUPPORTING LITERATURE: Full scope of dietetic practice in gestational diabetes mellitus

- Australian guidelines recommend a dietician as an important member of the multidisciplinary team caring for a woman with GDM and Medical Nutrition Therapy is the primary intervention strategy for managing blood glucose levels (BGLs) in women diagnosed with GDM.
- Reduced insulin requirements and improved BGL control have been documented in a study validating American Dietetic Association Nutrition Practice Guidelines. In this study, women receiving MNT according to an evidence-based appointment schedule, with an initial counselling session within a week of diagnosis, at least two review appointments with a dietician, plus a postnatal follow up session (31.7% of women on insulin required use, 24.6% once the guidelines were followed).
- Dietary counselling following GDM diagnosis can reduce the incidence of macrosomia and slow excessive gestational weight gain.

Five identified barriers to the delivery of best practice Nutrition & GDM care

1. Gaps in dietetic staffing/resourcing in GDM
   - A national audit of Australian maternal health dietetics services demonstrated that many services providing GDM care lack a systematic approach to their health care delivery.
   - Despite GDM care being the most consistently delivered service by maternal health dietitians, there exists a wide variety of time allocations and modes of care for delivering medical nutrition therapy to women with GDM.
   - No services served followed an evidence based schedule of visits or used nutrition practice guidelines.
   - Following the release of Queensland’s Dietitians and Nutritionists Strategic Coalition (QDNS) report (2005) titled “Internal review of dietetic services delivered in the community in Queensland”, a working party investigated the need for a state-wide evidence based model of care for GDM. It found that state-wide GDM services lacked consistency across metropolitan, regional and rural areas and were not delivered in a systematic way even in clinics with sufficient dietitian time, with poor NPG awareness.

2. Gaps in the delivery of MNT for GDM
   - A wide variety of resources, dietary prescription/advice, practices around monitoring gestational weight gain and recommendations regarding risk of T2DM are used by Australian dietitians in the care of women with GDM.
   - There was as clinically relevant decrease in the percentage of women requiring pharmacologic treatment (from 31.1% (pre) to 26.9% (post-implementation)) and this was more pronounced in women who received best practice care (27.3% (pre) vs. 25.0% (post)). These changes mirror the changes seen in the American guidelines validation study.
   - Generally, the first visit with a dietician involves the delivery of MNT regarding dietary and other lifestyle modifications required to manage BGLs, to meet pregnancy dietary requirements, and to manage gestational weight gain. Clinic structure and model of care should be structured to allow a woman to receive advice tailored to her individual circumstances.

3. Lack of tailored, individualised advice
   - In the Mater Mother’s Hospital’s (MMH) GDM project, only one third of women received an individual appointment for their first MNT appointment, deviating from best practice.

4. Integrated into appointment schedule and clinical pathway
   - In the MMH GDM project significantly more women received best-practice care when the new model of dietetic care was implemented. This included a GDM clinical pathway that outlined visits by week and the clinicians to be seen at these visits.

5. Monitoring of outcomes
   - Lack of regular, real-time monitoring of clinical and process outcomes prevents documentation of GDM clinic effectiveness and affects awareness of areas for improvement.
   - Based on the American validation study, useful outcomes to measure are number of visits a woman has with a dietician (processes) and the proportion of women who are diet vs medication controlled for their GDM.

Figure 1: Double-sided tool displaying an evidence-based decision tree and evidence-statements to facilitate sites to identify site-specific barriers to the implementation of a best practice model of care for gestational diabetes mellitus and potential solutions to overcome these barriers.
appointment schedule and clinical pathway and (v) monitoring of outcomes.

The project research team supported the sites (February 2015—December 2016) through three site visits, five quarterly teleconferences and communication and clarification of issues between teleconferences through telephone, email and/or face-to-face visits, as suited sites. Communications included six newsletters distributed at key project milestones through the Statewide Clinical Networks and to project sites. Newsletters included translating research into practice tips, site’s baseline data, as well as team member reflections on project progress.

‘GDM Assist’, an Access database that enabled service activity documentation and audit, was used to collect and calculate the minimum data set informed by the GDM best practice guidelines. This included date of glucose tolerance test (GTT), week of pregnancy, date of first dietetic appointment, format of appointment (group or individual), number of review appointments and the use of pharmacotherapy (insulin or metformin). Only women who were diagnosed with GDM between 24 and 28 weeks were included. Women with ‘early’ GDM (<23 weeks) or who entered the service after 30 weeks were excluded from data analysis as the guidelines had not been validated in these patient groups and their data were not collected systematically.

Quantitative data were analysed with SPSS for Windows version 15 (SPSS, Chicago, IL, USA). Means and standard deviations were calculated for continuous data and medians and interquartile ranges were reported for skewed data. Frequencies and percentages were calculated for categorical data. Difference from time 1 to time 2 was calculated for variables. Differences were examined with independent group t-tests and independent group \( \chi^2 \) tests. Three ‘best practice’ outcome variables were constructed based on the guideline recommendations; one for ‘time to first appointment’ (i.e. the proportion of women who had their first visit with the dietitian within a week of referral, one for ‘schedule of visits’ (i.e. the proportion of women who had at least three individual visits with a dietitian), and a combination of these (i.e. women who were seen within a week of referral and received at least three individual appointments with the dietitian).

As this was a quality improvement activity, exemption from ethics review was obtained from the Darling Downs and Cairns and Hinterland hospital and health ethics committees (HREC) (HREC/15/QCH/21-958 QA) and (HREC/15/QTD/22-SA/QA), including retrospective exemption for inclusion of newsletter quotes.

**Results**

**Site engagement and timeline adherence**

Role clarification of site members (lead, champion, clinician and researcher), management engagement (dietetic, medical, allied health and dietetic), site visits, service assessment decision tree tool and database review and update were all completed in the project’s first three months. Minimal changes were made to the flowchart with the only update being links to the preferred recommended resources for Aboriginal and Torres Strait Islander women with GDM.

Both sites aimed to recruit for six months or up to 120 women (whichever came first) for sufficient power, but unexpected barriers arose that affected planned timeline procedures. Baseline and implementation phases ran for five (Site 1) and six months (Site 2) (Table 1). Both sites negotiated resources to achieve project deliverables (Site 1 from 0.25 to 0.6FTE; Site 2 from 0.05 to 0.5 FTE plus 0.2 Administrative assistant). Site 1 redistributed dietetic departmental funding from low value to this high value MOC and Site 2 obtained extra funding from within Allied Health to provide the MOC with extra funding to support a week of data entry provided by administration services.

Data entry delays occurred at both sites due to balancing dietitian workloads with project needs and hence timely monthly progress feedback to each site did not occur. During the two-month consultation phase, both sites practiced using the database. Site 2 used the consultation phase and the four-month baseline phase as their baseline data due to having a smaller GDM population and extra administrative assistance in only the earlier part of the project.

**Implementing the model of care: barriers and site experiences**: Two groups of barriers emerged, those expected in the MOC’s delivery (Table 1), as well as local barriers that arose when operationalising the solutions. Barriers listed by both sites included only partial integration of the dietitian into the multi-disciplinary GDM clinic and no use of an evidence-based schedule of visits with few women receiving an individual appointment for their initial visits or receiving the correct number of review appointments. Neither dietetic service had sufficient dietetic resources allocated to the GDM service to enable the delivery of the evidence-based schedule and no system or program was in place to allow data to be routinely collected to allow monitoring of outcomes. Evidence-based MNT was delivered within consultations.

At Site 1, additional barriers included difficulties with data entry and limited dietetic clinic space. This site was one of two sites statewide implementing a new electronic record, ‘teMR’. Despite numerous discussions with the teMR team, the minimum data set required for this project was unable to be collected in the database resulting in an increased administrative burden for clinicians. Additional clinic space was unavailable due to refurbishment of the hospital’s antenatal clinic (ANC) which impacted the ability to see all women in prescribed timeframes.

Through consistent diabetes team and facility-wide negotiations with multiple stakeholders by the project team at Site 1, progression of the implementation of the MOC occurred within the planned timeframe. Re-negotiation of staffing needs (with reallocation from funds within the Nutrition and Dietetics Department) and clinic times allowed project delivery as planned. Despite limited interest from some stakeholders and concern from others about
### Table 1: Barriers and planned actions identified by sites during the baseline phase of the project after working through the decision tree

<table>
<thead>
<tr>
<th>Site</th>
<th>People involved</th>
<th>Do dietitians use standardised, best practice resources appropriate to your patient group?</th>
<th>Do dietitians deliver evidence-based MNT?</th>
<th>Consider if your clinic’s GDM medical MNT is aligned with best practice principles</th>
<th>Consider if you have an effective clinic and how you monitor this?</th>
<th>Are data routinely collected and used to monitor processes and resultant clinical outcomes?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site 1</td>
<td>Project lead, GDM dietitian, Site champion, Research position Manager, Diabetes Centre Diabetes educator Endocrinologist, Indigenous health worker, Endocrinologist/Director Diabetes Centre</td>
<td>Yes, as per flowchart. ACTION: nil change</td>
<td>Yes, as per flowchart. ACTION: Integrate flowchart identified webinars into training for new GDM dietitians.</td>
<td>Partially, introductory groups with diabetes educator, 1:1 review in multidisciplinary GDM ANC or at Diabetes Centre. ACTION: Need to negotiate room allocations with stakeholders and share clinical pathway outlining multidisciplinary visit timing from (project site).</td>
<td>Rarely, currently 0-0.25 FTE GDM initial, group 0.6 FTE for GDM for intervention does not allow. ACTION: Need to investigate potential reallocation of resources within department (extra project staff 0.4 FTE) as per flowchart calculations.</td>
<td>No, currently women are seen within groups and have ad hoc reviews. ACTION: as documented—to negotiate clinic space and extra FTE.</td>
</tr>
<tr>
<td>Site 2</td>
<td>Project lead and GDM dietitian</td>
<td>Yes, as per flowchart. ACTION: nil change</td>
<td>Yes, ACTION: rewatched webinars recommended on flowchart for completeness</td>
<td>Partially, joint group education session—diabetes educator and dietitian. Patients also have access to medical consultants, lactation consultant and midwives. Individual sessions are available if interpreter required. ACTION: If individual review appointment could be offered, the clinical pathway will need to be reviewed. To be raised with O&amp;G team, diabetes services and midwifery.</td>
<td>No. Current FTE: 0.05 FTE does not allow. ACTION: A business case to be raised to request additional FTE from business manager to 0.5–0.6 FTE as per flowchart.</td>
<td>No. Lack of resource (FTE) ACTION: as documented—to request extra FTE.</td>
</tr>
</tbody>
</table>

**Abbreviations:** ANC, antenatal clinic; FTE, full time equivalent; GDM, gestational diabetes mellitus; MNT, nutrition therapy; O&G, obstetrics and gynaecology team.
disrupting processes that were working well (e.g. referrals from ANC, booking simplicity, speed of access and frequency of appointments/not as easily coordinated with the diabetes educators) presence of key individuals with an interest in and responsibility for the area strongly influenced the change management process. Support of senior medical staff particularly enabled the project to be recognised as valid. This is illustrated in the newsletter reflections over the project phases (below and Appendix III).

During the resource refinement/consultation and baseline phases there was multi-disciplinary support and hopes for the project:

I welcome the GDM model of care project and recognise the importance of this work... It’s going to be good to have a proper GDM database to help us identify and follow up our patients. (Director, Diabetes Centre)

Our Department are very excited about being part of this project, in particular the assistance in identifying the areas that require improvement. It is very exciting to be able to collaboratively work together across Obstetrics, Diabetes Centre and Dietetic Departments to strive to provide best practice for our patients. (Dietitian)

During the Transition phase, reflections illustrated the substantial multidisciplinary negotiations underway as the team worked to overcome the identified barriers integrating into the antenatal clinic (location, bookings and structure), and the benefits in using the project database;

Taking part in the project has improved our communications between Diabetes Educator, Endocrinologist and Dietitian for patient care and the patient’s journey. The project has been a great opportunity for team work. (Dietitian)

As the implementation phase progressed, the shift from transition and establishment of the MOC to a functioning new service was apparent, with positive reflections at the conclusion,

The team is eagerly awaiting results from the implementation. Involvement in this project has demonstrated that formalised research is an effective way to make change happen. [which] would have been very difficult to achieve otherwise …That it has been part of a larger project outside our health service has also been a key factor, as the health service had an obligation. (Dietitian and Project Site Champion)

Site 2’s additional barriers included lack of capacity for data entry, lack of clinical space, and difficulty adjusting administration processes (clinic appointment bookings), as well as barriers that resulted from the project team’s expectations of outcomes of and involvement in the project. Prior to project participation, Site 2 identified insufficient dietetic FTE to deliver the MOC in the implementation and had planned to use baseline data for a business case to obtain additional funding before engaging a wider group of stakeholders. Following the stakeholders being informed of the project and support from the District Allied Health manager, midwifery and endocrinology, funding was made available for additional data entry assistance for one week. When the project stalled prior to the implementation Phase due to difficulties obtaining funding for additional dietetic resources to deliver the MOC, higher level support was provided by the District Allied Health manager and Chief Allied Health Officer who had supported the project from the outset. This enabled a temporary increase of 0.5 FTE dietetics hours (20 hours/week) for the delivery of the implementation phase. These barriers resulted in a shorter baseline and implementation phases at Site 2.

As with Site 1, the processes and teamwork undertaken at Site 2 in addressing the project barriers to deliver the new MOC were illustrated in the newsletter reflections. The contributions acknowledged the collaborative approach emerging from the project participation in the Consultation phase, ongoing negotiation and rewards recognised.

It’s the great team who worked close together and the never-give-up spirit to bring this project to implementation phase in our hospital. It hasn’t been easy to set up the new clinics, but everything is worthwhile to bring a better service for pregnant ladies with GDM in the region. And we are super excited that we have successfully implemented the new model of service which seemed almost impossible at the beginning! Although the implementation phase is finishing by the end of September, we all look forward to see what the future holds for GDM within our service. (Dietitian)

Effect of implementation on clinical outcomes: As shown in Table 2, Site 1 had between 70 and 90 women and Site 2 had 40–60 women with GDM diagnosed after 23 weeks attending their service over each phase of the project. The time taken for women to have their first appointment with the dietitian after GDM diagnosis was above the one week as recommended in the guidelines at both sites (from a median of 1.3 to 1.7 weeks, and 2.3 to 2.1 weeks, respectively). The proportion of women who received care within the recommended time period dropped from 36.0 to 27.0% in site 1 and increased from 13.6 to 19% in site 2.

The proportion of women who received best practice care as defined as number of visits (at least one new, individual and a minimum of two reviews)16 increased significantly at Site 1 from 3.5 to 87.8% (P < 0.001) and increased minimally from 0 to 4.8% at Site 2 (P = 0.09) (Table 2). The proportion of women seen individually but not receiving any reviews increased from 5.1 to 83.3% at Site 2. In addition, there was an increase in the proportion of women who did not receive any reviews in the implementation phase. The proportion of women seen in group sessions decreased (Site 1, 87.2–2.7% Site 2, 93.2–57.1%) and a corresponding increase in individual appointments occurred at both sites (Site 1, 9.2–93.2%; Site 2, 1.7–42.9%) (Table 2).

Combining the guideline-recommended time to first appointment and number of visits variables into a composite best practice score, a significant increase in the proportion of
Table 2  Minimum best practice data set for Sites 1 and 2, baseline and implementation

<table>
<thead>
<tr>
<th>Variable</th>
<th>Site 1</th>
<th>Site 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project phase (months)</td>
<td>Pre (July–November 2015)</td>
<td>Post (February–June 2016)</td>
</tr>
<tr>
<td></td>
<td>87</td>
<td>74</td>
</tr>
<tr>
<td>Number of ‘eligible’ women (n)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial dietetic consult format % (n)</td>
<td>Group 87.2 (75)</td>
<td>2.7 (2)</td>
</tr>
<tr>
<td></td>
<td>Individual 9.2 (8)</td>
<td>93.2 (69)</td>
</tr>
<tr>
<td></td>
<td>Missing 3.5 (3)</td>
<td>4.1 (3)</td>
</tr>
<tr>
<td>Time from referral to first appointment, weeks (median; interquartile range)</td>
<td>1.3 (1.3)</td>
<td>1.7 (2.0)</td>
</tr>
<tr>
<td>Proportion of women who had review appointments (%)</td>
<td>0</td>
<td>5.8</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>23.3</td>
</tr>
<tr>
<td></td>
<td>2+</td>
<td>70.9</td>
</tr>
<tr>
<td>Time to first appointment = best practice (&lt;a week), % (n)(a)</td>
<td>36.0 (31)</td>
<td>27.0 (20)</td>
</tr>
<tr>
<td>Schedule of visits (1 new and 2+ reviews; all individual) = best practice, % (n)(b)</td>
<td>3.5(3)</td>
<td>87.8 (65)</td>
</tr>
<tr>
<td>Best practice care (timing and number of visits), % (n)</td>
<td>2.3 (2)</td>
<td>25.7 (19)</td>
</tr>
<tr>
<td>Requirement for pharmacotherapy, % (n)</td>
<td>37.2 (32)</td>
<td>33.8 (25)</td>
</tr>
</tbody>
</table>

(a) Guidelines recommend that women have their first visit with the dietitian within a week of referral.
(b) Guidelines recommend that women have at least three individual visits with a dietitian.
(c) Appointment within a week and at least one new and two review appointments.
*P < 0.001 (84.3% change), **P = 0.09 (4.8% change), ***P < 0.001 (23.4% change).

Women who received best practice care increased at Site 1 (by 23.4%, P < 0.001) and Site 2 (by 2.4%, ns).

Small clinically significant decreases in medication use were observed at both sites (Site 1, 3.4%; Site 2, 9.1%).

Discussion

This paper describes the planning, delivery, challenges and outcomes of the facilitated implementation across two sites of a best practice GDM dietetic MOC. Initial engagement processes involved sites refining and trialling resources and processes developed through the Mater’s (tertiary site) project. Improvements included a method to monitor patient outcomes, a compilation of the evidence for multidisciplinary training and education and an evidence-based flowchart that allowed sites to diagnose local implementation barriers. Importantly, the flowchart prompted sites to develop solutions underpinned by successful strategies from the literature and the Mater’s (tertiary centre) experience. Barriers to delivery of the best practice MOC were primarily around lack of dietitian staffing, administrative support and clinical space affecting each site’s ability to deliver timely, individualised care at an appropriate frequency.

No improvements were seen in the time to first visit after referral. This may be explained by the lack of integration of the dietitian into the multi-disciplinary services at baseline as identified in the barrier analysis, as well as service capacity issues. Addressing structural changes to clinic integration and flow are potentially more difficult barriers to address compared with changes to education material or staffing levels with these changes involving multiple stakeholders outside of the project team and may be a reason for the increase in the proportion of women who were not able to be offered review appointments in the implementation phase. It has been documented that characteristics of guidelines, implementation strategies, the environment, professionals and patients can all influence the success of guideline adoption and no one approach is superior for all settings. However, as noted in the newsletter reflections, both sites had considerable success in reorienting their dietetic service within the multidisciplinary clinic flow and space and perhaps with time the delay in care could be overcome. This change might be suggested by the observed increase in the number of women offered individual appointments rather than being seen in groups and the partial implementation of the MOC improvement at Site 2 with a large proportion of women receiving one new and one review appointment.

Statistically significant improvements in the number of visits a woman had with a dietitian were observed at Site 1 with clinically significant decreases in medication use at both sites (3.4 and 9.1%) that mirrored the (tertiary centre site) project and the guideline validation trial (7.1%). Both sites lacked the sample size to detect significant changes in medication use and analyses did not take into account covariates, such as parity and ethnicity. However, this clinical outcome measure was not the study’s primary purpose which focused on the local implementation of an already effective MOC. It may be expected that unmeasured dietary quality...
and physical activity levels also improved, as seen in the tertiary centre and larger differences may have been seen with greater adherence to the MOC.

Processes outside the scope of the project may also have influenced medication use. As in the Mater (tertiary site) project, there was no standard procedure for medication initiation. Individual medical practitioners used their own judgement for medication commencement, and it is likely that this happened before women saw a dietitian because of the delay in time from referral to first visit and review. This was not formally documented, but anecdotally reported at both Site 1 and during the tertiary site’s project; an area for greater focus in the next project stage.

Learnings from the project come from how barriers to both the MOC and the project delivery were addressed and may explain the extent of changes observed. Documenting and understanding these will assist future dissemination of MOC projects. The two-tiered engagement approach contributed to the project’s success. Involving both clinicians and clinical champions, as well as high-level management allowed for flexibility in care planning and delivery, as well as high-level strategic negotiation, support and decision-making required. In designing the site engagement approach, it was recognised that lack of peer and management support are commonly documented barriers to guideline adoption. Commitment to the project can ensure that management support persists. In addition, it appeared that the changes made at Site 1 were approved earlier in the project because of the multidisciplinary involvement, as illustrated by the wide stakeholder engagement.

The strengths of this project include the implementation strategy being developed through a successful evidence-based project, and learnings around project processes, team expectations, potential risks and communication strategies clearly defined and articulated from the outset. The engagement of both sites in the planning process and regular visits and teleconferences reinforced this approach, particularly with the appointment of defined roles of researcher, clinician, champion, project lead at each site. Aligning the project goals with state health priorities (full scope of practice; models of care), as well as relevant clinical focus area GDM provided the impetus and urgency for the project, and the active involvement of the Chief Allied Health Officer and engagement with the Allied Health managers in the project outset also ensured buy-in, and management support to address implementation barriers. The involvement of the research role assisted the ethics application process as well as ensuring local guidance to adherence to planned research processes.

A project limitation included the focus on a subset of women with GDM coming through the clinic (i.e. only diagnosed 24–28 weeks). These women were chosen as they were represented in the American validation study of the guidelines. However, there were a large proportion of women who were diagnosed with GDM in early and later pregnancy creating a service burden influencing capacity (space and time) to deliver evidence-based care. This also potentially influenced the deviation from timeline adherence. The GDM Assist database was introduced to facilitate the documentation of clinical processes (and capture project evaluation measures), however, this became an added time pressure for clinicians. Ideally, this step should be integrated into routine documentation of care delivery for ongoing service evaluation and quality assurance. Future introduction of electronic records should consider these elements as essential.

The next steps will involve further engagement with dietitians across the state with the Allied Health Professionals Office of Queensland to adapt the project’s approach to provide a sustainable facilitated implementation model across a variety of sites. This ongoing higher level support and guidance has been shown to be essential to navigate the often unforeseen pitfalls and challenges that can obstruct project momentum. This approach may help to circumvent potential problems of buy-in from sites with fewer resources and/or initial stakeholder engagement. However, sometimes resourcing is only a perceived barrier, with numerous sites in Queensland being identified as having but not efficiently organising staffing in their GDM dietetic clinics. The project’s decision tree flowchart provides a mechanism to facilitate this process (reallocation or business case) as one strategy for roll out. We hope to raise the awareness of the need for reallocation through potential disinvestment away from historic practices. Furthermore, findings from this paper as well as a planned qualitative analysis of sites’ experiences (individual, team and organisational) will strengthen approaches to engagement and implementation in the project’s future stages.

This project demonstrates a successful facilitated best practice MOC implementation using a rigorous evaluation strategy to refine a mechanism for wider dissemination. This project was successful in increasing the proportion of women seen according to best practice with clinically relevant outcomes that mirror the Mater’s (tertiary site) findings. Support at many levels was key to successful implementation at both sites. The present study illustrates the opportunities and challenges of conducting evidence-based implementation research in routine clinical care, particularly in resource-challenged sites.

**Funding source**

Funding was received from Allied Health Professions of Queensland to fund site visits for the present study. SW is supported by a Queensland Government Health Research Fellowship and AHPOQ (Allied Health Professions’ Office Queensland) Collaboratives funding. Maternity leave RA support from Queensland Government – Advance Queensland grants.

**Conflict of interest**

The authors have no conflict of interest to declare.

**Authorship**

All authors have participated sufficiently in the article to take public responsibility for the content. SW (corresponding author) developed the study, with input from SM.
collection was completed by AK and BS and analysis was completed by SW. Data interpretation was completed by all authors. SW drafted the manuscript. All authors provided significant critical input into the manuscript. †Thanks to Dr Desley Harvey, Julie Hulcombe, Dr Anna McLean, Dr Maxine O’Brien, Yvonne Chen, Welma Joubert, Louise Moran for their input into the project and manuscript. Thanks to both trial Hospital and Health Services (Cairns and Hinterland Hospital and Health Service and Darling Downs Hospital and Health Service) Diabetes, Obstetrics, Midwifery, Diabetes Educator and Administrative Support teams, as well as the women who attended the services.

†[Correction added on 14 February 2018, after first online publication: Statements have been added to ‘Funding source’ and ‘Authorship’ sections.]

References

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Appendix I

Overview of the planned project phases and tasks undertaken during each phase

<table>
<thead>
<tr>
<th>Project phase</th>
<th>Time (months)</th>
<th>Task/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consultation</td>
<td>2</td>
<td>Site project team formation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Role negotiation and specification, for example, <strong>Roles/expectations of project lead:</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Project team member</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Advocate re project with Hospital and Health Service (HHS) executive (or has link to get Executive support)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Has seniority to authorise (or facilitate) actions from project meetings</td>
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<tr>
<td></td>
<td></td>
<td>Supports/facilitates service changes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Oversees process for data collection at site</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Facilitates obtaining signatures for governance/site-specific approval</td>
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<tr>
<td></td>
<td></td>
<td>Opportunity to be author of project publication/s (see authorship guidelines)</td>
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<tr>
<td></td>
<td></td>
<td><strong>Roles/expectations of site champion:</strong></td>
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<td></td>
<td>Project team member</td>
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<td></td>
<td></td>
<td>Communicate meeting outcomes to site GDM team (e.g. meeting actions; assist newsletter compilation and distribution)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lead, support and facilitate collection and collation of data</td>
</tr>
</tbody>
</table>
Appendix I continued

Opportunity to be author of project publication/s (see authorship guidelines)

**Roles/expectations of GDM dietitian:**
- Project team member
- Participates in service changes
- Participates in/facilitates collection of data
- Facilitates obtaining signatures for Governance/Site-specific approval
- Opportunity to be author of project publication/s (see authorship guidelines)

**Roles/expectations of Research position:**
- Project team member
- Supports data collection at site
- Liaison with HHS’s HREC for Governance/Site-specific approval
- Facilitates obtaining signatures for Governance/Site-specific approval
- Opportunity to be author of project publication/s (see authorship guidelines)
- Project planning, including refinement of a communication plan with sites
- Site visits for launch by project lead
- Site’s resource familiarisation, refinement and provision of feedback to project team
  (decision tree and ‘GDM Assist’ database)

<table>
<thead>
<tr>
<th>Baseline</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site’s monitoring of current practice (for six months or until data for 100–120 women collected, based on initial implementation study to allow comparison) (8)</td>
<td></td>
</tr>
<tr>
<td>Stakeholder assessment of GDM service with a best practice decision tree flowchart, facilitating decision making around space and human resources, recommended education materials developed from the findings of the initial project</td>
<td></td>
</tr>
<tr>
<td>Service monitoring processes (GDM Assist)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Transition</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Embedding the new MOC, informed by the best practice decision tree assessment</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Implementation</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delivering the evidence-based MOC while continuing to evaluate process and clinical outcomes (using GDM Assist)</td>
<td></td>
</tr>
</tbody>
</table>

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Appendix II

Reporting sheet template to assist action planning following barrier identification with decision tree
Appendix III
Site reflections included in each newsletter as the project progressed

<table>
<thead>
<tr>
<th>Newsletter number</th>
<th>Site reflections—Site 2</th>
<th>Site reflections—Site 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>It has been a great experience to work with everyone in the team—the project lead, the department director, the local researcher! There have been some up-and-downs, but luckily we were able to get support and resources to assist us with the project, especially with the extra administration officer assistance to help with data entry. We have also had buy-in from midwifery and interest from the other facilities in the health district, which are all invaluable resources for us to progress this project!—GDM dietitian</td>
<td>I welcome the GDM model of care project and recognise the importance of the present study for the &lt;Site 1&gt; area. It's going to be good to have a proper GDM database in GDM Assist to help us identify and follow-up our patients.—Director, Diabetes Centre</td>
</tr>
<tr>
<td>3</td>
<td>At this stage of the project we have nothing profound to say, but what I keep saying and thinking is 'keep calm and keep going'—DE and Project Site Champion</td>
<td>The Dietetic Department are very excited about being part of this project, in particular the assistance in identifying the areas that require improvement. It is very exciting to be able to collaboratively work together across Obstetrics, Diabetes Centre and Dietetic Departments to strive to provide best practice for our patients.—GDM Dietitian</td>
</tr>
<tr>
<td>4</td>
<td>‘It has been a quiet couple of months with the project but we wish everyone a very happy New Year and look forward to progressing in 2016’—CDE and Project Site Champion</td>
<td>‘&lt;Site 1&gt; is busy with establishing the clinics for the implementation stage of the project. We are eager to see how this new model of care is going to work in our service. We have been able to organise temporary staff to enable us to implement the project. Also very busy with data entry.’—GDM Dietitian</td>
</tr>
<tr>
<td>5</td>
<td>‘It’s the great team who worked close together and the never-give-up spirit to bring this project to implementation phase in &lt;Site 2&gt;. It has not been easy to set up the new clinics, but everything is worthwhile to bring a better service for pregnant ladies with GDM in the region.’—GDM Dietitian</td>
<td>The Diabetes Centre and Dietetic Department are very busy with the implementation phase of the GDM Model of Care. It has very much been a team effort with the implementation phase of this project with amazing efforts from the clinical staff with patient documentation from the Antenatal/Diabetic Clinic. The project team are also very grateful to the Diabetes Centre Administration Team whose workload has increased with their assistance with the scheduling of appointments for the women.’—GDM Dietitian</td>
</tr>
<tr>
<td>6</td>
<td>We are super excited that we have successfully implemented the new model of service which</td>
<td>The Diabetes Centre has completed the data collection for the GDM MOC project. The team is</td>
</tr>
</tbody>
</table>

© 2018 Dietitians Association of Australia
Although the implementation phase is finishing by the end of September in Toowoomba, we all look forward to see what the future holds for GDM within our service.—Diabetes Dietitian

eagerly awaiting results from the implementation phase.

Uptake of the post-natal review does vary. Currently we are providing women with the option of a three months review with either a face-to-face or telephone appointment. We are strongly encouraging this follow-up and are fortunate that we can offer HbA1c testing if women have not had their oral GTT. The dietitian also uses the opportunity to discuss and provide education on nutritional requirements for breastfeeding and weight management, diabetes prevention and introduction to solids. Options for further dietary follow-up—for example, for weight management—can also be discussed.

Involvement in this project has demonstrated that formalised research is an effective way to make change happen. The amount of change needed to make this project work would have been very difficult to achieve otherwise. Commitment from the whole diabetes service (administration, medical, diabetes education and space allocation), the obstetric service (space allocation) and the nutrition and dietetics service (additional staffing) has been required. That is a lot of negotiation! It has also been specifically dependent on the people involved in facilitating change. That it has been part of a larger project outside our health service has also been a key factor, as the health service had an obligation agreed to with the lead project team at a high management level.

The project has allowed us to establish a booking system for organised patient follow-up (which had been a long-term problem), has made other health professionals more conscious of dietetic services for GDM and has given us a database on which to track activity and some outcomes.

Ideally, using what we have learnt from the project, we would like to continue to develop services for pregnant women with diabetes following a formal registered work-based quality/research process. Potential areas for development are the management of Types 1 and 2 pregnant women as well as processes and communication for patient care with other sites within the Cairns and Hinterland Hospital and Health Service and Torres Strait and Cape York services.—GDM Dietitian and Project Site Champion
Improving nutritional discharge planning and follow up in older medical inpatients: Hospital to Home Outreach for Malnourished Elders

Adrienne M. YOUNG,1 Alison M. MUDGE,2 Merrilyn D. BANKS,1 Lauren ROGERS,1 Kristen DEMEDIO3 and Elisabeth ISENRING4

Departments of Nutrition and Dietetics and Internal Medicine and Aged Care, Royal Brisbane and Women’s Hospital, Department of Nutrition and Dietetics, The Prince Charles Hospital and Faculty of Health Science and Medicine, Bond University, Brisbane, Queensland, Australia

Abstract

Aim: Nutritional decline during and after acute hospitalisation is common amongst older people. This quality improvement initiative aimed to introduce a dietitian-led discharge planning and follow-up program (Hospital to Home Outreach for Malnourished Elders, HHOME) at two hospitals within usual resources to improve nutritional and functional recovery.

Methods: Prospective pre–post evaluation design was used. Medical patients aged 65+ years at-risk of malnutrition and discharged to independent living were eligible. Participants receiving nutrition discharge planning and dietetic telephone follow up for four weeks post-discharge (HHOME) were compared to usual care (pre-HHOME). Nutritional (weight and mini nutritional assessment (MNA)), functional (gait speed, handgrip strength and modified Barthel index) and assessment of quality of life-6D (AQoL-6D) outcomes were measured on discharge and six weeks later.

Results: At six weeks, no significant difference in nutritional status was observed between pre-HHOME (n = 39) and HHOME cohorts, although the HHOME cohort on average maintained weight while pre-HHOME cohort lost weight (0.4 ± 2.9 kg vs −1.0 ± 3.7 kg, P = 0.060). Greater improvement in gait speed was seen in HHOME group (+0.24 ± 0.27 vs +0.11 ± 0.22, P = 0.046) with no other significant outcome improvements. Across both cohorts, half were readmitted to hospital and 10% died within 12 weeks post-discharge.

Conclusions: The nutritional discharge planning and dietetic follow up provided to older community-living malnourished patients made a small impact on nutritional and functional parameters but clinical outcomes remained poor.

Key words: ageing, dietetics, hospitalisation, malnutrition, older adults, patient discharge.

Introduction

Malnutrition is a significant problem in hospitalised older patients. Around half of older inpatients are malnourished at the time of admission to hospital,1 which puts them at-risk of longer hospital stays, more readmissions and reduced quality of life.2–4 Despite careful implementation of inpatient nutritional interventions, older inpatients continue to have suboptimal nutritional intake,5–7 that compounds the catabolic conditions of acute illness. A greater focus on nutritional recovery in the early post-hospital period might complement inpatient care and may improve post-hospital outcomes. Studies suggest that older patients are slow to return to their baseline nutritional state after hospitalisation,8,9 and frequently experience low nutritional intake,10 weight loss11 and often have limited dietetic follow up12 once home in the community. Dietetic intervention in the early post-discharge period (via telehealth counselling or home visits) may help in improving intake from food and/or oral nutritional supplements (ONSs) with early restoration of nutritional and functional status,13–16 with potential for reducing morbidity and decreasing utilisation of health care resources.

We previously conducted a feasibility pilot of a multidisciplinary (dietetic and nursing) discharge intervention providing follow up by home visits and telephone.17 This model was acceptable to patients and identified local gaps and opportunities for improving nutritional discharge care,
but was resource intensive. Informed by this experience and a multidisciplinary stakeholder group, we designed a quality improvement intervention to improve nutritional discharge planning and follow up within existing hospital and community resources. The aim was to introduce a dietitian-led discharge planning and follow-up program for malnourished or high malnutrition risk older patients admitted to internal medicine services of two hospitals, in order to improve nutritional and functional recovery measured six weeks after hospitalisation.

**Methods**

The study was undertaken within a metropolitan health service district which provides care to approximately one million people in northern Brisbane, Australia. Primary care services are provided by a large primary healthcare network and a range of non-government service providers. The study was conducted in the internal medicine wards of the two metropolitan hospitals, which together provide acute general medical inpatient services for about 8000 patients annually. Most patients are admitted via the emergency departments, the majority are aged over 65 years and both departments focus on interdisciplinary care and early discharge planning.

The baseline model of nutrition care has been described previously. Each hospital had approximately 0.5 full time accredited practising dietitians per 30-bed ward, with the dietitian role focused on inpatient malnutrition care. Beyond individual dietary counselling and prescription of ONS, the dietitian had little role in discharge planning. Each ward had a nursing case manager and access to a specialist discharge facilitation nurse. Existing roles and responsibilities for nutrition care are shown in Table 1.

An action research approach was used to engage clinicians and managers in the design and implementation of the Hospital to Home Outreach for Malnourished Elders (HHOME) program. Formal and informal consultation was undertaken with stakeholders from a range of disciplines (clinicians and managers from dietetics, nursing and medical streams), health care settings (hospital, community services and general practitioner (GP) networks) and consumer representative. The purpose of consultation was to identify service goals, current services and practices and barriers and enablers to nutritional discharge planning and follow up. A steering committee representing these stakeholders endorsed the proposed service model, identified and prioritised intervention strategies and supported their implementation.

The HHOME model is outlined in Table 1 and targeted patients aged 65 years and older being discharged to independent living in the community and identified at nutrition risk (as part of routine care using the Malnutrition Screening Tool). New roles for the ward dietitian included comprehensive nutrition discharge assessment and planning, liaison with nursing staff to identify and refer to appropriate community nutrition services if required and post-discharge dietitian follow up for all at-risk patients. Dietitian review within one week of hospital discharge was provided by telephone to the patient (and carer if identified as beneficial) by the ward dietitian already known to the patient. Where patients were referred to other post-acute dietetic services, they would instead receive a home visit by the dietitian of that team. The dietitian provided up to four weeks of nutrition-related case management to resolve new or existing nutritional issues. This included reassessment of nutritional intake and barriers experienced, review of nutrition goals and strategies, provision of further education and liaison with family/carers, GP, community service providers and/or hospital staff. A written summary of the telephone review was posted to the patient after each contact. Referrals were made to community service providers for nutrition-related cares (meal delivery, meal preparation, shopping assistance and ongoing dietitian review) as well as non-nutrition-related cares (e.g. personal hygiene assistance, nursing or other allied health review) as required. Three senior dietitians (AY, LR and KD) used action research cycles of ‘look, think, act’ and an enabling facilitation approach to support co-design and implementation of strategies with dietitians at each site over a six-month period, starting in mid-2013. Implementation challenges identified by stakeholders and dietitians were mapped to the COM-B-system, a behaviour change theory founded on the understanding that capability, opportunity and motivation interact to generate behaviours. Barriers to changing dietetic behaviours and routines related to capability (limited awareness of community nutrition services amongst dietitians and discharge nurses), opportunity (no system to support transfer of nutrition information to the community, no process to ‘book in’ outreach telephone calls to ensure appropriate funding allocated for this service) and motivation (limited confidence amongst dietitians in their ability to undertake post-discharge case management, perception that post-discharge care was of lower priority than traditional inpatient role). Figure 1 outlines the implementation strategies used to address these challenges.

A prospective before-and-after study design measured processes of nutrition care and outcomes in a cohort of older medical patients before (pre-HHOME cohort, recruited 2012–2013) and after (HHOME cohort, recruited 2014) implementation of the new model of care. Characteristics and outcomes of the pre-HHOME cohort have been reported previously, and the same inclusion criteria were used for the HHOME cohort. Consecutive patients admitted to the medical wards at each hospital were screened for inclusion. Patients were eligible if they were aged 65 years or older, had an inpatient stay of three or more days, were discharged back to the community within the local hospital district and were screened at-risk of malnutrition. Patients were excluded if receiving palliative care (expected prognosis <3 months), already receiving enteral or parenteral nutrition support or were assessed as well-nourished using mini nutritional assessment (MNA). Written informed consent was obtained from all participants or substitute decision maker where the patient could not provide consent themselves. The study was approved by Human Research Ethics Committee.
Participants were instructed to walk at their normal pace from a stopwatch precise to 0.1 seconds over a 4-m track, with neutral wrist position. Walk speed was measured with a digital watch. Assessments included whether the dietitian documented the following: nutrition assessment for at-risk patients, nutrition monitoring, delivery of prescribed snacks and supplements, and tailoring nutrition plan based on intake and preferences.

Discharge needs assessment
- Review of existing services and needs
- Dietary counselling and supply of oral nutrition supplements if required
- Referrals to community services as required
- Overall summary of presenting condition, diagnosis and management plan

Follow up in the community
- Referral for community dietitian services if required
- Provision of community services, including nutrition goals, barriers and strategies, written summary
- Telephone follow up at 1 week, case management for up to 4 weeks
- Referral for community dietitian services if ongoing follow up required
- Provision of community services, community dietitian review if required

Italic type represents changes to nutrition practices and/or responsibilities.

CS, community services; D, dietitian; DA, dietetic assistant; N, nurse; MO, medical officer.

1 Meal delivery services, shopping assistance, meal preparation assistance, personal hygiene assistance and visits by community nurses.

Committees of both hospitals (HREC/12/QRBW/159, 23 July 2012).

The primary outcomes were change in weight and MNA score at six weeks. Secondary outcomes were functional outcomes, including hand grip strength, walk speed, self-reported functional status using modified Barthel index (MBI), and health-related quality of life using assessment of quality of life-6D (AQoL-6D). Assessments were conducted by a trained research assistant (APD or medical registrar) at baseline (as close to hospital discharge as was practical) and repeated in the participant’s home six weeks post-discharge. MNA is a validated measure of nutritional status with a score <17 indicating malnutrition and 17–23.5 indicating risk of malnutrition. Weight was measured using a single Tanita HD351 scale, precise to 0.1 kg. Grip strength was defined as best of three measurements on dominant hand, using a single Jamar hydraulic dynamometer (second position) with participants seated (elbow by their side, flexed to right angle; neutral wrist position). Walk speed was measured with a stopwatch precise to 0.1 seconds over a 4-m track, with participants instructed to walk at their normal pace from a static start. AQoL-6D was completed by the participants, usually with assistance from the research assistant due to poor vision. As quality of life was introduced as an outcome mid-way, data are only available for 13 participants from the pre-HHOME group. Patient characteristics (age, gender, living arrangements, diagnosis and comorbidities) and length of hospital stay were collected from hospital records. Information about nutrition and community-based care was obtained from patients, carers and/or medical notes. Unplanned hospital readmission and mortality data were obtained from a state-wide hospital admissions database 12 weeks post-discharge to allow description of clinical outcomes of participants.

Data on nutrition care processes were obtained from medical records and discharge summaries of all participants by a student dietitian (blinded to intervention group) to determine fidelity of the intervention. Process measures included whether the dietitian documented the following: dietetic assessment of discharge needs, completion of nutrition discharge summary, prescription of ONS, post-discharge dietetic follow up and referral to nutrition-related community services.
Participant characteristics were described using standard summary statistics and compared between the pre-HHOME and HHOME cohorts. Analyses of nutritional and functional outcomes were conducted using intention-to-treat principles; that is, all available data from all participants were included in analysis regardless of whether they received the HHOME program as intended. Paired t-tests were used to assess differences in outcomes (weight, MNA score, grip strength, MBI, walk speed and overall quality of life) at baseline and six weeks post-discharge for each intervention cohort. Independent t-tests were used to compare the mean change in each outcome (from baseline to six weeks post-discharge) between the pre-HHOME and HHOME cohorts. Where variance was not normally distributed (MBI), a non-parametric equivalent was used (within-group change: Wilcoxon matched-pair signed-rank test, between group change: Mann-Whitney U-test). Based on pilot data, it was estimated that 48 participants were required for each group to show a difference of 2 points on the MNA (two-tailed, $\alpha = 0.05$, 80% power).

**Results**

Of 2578 older medical inpatients screened for inclusion in the evaluation, 202 were eligible and 80 consented to participate (pre-HHOME: $n = 39$, HHOME: $n = 41$; Figure 2). Participant characteristics are summarised in Table 2. Half of participants lived alone and half had been hospitalised in the previous six months. Overall, 41% of participants ($n = 33$) were malnourished (MNA $< 17$) with the remainder at-risk of malnutrition (MNA $= 17$–$23.5$) and 43% ($n = 34$) had some dependency with activities of daily living (MBI $< 90$). Participants had slow mean gait speed and poor grip strength at discharge. Cohorts had similar age, nutritional status and functional measures at baseline; comorbidity levels, weight and body mass index (BMI) were lower in the HHOME group.

Improved discharge care was seen for the HHOME group, with 100% of patients in this group assessed by the hospital dietitian for discharge needs (compared to pre-HHOME: 51%, $n = 20$). More HHOME participants had a nutrition care plan documented in the discharge summary (75% vs 33%), were prescribed ONS (90% vs 41%) and received post-discharge dietetic follow up at six weeks (88% vs 18%), compared with pre-HHOME. Of those who did not receive dietitian follow up ($n = 4$), three were readmitted to hospital before the scheduled review and one declined follow up. There was no significant difference between groups in regards to referrals to nutrition-related community services such as meal delivery, meal preparation and/or shopping assistance (pre-HHOME: 31%, HHOME: 38%).

Nutritional, functional and quality of life outcomes are shown in Table 3. Over the six-week post-discharge period, the HHOME cohort maintained average weight (mean difference: 0.4 kg (SD 2.9), $P = 0.48$), compared with mean weight loss of 1 kg (SD 3.7, $P = 0.06$) in the pre-HHOME group, with a non-significant between-group difference ($P = 0.06$). When weight change was calculated as a percentage of discharge weight (to account for a lower mean weight in the HHOME group at baseline), there was a significant difference in percentage weight change between the two groups (pre-HHOME: $-1.7%$ (SD 4.6%); HHOME: 0.1% (SD 5.3%), $P = 0.04$). MNA scores improved in both groups, with no difference observed between the pre-HHOME and HHOME groups. Walk speed improved in
both groups, with significantly greater improvement in the HHOME group. No significant difference was seen in grip strength, functional dependency or overall quality of life.

Length of hospital stay was significantly shorter in the HHOME group (pre-HHOME: 9 days (interquartile range, IQR 4–14), HHOME: 6 days (IQR 5–19), P = 0.047). Over the 12-week post-discharge period, 49% of participants (n = 39) had at least one unplanned hospital admission (pre-HHOME: 15 (48%), HHOME: 24 (59%), P = 0.073), with nine participants having ≥2 hospital admissions. By 12 weeks post-discharge, three participants (4%) were admitted to residential aged care facilities (pre-HHOME: 1, HHOME: 2) and eight participants (10%) had died (pre-HHOME: 4, HHOME: 4).

**Discussion**

Previous controlled trials suggest that nutritional discharge planning and post-discharge follow up may improve

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**Table 2** Baseline patient characteristics of the pre-HHOME and HHOME cohorts

<table>
<thead>
<tr>
<th></th>
<th>Pre-HHOME (n = 39)</th>
<th>HHOME (n = 41)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean years (SD)</td>
<td>81.9 (7.9)</td>
<td>82.7 (8.6)</td>
<td>0.65</td>
</tr>
<tr>
<td>Male, n (%)</td>
<td>15 (39)</td>
<td>11 (27)</td>
<td>0.27</td>
</tr>
<tr>
<td>Living alone, n (%)</td>
<td>21 (54)</td>
<td>18 (44)</td>
<td>0.37</td>
</tr>
<tr>
<td>Hospital admission in previous six months, n (%)</td>
<td>22 (56)</td>
<td>21 (51)</td>
<td>0.64</td>
</tr>
<tr>
<td>Primary diagnosis, n (%)</td>
<td></td>
<td></td>
<td>0.59</td>
</tr>
<tr>
<td>Infection</td>
<td>9 (23)</td>
<td>13 (32)</td>
<td></td>
</tr>
<tr>
<td>Fall or fracture</td>
<td>5 (13)</td>
<td>5 (12)</td>
<td></td>
</tr>
<tr>
<td>Cardiorespiratory</td>
<td>5 (13)</td>
<td>6 (15)</td>
<td></td>
</tr>
<tr>
<td>Neurological</td>
<td>6 (15)</td>
<td>2 (5)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>14 (34)</td>
<td>15 (37)</td>
<td></td>
</tr>
<tr>
<td>Charlson comorbidity score, mean (SD)</td>
<td>2.0 (1.1)</td>
<td>1.3 (0.9)</td>
<td>0.006</td>
</tr>
<tr>
<td>Weight on discharge, kg, mean (SD)</td>
<td>64.3 (14.9)</td>
<td>56.0 (13.2)</td>
<td>0.011</td>
</tr>
<tr>
<td>BMI on discharge, kg/m², mean (SD)</td>
<td>23.1 (5.2)</td>
<td>21.2 (2.5)</td>
<td>0.02</td>
</tr>
<tr>
<td>MNA score¹ on discharge, mean (SD)</td>
<td>17.6 (4.1)</td>
<td>17.1 (3.5)</td>
<td>0.54</td>
</tr>
<tr>
<td>Grip strength on discharge, kg, mean (SD)</td>
<td>20 (8)</td>
<td>18 (9)</td>
<td>0.42</td>
</tr>
<tr>
<td>MBI score² on discharge, median (IQR)</td>
<td>92 (20)</td>
<td>90 (15)</td>
<td>0.77</td>
</tr>
<tr>
<td>Walk speed on discharge, m/s, mean (SD)</td>
<td>0.64 (0.26)</td>
<td>0.56 (0.20)</td>
<td>0.13</td>
</tr>
</tbody>
</table>

BMI, body mass index; HHOME, Hospital to Home Outreach for Malnourished Elders; IQR, interquartile range; SD, standard deviation. ¹ MNA: mini nutritional assessment (score from 0 to 30); score <17 indicating malnutrition, score 17–23.5 indicating malnutrition risk. ² MBI: modified Barthel index (score from 0 to 100); score <90 indicating at least moderate dependence.
Table 3 Nutritional and functional outcomes at discharge and six weeks post-discharge of the pre-HHOME (n = 34) and HHOME (n = 34) cohorts

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pre-HHOME (n = 34)</th>
<th>HHOME (n = 34)</th>
<th>Intervention effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight, kg, mean (SD)</td>
<td>32 65.1 (14.8)</td>
<td>34 56.4 (12.9)</td>
<td>0.4 (2.9) 0.482 0.040</td>
</tr>
<tr>
<td>MNA score, median (SD)</td>
<td>32 19.6 (3.9)</td>
<td>34 16.9 (3.5)</td>
<td>0.3 (3.4) 0.001 0.609</td>
</tr>
<tr>
<td>Grip strength, kg, mean (SD)</td>
<td>32 20.1 (8.3)</td>
<td>33 19.1 (8.3)</td>
<td>0.1 0.794 0.219 0.428</td>
</tr>
<tr>
<td>MBI score, median (IQR)</td>
<td>34 97 (89–100)</td>
<td>34 90 (85–100)</td>
<td>N/A 0.195 0.109 0.862</td>
</tr>
<tr>
<td>4-m walk speed, m/s, mean (SD)</td>
<td>30 0.69 (0.23)</td>
<td>29 0.55 (0.20)</td>
<td>0.05 (0.17) 0.000 0.046</td>
</tr>
<tr>
<td>Overall QoL, mean (SD)</td>
<td>13 0.57 (0.23)</td>
<td>28 0.63 (0.20)</td>
<td>0.122 0.639</td>
</tr>
</tbody>
</table>

AQoL-6D, assessment of quality of life-6D; HHOME, Hospital to Home Outreach for Malnourished Elders; IQR, interquartile range; SD, standard deviation.
1 Paired t-test (or Wilcoxon matched-pair signed-rank test) comparing discharge and six weeks outcomes.
2 Independent t-test (or Mann–Whitney U-test) comparing change in outcomes between the pre-HHOME and HHOME cohorts.
3 MNA: mini nutritional assessment (score from 0 to 30); score <17 indicating malnutrition, score 17–23.5 indicating malnutrition risk.
4 MBI: modified Barthel index (score from 0 to 100); score <90 indicating at least moderate dependence.
5 QoL: quality of life, measured using the AQoL-6D (score from 0 to 1, higher score indicating a higher health-related QoL).

What can we learn from these studies? First, post-discharge dietetic support and follow-up likely improves discharge outcomes for older adults, weight gain and reduced mortality. This aligns with the finding of Sharma et al. in their post-discharge nutrition intervention, suggesting a possible intervention effect. Our results are generally consistent with other studies of hospital nutrition interventions. The Australian randomised controlled trial of post-hospital nutrition interventions described a reduced length of stay, perhaps reflecting earlier discharge planning and increased follow-up care. The randomised controlled trial of post-hospital nutrition interventions in the present study showed an increase in weight gain and a trend to reduced functional limitations but no change in mortality. Similar to the present study, they found a trend to increased reductions in functional status, perhaps reflecting earlier intervention.

Future trials with a focus on long-term nutrition intervention may help to verify this hypothesis. Second, we have shown that enhanced recovery of nutritional status within six months, discharge dietetic support and follow-up likely improves discharge outcomes for older adults, weight gain and reduced mortality. This aligns with the finding of Sharma et al. in their post-discharge nutrition intervention, suggesting a possible intervention effect. Our results are generally consistent with other studies of hospital nutrition interventions. The Australian randomised controlled trial of post-hospital nutrition interventions described a reduced length of stay, perhaps reflecting earlier discharge planning and increased follow-up care. The randomised controlled trial of post-hospital nutrition interventions in the present study showed an increase in weight gain and a trend to reduced functional limitations but no change in mortality. Similar to the present study, they found a trend to increased reductions in functional status, perhaps reflecting earlier intervention.

Improvements in weight and body composition following hospitalisation have been associated with reductions in mortality and hospital readmissions. A recent meta-analysis of 33 randomised controlled trials found that nutritional interventions reduced mortality by 40% and readmissions by 20%. The most effective interventions included individualised nutrition planning and discharge planning, telephone follow-up and nutrition education. The present study is the first to evaluate the impact of a comprehensive post-discharge nutrition intervention on weight gain and functional outcomes. Our results suggest that such interventions may be effective in improving weight gain and functional outcomes following hospital discharge.

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hospital dietetic practice, although the background work required to identify and liaise with community-based services and other partners should not be underestimated and requires continuing efforts within evolving systems. For example, the recent introduction of Consumer Directed Care will help to focus more on patient goals, but may require significant information and advocacy from referring practitioners especially in vulnerable patient groups like these malnourished elders to ensure services are well matched to needs and preferences. Third, studies with structured individualised discharge planning focus may reduce length of hospital stay. Finally, these studies clearly enrol a frail and multi-morbid group where a nutrition-focussed intervention alone is unlikely to address underlying health needs. Broader consideration of patients’ needs and incorporation of these into tailored, multifaceted and multidisciplinary interventions are likely required to achieve meaningful functional and clinical outcomes for patients.

The strength of this study is that the HHOME program was implemented and evaluated in usual clinical practice, allowing us to observe its effects within the context of a complex health system. This pragmatic design does present a number of limitations. First, the systematic approach to changing nutrition practice meant that a randomised controlled trial design was not possible and some of the observed outcome difference may have been explained by differences in baseline characteristics between groups. The pre–post design means that intervention delivery and/or outcomes may have been affected by a change in the health system beyond the intervention. For example, the shorter length of stay and higher readmission rates in the HHOME group may reflect other changes in the organisation related to patient flow; however, these findings have been reported in other randomised controlled trial designs, suggesting that an intervention effect is possible. As the intervention was delivered by up to 10 different dietitians as part of their usual practice, there may have been variability in intervention delivery although standardised resources were used to enhance fidelity. Research assistants involved in outcome measurement were not involved in design or delivery of the intervention but were aware of the HHOME program and the pre–post design. It is possible that the six-week follow-up period was too short to observe significant improvement in nutritional and functional after acute hospitalisation, with other studies showing some benefits at 12 weeks post-discharge. We did not assess individual adherence to post-nutrition support strategies such as supplements. Finally, our sample size was below target despite recruitment sites with large volumes of older medical inpatients and inclusive eligibility criteria, resulting in limited power. Our eligibility and recruitment rates were lower than anticipated, but similar to or better than other nutrition intervention studies, highlighting the challenge of conducting rigorous research in this complex patient group. This was also reflected in the inability for some participants to complete all measures due to functional limitations, leading to missing data.

In conclusion, introducing enhanced nutritional discharge planning and post-discharge dietetic follow up may reduce weight loss for older medical patients at-risk of malnutrition, but this low intensity dietitian-only intervention may not be enough to significantly improve clinical outcomes. Future research should consider evaluating more intensive post-discharge nutrition programs and/or programs where nutrition is included as one element of a multicomponent approach to improve functional and quality of life outcomes in this vulnerable patient subgroup. Large studies with adequate follow-up measuring outcomes of importance to patients are needed, recognising that recruitment to such trials is challenging.

Funding source
This study was supported by Queensland Health (QH) Allied Health Professions Office of Queensland Models of Care funding and Australian Centre for Health Service Innovation Project Grant. The sponsors had no role in study design, analysis or manuscript preparation.

Conflict of interest
The authors have no conflicts of interest to declare.

Authorship
AY, AM, MB and EI conceived and designed the study; AMY, LR and KD supported the implementation of the interventions; AY conducted data analysis; AY, AM, MB, KD and EI interpreted the data; AY drafted the manuscript; all authors provided critical review of the manuscript and read and approved the final manuscript. This research has not been published elsewhere.

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Influence of grandparents on the dietary intake of their 2–12-year-old grandchildren: A systematic review

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Abstract
Aim: Grandparents are assuming increased child-caregiving responsibilities, which potentially influences the dietary intake of grandchildren. The aim of this systematic review is to determine the influence of grandparental care on the dietary intake, food-related behaviours, food choices and weight status of their preschool and school-aged grandchildren.

Methods: Six electronic health databases were searched in January 2017. Inclusion criteria were publication in English language, peer-reviewed journal between 2000 and 2017; children aged 2–12 years; study outcomes included child dietary intake/weight status, grandparent nutrition knowledge/beliefs or grandparent/parent feeding practices. Included studies were appraised for quality and bias. The review was registered with PROSPERO, number CRD42016047518.

Results: Sixteen studies were identified in the review, published between 2007 and 2016, with 15 assessed as moderate or high quality. Nine studies reported grandparental child feeding attitudes and behaviours that are considered to negatively influence child dietary intake, while three studies identified positive influences. Seven studies identified that differences in child feeding attitudes and behaviours between parents and grandparents created conflict and tensions between caregivers, often resulting in poor feeding practices. Statistically significant positive associations (odds ratio 1.47–1.72) between grandparent cohabitation and increased rates of child overweight and obesity were found in four studies.

Conclusions: Grandparents in caregiving roles may negatively influence the dietary intake and weight status of their grandchildren. More rigorous, targeted studies are required to further define the mechanisms by which grandparents’ knowledge, attitudes and feeding behaviours may influence child dietary intake. This review suggests that grandparents may be an important audience to target in future child nutrition interventions.

Key words: child feeding, dietary intake, grand/child, grand/parent/mother/father.

Introduction
Optimal childhood nutrition enhances wellbeing and the achievement of physical and developmental milestones.1,2 Early-life and ongoing consumption of a diet rich in energy-dense nutrient-poor foods and low in vegetables and fruits increases risk of obesity and chronic disease in adulthood3–5 and thereby impacts substantially on quality of life.6

The prevalence of childhood overweight (25%) and obesity (8%) in Western countries7–10 represents a significant public health issue, with an additional 50% of healthy weight children likely to become overweight or obese adults, based on current prevalence of combined overweight and obesity of 70% for males and 56% for females.10 Understanding of the most effective means by which to prevent unhealthy weight gain in children remains relatively poor.11–15

According to Davison and Birch’s socio-ecological model of the determinants of child weight status,16 a child’s dietary intake is determined by a combination of proximal factors related to parenting styles and family characteristics and more distal factors related to the child’s community, demographic and societal characteristics.16 For example, the increased proportion of families with two working parents17 includes fewer family meals, less frequent encouragement of healthful eating, lower vegetable and fruit intake, less time spent on food preparation and more frequent sugar-sweetened beverage and fast food consumption.18 Employment participation by both parents has resulted in half of the children under the age of 12 years in Australia receiving child care, and the high cost and low accessibility of formal child care means that half of these children are cared for by grandparents.19 The trend towards grandparent-provided

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child care also applies internationally, with reported rates of grandparental caregiving of approximately 40% to 58%.

The impact of grandparental caregiving on child feeding becomes more direct and influential as their caregiving role with grandchildren increases. Previous research has shown that parent attitudes, beliefs and feeding practices have a significant influence on child dietary intake and weight status. In general, the existing evidence suggests that improved child dietary intake and lower risk of child overweight are associated with high parental responsibility for feeding and monitoring of food provision and consumption, but without pressuring the child to eat the food provided, and without overt (obvious) food restriction. This delineation of child feeding responsibility is referred to as the ‘caregivers/parent provide, children decide’ philosophy. As grandparents take increasingly responsible roles in the lives of their grandchildren, it could reasonably be assumed that their attitudes, beliefs and feeding practices may have a similarly significant influence on child dietary intake and weight status.

As the increase in child care provided by grandparents is a very recent phenomenon in many countries, little rigorous research has been performed that focuses primarily on the influence grandparents may have on child dietary intake and weight status. While a large number of studies have examined the influence of various familial factors on child dietary intake or weight status, the vast majority of these have focused primarily on parents, with a small number reporting outcomes relating to grandparents only as a secondary focus.

The predominance of studies conducted on grandparental influences on child feeding or nutritional status relates to grandparents raising grandchildren in households without a parent generation, in which grandparents assume a parent-like role, or three-generation families in cultures or socio-economic groups where this family structure is more common. It is therefore difficult to ascertain whether the cultural or socio-economic factors or three-generation household structure influence child health outcomes.

The aim of this systematic review is to determine the influence of grandparental care on the dietary intake, food-related behaviours and weight status of their preschool and school-aged grandchildren. It is hypothesised that grandparents in caregiving roles do not alter their child-feeding practices to match their level of responsibility for child feeding, but continue to exert indulgent and permissive child feeding practices, and therefore the proportion of care provided by grandparents will significantly influence child dietary intake, food-related behaviours and weight status.

Methods

A search of health and medical literature was conducted using CINAHL, Medline, Embase, PsychINFO, Proquest and the Cochrane Library to identify literature published about the role of grandparents in child feeding. Google Scholar was searched using the same search terms and date range (automatically sorted by relevance) to check for any publications not identified in the database searches. The Google Scholar search concluded when no titles within the previous 50 most relevant were considered possible for inclusion. The search terms were grouped within three domains, that had been established based on relevant MeSH terms for the review question:

1. grandparents (grandparent, grandmother, grandfather, grandmaternal, grandpaternal)
2. dietary intake (dietary intake, nutrition, feeding, food choice, eating habits)
3. child (child, children, grandchild)

Titles and abstracts of the papers identified in the initial search were independently screened for possible inclusion by two reviewers (KGY, KD), with discrepancies referred to a third reviewer (TB). Full-text versions of all relevant papers were obtained and assessed against the inclusion criteria by both reviewers. The reference lists of all identified relevant studies were hand-searched for additional relevant articles.

Inclusion criteria: The review considered both experimental and epidemiological study designs including randomised controlled trials (RCTs), non-RCTs, quasi-experimental, prepost studies, prospective and retrospective cohort studies, case–control studies, analytical or descriptive cross-sectional studies, systematic reviews and qualitative studies. Inclusion criteria were English language studies (due to time and cost factors) published between January 2000 and 31 January 2017 that related to associations between nutrition knowledge and beliefs or feeding practices of grandparents in child-care roles for children aged 2–12 years and child dietary intake, weight status or food-related behaviours of those children. The search start date was chosen based on the increase in awareness, research and scientific reporting about child overweight and obesity in the early 2000s, and age range selected based on the relative stability of influences on child dietary intake within this age range compared to the relative instability of diet in children under age 2 and the little influence of caregivers on intake of adolescents (>12 years). Studies were included if more than 80% of participants were aged between 2 and 12 years and the focus of the study was child feeding rather than infant or adolescent feeding and eating behaviours.

Exclusion criteria: Studies were excluded if they focused on infant feeding, breastfeeding, infant weaning or introduction to solids. Studies in which grandparents were primary caregivers without parent cohabitation (or were not differentiated from parents in relation to child feeding) were excluded because the primary caregiver role alters the feeding relationship between grandparent and grandchild. Research conducted in a country listed on the United Nations list of less developed countries was not considered for inclusion due to differing child feeding priorities in such countries.

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Quality appraisal and risk of bias: Papers were assessed independently by two reviewers according to the established eligibility criteria. Disagreement between investigators was resolved by consensus, with the third reviewer not required to adjudicate. All articles remaining after the selection process were critically appraised for quality (including risk of bias) using relevant tools (Critical Appraisal Skills Programme (CASP) for qualitative observational studies,27 Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) for quantitative observational and experimental studies28 and CASP for RCTs.29 Each article was scored as low, moderate or high quality according to the number of criteria in the tool or checklist that were met (0–50% of criteria met = low, 51–74% of criteria met = moderate, 75–100% of criteria met = high) (Table S1, Supporting Information). Where disagreement regarding the quality of an article occurred between reviewers, the two reviewers discussed results and consensus was reached. The available third reviewer was not required to resolve disagreement. Articles that received a low-quality score were not excluded from the review, but this was taken into consideration in the data analysis.

Data collection: An evidence table summarising the results of the included studies was populated using data from the included studies (Table 1). The results of individual studies were extracted from papers into this table, including statistical significance of results where available.

Data analysis/synthesis: The characteristics of quantitative studies with equivalent measures were assessed for potential meta-analysis of child body mass index (BMI), but this was not conducted due to study heterogeneity.30 The quantitative results were therefore presented in narrative, tables and figures and aligned with qualitative findings that had been pooled into the following topic areas relating to the research question: grandparent attitudes and feeding behaviours; grandparent influence on parent attitudes and feeding behaviours; and association between grandparent caretaking and child weight status. Some studies reported outcomes relating to more than one topic area.

Outcomes that related to grandparents' child feeding practices were classified as positive or negative influences by the authors based on the existing evidence base relating to child feeding practices and child health outcomes. Positive influences were defined as evidence or examples of grandparental responsibility for child feeding and monitoring of food consumption and 'negative' included pressure to eat, coercion and overt food restriction.

This systematic review did not require the identification of any personal information and therefore did not require Institutional Review Board approval. The review protocol was registered with PROSPERO under the registration number CRD42016047518. The PRISMA reporting checklist and flowchart31 were used as the basis for reporting.

Results
A total of 483 studies were identified through the search strategy, with 83 full-text articles retrieved, of which 16 studies met the inclusion criteria and were included in the review (Figure 1).32–47

The reasons for exclusion at each stage in the search are outlined in Figure 1. Of the 16 included studies, seven were qualitative studies,32,34,35,33,37,35,39,44,46 eight were quantitative studies,34,36,38,40,42,45,47 and one was a mixed methods study.39 Studies were published between 2007 and 2016 in the USA (n = 6),33,37,40,42,45,46 China (n = 3),35,38,39 Greece (n = 2),36,41 Australia (n = 2),43,44 Canada (n = 2)32,33 and Japan (n = 1).37 Studies included in the review included grandparents as the primary study population (n = 2),45,46 children as the primary study population (n = 5)36,40–42,47 or a combination of grandparents, parents and children (n = 9).32,33,37–39,43,44 The studies therefore included a range of family structures, cultural groups and food availability. Six studies included households that contained three generations,35,38–41,47 and the level of involvement of grandparent in child feeding ranged from organised care on at least a weekly basis to provision of most meals.

The total number of subjects reported were 13 366, including 6902 children from 10 studies,33,36,40–44,47 of whom 3517 (51%) were boys. Reported parent participant numbers were 492 (from 12 studies),32–34,37–41,43,46 of whom 61 (1.4%) were males. Nine studies reported a total of 1972 grandparents,33–35,36,40,43,45,46 of whom 31 (<1%) were males (from five studies). The mean age of children was reported in four studies33,34,41,42 and was 6.9 years, and 28% of children were reported as overweight or obese across six studies that reported weight status.32,33,36,40–42,47 Mean parent age was 34 years across five studies32–34,37,45 and mean age of grandparent 55 years from three studies.33,34,45 Parents were predominately high school but not university educated, and of low to medium socio-economic status from a range of Anglo-Saxon, Hispanic, African American, Asian, Mediterranean and European backgrounds.

Of the 16 included studies, eight were assessed to be of high quality,34,35,38–41,43,45,47 eight of moderate quality32,33,36,37,42,44,46 and one of low-moderate quality35 based on the relevant quality/risk of bias tools to study type (Table S1). Variability in the reporting of study methodology was the main factor differentiating study quality between papers. The results of individual studies were extracted and are summarised in Table 1.

Grandparent attitudes and feeding behaviours: Three studies identified that grandparents demonstrated positive feeding behaviours towards their grandchildren.34,43,45 These behaviours included providing a healthy food environment by role-modelling healthy food intake, teaching children about nutrition and involving them in mealtimes and cooking, while also allowing children more control and input into meal times and healthy food choice,34 monitoring and encouraging children to eat nutritious foods such as fruit.
<table>
<thead>
<tr>
<th>Author (year), country</th>
<th>Study type or methodology/Year of study/recruitment</th>
<th>Inclusion criteria/demographic measures</th>
<th>Subject characteristics</th>
<th>Method of diet/health measurement</th>
<th>GP feeding</th>
<th>Overall results</th>
<th>Significance</th>
<th>Study quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farrow (2014), England</td>
<td>Type: Cross-sectional</td>
<td>Inclusion: Parents of PS-aged children, GP involved in non-custodial care of PS-aged GC</td>
<td>Subjects: 50 parents (one male), 50 GP (11 male), 100 children (47 male)</td>
<td>CFPJ structured validated questionnaire</td>
<td>GP involvement in family meals, GP feeding practices</td>
<td>GP involvement in family meals (Quantitative)</td>
<td>$P &lt; 0.01$ for 8 measures</td>
<td>High</td>
</tr>
<tr>
<td>Hassapidou et al. (2009), Greece</td>
<td>Type: Cross-sectional</td>
<td>Inclusion: Child aged 8–12 years</td>
<td>Subjects: 266 children (130 male), 30 immigrant Child age: 8–12 years GP contact with GC: Not reported</td>
<td>Dietary intake 24-hour recall, one-week FFQ Anthro: weight, height, waist and hip circumference, 5 skinfolds</td>
<td>GP involvement in family meals, Child dietary intake, Child BMI</td>
<td>GP involvement in family meals (Quantitative)</td>
<td>More obese children reported food preparation by grandmother vs normal weight children (40% vs 10.2%, $P = 0.006$)</td>
<td>Moderate</td>
</tr>
<tr>
<td>Li et al. (2014), China</td>
<td>Type: Cross-sectional</td>
<td>Inclusion: Parents of children from randomly selected Year 3 classes from each included school</td>
<td>Subjects: 497 parents (45.9% lived with at least one GP, 17.6% had GP as main carer)</td>
<td>FFQ and Health Behaviours (validated), anthropometric measures, Godin leisure-time exercise questionnaire, BMI</td>
<td>GP feeding practices, Child dietary intake, Child BMI</td>
<td>Child BMI (Quantitative)</td>
<td>GP carer and overweight; OR 2.03</td>
<td>High</td>
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<tr>
<th>Author (year), country</th>
<th>Study type or methodology/Year of study/recruitment</th>
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<th>Subject characteristics</th>
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<th>GP feeding</th>
<th>Overall results</th>
<th>Significance</th>
<th>Study quality</th>
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</thead>
<tbody>
<tr>
<td>Moschonis et al (2010), Greece</td>
<td>Type: Cross sectional When: 2007 Recruitment: Healthy Growth Study sample</td>
<td>Inclusion: Child aged 9–13 years in Healthy Growth Study Exclusion: Not reported Other measures: BMI, parent's age, parent educational level, nationality, family mean annual income, family residence ownership, family size, primary caregiver, parental marital status, child 'popularity' score</td>
<td>Subjects: 729 children (52% male) Structured questionnaire and anthropometric measures Child BMI</td>
<td>Child BMI (Quantitative)</td>
<td>GP primary carer and overweight OR 1.53</td>
<td>High</td>
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Children who lived with two or more GPs in household more likely to be overweight or obese than children who did not live with any GP (adjusted OR 1.72 (95% CI 1.00–2.94))

Child dietary intake (Quantitative)

Children who were mainly cared for by GPs more likely to consume more sugar added drinks and unhealthy snacks (Coefficient B 2.13 (95% CI 0.87–3.40))
<table>
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<tr>
<th>Author (year), country</th>
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<th>Study of recruitment</th>
<th>Inclusion criteria/demographic measures</th>
<th>Subject characteristics</th>
<th>Method of diet/health measurement</th>
<th>GP feeding</th>
<th>Overall results</th>
<th>Significance</th>
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<tr>
<td>Pulgarón et al. (2013), USA</td>
<td>Type: Cross sectional</td>
<td></td>
<td>Inclusion: Study child 5–12 years, Hispanic descent</td>
<td>Subjects: 199 children (53% female, 100% Hispanic)</td>
<td>54 item Structured questionnaire and anthropometric measures</td>
<td>GP involvement in family meals, GP feeding practices, GP influence on parent feeding practices, Child BMI</td>
<td>Child BMI (Quantitative)</td>
<td>Children who had GP involved in caretaking did not have significantly different zBMI scores than no GP involved</td>
<td>GP involved and negative eating $P = 0.02$</td>
</tr>
<tr>
<td></td>
<td>When: Not reported</td>
<td></td>
<td>Exclusion: Medical condition that affected eating habits</td>
<td>Child age: Mean years (SD): 7.8 (1.7)</td>
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<td></td>
<td>Recruitment: Elementary school, Miami</td>
<td></td>
<td>Other measures: BMI, Demographics, grandparent involvement in caretaking, feeding and physical activity practices. Negative eating, sedentary activity and level of disagreement between parent and GP</td>
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<tr>
<td>Speirs et al. (2009), USA</td>
<td>Type: Cross sectional</td>
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<td>Inclusion: Parents eligible for food stamps, over 18 years old, with at least one child aged 2–6 years. Grandmother of eligible mother and caring for child at least once weekly</td>
<td>Subjects: 44 mothers, 18 grandmothers</td>
<td>Separate structured food purchasing, food provision questionnaires for parents and GM</td>
<td>GP involvement in family meals, GP feeding practices, GP nutrition knowledge and attitudes</td>
<td>GP involvement in family meals (Quantitative)</td>
<td>Not reported</td>
<td>High</td>
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<tr>
<td></td>
<td>When: 2008</td>
<td></td>
<td>Exclusion: Grandmother not primary carer</td>
<td>Mean age: 30 years (mothers), 53 years grandmothers</td>
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<td></td>
<td>Recruitment: Convenience sample from SNAP-Ed and EFNEP studies</td>
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<td>Other measures: Ethnicity, education level, marital status</td>
<td>Ethnicity: Mothers (68% African American, 23% White, 9% other) Grandmothers (72% African American, 28% White); Socioeconomic: Low Education: 50% High school or less</td>
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<th>GP feeding</th>
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<th>Significance</th>
<th>Study quality</th>
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<tr>
<td>Watanabe et al. (2011), Japan</td>
<td>Type: Cross sectional</td>
<td>Inclusion: Primary caregivers of children aged 3–6 years who attended all child care</td>
<td>Subjects: 1765 children (910 boys, 52%)</td>
<td>Child age range: 3–6 years</td>
<td>Child dietary intake, Child BMI</td>
<td>Three generations households and overweight, OR 1.99</td>
<td>Three-generation families were associated negatively with irregular meal times after adjustment for children's characteristics and family environments (OR 0.74 (0.59, 0.94))</td>
<td>High</td>
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<tr>
<td></td>
<td>Recruitment: Child care</td>
<td>Exclusion: Not reported</td>
<td></td>
<td>Structured self-administered questionnaire, anthropometric measures</td>
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<td></td>
<td>Methodology: Quantitative</td>
<td>Other measures: Child weight and height, family environments (family members, maternal employment, single parent, number of siblings and parental weight status) and lifestyles (dietary, physical activity and sleeping habits)</td>
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<td></td>
<td>Intervention: Nil</td>
<td>GP contact with GC: All three-generation households</td>
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<td>Marital status: 34% mothers and 50% GM married</td>
<td>GP contact with GC: 70% more than 11 hours Child care/week, 83% involved in food preparation, 51% contributed to food costs of GC</td>
<td>GP feeding practices (Quantitative)</td>
<td>75% reported always or almost always serving vegetables for their evening meal. Half of GM and mothers classified as low or very low food security</td>
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<td>27% of mothers and GM reported eating fruit more than once per day, and 45% reported eating vegetables more than once per day</td>
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<td></td>
<td></td>
<td></td>
<td>GP nutrition knowledge and attitudes (Quantitative)</td>
<td>Over 80% of mothers and grandmothers aware of importance of fruits and vegetables for their children/GC</td>
<td></td>
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<tr>
<td>Author (year), country</td>
<td>Study type or methodology/Year of study/recruitment</td>
<td>Inclusion criteria/demographic measures</td>
<td>Subject characteristics</td>
<td>Method of diet/health measurement</td>
<td>GP feeding</td>
<td>Overall results</td>
<td>Significance</td>
<td>Study quality</td>
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<tr>
<td>Li et al. (2015), China</td>
<td>Type: Mixed methods; Recruit: School staff (health monitoring program)</td>
<td>Inclusion: Parents of children from randomly selected Year 3 classes from each included school; Exclusion: Not reported</td>
<td>Subjects: 25 parents (14 male); 24 GP (12 male), 50 other (16 males); Child age range (years): 8–10</td>
<td>Semi-structured interviews, structured validated questionnaire, anthropometric measures</td>
<td>GP involvement in family meals, GP feeding practices, GP influence on parent feeding practices, GP nutrition knowledge and attitudes, Child dietary intake, Child BMI</td>
<td>Child BMI (Qualitative)</td>
<td>GP carer and overweight, OR 2.03</td>
<td>High</td>
</tr>
<tr>
<td>Dwyer et al. (2008), Canada</td>
<td>Type: Qualitative; Recruit: Child care</td>
<td>Inclusion: Parent of child age 2–5 years; English speaking; Child care used ≥3 months; Exclusion: Not reported</td>
<td>Parent age: (mean years ± SD), Mother: 35.3 ± 3.7 years, Father: 39.0 ± 11.0 years</td>
<td>Semi structured parent interviews</td>
<td>GP involvement in family meals, GP feeding practices, GP influence on parent feeding practices</td>
<td>NA</td>
<td>Moderate</td>
<td></td>
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<tr>
<td>Eli et al. (2016), USA, Canada</td>
<td>Type: Qualitative</td>
<td>Inclusion: At least one parent and one GP willing to be interviewed; Age 2–3 years; English speaking; Child care used ≥3 months; Exclusion: Not reported</td>
<td>Subjects: 16 children, 22 parents, 27 GP</td>
<td>Semi structured interviews</td>
<td>GP nutrition knowledge and attitudes, GP influence on parent feeding practices</td>
<td>NA</td>
<td>Moderate</td>
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**Table 1 Continued**
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<tr>
<th>Author (year), country</th>
<th>Study type/methodology/Year of study/recruitment</th>
<th>Inclusion criteria/demographic measures</th>
<th>Subject characteristics</th>
<th>Method of diet/health measurement</th>
<th>GP feeding</th>
<th>Overall results</th>
<th>Significance</th>
<th>Study quality</th>
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</thead>
<tbody>
<tr>
<td>Goh EC (2013), China</td>
<td>Type: Qualitative</td>
<td>Inclusion: Child aged 6–9 years, GP involved in feeding Exclusion: Not reported</td>
<td>Subjects: 39 parents (19 male, 18 GP (8 male), 20 children (10 male)) Child age range: 6–9 years</td>
<td>In-depth interviews</td>
<td>GP involvement in family meals, GP feeding practices, GP influence on parent feeding practices, Child dietary intake</td>
<td>NA</td>
<td>Low</td>
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<tr>
<td></td>
<td>Recruitment: Local newspaper</td>
<td></td>
<td>Parent: 32.2 (23–50); GP: 56.9 (43–78) Child mean BMI percentile (range): 74.6 (22–99)</td>
<td>Familial homeostasis theoretical perspective</td>
<td></td>
<td>differing definitions of healthy feeding</td>
<td>GP influence on parent feeding practices (Qualitative) Differences between parents’ and GPs CFP reflect differences in perceived caretaking roles Parents and GP negotiate differences in CFP through GP compliance and parental compromise</td>
<td></td>
</tr>
<tr>
<td>Johnson et al. (2010), USA</td>
<td>Type: Qualitative</td>
<td>Inclusion: Low-income women, at least 1 child &lt;18 years in household Exclusion: Not reported Other measures: Highest completed education, car ownership, income, food assistance, household composition, age (mother)</td>
<td>Subjects: 7 mothers Mean age in years (range): 37 (26–42) Ethnicity: 5 non-Hispanic, 2 Hispanic Income: 5 &lt; US$25K, 2 US $25K–US$35K Education: 100% high school, 0% higher education</td>
<td>Semi-structured interviews</td>
<td>GP influence on parent feeding practices</td>
<td>NA</td>
<td>Moderate</td>
<td></td>
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<tr>
<td></td>
<td>When: 2008</td>
<td></td>
<td>GP contact with GC: 80% 2 GP in household, 20% 1 GP household</td>
<td></td>
<td>GP feeding practises</td>
<td></td>
<td>GP placed high importance on child finishing meals; Parents more liberal Differences in CFP created conflict between caregivers in three-generational families compared to nuclear households Children in multigenerational families more frequently force fed by caregivers, nuclear family children more capable of self-feeding</td>
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<tr>
<td></td>
<td>Recruitment: Telephone</td>
<td></td>
<td>Employment: 100% parents employed outside home</td>
<td></td>
<td>GP influence on parent feeding practices (Qualitative)</td>
<td></td>
<td>GP influence on parent feeding practices (Qualitative)</td>
<td>Mother or other female relation has a major influence on a daughter’s family food choices, even when the mother is no longer present.</td>
</tr>
<tr>
<td>Author (year), country</td>
<td>Study type or methodology/Year of study/recruitment</td>
<td>Inclusion criteria/demographic measures</td>
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<tr>
<td>Rhodes et al. (2016), Australia</td>
<td>Type: Qualitative</td>
<td>Inclusion: One or more child 7–18 years, one parent, and one grandparent. Family identified as English speaking, Chinese or Italian background with at least one participant first generation migrant to Australia</td>
<td>Subjects: 35 children (14 male), 43 parents (14 male), 36 GP (12 male)</td>
<td>Semi structured interviews</td>
<td>GP involvement in family meals, GP feeding practices, GP influence on parent feeding practices, GP nutrition knowledge and attitudes, Child dietary intake</td>
<td></td>
<td></td>
<td>NA</td>
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<tr>
<td>When: Not reported</td>
<td></td>
<td>Exclusion: Not reported</td>
<td>Child age: 7–18 years</td>
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<td>Recruitment: Flyers, emails, community announcements</td>
<td>Other measures: Ethnicity, generation, gender, education, socio-economic status</td>
<td></td>
<td>Ethnicity: 44% Anglo-Aus, 27% Italian-Aus, 29% Chinese-Aus</td>
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<tr>
<td></td>
<td>Child age: 7–18 years</td>
<td></td>
<td>Socioeconomic: Middle class, each parent generation had some university education</td>
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<td></td>
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<td></td>
<td>GP contact with GC: 3 generations cohabiting</td>
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<tr>
<td>Roberts and Pettigrew (2010), Australia</td>
<td>Type: Qualitative</td>
<td>Inclusion: parents of child in one higher, one middle or one lower socio-economic status (SES) school</td>
<td>Subjects: 124 children (50 male), 39 parents (3 male)</td>
<td>Grounded theory interviews about influences on children’s diets</td>
<td>GP involvement in family meals, GP feeding practices, GP influence on parent feeding practices</td>
<td></td>
<td></td>
<td>NA</td>
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<tr>
<td>Author (year), country</td>
<td>Study type or methodology/Year of study/recruitment</td>
<td>Inclusion criteria/demographic measures</td>
<td>Subject characteristics</td>
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<tr>
<td><em>Styles et al.</em> (2007), USA</td>
<td>Type: Qualitative Inclusion: Parent of children aged 5–8 years (at least one overweight) Black, White, Hispanic Exclusion: Not reported When: 2004 and 2005 Recruitment: Purposive sampling in healthcare settings, word of mouth and email</td>
<td>Subjects: 39 parents (5 male), 11 GM Other measures: No. of children, education level, work status, income</td>
<td>Age range: 1–6 years Education: 56% high school education or less Employment: 46% working full-time, 47% annual incomes under $20 000 GP contact with GC: Not reported</td>
<td>GP involvement in family meals, GP feeding practices, GP influence on parent feeding practices</td>
<td>GP feeding practices (Qualitative)</td>
<td>NA</td>
<td>Moderate</td>
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</table>

Grandparents reported by parents as having considerable negative impact on their grandchildren's diets, through their use of foods as gifts and role as child-care providers. Relatives other than primary caregivers played a pivotal role in their children's nutritional intake, especially in multiple-generation households. Grandparents provided child care in their own homes, requiring children to adapt to different routines and eating habits. Participants reported problems managing their children's eating because of different rules at the grandparents' home.

AUS, Australian; BMI, child body mass index/weight status; C, child/ren; CFPQ, comprehensive feeding practices questionnaire; GC, grandchild/ren; GM, grandmother; GP, grandparent; NA, not applicable to study type; PA, physical activity; PS, preschool.
and especially vegetables\(^{43}\) and regularly serving vegetables.\(^{45}\)

Nine studies identified that grandparents exhibit ‘negative’ (unhelpful, undesirable and/or detrimental) feeding attitudes and behaviours towards their grandchildren.\(^{32–35,39,43,44,46,47}\) Of these, four studies identified that grandparents ‘give in’ to their grandchildren’s food preferences or ‘spoil’ them with food.\(^{33,39,44,46}\) Two studies identified that grandparents pressure grandchildren to eat more.\(^{35,39}\) Feeding behaviours associated with poor health outcomes that were reported (by either parents or grandparents) in two studies included provision of energy-dense nutrient-poor food and drinks\(^{32,43}\) and the use of food as a reward or gift.\(^{43,44}\) Using food for restriction due to weight concerns,\(^{47}\) not encouraging energy balance and variety, using food to regulate emotions, lack of role modelling of healthy choices\(^{34}\) and irregular mealtimes\(^{47}\) were each reported in one study.

In one study of multigenerational households in China, grandparents commonly held the perception that heavier children are healthy and well cared for, and this perception often led to inappropriate child feeding practices such as overfeeding, pressure to eat more meals and larger portions and indulging children’s food preferences.\(^{39}\) Another study identified an intergenerational transmission of inappropriate feeding practices from grandmother to mother, such as use of desserts as a reward for consumption of meals.\(^{37}\) Conversely, Rhodes et al. reported that grandmothers model mothers’ responsibility for meal planning, preparation and cooking when mothers worked.\(^{43}\)

**Grandparent influence on parent attitudes and feeding behaviours:** Seven studies identified that differences in child feeding attitudes and behaviours between parents and grandparents created conflict and tensions between caregivers, often resulting in poor feeding practices.\(^{32,35,37,40,42,44,46}\) Pulgarón et al.
reported a significant association between the level of disagreement between parents and grandparents, and more ‘negative eating’ (practices known to result in negative health outcomes for the child) \((P = 0.02)\).\(^{42}\)

The differences in feeding practices between grandparents and parents that were identified to cause conflict included different rules or practices around food, grandparents expressing negative opinions about nutritious food in front of children or during meal times,\(^{30}\) disregard of parent preferences around foods offered to children, including sneaking of food to children without parents knowledge\(^{32,44}\) and dismissing health concerns of parents.\(^{44}\)

Two studies identified overt influences of grandparents’ attitudes on parental feeding: one in which grandparents deliberately undermined parental authority and flouted parental food rules,\(^{44}\) while the second study reported that grandparents placed higher importance on a child finishing his/her meals than parents.\(^{35}\) Both influences created conflict and tensions between caregivers.\(^{35}\)

In contrast, Rhodes et al. found that mothers in the parent generation continued with the same focus on healthy nutrition for their own family.\(^{43}\) Specifically, in Italian families, ‘traditional’ foods and recipes were passed down from the grandparent generation to the younger generations.\(^{43}\)

The feeding behaviours of grandmothers and mothers in this study were closely aligned, with women in each generation insisting on consumption, monitoring and reminding, utilising food as a prerequisite for conditional treats, instigating and enforcing food rules and restricting others’ food choices.\(^{43}\)

Eli et al.\(^{33}\) identified that disagreements about feeding practices stem from parents’ and grandparents’ differing definitions of healthy feeding and reflect differences in perceived caretaking roles. This disconnect was found to be mitigated through grandparental compliance with parents feeding preferences and parental compromise with grandparents feeding practices.\(^{53}\)

**Association between grandparent caretaking and child weight status:** The odds of child overweight and obesity in three-generation households were increased by about 1.5 times across three studies conducted in Japan, China and the USA (odds ratio range 1.47–1.79\(^{38,40,47}\) and four times (40% vs 10%) in one study of Greek households in which grandparents prepared family meals.\(^{36}\)

Pulgarón et al.\(^{42}\) identified that Hispanic children who had a grandparent involved in caretaking had significantly lower \(z\)BMI scores \((P = 0.04)\) than those who did not have a grandparent involved but that more disagreement between parent and grandparent was associated with higher \(z\)BMI scores in children \((P = 0.01)\).\(^{42}\)

**Discussion**

This study aimed to identify the influences on dietary intake of children aged 2–12 years of grandparents who undertake child-care roles for their grandchildren. Despite studies originating across four continents in six different countries with differing family structures, food, cultures and amount of child care provided by grandparents, the findings were relatively consistent. Study quality was reasonably consistent and of acceptable quality for synthesis of qualitative findings, but the quantitative studies were not homogenous enough for meta-analysis of child BMI in relation to three-generation cohabitation.

Child feeding attitudes and behaviours of grandparents that were reported in included studies\(^{34,45}\) related to grandparent or parent-reported food group provision, such as promoting fruit and vegetable consumption. Negative grandparental feeding attitudes and behaviours related more to child feeding practices and principles\(^{32–35,39,43,44,46–47}\) and were reported by either parent or grandparent. Pressure to eat, overt food restriction and coercion by grandparents were reported as being used to influence child dietary intake by both grandparents and parents.

It was unclear from the findings whether differences in grandparent and parent child feeding attitudes and behaviour were a result of parent education (and not grandparents) about how specific child feeding practices can positively or negatively influence child health or a result of grandparents continuing to indulge children with food as a grandparent, rather than converting to a caregiver role. Further investigation of grandparents’ level of awareness of the ‘caregivers/parent provide, children decide’ philosophy\(^{23,24,48}\) around child feeding would assist in understanding grandparents’ child feeding practices and whether they are amenable to change. It would also be useful to compare interventions targeted at grandparents alone and interventions aimed at both grandparents and parents, to establish whether consistency in child feeding and nutrition education is helpful.

It is evident that differing child feeding attitudes and behaviours can lead to conflict between parent and grandparent generations. This disconnect may arise from grandparents assuming a direct role and influence on child dietary intake as per Davison and Birch’s socio-ecological model, rather than having a peripheral influence.\(^{16}\) It is also possible that different factors affect parent–grandparent dynamics depending on their socio-ecological profile. For example, in a recent qualitative study involving Māori and Samoan parents and grandparents, Tapera et al.\(^{49}\) identified that grandparents possessed adequate understanding and appreciation of the relationship between food and the well-being of children, but felt limited in providing healthy food by economic and material factors.

The findings of Eli et al.\(^{33}\) that the conflict arising from differences in perceived caretaking role can be mitigated through grandparental compliance and parental compromise\(^{35}\) provides a potential intervention strategy for future studies. A more recent study by Eli et al.\(^{48}\) reported that both mothers and grandmothers cite role modelling and the home environment as being important in regulating preschoolers’ soda, juice and water intake but that differences exist regarding definitions of healthfulness (especially for juice) and the definition of ‘special occasion’.\(^{48}\)
Ideally, agreement between parents and grandparents about child dietary intake and feeding would be reached when the grandparental child-care arrangement first commences; however, this can be challenging when parents are reliant on grandparents for assistance. A potential barrier to intervening with grandparents could be the concern of parents about risking child-care arrangements if rules around caregiving are imposed. The risk of this adverse outcome could be mitigated through use of appropriate resources such as short video clips, a set of ‘21st century child feeding rules’ or other readily accessible and appropriate resources that assist parents and grandparents to negotiate child feeding. Such resources need to be readily available, accessible and appropriate for grandparents and parents who are time-poor due to the work and care commitments.

Less conflict between parents and grandparents was reported in families and in cultural groups where food is central to family relationships. Whether this is because the parents and grandparents within these individual families share similar belief systems about child feeding or their high levels of food exposure results in intergenerational compromise that carries through into child-care arrangements is not yet clear, but is worth further investigation as a possible model for future intervention.

The identified relationship between overweight and cohabitation in four studies remained after adjustment for confounding factors, indicating that it could not be attributed to factors such as education and socio-economic status. It is possible that there is a linear relationship between proportion of care and overweight status that has not been fully explored. More detailed analysis of actual care provision by grandparents and the rates of overweight and obesity is required, so that more support and resources could be provided to cohabiting three-generation families if indicated.

Although there was some consistency in findings across different cultures and socio-economic groups, there is scope for future studies to evaluate the role of culture-specific child feeding beliefs and attitudes, and to determine whether attitudes and beliefs are influenced by socio-demographic or economic factors.

Despite the rigorous application of systematic review guidelines, the generalisability of findings is limited somewhat by the quality and heterogeneity of few included studies. The studies were of moderate to high standard when assessed against appropriate risk of bias tools, but were heterogeneous in terms of location and primary outcome measures. The self-report measures in quantitative studies and aligning this with qualitative data from focus groups and interviews somewhat limit the rigour of data collation. Outcome level analysis was therefore limited to general grouping of findings rather than meta-synthesis or meta-analysis.

The generalisability of findings is limited by the caregivers being predominantly female, although this is somewhat reflective of the caregiving environment. As the study was limited to children aged 2–12 years, the findings cannot be generalised to younger children or adolescents; however, younger and older children both have relatively lower grandparental involvement in child feeding. Further, the total hours, proportion and definitions of child care provided by grandparents were not consistent, nor consistently reported across the studies, which influenced the capacity to compare study findings.

The articles in this review were predominantly cross-sectional and therefore no conclusions of significance can be drawn. While this review considers child BMI and the factors that are often reported in published studies, there are likely more positive attributes of grandparental caregiving that have not been reported. However, meta-analysis would have resulted in a publication bias that highlighted negative findings and relationship attributes. The included studies did tend to report more negative outcomes, possibly reflecting a publication bias rather than the overall relationship caregiving grandparents have with their grandchildren.

In conclusion, the combined effect of increasing reliance of families on grandparental child-care arrangements and increasing prevalence of obesity and chronic disease in early-life stages mean that child dietary intake, and therefore child health, may be increasingly influenced by grandparents’ child feeding practices. The summary of available evidence in this systematic review indicates that well-designed interventions aimed at improving the child feeding practices in grandparent care arrangements are warranted, but need to consider possible confounding cultural or socio-economic influences. For optimal effect, such interventions would focus on negotiation and clear delineation of child feeding responsibilities when care arrangements commence and take into consideration the time limitations of grandparent caregivers. Grandparents who provide regular care to their grandchildren are an important intervention group to consider when working towards reductions in child overweight and obesity rates.

**Funding source**

The systematic review program through which this review was initiated was funded by the New South Wales Health Education Training Institute Rural Research Capacity Building Program.

**Conflict of interest**

The authors have no conflicts of interest to declare.

**Authorship**

KGY, KD and TB contributed equally to the development of the systematic review protocol. KGY and KD conducted the search and identified papers for inclusion, with TB providing advice and expert opinion in this stage. KGY and KD conducted the data extraction, with TB providing advice and expert opinion in this stage. KGY, KD and TB all contributed equally to the development of the manuscript.
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Supporting information

Additional Supporting Information may be found in the online version of this article at the publisher’s website:

Table S1. Quality assessment outcomes and tools for included studies in systematic review of grandparents influence on child dietary intake

Table S2. Systematic review protocol of grandparent influence on child dietary intake
ORIGINAL RESEARCH

Dietetics students’ construction of competence through assessment and placement experiences

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Abstract

Aim: Competency standards are widely adopted as a framework to describe standards of performance required in the workplace. Little is known, however, about how students construct competence. This qualitative study aimed to explore how dietetics students ready to graduate construct the concept of competence and the role of assessment in developing professional competence.

Methods: A qualitative description was used to gather data from a convenience sample of students ready to graduate from universities with accredited dietetics programs across Australia (10 out of 15 at the time of the study). A total of 11 focus groups were conducted to explore perspectives of competence and experiences of ‘competency-based’ assessment. Data were audio-recorded, transcribed and analysed using a thematic analysis approach.

Results: A total of 81 (n = 81) participants across 10 universities representing 22% of total students participated in the focus groups. Themes revealed that: (i) there is no shared understanding of competence; (ii) current workplace experiences may not reflect current standards or workforce needs; (iii) assessment approaches may not fully support the development of competence; and (iv) the competent performance of supervising dietitians/clinical educators in the workplace influences the construction of competence.

Conclusions: There is a need to work towards a shared understanding of dietetic entry-level competence in the profession. ‘Work-based’ learning experiences may need to be modified to ensure students meet current competency standards. Practitioners involved in student supervision need to acknowledge the influential role they have in the development of the future workforce.

Key words: competence, dietetics, qualitative research, students.

Introduction

Nearly 15 years ago, Epstein and Hundert completed a landmark literature review on how competence was defined and assessed in medicine. Competence was defined as ‘the habitual and judicious use of communication, knowledge, technical skills, clinical reasoning, emotions, values, and reflection in daily practice for the benefit of the individual and the community being served’. This work has been instrumental in constructing competence as a concept for all health professions and in shaping the training and assessment of health professionals. Little is known, however, about how students construct and define competence.
Competency standards provide a framework to define required performance for all health professionals, including dietetics internationally. While standards have been criticised for hindering the advancement of professional practice and not being able to fully capture the complexity of practice, they have been used to provide a template for the development of curricula and assessment to prepare health professionals for practice. In dietetics, the Australian National Competency Standards have recently been revised. Previous versions of the standards were criticised as driving a reductionist, or ‘tick box’, approach to competency development and assessment having a focus only on entry-level practice rather than ongoing competence. The accompanying revised accreditation standards specify 800 hours of ‘work-based’ placement. Australian universities predominately use ‘hospital-based’ settings for placement as 10 weeks of direct patient care experience is mandated by the Australian Dietetics Council to fulfil accreditation requirements. Students are considered key stakeholders in the application of competency standards; however, little is known about how students engage with the concepts of competence and whether they see competency standards as relevant to them through assessment as they engage in learning to become dietitians.

In dietetics, the evidence that exists suggests that students see the role of assessment as preparing them for employment and in providing valuable, effective feedback in the development of their competence. In addition, students have reported a desire to be involved in assessment decisions to drive their own learning plans and reduce subjectivity implicit in assessment. There is a need to further explore how students develop an understanding of the concept of professional competence and the factors, including assessments, that facilitate their ability to do this. Understanding these phenomena will support the development of curricula and assessment that equip students to work in complex, dynamic and ever-changing health-care environments.

The present study aimed to qualitatively explore how dietetic students, ready to graduate and enter the workforce, construct the concept of professional competence and the role of assessment in developing professional competence.

Methods

The research was informed by qualitative description whereby researchers sought to describe the concept of competence from the perspectives of students ready to graduate and interpret this description to assist in understanding approaches to assessment. This work was undertaken just after the release of the revised National Competency Standards (2015), which were a significant shift from previous standards, having moved from nine domains of competence with 166 performance indicators to four domains and 55 performance indicators. Ethics approval was obtained from the primary university ethics committee (Monash University Human Research Ethics Committee approval number CF/2288-201500923) and then all other participating researchers’ university human ethics committees.

Sample: Convenience sampling was used to recruit students who had recently completed their final coursework and all assessment requirements of their degree, against the Competency Standards (2009), to be credentialed to work as dietitians in Australia (hereafter referred to as participants). Participants were recruited nationally from 11 of the 15 accredited dietetics programs at the time of the study. One university was excluded from the study as it had recently redesigned their assessment against the new competency standards (2015), while all others assessed students against the 2009 standards. A flyer was distributed to all eligible participants by course administrators via their online learning system (e.g. Moodle/Blackboard) inviting them to participate in the study. Participant consent was gained from those who volunteered to participate.

Approach: Focus groups were chosen for data collection as the interaction between participants and any consensus of opinions as well as opposing perspectives were sought.

The focus groups were conducted face to face in a convenient university location using a structured format whereby a protocol was created and researchers briefed on the approach to ensure consistency. Questions aimed to describe the participants’ perspectives of competence, their experience of ‘competency-based’ assessment and particular assessment approaches that are most appropriate and acceptable from their perspective. The questions were developed based on a review of the literature on the complexity of competence as a concept and on programmatic approaches to assessment (Table 1).

Table 1 Focus group questions

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<tr>
<th>Question</th>
<th>Question logic</th>
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<td>What does the term professional competence or competency mean to you?</td>
<td>Conceptualisation of competence</td>
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<td>In your opinion do the new competency standards define/describe the professional competence of a dietitian? If so why? If not, why not?</td>
<td>Competency standards connect to competence</td>
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<td>Can you describe your experience of ‘competency-based’ assessment while studying to become a dietitian? In your opinion would these current assessment approaches demonstrate competence against the new competency standards? Why? Why not?</td>
<td>Experience of ‘competency-based’ assessment</td>
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<tr>
<td>If you could create a system of assessment that allows you to show how you demonstrate competence what would it look like?</td>
<td>Conceptualisation of ‘competency-based’ assessment</td>
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universities with experience in conducting focus groups. The two researchers with no experience in focus groups were supported by an experienced facilitator from the research team or someone independent from their own university with facilitation skills. Given the lack of funding, national representation and the geographic spread of the sample, this was undertaken for convenience. Academics familiar to participants was purposefully chosen as the researchers proposed that having facilitators who had adequate knowledge of the subject, a deep understanding of learning experiences and assessment approaches and good communication skills would enable a deeper exploration of the issues under investigation, which is often prioritised over potential risk of bias in qualitative research approaches. In addition, the researchers believed participants would be more comfortable discussing these concepts with people whom they were familiar, which is recommended in medical education to explore issues associated with hidden curricula. The ability of the facilitator to understand elements of the experiences the students reported from an insider perspective was deemed to outweigh the potential for the facilitator to influence responses, as has been used in other dietetics education research. As the participants had completed all required coursework with no pending assessment and were deemed competent, this also contributed to the decision to use a known facilitator. In addition, the facilitator was accompanied by another of the researchers or other independent facilitator to aid consistency of approaches and assist interpretation. Where this was not possible, transcripts were sent to participants for confirmation of discussion. In addition, to further reduce the potential influence of the researchers’ perspectives on the responses, after two focus groups were conducted, a summary from these discussions was presented to other facilitators and the potential influence of facilitators in the data discussed as part of a reflexive process.

The focus groups were undertaken between October 2015 and June 2016. This varied because placement and course completion differed across the country. Focus groups ran for 60–90 minutes, were conducted face to face where possible or via Zoom Video Communications, Inc (2017), which has shown to be just as effective as face-to-face focus groups when facilitators are trained in the use of the technology, audio-recorded and transcribed verbatim (average 25 pages of single-space text). Researchers probed participants until there was data saturation of the concepts within the focus group. Where possible (n = 2 focus groups), transcripts were returned to the participants for verification; in all other instances (n = 8), transcripts were verified against recordings for accuracy.

Data analysis: The position of the researchers as educators of participants was acknowledged, and reflexivity related to this positioning was employed in this regard when collecting and analysing data. Reflexivity involved researchers considering why students may have provided a certain response. All researchers independently coded the transcript of the focus group that they conducted based on guidelines developed by the first author (CP). A thematic analysis approach was applied whereby the text was labelled as an open code, and then, once the transcript was coded, all codes were grouped into categories of similar concepts. All researchers met face to face to discuss the preliminary analysis, critique each other’s interpretations and agree on key ideas emerging from the data and their interpretations. After this initial data analysis process, the first author returned to the original unmarked transcripts and analysed all focus groups with the assistance of QSR-Nvivo 10 (V10.0.138.0 (64bit), QSR, Australia) using the same thematic analysis approach. The codes and categories were then analysed whereby the first author moved between categories, the existing literature on the development of competence in the health professions and across the different universities to develop themes. This inductive thematic analysis approach was deemed most able to interrogate transcripts, interpret meaning behind dialogue, allow for patterns to emerge clearly from the data and account for the different focus group facilitators. The difference between initial concepts and first-author analysis was the degree of depth to the interpretations and was resolved through discussions with all researchers. Analysis of difference in students’ perspectives of undergraduate versus postgraduate (student) courses was applied. In line with the qualitative description, the researcher interpreted the themes to assist in understanding approaches to competency development and assessment and presented the themes and a conceptual framework of interpretation to other researchers for verification and agreement.

Results

A total of 81 students across 10 Australian universities attended the 11 focus groups with between 4 and 10 participants per focus group and between 4 and 19 participants from each university. This sample represented approximately 22% of all students eligible to graduate in Australia at the time of the study. A total of 76 (94%) of the participating students had completed placement in the allocated timeframes and had not failed or required additional time to achieve competence; 5 students (6%) from two universities required additional placement time. All focus groups were conducted face to face except for one, which was conducted via videoconference for convenience for four participants located in rural areas, facilitated by the first author who was experienced in Zoom technology. All students were enrolled in an accredited dietetics course at either Bachelor (n = 43, 53%) or Master level (n = 38, 47%) level with a mean age 26 ± 5 years. Four students were enrolled as international students, and seven reported English as their second language. A total of 77 were female (95%) and 4 male (5%).

A conceptual model of students’ construction of competence is described (Figure 1) based on four major themes that emerged from the data (Table 2). There was no difference between undergraduate or postgraduate participants.
A shared understanding of competence is needed: Participants constructed competence as being ‘safe to practice’ or acknowledging limitations and boundaries, being flexible, having emotional intelligence and leadership and working independently. When asked specifically about the term competence, the majority of the participants explained that this was ‘being professional’. The participants also described other elements of dietetics practice as competence, including employing evidence-based practice and having an impact on nutritional health. Some key skills were identified by some participants, including performing malnutrition screening, counselling for behaviour change and advocacy. The breadth and depth of the participants’ descriptions of the role of a dietitian were linked to the work of a dietitian in a hospital.

‘… if you’re going to be a practising dietitian …. then you need to be able to show leadership, you need to be able to discuss exactly what you want done in terms of food services and in terms of nurses.’ (Focus group 9)

Participants acknowledged that assessment of competence is subjective and reported that there were inconsistencies between supervisors’ judgements, and this did not help their ability to construct competent performance. Assessment was reported to be a source of anxiety and confusion, which was challenging for some participants. Variation and inconsistency in supervisor feedback, interpretation of competencies and approaches to assessment were highlighted as some of the challenges for participants in negotiating and managing their progress and development towards competency.

‘hard to figure what exactly they [supervisor] wanted.’ (Focus group 7)

Given the trust placed by learners on supervisor judgement in the placement environment, feeling safe in the assessment process was highly valued. Many participants reported wanting more input about assessment decisions and expressed that, as learners, they needed to take more responsibility. Participants reported having a voice in the assessment process but highlighted that there needs to be an appropriate balance between student-led and supervisor-led assessment on placement. They recognised the role of multiple pieces of evidence from a range of sources shaping judgements of competence but reported incidences where competency decisions were made on single performances or pieces of evidence. The participants reported the value in being able to show progress towards the achievement of competence and that the concepts of milestones were useful; however, they implied that these are not clearly defined among supervisors or universities.

‘…all placement sites are different so it’s hard to make everyone equal.’ (Focus group 8)

Current work placement experiences may not reflect current standards of competence: The participants reported that different placement experiences provided them with the opportunity to demonstrate different competencies. They explained that, depending on their placement experience, some of the 2009 competency statements were difficult to
demonstrate as dietetics practice is diverse, and placements are not standardised.

Participants associated competency development more with the placement elements of their programs than university-based learning. They reported that placement was essential for developing the competence to work as a dietitian across multiple settings. However, case-based learning, simulated patients and hypothetical practice scenarios discussed in class were reported to be valuable preparation for placement. The participants emphasised that early assessment tasks that were simulated to mimic the work of a dietitian in practice supported their preparation for placement and construction of what it meant to be competent. While some focus group discussions did not emphasise the value of the development of competence at university, most still reported that being adequately prepared for placement and feeling confident about entering that setting was fundamental for any chance of successfully developing competence. Some participants reported that university assessments were not adequately linked to the tasks or skills they would need to perform in the workplace.

The current placement programs were reported to be focussed on individual patient care skills in an acute hospital environment and that this was at odds with future workforce needs. Participants recognised that the future work of a dietitian would be in managing food services in nursing homes, providing chronic disease self-management in ambulatory care settings, private practice or working with the food industry. They expressed there was an overemphasis on placement in hospital settings despite limited employment opportunities in this setting upon graduation. The placement experiences in food service or community/public health nutrition settings were regarded as inferior. They perceived that the profession believed that they were not settings in which a full picture of professional competence could be demonstrated. A culture of considering acute 'hospital-based' learning as being the only suitable preparation for practice was reported by participants to be the views of their supervisors and thus imparted to them. Participants reported wanting to embrace the diverse placement opportunities to enrich learning and prepare them for work, now and into the future.

‘I’m not saying there shouldn’t be so much focus on clinical but if there’s such a small number of clinical jobs and small numbers going into it…’ (Focus group 1)

<table>
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<th>Theme</th>
<th>Description</th>
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| A shared understanding of competence is needed | • Competence is being safe, working within scope and independently  
• Focused on the work dietitians do in hospitals  
• Competence is constructed based on assessment experiences which is subjective and controlled by supervisors who take a tick box or reductionist approach  
• Variation and diversity in interpreting competence  
• Multiple pieces of evidence were thought to be needed to demonstrate competence |
| Current work placement experiences may not reflect current standards of competence | • Work placement facilitates the development of competence  
• Preparation for ‘work-based’ learning supports transition to work-learning environment  
• Work placement focussed on the skills to work as a dietitian in a hospital  
• Appropriately timed independence supports the development of competence |
| Assessment may not fully support the development of competence | • Competency standards (2009) do not reflect current practice and are not used effectively in assessment  
• Some assessment may distract from the development of competence |
| Exposure to competent performance influences construction of competence | • Real-world learning experiences supported the construction of competence  
• Competency standards assist in understanding competence  
• Supervisors are role models in students construction of competence |
Participants also explained that they felt the different placement settings were siloed and not connected to their development of competence as a whole and that their work placement experiences were ‘pigeon-holing dietitians into clinical domains and food service domains’ (Focus group 6). Some reported feeling like their food service and community/public health nutrition placement was not considered in their final assessment of competence.

Participants reported that being provided an opportunity to undertake independent work, especially food service and community/public health nutrition contexts, supported the development of competence and construction of competent performance as a dietitian. The development of competence was also motivated and supported by participants believing that they were making a meaningful contribution to the workplace in which they were based.

‘…given a bit more independence, … I was given basically as much rope as I wanted to and it was so relieving, because I felt like I’m running this … and …. I’m being believed in that I can do this. Comparative to clinical where you had someone standing right next to you the entire time.’ (Focus group 6)

Assessment may not fully support the development of competence: When shown the revised National Competency Standards for Dietitians in Australia (2015), participants acknowledged that the standards provide a basis or framework for the work of dietitians but not the daily practice of a dietitian—‘[they don’t describe] how to be a dietitian’ (Focus group 2). The simpler structure to the 2015 standards and focus on outcomes were reported to be beneficial in making it clear as to what needed to be achieved to be able to enter the workforce. The participants explained that the 2009 Competency Standards were being used as a checklist for assessment whereby competence was viewed as a list of skills to be obtained rather than considering how these skills were put into practice across different situations and varying degrees of complexity. Participants revealed that some supervisors were focussed on checking them off against elements in a form rather than holding a broader view of competency and assessment.

The assessment requirements on placement, for example, completing written reflections or long-written nutrition care plans, were reported by some participants to distract them from learning or the development of competence. Participants suggested that the type of assessment on placement should include a range of different tasks aligned to what is actually performed in practice, rather than assessment for assessment sake.

‘When you’re on pract[ical placement] you don’t want to be thinking about doing assessment.’ (Focus group 5)

Participants reported that they believed the assessment approaches at university (grades) were at odds with competency assessment (competent or not). Descriptive rubrics were thought to be more aligned with ‘competency-based’ assessment to describe a continuum of performance. The participants explained that they are conditioned to be focused on marks and grades because of a range of factors. The highly competitive nature of gaining entry into dietetics programs together with a university culture of assessment based on grades were reported to influence the participants’ philosophies of assessment.

‘I liked it being on placement and it not being a graded part of the placement because I felt like, ‘okay, I can really focus on learning from this and okay if I go in there and do absolutely terribly I’m going to learn quite a bit from it,’ so that took away the stress. I wasn’t stressed going into it because it was more, ‘okay I’ve got an opportunity to really learn here.’’ (Focus group 10)

The role of formative assessment was valued. The opportunity for feedback was reported to play an important role in assessment. Participants reported valuing focussed and regular feedback, which allowed them to make plans for and improve their performance, from supervisors, peers, patients and other health professionals. Participants reported wanting feedback from academics as well as practice educators and others (eg. patients) to be considered as part of competency assessment decisions.

‘You get feedback… I had almost the whole [patients] family personally thanking me and it was like, that was just, blew anything out of the water that any mark could give me.’ (Focus group 2)

Some participants believed that they should lead feedback discussions. Being supported in self-assessment and reflective practice was also highlighted.

‘I’ve very often taken away learning experiences from assessment that I’ve done worse on… I’ve learnt more from those than ones where I did well.’ (Focus group 2)

Exposure to competent performance influences construction of competence: The concept of competence was found to be developed by participants more robustly in latter stages of their training programs because of the focus on ‘work-based’ learning or placements in the final semesters of programs/courses. Learning in real work settings supported the understanding of what it meant to function as a dietitian and, through this understanding, built confidence in what needed to be achieved. Placement or ‘work-based’ assessment was viewed as ‘real’, and participants reported that this setting motivated them to develop the skills needed for practice.

‘…developing that clinical judgment that we always get told about. I don’t really know what that ever means when I’m sitting in a lecture, but when you go into practice and you go, ’oh, I get what that actually means now.’’ (Focus group 6)

Early introduction to the competency standards and linking this to course content, assessment and ‘university-
Based learning more explicitly was recommended to assist in the construction of competence earlier. Participants from one university that had a professional practice subject in the first semester of the program reported understanding what was expected of professional practice (e.g. empathy, reflexive practice and cultural competency) early in their studies. Competency development was highlighted as needing to allow for flexibility in approaches to learning and progress.

The relationship with placement supervisors influenced participants’ development of competence in the placement setting. Competence was conceptualised based on placement supervisors’ role modelling, their perception of the role of a dietitian and the supervisors’ perception of competency and ‘competency-based’ assessment. The role of a dietitian in a hospital was constructed as ‘competence’ by participants. They reported a hierarchical stance on their hospital placement experiences, explaining that it is the component of practice that prepares them for work as a dietitian in the health-care team. ‘Clinical is what sets us apart from a nutritionist.’ (Focus group 9)

**Discussion**

This qualitative study aimed to explore how students construct and define the concept of professional competence and the role of assessment in developing professional competence. It found that there is a need for a shared understanding of competence between learners and supervisors, with greater acknowledgement of competence outside of a hospital setting and appreciation by supervisors on the need for multiple different pieces of evidence to inform competency judgements. Currently, students’ construction of competence is predominately based on the exposures they experience in the placement settings and influenced by supervisors’ interpretations of competence. These findings are significant given the current dominance of work experience in the acute hospital environment, which may not reflect emerging work practice.

To the researchers’ knowledge, this is the first study to explore how students construct competence in the profession of dietetics. Strengths of this research include the transferability or results to students nationally in that 67% of universities were sampled, reflecting a diversity of educational approaches, and the 81 focus group participants were highly representative of the new student dietetic workforce nationally.\(^{26}\) The findings may be limited to the views students were comfortable expressing with known academics; however, the depth of data obtained suggests students expressed themselves freely. The voice of international students may have further strengthened the results.

The development of competence is known to be dependent on the socio-cultural context of the work place.\(^{27}\) The literature also suggests that there is a ‘hidden curriculum’ during clinical placements where students feel forced to replicate the practices of their supervisors.\(^{28}\) Our findings also raise questions about the profession’s current approach to ‘competency-based’ assessment, which suggest reductionist assessment practices and a focus on hospital placements\(^{11}\) rather than a more holistic programmatic approach to assessing competence, potentially driven by the 2009 competency standards. While participants recognised the role of multiple pieces of evidence to inform assessment of competence, their perspectives suggest that supervisors involved in assessment decisions do not share this holistic picture. There is a need for universities to build the capacity of supervisors, educators and students in programmatic approaches to assessment. Our findings also suggest that there is a need for more authentic assessments or assessment that represents the ‘real’ or actual work requirements, a greater emphasis on formative assessment and enhanced feedback where students are more at the centre of the assessment, involved in a two-way dialogue about their performance and plans for development. This is in line with other literature suggesting reflections being valued by learners when they are undertaken in the context of critical incidents or lifelong learning.\(^{29}\)

The key role of dietitians as supervisors in supporting the development of learners is well recognised.\(^{30,31}\) This study not only shows the imperative role supervisors play in learning but highlights students’ perception of their role in promoting and role modelling current and future work practice. Dietitians need to recognise the powerful role they have in shaping the profession and the aspirations of future professionals. There is a need for shared understanding of what constitutes entry-level competence, which may be assisted in the development of milestones and entrustable professional activities for dietetics as has been undertaken in medicine.\(^{32}\) However, the success of these are dependent on assessors understanding the concept of programmatic approaches to assessment and the concept of entrustment. This study suggests that the profession needs development in this area to improve assessment practice and change assessment philosophies.

Given the increasing need for dietitians to practice in settings outside the acute care hospital environment\(^{26,33}\) and develop innovations for new problems across different environments,\(^{11}\) the present study provides further evidence to support diversifying placement experiences across multiple work contexts. Dietitians practice in different work contexts and work environments, and there is currently a range of non-traditional environments where dietitians could have a role; all of these should be explored for potential placement. With a refocussing of competencies from contexts to skills, a range of evidence and sites should be used to determine evidence of readiness to practice. A focus on placements that are in acute care and focus solely on medical nutrition therapy limit the future opportunities of the profession. This includes not only preparing students for practice in current work contexts but showing students the possibilities of what it could be and demonstrating a holistic understanding of the multiple perspectives dietitians need to take to improve nutrition outcomes. This will allow students to be able to effectively transform their
learning across contexts. The profession needs to challenge the current practice hierarchy. In designing programs of ‘competency-based’ assessment, this study found that students support the use of multiple methods and approaches that closely align with requirements for practice. Literature in other disciplines and some in dietetics suggests that the integration of practice exposures helps build context and motivates students to learn the theory and knowledge for practice. Future research could explore if the new (2015) National Competency Standards are effective in supporting students to transform their learning across contexts.

The present study explored the construct of professional competence from the perspectives of students ready to graduate and found that placement experiences, including role models in supervisors, powerfully influence how students perceive competent practice. There is also no shared understanding of what dietetics competence looks like and a dominance of acute care practice as preparation for the workplace. These findings suggest a need to consider alternative work placement experiences, such as private practice, nursing homes or food industry in addition to hospital, community or population health and food service settings, to better prepare students for changing workforce needs. Practitioners involved in student supervision need to recognise the powerful influence they have in shaping students’ construction of competence and not allow it to be limited to their area of practice; rather, practice in a way so as to promote the progressive development of competence through a range of experiences, both in the university and placement setting.

Funding source

This work was undertaken through a community of practice established as part of the first authors Fellowship funded by the Australian Government’s Office for Learning and Teaching. The views expressed in this publication do not necessarily reflect the views of the Australian Government Office for Learning and Teaching.

Conflict of interest

The authors declare that they have no conflicts of interest to report.

Authorship

All authors conceptualised the study, designed the research questions and completed the data collection. All authors completed analysis of at least one transcript, and CP and JD completed analysis of all data. CP drafted the manuscript with input from JD and AB. All authors reviewed the manuscript and approved its final contents. The authors acknowledge the input of the graduating students who participated in this study and shared their experiences.

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Preoperative nutritional management of bariatric patients in Australia: The current practice of dietitians

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Abstract
Aim: The aim of this observational study was to investigate the reported practices of Australian dietitians managing bariatric surgery patients in the preoperative stage.

Methods: An online survey of dietitians providing nutritional care to bariatric patients was developed for the purpose of this investigation. The survey questions were guided by the Clinical Practice Guidelines for the Perioperative Nutritional, Metabolic and Nonsurgical Support of the Bariatric Surgery Patient guidelines and current literature.

Results: Ninety-nine dietitians completed the survey. Most participants recommended one to two different medical nutrition therapy strategies for preoperative weight loss (n = 69, 74%), with a very-low-energy diet exclusively from liquid meal replacements being the most frequently prescribed (n = 62, 69%). A significantly higher proportion of dietitians working privately reported the involvement of a bariatric surgeon in the multidisciplinary team (P = 0.002). More private practitioners also reported providing education on the nutritional consequences of the different types of bariatric procedures (P = 0.005) and postoperative vitamin and mineral supplementation (P = 0.013), as well as the use of the guidelines to guide their practice (P = 0.014), compared to dietitians who worked in the public sector. A higher proportion of dietitians working in metropolitan areas reported that screening occurred more frequently for vitamin D (P = 0.008), fasting blood lipids (P = 0.03) and glycated haemoglobin (P = 0.003) compared to those in regional/rural/remote areas.

Conclusions: Reported preoperative screening practices were not consistent with the recommendations from the literature and current American guidelines. Further investigation into the difference in the nutritional management strategies and work environments is warranted.

Key words: adult, bariatric surgery, dietitian, practice guidelines, private sector, public sector.

Introduction
Bariatric surgery is an overarching term that refers to several different bariatric surgical procedures, which aim to either restrict food intake or induce a state of malabsorption.1–3 Bariatric surgery has shown to be a cost-effective treatment for obesity compared to other non-surgical interventions.4 There has been a threefold increase in the number of bariatric procedures performed worldwide since 2003.5 In Australia and New Zealand, there were 10 467 bariatric surgeries performed in 2013.5 This approach to weight reduction achieves greater weight loss and considerable reduction in obesity-related comorbidities compared to non-surgical interventions.6,7 However, bariatric procedures do have considerable nutritional risk and thus the role of the dietitian for both presurgery and postsurgery is crucial.8–11 Nutritional deficiencies are commonly seen in patients presenting for bariatric surgery.7,12–16 Pre-existing micronutrient deficiencies prior to bariatric surgery, can involve poorer prognosis and postoperative complications.13,15,16 Therefore, it is essential to screen and correct any abnormalities prior to surgery. The Clinical Practice Guidelines for the Perioperative Nutritional, Metabolic and Nonsurgical Support of the Bariatric Surgery Patient guidelines (ASMBS guidelines)8 recommend that a dietitian is involved within the bariatric preoperative stage to perform a clinical nutrition evaluation that includes, but is not limited to, iron studies, B12, folic acid and vitamin D (vitamin A and vitamin E are optional).8 Current literature also suggests that serum zinc and vitamin C may be included in routine screening as deficiency is high among bariatric patients.12,13 In addition, the ASMBS guidelines recommend screening for obesity-related biomarkers of chronic disease such as, fasting blood lipids, blood glucose level, HbA1c and liver function tests to provide base line measures to track change over time.8
A second role of the dietitian is to prescribe medical nutrition therapy (MNT) to reduce weight preoperatively, which can assist in minimising postoperative complications. A very-low-energy diet (VLED) has been shown to be an effective MNT strategy to induce preoperative weight loss. Preoperative dietetic education is recommended to facilitate informed decision making by the patient. Recommended education strategies include nutritional consequences of the different bariatric surgery procedures, long-term follow up requirements, compliance involved with adhering to a postoperative liquid diet and postoperative vitamin supplementation.

Bariatric care protocol varies among health services and standards of practice are yet to be established within Australia. The National Health and Medical Research Council (NHMRC) have released guidelines that focus on the management of obesity (Clinical Practice Guidelines for the Management of Overweight and Obese Adults, Adolescents and Children 2013); however, bariatric surgery is included as a treatment and the recommendations are not specific to bariatric care. The ASMBS guidelines consist of evidence-based recommendations specific to bariatric care, which recommend the inclusion of a bariatric multidisciplinary team (MDT). It is proposed that the MDT should consist of medical, surgical, psychiatric and nutritional expertise, to optimise patient outcomes.

It is evident that dietitians play an important role in the multidisciplinary bariatric care pathway. Yet, there is limited published evidence on the current practice of dietitians within the bariatric preoperative stage both internationally and within Australia. In view of the nutritional risk associated with bariatric surgery, further investigation is required to identify preoperative education strategies, MNT intervention and nutritional screening practices for bariatric patients in the context of current practice-based guidelines. The aim of the present study is to describe the reported practices of Australian dietitians working with bariatric surgery patients in the preoperative stage and to explore whether the workplace of the dietitian was associated with characteristics of practice.

**Methods**

A descriptive cross-sectional online survey was designed for the purpose of the present study to explore the current practices of Australian dietitians who work with bariatric surgery patients in the preoperative stage. The survey development was guided by recommendations from the ASMBS guidelines and evidence from the literature. The survey was reviewed for content validity by the research team and piloted with three Accredited Practising Dietitian’s (APD’s) specialising in bariatric nutrition. The final survey consisted of 27 categorical closed-ended questions, with either single or multiple responses permitted. The questions covered the following areas of practice; preoperative screening, assessment of nutrients and biomarkers of chronic disease and the course of action for abnormal results, preoperative MNT intervention strategies (such as for weight loss) and nutrition education strategies (such as postoperative meal plan and vitamin and mineral supplementation). There were an additional two open-ended questions that allowed participants to explain the factors that guide their intervention strategies and describe their processes and procedures within their practices. In addition, characteristics that may have influenced the primary outcomes such as, characteristics of participants, workplace (public or private sector and usual place they see bariatric patients) and practice location (metropolitan, rural/regional/remote) were included.

The population targeted for the present study was Australian APDs working with bariatric patients. Inclusion criteria were dietitians working in the preoperative stage of bariatric surgery with bariatric patients within Australia. Participants were recruited through the DAA weekly emails to the bariatric surgery interest group (n = ~603), the obesity interest group (n = ~1998), dietitians in the private sector (n = ~1844) and the gastroenterology interest group (n = ~1919). Participants were invited to complete the survey through a Survey Monkey link that was provided in the email that was sent in December 2014. The survey was available for completion between December 2014 and February 2015. Approval for the present study was obtained from the University of the Sunshine Coast Human Research Ethics Committee (approval number S/14/700).

Data were downloaded from Survey Monkey, then exported to SPSS Statistics (version 22, IBM Corporation Armonk, New York, USA) for analysis. Chi-square and Fisher’s exact tests were used to assess the possible associations between the primary outcome variables and characteristics of the cohort. Significance was set at P < 0.05. Open-ended questions were initially organised by the principles of descriptive coding, this involved reading through each response and organising the data into themes. Common themes were then grouped and placed into overarching key categories. This was initially undertaken by the principal researcher and cross checked by the research team.

**Results**

A total of 151 individuals responded to the survey. Of the total respondents, 21 did not meet the inclusion criteria and 31 only completed the demographic questions and thus were excluded from analysis. The survey responses from 99 participants were included in the final analysis; however, the number of respondents per question varied as a result of non-response to some answers. Of the 99 participants included in the analysis, 77 answered all questions.

Participants were located across Australia, were divided between metropolitan (55%) and regional and rural locations (45%) and reported to work in either the public (58%) or private sector (31%). A total of 11% of participants worked in both the public and private sector. Participant responses for usual workplace with bariatric patients was highest for a dietetic private practice, then for a private bariatric clinic service, followed by similar proportions of responses for a specialist bariatric service unit within a public hospital, a specialist bariatric service within a private hospital, and a specialist bariatric service within a private hospital.
hospital and with ‘other’ workplace settings (Table 1). Within the private sector 68% of participants’ usual workplace with bariatric patients/clients was within a dietetic private practice. There was a mixture of years of experience working with bariatric patients and the number of bariatric patients seen per month (Table 1). A significantly greater proportion (66%) of dietitians working privately saw 11 or more bariatric patients per month compared to dietitians in the public system (31%; \( \chi^2 = 11.68; P = 0.009 \)). There was no significant difference between workplace or practice location and years working with bariatric patients.

The reported factors that determine the number of times a patient was reported to be seen preoperatively were: time until surgery (n = 36, 37%); patient-related factors (i.e. financial, distance to travel, education level, the patients knowledge about the procedure and level of support) (n = 30, 31%); clinical factors (i.e. type of nutrition intervention, severity of comorbidities and amount of weight loss required preoperatively) (n = 25, 26%); perceived level of patient’s motivation and compliance (n = 23, 24%) and hospital/service protocols (n = 21, 22%). The majority (n = 59, 75%) of participants reported working as part of an MDT in the preoperative management of bariatric patients. Most respondents reported more than one individual involved in the MDT, with the bariatric surgeon (86%) and the mental health professional (63%) the most common response. A significantly higher proportion of dietitians working in the private system (28%) reported the involvement of a bariatric surgeon in the MDT, compared to those in the public system (18%) (Fisher’s exact test 10.72; \( P = 0.002 \)).

The bariatric surgeon was the most frequently reported (n = 76, 78%) health professional that referred patients to the dietitian in the preoperative stage. The bariatric surgeon, general practitioner (GP) and dietitian were the most frequently reported health professionals who requested both nutrient and biomarker screening (Table 2).

Four participants reported that they were the only practitioner to request screening. A greater proportion of participants who worked in the private system reported the

### Table 1: Demographic characteristics of a sample of Australian dietitians working with bariatric patients

| State/territory of employment (n = 99)
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| Location of practice (n = 99)
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| Years working with bariatric patients (n = 99) (year)
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<tr>
<td>0–2</td>
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<tr>
<td>3–5</td>
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<td>&gt;5</td>
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</table>

| Average patients seen preoperative per month (n = 85) (clients)
<table>
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<tbody>
<tr>
<td>Total n (%)</td>
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<tr>
<td>0–5</td>
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<tr>
<td>6–10</td>
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<tr>
<td>11–30</td>
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<tr>
<td>&gt;30</td>
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</tbody>
</table>

| Usual workplace with bariatric patients/clients within specific workplace settings (n = 122)
<table>
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<tbody>
<tr>
<td>Total n (%)</td>
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<tr>
<td>---------------</td>
</tr>
<tr>
<td>Specialist bariatric service/unit within a public hospital</td>
</tr>
<tr>
<td>Specialist bariatric service/unit with a private hospital</td>
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<tr>
<td>Private bariatric clinic/service</td>
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<tr>
<td>General gastroenterology unit within a public hospital</td>
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<tr>
<td>General medical unit within a public hospital</td>
</tr>
<tr>
<td>Dietetic private practice</td>
</tr>
<tr>
<td>Other (community/primary health services, specialist outpatient/clinic services)</td>
</tr>
</tbody>
</table>

\(^{(a)}\) No significant difference across workplace.

\(^{(b)}\) Significant difference between workplace and 11 or more clients per month (\( \chi^2 = 11.68; P = 0.009 \)).

\(^{(c)}\) Total is greater than number of respondents (n = 99) because of multiple responses.
bariatric surgeon requested the nutrient and biomarker screening, compared to those who worked in the public system ($\chi^2 = 6.38, P = 0.012$ and $\chi^2 = 9.78, P = 0.002$, respectively). The most frequent course of action for an abnormal nutrient screen was supplementation ($n = 59, 66\%$) and for an abnormal biomarker screen was referral onto another health profession ($n = 66, 74\%$).

A small proportion of participants reported always screening for all nutrients ($n = 7, 7\%$) and biomarkers of chronic disease ($n = 9, 10\%$). Most participants reported that liver function tests ($n = 76, 84\%$), fasting blood glucose ($n = 70, 80\%$) and iron studies ($n = 74, 79\%$) were always preoperatively screened. Fasting blood lipids ($n = 64, 72\%$), $B_12$ ($n = 65, 69\%$) and vitamin D ($n = 59, 63\%$) were reported to be screened by a higher proportion than those that reported screening rarely or never. Whereas vitamin A ($n = 16, 83\%$), vitamin E ($n = 12, 87\%$), 2-hour postprandial blood glucose ($n = 10, 89\%$) and vitamin C ($n = 8, 91\%$) were reported as rarely or never screened in the preoperative stage by most participants. A higher proportion of participants working in the metropolitan area reported that screening occurred more frequently for certain nutrients and biomarkers of chronic disease compared to those in regional/rural/remote areas (Figure 1).

All participants reported providing patients with some form of nutritional intervention in the preoperative stage. A significantly higher proportion of dietitians ($n = 60, 61\%$) working in the private system provided education on the nutritional consequence of the different types of bariatric procedures compared to those in the public system ($\chi^2 = 7.88, P = 0.005$) (Figure 2).

Where MNT for preoperative weight loss was provided as one of the interventions, an average of $38\%$ ($n = 34$) of participants recommended one or two different specific strategies. A VLED exclusively from liquid meal replacements was the most frequent response, followed by VLED with a combination of liquid meal replacement and food meals (Figure 2). There was no significant association between the dietitians’ workplace and the types of MNT for preoperative weight loss.

With the exception of one individual, all participants provided some form of education strategies on the dietary and lifestyle modifications required in the postbariatric surgery stage ($n = 76, 84\%$). Most participants reported providing education strategies on postoperative meal plans with ongoing dietary modification and supervision, postoperative vitamin and mineral supplementation and education on lifelong compliance (Figure 2). A higher proportion of dietitians working in the private system provided education on the requirement for postoperative vitamin and mineral supplementation compared to those in the public system (Fisher’s exact test $7.55, P = 0.013$) (Figure 2).

Participants reported a range of factors that guided their management and intervention strategies. After thematic coding, the four key categories of patient-related factors, clinical protocol and procedures, evidence-based guidelines and practice resources emerged from the data (Table 3).

A range of evidence-based guidelines, policies and procedures or literature was reported to inform the nutrition management of bariatric patients. These were categorised into the ASMBS guidelines9 ($n = 31, 40\%$), the NHMRC Obesity guidelines2 ($n = 20, 26\%$), health service/facility policies and procedures ($n = 20, 26\%$), OSSANZ/DAA resources ($n = 15, 19\%$) and other literature or web-based resources ($n = 30, 39\%$). Examples of DAA resources included webinars, DINER resources and the bariatric interest group. Other resources were journal articles, evidence-based databases, web resources, nutrition education resources and dietitian experts. There was a higher proportion of dietitians in the private system ($n = 21, 49\%$) that use the ASMBS guidelines versus other sources of information compared to those in the public system ($n = 5, 19\%$) ($\chi^2 = 6.24, P = 0.014$).

**Discussion**

The present study describes the preoperative nutritional management of bariatric patients within Australia and provides insight into the preoperative screening practices of nutrients and biomarkers of chronic disease. We found a difference between the type (public vs private) and location (metropolitan vs regional vs regional/rural) of the workplace in relation to the referral process, MDT involvement, the use of evidence-based guidelines and screening practices. Results from the present study also indicated that while the ASMBS guidelines9 were the most commonly used...
evidence-based guidelines, they were not as widely used by dietitians to inform their overall nutritional management or guide specific intervention strategies, compared to patient-related factors that specifically impacted the individual patient. This approach allows for individualised care compared to intervention strategies guided by clinical protocols and resources. This is not surprising given that there are currently no specific best practice guidelines for the nutritional management of bariatric patients within Australia. However, this did not mean that the participants were not providing evidence-based practice, as the findings of the present study showed that preoperative nutritional management mostly aligned with the ASMBS guidelines.8 A systematic evidence-based approach to nutrition care can result in patient positive outcomes and improved nutritional management.26,27 Therefore, further enquiry into the need for Australian nutritional guidelines specific to bariatric surgery is necessary as this may increase Australian dietitians’ access to evidence-based guidelines.

A higher proportion of participants working in the private system reported using the ASMBS guidelines8 than those in the public system. This may be because of private dietitians being more familiar with the ASMBS guidelines compared to those who work in the public system, who may use policies and procedures constructed by the hospital to guide their management. However, this still remains unclear and further investigation is required.

The preoperative screening rates for such a comprehensive range of nutrients and biomarkers in the present study have not been previously reported in the literature. However, we found rates of screening for specific nutrients (vitamin D, B12, folate and iron) were proportionally greater than previously reported in USA,28 although preoperative screening did not always occur for some of the nutrients and biomarkers. Fewer dietitians working in regional/rural and remote locations reported screening for nutrients and biomarkers than those in metropolitan areas. This may be because there is a higher number of bariatric surgeries performed in major cities within Australia, leaving more regional/rural and remote locations with less resources and equipment, making preoperative screening more difficult to complete compared to major cities.29 The ASMBS guidelines recommend all patients should undergo appropriate nutritional evaluation including micronutrient measurements before any bariatric surgical procedures, but do not specify whose role it is to screen.8 Over a third of dietitians in the present study requested screening of nutrients and biomarkers, this was usually in conjunction with another health professional, such as the bariatric surgeon, GP or physician.

Most of our participants reported preoperative education strategies that align with recommendations in the current literature.8,11 A higher proportion of participants who worked privately reported providing education on the nutritional consequences of each bariatric procedure compared to those who worked in the public health sector. This may be because of private dietitians having a greater opportunity to specialise in bariatric surgery and thus comprehensive education strategies may be more likely to be part of their clinical protocol. Preoperative education sessions

![Figure 1](image-url) **Figure 1** The proportion of dietitians reporting routine screening for nutrients and biomarkers of chronic disease by practice location: Vitamin D $\chi^2 = 7.11, P = 0.008$; fasting blood lipids $\chi^2 = 4.54, P = 0.03$; HbA1c $\chi^2 = 9.12, P = 0.003$. *Glycated haemoglobin, fasting blood glucose, 2 hour postprandial blood glucose and liver function test. Metro; R, Regional/Rural/Remote.
Figure 2 The proportion of dietitians reporting the use of specific preoperative nutrition interventions, medical nutrition therapy (MNT) strategies for preoperative weight loss and preoperative education strategies \( (n = 90) \). \( P \leq 0.05 \) tests included private and public system; more than one response may be selected by participants for all questions. \( \ddagger \) Education on dietary and lifestyle modification requirements postbariatric surgery, \( \ddagger \) education on the nutritional consequence of the different types of bariatric procedures, \( \ddagger \) very-low-energy diet—exclusive liquid meal replacement, \( \ddagger \) very-low-energy diet—combination of liquid meal replacement and food meals, \( \ddagger \) very-low-energy diet—food meals only, \( \ddagger \) general advice on diet and lifestyle change, \( \ddagger \) postoperative meal plans and ongoing dietary modifications and supervision, \( \ddagger \) postoperative vitamin and mineral supplementation, \( \ddagger \) lifelong compliance involved with bariatric surgery and \( \ddagger \) potential nutritional consequences of not undergoing the treatment. ■ Public; □ Private; △, Both.

Table 3 Key categories and subcategories of information used to guide intervention strategies of bariatric patients in the preoperative stage by Australian dietitians

<table>
<thead>
<tr>
<th>Key themes</th>
<th>Total count n (%)</th>
<th>Subthemes</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient-related factors</td>
<td>55 (64)</td>
<td>Pathology and biochemistry</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Motivation and compliance</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Current lifestyle and personal goals</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Body mass index and co-morbidities</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Diet history</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Type of surgery</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Knowledge</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Finances</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mental health</td>
<td>1</td>
</tr>
<tr>
<td>Clinical protocols and procedures</td>
<td>24 (28)</td>
<td>OPTIFAST protocol</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Health service/facility policies/procedures</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Information based on the GP/bariatric surgeons’ preference</td>
<td>4</td>
</tr>
<tr>
<td>Evidence-based clinical guidelines</td>
<td>16 (19)</td>
<td>The ASMBS guidelines</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NHMRC—Clinical Practice Guidelines for the Management of Overweight and Obese Adults, Adolescents and Children</td>
<td>6</td>
</tr>
<tr>
<td>Practice resources</td>
<td>16 (19)</td>
<td>Research journal articles</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bariatric interest groups</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Benchmarking</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Webinars and lectures</td>
<td>2</td>
</tr>
</tbody>
</table>
have been previously demonstrated to aid bariatric patients in making informed decisions regarding their treatment.\textsuperscript{11} These sessions included education on the advantages/disadvantages on each procedure, the psychological impact of weight loss and education on postoperative meal plans.\textsuperscript{11} However, few studies report how often these education strategies should be provided in the preoperative stage.

There was great variability in the reported MNT strategies for preoperative weight loss. Studies have demonstrated that the use of liquid meal replacement is an effective preoperative weight loss strategy.\textsuperscript{17,18} However, a study of bariatric patients undergoing a preoperative dietary restriction in the UK reported that the most recommended strategy is food-based low-energy/low carbohydrate meals (58%).\textsuperscript{30} In the present study, fewer dietitians reported the use of VLED with food alone as a strategy compared to dietitians who used VLED exclusively as a meal replacement or the use of VLED with a combination of liquid meal replacement and food meals. This difference in practice between countries is not clear but may relate to practitioner’s approach that promotes forming healthy and sustainable eating patterns prior to surgery using food to optimise postoperative behaviour.

In the present study, factors that determined the number of times a patient is seen before surgery depended on the patients’ individual circumstance. A recent systematic review of attendance rates of postoperative appointments in bariatric care found some similar findings to our results.\textsuperscript{31} The review demonstrated that attendance rates decreased with greater presurgery weight and greater time travelled to the follow up centres.\textsuperscript{31}

Participants in the present study reported working in an MDT, with the bariatric surgeon most commonly involved. The pivotal inclusion of the bariatric surgeon in the MDT is usually attributed to their role as the leader and the individual that performs the surgery.\textsuperscript{32,33} A higher proportion of dietitians in the private system reported the bariatric surgeon involvement, which may be because of the investment of the bariatric surgeon in specialised bariatric clinics and private hospitals compared to the public system where bariatric surgery is performed at lower rates.\textsuperscript{25}

The present study described current dietetic practice in bariatric surgery in Australia; however, it is not without limitations. Some specific demographic information was not collected from participants (such as gender, age, education level and type of DAA member) that would have assisted with interpretation of the data.

In conclusion, our findings demonstrate that the dietitian plays a role in preoperative bariatric nutrition intervention, prescribing MNT and providing education strategies on postoperative care. The reported practice of the bariatric dietitians surveyed in the present study is mostly consistent with recommendations from the literature and with the ASMBS guidelines. However, preoperative screening of all recommended nutrients and biomarkers of chronic disease was not consistent with current evidence and location of workplace showed significant difference in the proportion of individuals that conducted screening. Therefore, further investigation to explore the barriers to preoperative nutrient and biomarker screening for bariatric patients, the dietitian’s role in initiation of screening, the factors explaining the geographical and workplace discrepancy in practice and the dietitians perceived role in preoperative bariatric care within Australia is warranted.

**Funding source**

Internal funding for honours provided by the School of Health and Sport Sciences, University of the Sunshine Coast.

**Conflict of interest**

The authors have no conflicts of interest to declare.

**Authorship**

All authors were responsible for research design and methodology. RB was responsible for data collection and analysis. JT and FP provided feedback on the data analysis and interpretation and all authors contributed to interpretation of the data. RB wrote the manuscript and JT and FP reviewed and provided feedback on the manuscript.

**References**

Nutritional management of bariatric patients

Use of the malnutrition screening tool by non-dietitians to identify at-risk patients in a rehabilitation setting: A validation study

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Nutrition and Food Service Department and Rehabilitation Services, Gold Coast Hospital and Health Service and School of Allied Health Sciences and Menzies Health Institute Queensland, Griffith University, Gold Coast and School of Exercise and Nutrition Sciences, Queensland University of Technology, Brisbane, Queensland, Australia

Abstract

Aim: Malnutrition is highly prevalent in rehabilitation patients, and screening is important to allow for timely intervention to reduce the incidence of adverse clinical outcomes. We aimed to determine the reliability and validity of the commonly employed malnutrition screening tool by non-dietitian staff in categorising patients at risk of malnutrition in the rehabilitation setting.

Methods: This prospective observational cohort study recruited 100 participants on admission to a rehabilitation ward. The malnutrition screening tool was applied by nursing staff and repeated by nutrition assistants. Results were compared to malnutrition as determined by dietitian-applied subjective global assessment of each patient. Inter-rater reliability tests were conducted with two dietitians, two nutrition assistants and two nurses independently but simultaneously recording malnutrition screening tool scores on a subgroup of 15 participants.

Results: Agreement between dietitian-determined malnutrition and risk as identified by nutrition assistant and nursing staff screening tool application was only modest (64% and 51%, respectively). While both professions met the a priori criteria for acceptable specificity (≥60%), neither met the criterion for adequate sensitivity (≥80%). The inter-rater reliability of the tool was excellent, with almost perfect agreement (≥0.89) between ward dietitian and nutrition assistants, and moderate to substantial agreement (0.56–0.65) with nursing staff, when compared to a senior dietitian.

Conclusions: Non-dietitian staff failed to apply the malnutrition screening tool with sufficient sensitivity in normal ward practice to warrant its use in the rehabilitation setting. Alternative options for identification of malnutrition need to be considered to ensure appropriate treatment.

Key words: malnutrition, nursing staff, nutrition assistant, nutrition screening, rehabilitation.

Introduction

Undiagnosed malnutrition can contribute to adverse clinical outcomes such as delayed wound healing, physical and cognitive impairment, increased length of stay (LOS) and associated costs in hospitalised patients.1–3 Malnutrition in the rehabilitation setting is common, with a reported prevalence as high as 30% and a further 53% of patients being at risk of malnutrition.3 Screening of patients to identify those at risk of malnutrition allows clinicians to provide timely and targeted nutrition interventions to prevent and treat malnutrition. The best practice for determining nutritional status is by administration of a validated tool such as the subjective global assessment (SGA), delivered by a dietitian or other trained health professional.4,5 SGA is a valid nutrition assessment tool used in acute, rehabilitation, community and residential aged care settings, and it is frequently used to investigate prevalence of malnutrition.4,6

In Australia, accreditation for healthcare organisations requires adoption of routine malnutrition screening,7 and in the future screening will be mandated by the National Safety and Quality Health Service (NSQHS) standard.8 However, only half of hospitals report having a documented screening policy.9 Limited access to qualified dietitians precludes the use of the SGA in routine assessment of all patients. Instead, the malnutrition screening tool (MST) is a
simple tool designed to be used by non-dietitian health workers, and is most frequently used in Australian healthcare facilities to screen for malnutrition.9 The MST has been validated within the acute care setting with the premise of being used by non-dietitian staff to identify patients at nutritional risk and provide the basis for referral for further assessment and intervention.10 The MST has a high sensitivity of 93% and specificity of 93% in the acute care setting with strong inter-observer reliability of 93–97%, when delivered by nutrition professionals.11 Further, the MST has been reported as a useful tool for identifying malnutrition risk in emergency department and residential aged care settings and has recently been validated in the geriatric rehabilitation setting with a sensitivity of 80.8% and a specificity of 67.7%, when delivered by an experienced dietitian.12-14

In our health district, the responsibility of screening patients for malnutrition in the rehabilitation setting lies with the nursing staff. The district also has a number of nutrition assistants who support nursing staff in malnutrition screening using the MST. Currently, the reliability and validity of the MST to identify patients at risk of malnutrition in the rehabilitation setting when delivered by non-dietitian health staff, is unknown. The purpose of this study was to determine the reliability and validity of the MST in identifying patients at risk of malnutrition in a rehabilitation setting, when delivered by non-dietitian staff.

Methods

This single-centre observational cohort study was conducted in a subacute rehabilitation ward with 32 beds in South East Queensland. This ward accepts patients from surrounding acute care hospitals with a variety of clinical conditions, including fracture, stroke, post-operative recovery and chronic pain. A sample of convenience of 100 consecutive patients was recruited prospectively between September 2013 and January 2015. Patients were invited to participate in the study if they met the following inclusion criteria: over 18 years of age, cognitively intact and able to participate in the study if they met the following inclusion criteria.

Baseline data collected at admission included MST score, SGA score, age, height, weight, gender, body mass index (BMI) and acute hospital LOS prior to admission to the rehabilitation ward. Further data collected at discharge included LOS in the rehabilitation ward and total LOS (hospital + rehabilitation). All participants provided informed written consent prior to enrolment in the study, and the study was approved by the Gold Coast Hospital and Health Service.

Nutrition assistants and nurses were trained in applying the MST prior to commencement of data collection, and ongoing training refreshment was offered to ward staff every 6 months, in line with local hospital and health service guidelines and relevant standards. New nursing staff to the ward during the study period were orientated and familiarised with the standard admission paperwork for the setting, which included the MST, as per normal clinical practice. Participants were screened for malnutrition on admission to the ward by a registered nurse using the MST as per standard ward protocol. Numerous nursing staff were involved in this across the 18-month study period, with staff rotation through three shifts per 24 hour period, between wards, and with employment changes for individuals reflecting normal practice within the real-life clinical setting. In addition, one of two nutrition assistants, blind to nursing staff results, also applied the MST to participants within 72 hours of admission. Following the MST assessment by nursing and nutrition assistants, a dietitian, blinded to MST scores and trained in the application of the SGA, assessed participant’s nutritional status using the SGA tool within 72 hours of admission.5

All MST and SGA scores were entered manually into an electronic database by researchers not involved in the malnutrition screening or assessments (DE, ML, PW). The MST scores were grouped into (i) not at risk of malnutrition (score 0–1) and (ii) at risk of malnutrition (score 2–5).11 The SGA scores were categorised into SGA-A = well nourished, SGA-B = mild to moderate malnutrition and SGA-C = severe malnutrition. SGA results were further dichotomised into SGA-A = not malnourished and SGA-B or SGA-C = malnourished, prior to further data analyses.

Descriptive statistics were calculated for all baseline demographic and clinical characteristics and were compared between groups (malnourished and not malnourished) based on the SGA categories. For a small number of participants, no record was available for weight on admission (n = 3) or LOS in rehabilitation (n = 4). It was assumed that the missing data was completely at random, therefore no imputation was performed, and these participants were included in all demographic analyses, with the exception of the missing categories.

Inter-rater reliability was conducted on 15 participants enrolled during the penultimate month of the study, to investigate agreement between professions applying the MST. The ward dietitian, one senior dietitian, two registered nurses and two nutrition assistants independently, but simultaneously, carried out the MST on a subgroup of participants, blind to each other’s scores. Each research clinician took a turn in asking the participant the MST questions, while the other clinicians listened and recorded their MST scores based on answers provided by each participant. That is, each participant was asked the MST questions by one team member, with all investigators present and entering their own scores based on the participant’s response.

Data were analysed using IBM SPSS Statistics version 21.0 (IBM, Chicago, IL, USA) and AgreeStat 2013.4 Excel (Advanced Analytics, Gaithersburg, MD, USA), with level of significance set at P ≤ 0.05. Gwet’s AC1 was used to calculate agreement coefficients to compare nutrition assistant and nursing staff MST to the dietitian SGA as well as to investigate the inter-rater reliability of the MST application between the dietitian, nutrition assistants and nursing staff. Gwet’s AC1 was used as it removes agreement by chance.
and remains stable when high levels of inter-rater agreement is seen.\textsuperscript{15,16} The senior dietitian was considered the reference standard for investigating agreement between professions. The levels of agreement were defined using criteria set by Landis and Koch: slight $<0.2$, fair $0.21–0.4$, moderate $0.41–0.6$, substantial $0.61–0.8$ and almost perfect $0.81–1.\textsuperscript{17}$

Contingency tables (chi-square) were used to determine the specificity, sensitivity, positive and negative predictive values as well as likelihood ratios for the nursing staff and nutrition assistant MST compared to SGA. An accepted a priori criteria for an appropriate screening tool defined by a sensitivity $\geq80\%$ and specificity $\geq60\%$ was applied.\textsuperscript{15,16} Compliance with STROBE guidelines has been addressed in this report.

Results

Figure 1 demonstrates the flow of participants through the study. Participant characteristics on admission to rehabilitation are outlined in Table 1. Fifty-five participants were assessed as SGA-A (well nourished), 39 SGA-B (mild–moderate malnutrition) and six SGA-C (severe malnutrition). The malnourished group were significantly older ($P = 0.014$) and had significantly lower weight ($P < 0.001$) and BMI ($P < 0.001$) on admission in comparison to those who were not malnourished. There were no significant differences between gender, LOS prior to admission to rehabilitation, total LOS (hospital + rehabilitation) or reason for admission.

The nutrition assistants and nursing staff failed to complete the MST on 8/100 (8\%) and 16/100 (16\%) of occasions respectively, with 6/8 (75\%) and 6/16 (32.5\%) of these participants found to be malnourished when applying the SGA. Table 2 reports the number of participants who were correctly and incorrectly categorised for nutritional status by the nutrition assistant and nursing staff. Overall, the level of agreement for the nutrition assistant was higher (64\%) than for nursing staff (51\%) when the MST scores were compared to the SGA (Table 2). Neither nutrition assistant nor nursing staff met the a priori criteria for acceptable sensitivity; however, both met the a priori criteria for specificity. The positive and negative likelihood ratios indicate that the nutrition assistant was more likely to correctly predict well-nourished patients as not at risk of malnutrition than the nursing staff. However, the nursing staff had a slightly higher probability of correctly predicting patients as at risk of malnutrition than the nutrition assistant (Table 2).

Agreement between the MST and the SGA revealed the nutrition assistant MST had moderate agreement with the SGA (Gwet’s $AC_1 = 0.51$, 95\% CI 0.37–0.64, $P < 0.001$) compared to nursing staff MST, which had only fair agreement with the SGA (Gwet’s $AC_1 = 0.33$, 95\% CI 0.18–0.48, $P < 0.001$).

Results of the inter-rater reliability tests, used to investigate the agreement between different professions applying the MST are described in Table 3. These revealed almost perfect agreement between the senior dietitian and both the ward dietitian and nutrition assistants (93.3\%). The ward dietitian incorrectly categorised only one participant as at-risk of malnutrition, while correctly categorising 11 participants as at-risk and three as not-at-risk. Similarly, each nutrition assistant incorrectly categorised one participant, with one incorrectly categorising an at-risk patient as not-at-risk, and the other categorising a well-nourished patient as at-risk of malnutrition. The nursing staff displayed moderate to substantial agreement with the senior dietitian (73.3\%). One nursing staff member categorised all participants as at-risk of malnutrition, incorrectly categorising four well-nourished participants. The second nursing staff member incorrectly categorised two participants as not-at-risk and another two as at-risk of malnutrition.

Discussion

The aim of this study was to investigate the reliability and validity of using the MST to categorise patients at risk of malnutrition in a rehabilitation setting, using non-dietitian staff. The level of agreement between the MST, delivered by non-dietitians as part of usual ward activities, and the SGA, delivered by an experienced dietitian, was only modest. In contrast, the inter-rater reliability of the MST itself was excellent for ward dietitians and nutrition assistants, and also reasonable for nursing staff, when compared to a senior.
Table 1: Participant characteristics on admission to rehabilitation based on malnutrition as defined by the subjective global assessment, reported as means ± SD (range) unless otherwise specified.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Total, N = 100</th>
<th>Not malnourished, N = 55</th>
<th>Malnourished, N = 45</th>
<th>Difference between groups, mean (95% CI)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women, n (%)</td>
<td>53 (53)</td>
<td>33 (60)</td>
<td>20 (44.4)</td>
<td></td>
<td>0.16</td>
</tr>
<tr>
<td>Men, n (%)</td>
<td>47 (47)</td>
<td>22 (40)</td>
<td>25 (55.6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age, years</td>
<td>76.4 ± 12.0 (26–97)</td>
<td>73.7 ± 13.6 (26–97)</td>
<td>79.6 ± 8.9 (55–93)</td>
<td>5.9 (1.2 to 10.6)</td>
<td>0.01</td>
</tr>
<tr>
<td>Weight on admission, kg</td>
<td>72 ± 22.5 (33–160)</td>
<td>81.4 ± 23.3 (45–160)</td>
<td>60.6 ± 15.3 (33–112)</td>
<td>20.7 (12.6 to 28.9)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>BMI, kg/m²</td>
<td>26.2 ± 8.3 (14.5–59.7)</td>
<td>29.9 ± 8.7 (19.1–59.7)</td>
<td>21.7 ± 5.0 (14.5–41.3)</td>
<td>8.3 (5.3 to 11.2)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>LOS prior to rehabilitation, days¹</td>
<td>10.0 IQR 7–22 (1–89)</td>
<td>10.0 IQR 7–22 (1–68)</td>
<td>11.0 IQR 7–23 (1–89)</td>
<td>2.7 (–4.9 to 10.2)</td>
<td>0.61</td>
</tr>
<tr>
<td>LOS at rehabilitation, days</td>
<td>16.0 IQR 10–30 (1–87)</td>
<td>15 IQR 10–27.5 (1–87)</td>
<td>20 IQR 10–34 (4–64)</td>
<td>1.0 (–6.3 to 8.3)</td>
<td>0.29</td>
</tr>
<tr>
<td>Total LOS, days</td>
<td>31.0 IQR 20.3–56.8 (8–151)</td>
<td>29.0 IQR 20–56 (8–149)</td>
<td>33 IQR 24–57 (12–151)</td>
<td>4.1 (–8.1 to 16.2)</td>
<td>0.33</td>
</tr>
<tr>
<td>Reason for admission, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Falls</td>
<td>40</td>
<td>16 (29)</td>
<td>24 (53.3)</td>
<td></td>
<td>0.052</td>
</tr>
<tr>
<td>Post-operative</td>
<td>18</td>
<td>14 (25.4)</td>
<td>4 (8.9)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pain</td>
<td>6</td>
<td>5 (9.1)</td>
<td>1 (2.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stroke</td>
<td>2</td>
<td>1 (1.8)</td>
<td>1 (2.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other reason</td>
<td>34</td>
<td>19 (34.5)</td>
<td>15 (33.3)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Median and interquartile range reported.
BMI, body mass index; IQR, interquartile range; LOS, length of stay.
The prevalence of malnutrition in the rehabilitation setting used in this study was 43%, which is similar to that reported in other Australian studies. Older patients displayed a higher prevalence of malnutrition. Prompt treatment of malnutrition reduces the risk of negative health outcomes such as poor wound healing, reduced mobility, increased LOS and the associated health care costs. The benefits of malnutrition screening using tools such as the MST to facilitate prompt assessment and subsequent treatment have been clearly elucidated and substantial uptake of nutrition screening programs has been observed in Australian hospitals over the past 15 years. For healthcare facilities in Australia to meet NSQHS standards, all patients should be screened upon admission to a ward. However, a compliance rate of only 50% has been indicated in hospitals that reported auditing of the process. Our study found a completed screening rate of 84–92%, similar to that reported by other studies in the rehabilitation setting. The nutrition assistants were more reliable than nursing staff in completing the MSTs. Nursing staff failed to screen twice as many patients. Up to three quarters of missed patients were later assessed as malnourished. The lower completion rate observed for nurses may be attributed to insufficient time, staffing and limited awareness of the importance of nutrition screening. The lower inter-rater reliability result (<0.65) for the MST as applied by nursing staff indicates an increased chance of measurement error, which undermines the ability of the tool to detect malnutrition. This finding was supported by the observation that overall, MST scores from nursing staff showed only fair agreement with the nutrition status of participants as assessed by the dietitian-conducted SGA. Quality improvement initiatives including audits, additional training and ongoing education have been shown to increase the compliance with nutrition screening policy, reduce errors and improve the referral process. However, the low sensitivity observed for the MST in our study occurred despite the fact that ongoing MST training refreshment was provided to the ward throughout the 18-month study period.

Nutrition screening would ideally be conducted by nursing staff as part of the nursing care plan completed for all patients on admission. However, the use of dedicated nutrition staff, such as nutrition assistants, has previously been reported as the most effective strategy in successfully implementing a malnutrition screening program. Our study found that nutrition assistants had high inter-rater reliability with dietitians in MST application, and a higher level of agreement with the dietitian assessment using the SGA compared to nursing staff. An ideal screening tool will identify patients at risk of malnutrition with few false negatives (sensitivity) and false positives (specificity). While specificity was adequate, the MST failed to meet the a priori

Table 2 Measure of diagnostic accuracy for the malnutrition screening tool delivered by nutrition assistants and nursing staff compared to the subjective global assessment

<table>
<thead>
<tr>
<th></th>
<th>Nutrition assistant n = 92</th>
<th>Nursing staff n = 84</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MST</td>
<td></td>
</tr>
<tr>
<td></td>
<td>At risk</td>
<td>Not at risk</td>
</tr>
<tr>
<td>Dietitian SGA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malnourished n = 45</td>
<td>27 (63%)</td>
<td>12 (24.5%)</td>
</tr>
<tr>
<td>Not malnourished n = 55</td>
<td>16 (37%)</td>
<td>37 (75.5%)</td>
</tr>
<tr>
<td>Total</td>
<td>43</td>
<td>49</td>
</tr>
<tr>
<td>Agreement</td>
<td>64%</td>
<td>51%</td>
</tr>
<tr>
<td>Sensitivity (%) (95% CI)</td>
<td>69.2 (52.4–82.9)</td>
<td>33.3 (19.1–50.2)</td>
</tr>
<tr>
<td>Specificity (%) (95% CI)</td>
<td>69.8 (55.7–81.7)</td>
<td>84.4 (70.5–93.5)</td>
</tr>
<tr>
<td>PPV (%) (95% CI)</td>
<td>62.8 (46.7–77.0)</td>
<td>65.0 (40.8–84.6)</td>
</tr>
<tr>
<td>NPV (%) (95% CI)</td>
<td>75.5 (61.1–86.7)</td>
<td>59.4 (46.4–71.5)</td>
</tr>
<tr>
<td>+ve LHR (95% CI)</td>
<td>2.3 (1.5–3.6)</td>
<td>2.1 (1.0–4.8)</td>
</tr>
<tr>
<td>-ve LHR (95% CI)</td>
<td>0.4 (0.3–0.7)</td>
<td></td>
</tr>
</tbody>
</table>

+ve LHR, positive likelihood ratio; -ve LHR, negative likelihood ratio; MST, malnutrition screening tool; NPV, negative predictive value; PPV, positive predictive value; SGA, subjective global assessment.

Table 3 Inter-rater reliability results for the malnutrition screening tool administered by the ward dietitian, two nutrition assistants and two nursing staff compared to a senior dietitian as the reference standard

<table>
<thead>
<tr>
<th></th>
<th>DT2</th>
<th>NA1</th>
<th>NA2</th>
<th>NS1</th>
<th>NS2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gwet’s AC1 (95% CI)</td>
<td>0.90 (0.7–1.0)*</td>
<td>0.90 (0.7–1.0)*</td>
<td>0.89 (0.6–1.0)*</td>
<td>0.65 (0.2–1.0)*</td>
<td>0.56 (0.1–1.0)*</td>
</tr>
<tr>
<td>Agreement %</td>
<td>93.3</td>
<td>93.3</td>
<td>93.3</td>
<td>73.3</td>
<td>73.3</td>
</tr>
</tbody>
</table>

DT2, ward dietitian; NA1, nutrition assistant 1; NA2, nutrition assistant 2; NS1, nursing staff 1; NS2, nursing staff 2.

*P < 0.001, significantly associated with the reference standard.
criteria (≥ 80%) for sensitivity in the hands of either nutrition assistants or nursing staff in this rehabilitation setting. The small number of participants who were categorised as SGA-C (severely malnourished) may have impacted sensitivity calculations for the MST. However, as the cohort in this study reflects the true population found in a rehabilitation setting, the lack of sensitivity of the MST identified here supports the conclusion that the MST may not be the ideal tool to screen for malnutrition in this setting.

In contrast, other recent research has validated use of the MST in geriatric rehabilitation. Differences between findings may be related to variation in the participant population (the current study was not geriatric specific, enrolling participants aged from 26–97 years). Alternatively, methodological differences related to disparity in nutrition knowledge between professions applying the MST may be responsible. Marshall et al. used a dietitian to apply the MST rather than non-dietitian staff as used in our study. Much of the research in acute care settings in which the MST was originally validated was also conducted using highly trained nutrition professionals. In these previous studies, high sensitivity (84–100%) and specificity (81–90%) were reported for acute medical, oncology and mechanical falls patient groups. Bell et al. (2014) previously discussed that the less than optimal MST sensitivity in an elderly population in part may be due to the inclusion of difficult to screen patients, who are often omitted from validation studies. Our study found low sensitivity of the MST in the rehabilitation setting despite exclusion of patients with cognitive impairment or insufficient English language communication skills. Thus, we suggest that differences in application of the tool based on the skills and knowledge of the professional applying it may be the factor of key importance, more so than the patient population.

The risk of bias in our study was minimised through the use of different assessors for each tool, and blinding of assessors to each other’s scores. One limitation in this study is the lack of an a priori formal sample size calculation. However, a relatively large sample was recruited, which gave an almost equal distribution of participants between groups (malnourished n = 45, not malnourished n = 55) based on the reference standard measure (SGA). There was some loss of data from both the nursing and nutrition assistant assessors, which resulted in lower numbers of participants identified at risk of malnutrition (n = 39 on the SGA). Despite the apparent random nature of this loss of data, it may nevertheless increase the risk of type II error in results.

Malnutrition screening protocols are intended as a quick and easy method for use by generalist staff to enable prompt and appropriate referral to dietitians for nutrition intervention. The MST is used in two thirds of Australian hospitals that reported use of malnutrition screening, with it being applied by nutrition assistants and nursing staff in over half of these facilities. In our study, which examined application of the tool in a real world clinical practice environment, neither of these professions applied the MST with sufficient sensitivity to warrant its use as a screening tool in the rehabilitation setting. Alternative options for identification need to be instigated to ensure prompt treatment of malnutrition to alleviate the associated negative health consequences. Further, maintenance of adequate nutrition is a critical component of preventing hospital acquired pressure injuries, for which financial penalties are applied under the current Australian health services funding model. Comprehensive nutritional assessment of each patient by a dietitian has been previously suggested; however, the feasibility of this is questionable. Further investigation is needed to identify models of care in which the cost of full nutritional assessment may be offset by improvements in the ratio of reimbursement and disbursements acquired by the hospital.

In conclusion, non-dietitian staff failed to apply the malnutrition screening tool with sufficient sensitivity in normal ward practice to warrant its use in the rehabilitation setting. Alternative options for identification of malnutrition need to be considered to ensure appropriate treatment.

Funding source
This research was supported financially by grants from the Gold Coast Hospital Foundation as well as the Allied Health Clinical Backfill Funding Scheme, Queensland Health, Gold Coast Hospital and Health Service.

Conflict of interest
The authors have no conflicts of interest to declare.

Authorship
PW was chief investigator and conceptualised the study design, was responsible for data collection, processing and analysis and was the primary author of the manuscript. The other authors contributed to study design (LB, BC, ML), data collection (ML, DE), data processing and analysis (LB, BC, DE, RA), and interpretation and manuscript preparation (LB, RA). All authors reviewed the manuscript. The content of this manuscript has not been previously published elsewhere.

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ORIGINAL RESEARCH

The accuracy and consistency of nutrition care process terminology use in cases of refeeding syndrome

Kylie L. MATTHEWS, Michelle A. PALMER and Sandra M. CAPRA

Methods: A multimethod action research approach was used, incorporating two projects. The first was a survey examining Australian dietitian nutritionists’ (n = 195) opinions regarding NCPT use in cases of RFS. To establish if results were similar internationally, an interview was then conducted with 22 dietitian nutritionists working within 10 different countries.

Results: ‘Imbalance of nutrients’ was only identified as a correct code by 17% of respondents in project 1. No mention of this term was made in project 2. Also 86% of respondents incorrectly selected more than one diagnostic code. The majority of respondents (80%, n = 52/65) who incorrectly selected ‘Malnutrition’, without also selecting ‘Imbalance of nutrients’, selected ‘reduce intake’ as an intervention, suggesting some misunderstanding in the requirement for interrelated diagnoses, interventions and goals.

Conclusions: Our findings demonstrate that there is limited accuracy and consistency in selecting nutritional diagnostic codes in relation to RFS. Respondents also demonstrated limited knowledge regarding appropriate application of the NCP and NCPT. Implementation practices may require further refinement, as accurate and consistent use is required to procure the benefits of standardised terminology.

Key words: clinical nutrition and dietetics, diagnosis, nutrition care process terminology, nutrition care process, refeeding syndrome.

Introduction

In the acute care setting, the use of standardised terminology has encouraged increases in both knowledge and self-awareness of each health professional’s role in patient care. It also simplifies the continuity of patient care, the coordination of treatment and assists in the evaluation of patient outcomes. While standardised languages have been utilised across both the nursing and medical professions for a number of decades, there has been a noticeable gap in their use by allied health professionals. In recent years, many peak professional bodies have been working to address this gap. Within the field of nutrition and dietetics, this has resulted in the creation of a standardised model to assist dietitian nutritionists in the delivery of high-quality nutrition care worldwide.

The Nutrition Care Process (NCP) is a model developed in 2003 that includes four key processes: nutritional assessment, diagnosis, interventions and monitoring and evaluation. To support these four processes, and to assist in standardising vocabulary, the Nutrition Care Process Terminology (NCPT) was also developed. A key benefit of using both the NCP and NCPT is the consistent formulation of nutrition diagnoses, otherwise known as PES statements, incorporating the problem (P), aetiology (E) and signs and symptoms (S) experienced by a patient. Nutritional diagnostic terms, incorporated within NCPT, are utilised to formulate the problem component of PES statements. The use of consistent communication and documentation in making nutritional diagnoses benefits both clinical practice and nutrition and dietetics research.

By 2010, more than 20 countries had commenced using NCPT, including Australia. The Dietitians Association of Australia officially endorsed the use of NCPT in 2009, however, despite this endorsement and its inclusion in...
student competency standards, NCPT remains underutilised in Australian hospital dietetics departments, with the exception of some in Queensland.\(^10\)\(^14\) The uptake of NCPT is higher in this state of Australia, following a statewide project to incorporate NCPT in public institutions.\(^10\) However, after 14 educational sessions, only 42% of Queensland dietitian nutritionists were able to identify the correct PES statement for a posed case study,\(^10\) suggesting that educational sessions may not be the best tool for NCPT implementation.

Despite challenges in translating the document from English, the NCPT manual has been translated and is already in use in parts of Sweden, Japan, Korea, Hungary, Israel and Turkey.\(^14\) However, there is limited literature as to whether implementation has been successful within these countries. Dietitian nutritionists in the United States of America (USA) remain the highest users of NCPT, with the majority of research focused around its use within American practice.\(^14\)

Coinciding with the gradual implementation of NCPT, limited research has been conducted around the accuracy or consistency of documentation following the creation and use of the NCP. Only two studies conducted within the USA\(^3\)\(^10\) and one in Australia\(^14\) have examined accuracy in components of the NCP within specific environments. To the authors' knowledge, no research has been conducted examining the diagnostic terminology that dietitian nutritionists, working in a number of different countries, would choose to formulate a PES statement for a specific nutrition-related condition. As such, the aim of this study was to examine the nutritional diagnostic term dietitian nutritionists would utilise in managing a patient with refeeding syndrome (RFS).

**Methods**

A multiple method action research approach was used for this study, incorporating two major but disparate sources of information. This descriptive study commenced with a national survey examining Australian dietitian nutritionists' opinions regarding specific diagnostic terms used for patients with RFS. To establish if results found were similar internationally, in-depth interviews were then conducted with dietitian nutritionists working within 10 different countries. The authors adhered to STROBE guidelines for reporting observational studies.

**Project 1: Survey**

**Study design:** A cross-sectional national survey of Australian clinical dietitian nutritionists, using a specifically designed and tested tool was undertaken in 2015. Ethical approval was obtained from the University of Queensland (approval number: HMS15/1708).

**Participant eligibility:** Eligible participants were clinical dietitian nutritionists currently working or with prior work experience within the acute care hospital setting. Dietitian nutritionists with no recent experience in this setting and students were considered ineligible. Participants who reported completing the survey more than once and those who selected erroneous responses were also excluded (e.g. selecting high serum potassium as an indicator for the development of RFS) to ensure participants had adequate knowledge of the topic.

**Survey tools and data collection:** A 33-item questionnaire was created, commencing with questions from previous surveys\(^17\)\(^18\) and using gaps in the literature to identify topics. Survey piloting for construct validity was completed by six individuals, including a new graduate dietitian nutritionist, two Doctor of Philosophy (Nutrition and Dietetics) candidates and three experienced clinical researchers from a large metropolitan hospital. The survey incorporated 10 demographic and workplace questions including gender, age, qualifications, years of clinical experience, and the country, geographical area and size of the current workplace. Among the remaining questions examining assessment, management and treatment of RFS, two questions concerning the NCPT process were included: 'Do you use any of the standard nutritional diagnostic terms (NCPT), previously known as International Dietetics and Nutrition Terminology, for patients with refeeding syndrome?' and 'If yes, which of the NCPT code/s do you use?' Relating to these questions, respondents were also asked, 'When refeeding syndrome risk is identified, which of the following do you recommend?' A convenience sample was recruited via a web-link to the online survey advertised through email via: the professional association's interest groups email lists (Gastroenterology, Nutrition Support, Oncology and Aged Care and Rehabilitation); Dietitian Connection’s weekly update; and professional contacts of the research team, including via social media. Survey completion reminders were advertised by Dietitian Connection and the research team. Members of both the professional association and Dietitian Connection comprise dietitian nutritionists and dietetics students working in all fields, both in Australia and overseas. This recruitment process was chosen as it is the only known method of contacting dietitian nutritionists within Australia.

The survey was distributed via Checkbox survey software (Version 6.7, 2015; Checkbox Survey, Inc., Watertown, MA, USA). Respondents were given five weeks to complete the survey. Respondents could opt for a summary of results by contacting the research team, which were emailed upon study completion. No incentive was offered for completing the survey.

**Data analysis:** After cleaning and the verification of data using double entry, the Statistical Package for the Social Sciences was used for data analysis (version 23.0; IBM Corporation, Armonk, NY, USA). Descriptive statistics were used to present participant demographics and results from the NCPT and RFS management questions.

**Project 2: Semistructured individual and group interviews**

**Study design:** A semistructured interview design was chosen to elicit the opinions of dietitian nutritionists working in countries other than Australia with respect to the diagnosis
of RFS. Ethical approval was obtained from the University of Queensland (approval number: HMS16/0903).

Participant eligibility: A convenience sample of participants was recruited from those attending an international nutrition conference in 2016. Participants could opt to be interviewed individually or in a group with delegates from the same country. Students and those working in Australia were considered ineligible. All participants provided written consent.

Interview questions and data collection: The original 33 questions utilised in the initial project were condensed to limit participant burden in the second project. As such, eight open-ended interview questions were created using the same study domains used in project 1, with two questions specifically relating to NCPT use in cases of RFS: ‘Do you currently use the NCPT process in your place of work?’ and ‘Which diagnostic code would you use for a patient with refeeding syndrome?’ Interview questions were tested with three professionals and two Doctor of Philosophy students prior to sampling. Respondents were interviewed once over three days, with interviews lasting between 10 and 30 minutes in a private room.

All individual and group interviews were recorded on an MP4 recorder to assist with transcription. A second interviewer was present during all interviews to assist with participant understanding and ensuring validity of the responses captured.

Data analysis: Interviews were transcribed verbatim. Inductive thematic analysis, guided by the framework described by Braun and Clarke, was applied to the survey questions. This involved six phases: (i) familiarisation with the data; (ii) initial code generation; (iii) searching for themes; (iv) reviewing themes; (v) defining and naming of themes and (vi) writing up of results. Coding of the responses was performed using the NVivo qualitative analysis software (Version 11, 2015; QSR International Pty Ltd., Victoria, Melbourne, USA). One researcher (KM) conducted the analysis, coding all responses to allow for data immersion and to obtain an overall sense of the entire data set. Generated codes and subsequent themes were checked through a process of ongoing discussion with a second researcher (SC) who was familiar with the data before finalisation.

Results

Project 1: Survey: Two hundred and three completed surveys were submitted through Checkbox. Eight responses were deemed ineligible with three respondents selecting ‘yes’ for having previously completed the survey and five respondents deemed ineligible based on their selection of erroneous responses, leaving a total sample of 195. No respondent self-declared as a student. The potential member overlap across the interest groups and Dietitian Connection could not be determined, and so a response rate could not be calculated.

Respondent characteristics: Of the 195 eligible responses, the majority were female and working within Australia (96%) with an average age of 31 ± 7 years (see Table 1). More than half (56%) the respondents held a Bachelor degree in Nutrition and Dietetics and were working within the acute care setting in metropolitan area, in hospitals with ≥200 beds. Respondents had a median of five years hospital clinical experience and were working within a department of 11 dietitian nutritionists.

Furthermore, 90% of respondents reported access to workplace protocols for the management of RFS. Only 60% of respondents reported using the NCPT in the workplace.

Survey responses: When respondents assessed a patient as at risk of RFS, more than half reported always monitoring electrolytes (98%), having a discussion with the medical team in charge (92%), recommending multivitamin (75%) and B-vitamin supplementation (66%), increasing intake slowly (64%), and monitoring patient weight (54%) (see Table 1). Three respondents selecting ‘yes’ for having previously completed the survey and five respondents deemed ineligible based on their selection of erroneous responses, leaving a total sample of 195. No respondent self-declared as a student. The potential member overlap across the interest groups and Dietitian Connection could not be determined, and so a response rate could not be calculated.

Table 1 Demographics and characteristics of the survey sample

<table>
<thead>
<tr>
<th>Respondent characteristics</th>
<th>n = 195</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respondent descriptors</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>188 (96)</td>
</tr>
<tr>
<td>Dietetics qualification</td>
<td></td>
</tr>
<tr>
<td>Bachelor</td>
<td>110 (56)</td>
</tr>
<tr>
<td>Masters</td>
<td>64 (33)</td>
</tr>
<tr>
<td>Postgraduate diploma</td>
<td>18 (9)</td>
</tr>
<tr>
<td>Diploma</td>
<td>3 (2)</td>
</tr>
<tr>
<td>Hospital clinical experience, years, median [IQR]</td>
<td></td>
</tr>
<tr>
<td>Working within Australia</td>
<td>187 (96)</td>
</tr>
<tr>
<td>Workplace geographical area</td>
<td></td>
</tr>
<tr>
<td>Metropolitan/Urban</td>
<td>129 (66)</td>
</tr>
<tr>
<td>Regional</td>
<td>46 (24)</td>
</tr>
<tr>
<td>Rural</td>
<td>20 (10)</td>
</tr>
<tr>
<td>Currently working within the acute care setting</td>
<td>166 (85)</td>
</tr>
<tr>
<td>Number of dietitians at current workplace, median [IQR]</td>
<td>11 [12]</td>
</tr>
<tr>
<td>Size of current workplace (number of beds)</td>
<td></td>
</tr>
<tr>
<td>&lt;50</td>
<td>5 (3)</td>
</tr>
<tr>
<td>50–99</td>
<td>12 (7)</td>
</tr>
<tr>
<td>100–199</td>
<td>16 (10)</td>
</tr>
<tr>
<td>200–500</td>
<td>81 (49)</td>
</tr>
<tr>
<td>&gt;500</td>
<td>52 (31)</td>
</tr>
<tr>
<td>Have access to workplace protocols for refeeding syndrome</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>149 (90)</td>
</tr>
<tr>
<td>Unsure</td>
<td>3 (2)</td>
</tr>
<tr>
<td>Do dietitians use NCPT in the workplace</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>99 (60)</td>
</tr>
<tr>
<td>Not applicable</td>
<td>5 (3)</td>
</tr>
</tbody>
</table>

(a) Thirty-five participants chose not to report their age.
(b) n = 166.
Table 2 Management of patients at risk of refeeding syndrome in acute care (n = 166)

<table>
<thead>
<tr>
<th>Management type</th>
<th>Always n (%)</th>
<th>Sometimes n (%)</th>
<th>Never n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitor electrolytes (a)</td>
<td>162 (98)</td>
<td>3 (2)</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Discuss with the medical team in charge</td>
<td>153 (92)</td>
<td>12 (7)</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Advise multivitamin supplementation</td>
<td>125 (75)</td>
<td>30 (18)</td>
<td>11 (7)</td>
</tr>
<tr>
<td>Advise B-vitamin supplementation</td>
<td>109 (66)</td>
<td>23 (14)</td>
<td>34 (20)</td>
</tr>
<tr>
<td>Increase intake slowly (a)</td>
<td>107 (64)</td>
<td>57 (34)</td>
<td>2 (1)</td>
</tr>
<tr>
<td>Monitor weight</td>
<td>89 (54)</td>
<td>67 (40)</td>
<td>10 (6)</td>
</tr>
<tr>
<td>Advise electrolyte supplementation</td>
<td>81 (49)</td>
<td>78 (47)</td>
<td>7 (4)</td>
</tr>
<tr>
<td>Monitor blood glucose levels</td>
<td>63 (38)</td>
<td>90 (54)</td>
<td>13 (8)</td>
</tr>
<tr>
<td>Monitor fluid balance (a)</td>
<td>55 (33)</td>
<td>87 (52)</td>
<td>24 (14)</td>
</tr>
<tr>
<td>Wait for electrolytes to stabilise before feeding (a)</td>
<td>31 (19)</td>
<td>71 (43)</td>
<td>64 (39)</td>
</tr>
<tr>
<td>Reduce intake (a)</td>
<td>26 (16)</td>
<td>94 (57)</td>
<td>46 (28)</td>
</tr>
<tr>
<td>Increase intake quickly</td>
<td>0 (0)</td>
<td>35 (21)</td>
<td>131 (79)</td>
</tr>
</tbody>
</table>

(a) Percentages ≠ 100 due to rounding.

Table 2. More than half reported sometimes reducing intake (57%), monitoring blood glucose levels (54%) and fluid balances (52%), and never increasing nutritional intake quickly (79%).

Of those dietitian nutritionists that reported using NCPT in the workplace (n = 99), the most commonly used diagnostic terms were incorrect according to the NCPT manual, and included ‘Malnutrition’, ‘Altered nutrition-related laboratory values’ and ‘Inadequate protein and energy intake’ (see Table 3). ‘Imbalance of nutrients’, considered the correct diagnostic term, was selected by only 17 respondents. Eight-five respondents selected more than one code, including 15 of those who selected ‘Imbalance of nutrients.’

Eighty percent of the respondents (n = 52/65) who selected ‘Malnutrition’, without also selecting ‘Imbalance of nutrients’, reported that they recommend ‘sometimes’ or ‘always’ reducing nutritional intake as part of patient management. Reducing intake in patients suffering from malnutrition differs from guideline recommendations, which support a substantial increase in energy intake for the treatment of malnutrition.20

Table 3 NCPT used by respondents for patients with refeeding syndrome

<table>
<thead>
<tr>
<th>Nutritional diagnostic terms used (a)</th>
<th>n = 99</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malnutrition</td>
<td>75 (76)</td>
</tr>
<tr>
<td>Altered nutrition-related laboratory values</td>
<td>66 (67)</td>
</tr>
<tr>
<td>Inadequate protein and energy intake</td>
<td>51 (52)</td>
</tr>
<tr>
<td>Predicted suboptimal nutrient intake</td>
<td>38 (38)</td>
</tr>
<tr>
<td>Suboptimal protein and energy intake</td>
<td>19 (19)</td>
</tr>
<tr>
<td>Altered gastrointestinal function</td>
<td>18 (18)</td>
</tr>
<tr>
<td>Imbalance of nutrients</td>
<td>17 (17)</td>
</tr>
<tr>
<td>Increased nutrient needs</td>
<td>14 (14)</td>
</tr>
<tr>
<td>Starvation related malnutrition</td>
<td>11 (11)</td>
</tr>
<tr>
<td>Excessive enteral nutrition infusion</td>
<td>11 (11)</td>
</tr>
<tr>
<td>Excessive parenteral nutrition infusion</td>
<td>7 (7)</td>
</tr>
<tr>
<td>Excessive energy intake</td>
<td>5 (5)</td>
</tr>
<tr>
<td>Inadequate vitamin intake</td>
<td>4 (2)</td>
</tr>
<tr>
<td>Excessive carbohydrate intake</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Decreased nutrient needs</td>
<td>1 (1)</td>
</tr>
</tbody>
</table>

(a) Participants had the option to select as many diagnostic terms as applicable.
Discussion

This is the first study to examine clinical dietitian nutritionists’ use of NCPT in relation to RFS in 11 different countries. Diagnosis and application: ‘imbalance of nutrients’ was only identified by 17% of respondents as a correct code for use in cases of RFS in project 1, with no mention of this term in project 2. Studies suggest that undertaking a diagnosis typically requires the most orientation within the NCPT process and educational programs have shown limited improvements (0–21%).

Our results suggest that different NCPT implementation practices are warranted to assist dietitian nutritionists to select the correct diagnostic code(s). The need for a different approach is also supported by the finding that 86% of respondents chose more than one diagnostic code for one condition. This practice is deemed inappropriate by the NCP manual instruction, as only one diagnostic code should be used for any one condition. Computer programs or other formal systems that guide dietitian nutritionists to choose applicable diagnostic codes, based on signs and symptoms experienced by the patient, may be a potential solution. Alternative solutions are necessary if the projected benefits of the NCPT are to be achieved.

The mismatch between the diagnosis of ‘Malnutrition’ and reducing intake as an intervention, indicates some additional misunderstanding that the diagnosis, interventions and goals need to be interrelated. This disconnect was also seen in an American institution with limited documentation regarding nutritional steps and relationships between diagnosis and interventions and in a review of dietetic notes completed by Swedish dietitian nutritionists. Along with guided computer programs, readily available NCPT manuals and NCP champions may assist in the correct use of the NCPT.

As standardised terminology has a key role in improving the standard of care, inaccurate use may result in an inferior quality of patient care. In addition, future research examining case histories, patient outcomes and/or planned interventions relating to NCPT may not be practical if inaccurate use of the NCPT and NCP continues.

Despite its inaccuracy, ‘Inadequate protein and energy intake’ was a common diagnostic term choice in cases of RFS. ‘Inadequate protein and energy intake’ was also the third most common term utilised by dietitian nutritionists in a haemodialysis unit. Likewise, ‘Inadequate oral intake’ was the most common term utilised in an American hospital. While this may suggest that these diagnostic codes are common nutritional problems or are used as default options, diagnoses were not assessed for accuracy in the studies conducted within the haemodialysis unit or in the hospital. Further study is warranted to examine if these diagnostic terms are used appropriately, with correlating interventions and outcomes, or if they are selected as innocuous and generic diagnoses.

We found that 60% of respondents in Australia use NCPT in the workplace but it is unknown if the reported NCPT use in Australia is uniform across the nation. In comparison, respondents from half of the countries interviewed in project 2 reported no use of NCPT in the workplace anywhere in those countries, with respondents from three additional countries unable to report a diagnostic code for use in cases of RFS. Implementation is relatively new in Asian countries and may be secondary to issues in translating the manual from English. For example, Swedish translators faced a number of challenges when translating the NCPT manual, including differences in professional language and clinical practice, differences in culture and society, and legal issues. As a result, the translation process took a total of six months. However, with translations completed, NCPT is theoretically used as recommended within Sweden. Taking learnings from the Swedish experience, translations for countries within Asia may take less time and assist with standardised language across the dietetics profession, globally. In addition to low levels of accuracy, low levels of consistency were also demonstrated across countries. While Australian respondents did exhibit higher rates of consistency between selections, survey respondents were provided with a list of potential options whereas interview respondents were not.

There were a number of limitations within the two projects. In both projects, respondents were not requested to provide information regarding their previous education or experiences in using NCPT, therefore it is unknown if independent study or university teachings had any influence on results. The tick-box responses used in project 1 have limited the information obtained, for example, we are unsure why NCPT is not being used by all dietitian nutritionists working within Australia or which diagnosis respondents would have chosen if it had been an open-ended response. Second, survey reminders were not sent by every association who initially advertised for participants which could have limited our sample size. In project 2, respondents may have had difficulty interpreting questions as English was not the primary language utilised by the majority of respondents, although translation and rephrasing were used where possible. Respondents from Canada or any country within Europe were not available for interviewing; therefore, the results found are not generalisable to all dietitian nutritionists working with the NCP process.

Our findings demonstrate that there is limited accuracy and consistency across the dietetics profession in selecting nutritional diagnostic codes in relation to RFS. The correct diagnostic code was selected by very few respondents in Australia and by no respondents working in other countries. Respondents also demonstrated limited knowledge regarding appropriate application of the NCP and NCPT. Our findings suggest that implementation practices require further refinement as education has resulted in limited success. Consistent use of NCPT is required to achieve the benefits of using a standardised language and without it; clinical practice and future research examining nutritional outcomes are compromised.

Funding source

Funding for both projects was provided by the University of Queensland.

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Conflict of interest
The authors report no conflict of interest.

Authorship
KLM, MAP and SMC contributed to the conception and design of the research project. KLM and SMC contributed to the acquisition, analysis and interpretation of the data. KLM drafted the manuscript. KLM, MAP and SMC critically revised the manuscript, agree to be fully accountable for ensuring the integrity and accuracy of the work, and read and approved the final manuscript.

References

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IMPORTANT PRIVACY CONSIDERATIONS WITH ELECTRONIC HEALTH RECORD DOCUMENTATION

To the Editor:

With the increase in electronic health records implementation both privately and publically, health professionals need to be cognisant of a new privacy consideration for digitising patients’ health records, that is, where the electronic information is to be stored.

Server location is one key consideration for electronic health documentation and is particularly pertinent for services without their own organisational electronic health record options. Data protection laws are not the same in all countries. This will become an increasing problem if information travels across borders and into different countries that have different levels of legal protection of rights and differences in recourse if privacy rights are not upheld. Globally, the countries of the European Union have implemented the strongest and most comprehensive directives concerning data protection (https://www.privacyinternational.org/node/44) and are the most stringent internationally.

In Australia, there is a legal requirement for national government electronic health records (My Health Record) to be held on servers located within Australia (section 77 of Personally Controlled Electronic Health Records Act 2012 Cth). To the best of our knowledge, both public and private health services in Australia use only Australian servers for their electronic health records and are now exploring Australian-based cloud services. Although it is not specifically stipulated for other health information governed by the Privacy Act 1988 (Cth) but which is not contained in My Health Records (such as data from popular fitness or other monitoring devices), Australian-based servers may be considered best practice approach.

In principle, under Commonwealth privacy legislation, personal information should only be transferred overseas if the Australian-based organisation ‘takes reasonable steps in the circumstances’ that the overseas organisation does not breach the Australian Privacy Principles (APPs) in accordance with APP 8 (https://www.oaic.gov.au/individuals/privacy-fact-sheets/general/privacy-fact-sheet-17-australian-privacy-principles). However, the Australian organisation does not need to take these steps if there is a ‘substantially similar’ scheme to the APPs (which could be an industry self-regulated code) being applied in the recipient country. This does not provide Australian citizens with a high level of privacy protection for their personal information and can be contrasted with European Union data protection law.

Extra-territorial data transfers have been a recent hot topic within the EU, with the United States (US) data transfer agreement for EU citizens’ personal information found to be inadequate and inapplicable in the recent Schrems case by the Court of Justice of the EU (CJEU) (http://europeanlawblog.eu/2015/10/15/schrems-vs-data-protection-commissioner-a-slap-on-the-wrist-for-the-commission-and-new-powers-for-data-protection-authorities/). The Schrems decision was handed down subsequent to Edward Snowden’s revelations that US security agencies had unrestricted access to data stored in servers located within the US, which, in the CJEU’s view, demonstrated that the US did not provide an ‘adequate’ level of protection for EU citizens’ data. Indeed, the US Foreign Intelligence Surveillance Act 1978 (including subsequent amendments) and Presidential Executive Order 12333 give US security agencies broad access to the private communications and data of both US and non-US persons around the world, with foreign citizens not protected by certain safeguards which apply to US citizens. This means that data stored offshore, particularly in the US, can be accessed by these authorities with little or no recourse available to foreign nationals, including Australians. The privacy of data stored within US servers or the Cloud servers of US providers is affected by these measures.

Recent investigations also appear to negate the use of de-identified data as a means to safeguard privacy. Undertaken for research purposes in order to explore encryption and anonymisation, recent news reports have shown how academics were able to re-identify information relatively easily from Medicare datasets (http://www.abc.net.au/news/2016-09-29/medicarepbs-dataset-pulled-over-encryption-concerns/7888686). There are additional concerns that the capacity to re-identify datasets will increase due to advances in powerful analytical tools, artificial intelligence and cross referencing against available data, whether private or public, published or hacked (https://www.privacy.org.au/Papers/SLCA-Deld-161216.pdf). The suitability of ‘de-identified’ information continues to be a topic of debate, but it cannot provide complete information security.

In summary, even if not a current legal requirement in Australia, it would currently be considered ‘best practice’ that no health information be transferred outside Australia. To emulate the principles conveyed by the Australian national government electronic health records (“My Health Record” https://myhealthrecord.gov.au/internet/mhr/publishing.nsf/Content/privacy-statement), which are created and stored within Australia, dietitians should enquire as to where data are stored when either exploring or using electronic storage solutions.

Only keeping our information onshore allows a level of oversight with regards to data security and level of compliance with the relevant laws in practice. This is particularly the case when considering sensitive information, such as...
information about an individual’s health. Keeping data onshore better protects the health privacy of Australian citizens given an environment with borderless networks and varying legal stringency to privacy.

**Funding source**

The authors received no funding for this letter.

**Conflict of interest**

The authors have no conflict of interest to declare.

**Authorship**

Both authors have contributed, written and reviewed the letter to the editor.

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