Exploring Barriers and Enablers to Dietitians Completing Body Composition Assessments as Part of Routine Clinical Care

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Abstract

Background:

Malnutrition, sarcopenia and cachexia are clinical wasting syndromes characterised by muscle loss. Systematic monitoring by body composition assessment (BCA) is recommended for the diagnosis, treatment and monitoring of the syndrome(s). However, limited literature exists regarding integration of BCA into routine practice. This study investigated practices, competency, and attitudes of Australian dietitians regarding BCA, to inform a local implementation process.

Methods:

Applying the Action cycle in the Knowledge to Action framework, surveys were distributed to the 26 dietitians in our department. The survey assessed barriers and enablers to performing routine BCA in clinical care. Results were categorised using the Theoretical Domains Framework (TDF) and suitable interventions mapped using the Behaviour Change Wheel.

Results:

Twenty-two dietitians (84.6%) completed the survey. Barriers to BCA were identified in all TDF domains. Enablers existed in domains of: Skills; Beliefs about consequences; Goals; Environmental context and resources; Social influences; Intentions; Optimism; Reinforcement.

Conclusions:

This study showed that hospital dietitians experience numerous individual, team, and organisational barriers to adopt BCAs in clinical practice. Information on barriers and enablers and implementation strategies have been suggested to overcome these barriers to assist BCA adoption into routine practice.

Background

Malnutrition, sarcopenia and cachexia are clinical wasting syndromes, prevalent in patients with acute or chronic diseases and frail elderly.[1-3] Malnutrition occurs in 20-50%[1,4] of patients in acute care settings, sarcopenia in 15-70%[5,6] and cachexia in 5-80%.[7-9] Malnutrition is defined as "*a state resulting from lack of intake or uptake of nutrition that leads to altered body composition (decreased fat free mass) and body cell mass leading to diminished physical and mental function and impaired clinical outcome from disease*".[10] Malnutrition is associated with reduced treatment efficacy and increased healthcare costs.[11,12] Disease-related malnutrition is characterised by inflammation and can be acute or chronic. Chronic disease-related malnutrition is also called 'cachexia' and is characterised by *"inflammation and ongoing loss of weight and muscle mass"*.[10] Sarcopenia is a condition which is often associated with malnutrition. It is defined as "*loss of skeletal muscle mass and strength related to ageing and/or chronic disease*", [13,14] and is associated with negative outcomes across health care settings including reduced survival, worse clinical outcomes and impaired quality of life in many clinical populations including oncology, surgical, hepatology, and older adults.[15-17] As sarcopenia is prevalent amongst elderly and chronically ill, assessment and treatment has been encouraged by several leading expert groups.[13,18]To be able to identify sarcopenia, assessment of muscle strength and muscle quantity or quality is required.

The three syndromes of malnutrition, cachexia, and sarcopenia are present in hospital populations and although they have been well defined in clinical practice the umbrella term 'malnutrition' is used for patients who show signs of inadequate food intake, weight loss, and muscle wasting. It is recommended to screen for malnutrition on admission to the hospital and regularly during hospital stay, and to treat malnutrition as early as possible. Malnutrition is typically 'managed' with a two-step process of screening and assessment. The initial step uses a malnutrition screening tool, such as the Malnutrition Screening Tool (MST), Nutritional Risk Screening (NRS) or Malnutrition Universal Screening Tool (MUST).[10,19] Patients with screening scores above a certain number are classified as 'at risk of malnutrition' and subsequently referred to a dietitian. The second step is a dietitian assessment using a validated tool, such as the Subjective Global Assessment (SGA), or Patient-Generated Subjective Global Assessment (PG-SGA) or Mini-Nutritional Assessment (MNA).[10,11] These assessment tools diagnose malnutrition by drawing on objective parameters such as weight and metabolic demand, as well as subjective parameters like weight history, nutrition impact symptoms, and physical examination of muscle mass and subcutaneous fat stores.[20] Based on these measures, a patient is diagnosed as 'well nourished' (SGA/PG-SGA 'A') or 'no nutritional risk', 'moderately malnourished' (SGA/PG-SGA 'B') or 'at risk of malnutrition' or 'severely malnourished' (SGA/PG-SGA 'C') or 'malnourished'. The PG-SGA also produces a corresponding numerical score which provides a guideline to the level of nutrition intervention that is required.[11] Nutritional assessment may include additional anthropometric assessments such as mid upper arm circumference, skin fold thickness and mid upper arm muscle circumference.[21]

Whilst parameters of nutrition assessment tools are easy to gather and rate highly regarding sensitivity, specificity and inter-rater reliability, they do not provide objective data on body composition such as muscle mass.[22] In addition, there is a subset of patients who cannot be weighed and using an estimated weight leaves a margin for error in classifying malnutrition. A patient's perception of their weight loss can be incorrect, thus decreasing the efficacy of malnutrition assessment tools.[23] Nutrition assessment tools also fail to recognise that patients can have a low level of lean tissue with any BMI category.[24]

Thus, measures of overall weight loss lack the sensitivity to detect the amount of lean mass an individual has and the potential loss of lean mass experienced. This introduces the potential to grossly underestimate the prevalence of hospital malnutrition if diagnosis is based on body weight and body weight changes alone. Other challenges that impact the correct identification of malnutrition are our ageing society and the global epidemic of overweight and obesity, resulting in a higher number of patients with sarcopenia, as well as overweight and obese patients with chronic or acute diseases. Malnutrition in these patients is harder to recognise using the aforementioned assessment tools, but is nonetheless associated with worse outcomes.[24,25]

As a result of these shortcomings there is a lack of consensus amongst the dietetic and medical community surrounding malnutrition assessment methodologies.[17,26-31] With societal changes and improved technologies available, it is prudent to consider additional objective ways to obtain information on lean mass, in order to diagnose and monitor the effectiveness of the treatment of malnutrition.[17,31,32]

Routinely measuring lean mass provides an objective measure to diagnose and monitor malnutrition. This aligns with the international clinical nutrition community's recognition of the need for BCA as part of malnutrition assessment.[15,17,33] Indeed, the new Global Leadership Initiative on Malnutrition (GLIM) criteria recommends the measuring of body composition and identifying loss of lean mass as one of the top five criteria to assist in diagnosing malnutrition.[27] Since the launch of the GLIM criteria, several initiatives have been taken to validate the criteria. These showed that the GLIM criteria have a fair agreement with the reference standard.[34,35,36]

Despite available evidence of the benefits of BCA, body composition is not routinely used by dietitians in clinical practice. This is reportedly due to incomplete knowledge and awareness, uncertainty of how and when to measure, poor availability of assessment tools and a lack of time.[17, 37] Given the role that lean mass plays in the clinical outcomes of certain illnesses, it is of critical importance that its assessment be added into the nutrition field.[15,17]

It is widely recognised that the dissemination of information alone does not change practice;[38] thus drawing on an implementation science methodology facilitating this change and adoption process.[39] This theory-driven approach guides the rigorous and systematic processes of evidence selection, adapting knowledge to the local context, understanding barriers and enablers to its use, selecting appropriate interventions to support its adoption, and monitoring and evaluating outcomes, as well as sustaining knowledge use, as outlined in the Knowledge-to-Action (KTA) framework.[40] Within this framework additional theories, models, and frameworks can be applied to guide structured and systematic barrier identification and intervention selection, such as the Theoretical Domains Framework (TDF) and the Behaviour Change Wheel (BCW).[41,42]

The aim of this project was to develop a department-wide strategy to incorporate BCA by dietitians into routine clinical care using an Implementation Science approach. To inform this process we planned to investigate the current local practices, competency, and attitudes of our departmental clinical dietitians with regards to the utilisation of BCA.

Methods

The study was declared as Exempt from Review – Not Research according to the Human Research Ethics Committee of Mater Research Institute – UQ Human Research Ethics Committee (Project ID: EXMT/MML/58778). All methods were carried out in accordance with relevant guidelines and regulations. All participants who completed surveys were informed their completion implied consent.

This implementation planning project occurred in an 800-bed tertiary hospital in Brisbane, Australia. The hospital provides services to both private and public inpatients and outpatients and includes a variety of patient populations. At the start of this project (May 2017), The Dietetics and Foodservices department consisted of 20.55 full time equivalents (FTE) with 26 dietitians.

To develop our BCA implementation strategy we followed the KTA framework which is an iterative approach that allows building (Knowledge Creation) and application of knowledge (Action Cycle).[40] The Action Cycle was the focus of this work; with steps that can occur sequentially or concurrently and involve identification of the problem, assessing knowledge use determinants, evaluating the impact of knowledge use or outcomes, and ensuring sustainability.[40] This project focused on the problem and barrier identification steps, as well as the intervention design step. In this project assessment and intervention selection required use of the TDF[42] and BCW;[41] the TDF as a system for categorising and defining barriers, and the BCW as a system for guiding decision-making around designing behaviour change interventions based on the identified barriers.

Below, we outline the survey process which allowed determination of a dietetic departmental practices, competency, and attitudes. A survey was developed to assess barriers and enablers to BCA use within the dietetic department (Appendix A). Questions were designed to map against domains of the TDF.[42] Questions covered knowledge attitudes on, and confidence in BCA device use, frequency and predicted time taken to use the devices, views on how it would change dietetic practice, and which patient cohorts would benefit from BCA. All department dietitians were invited to complete the survey via an email link to an online survey portal (Survey Monkey, San Mateo, CA, USA) in May 2018. The survey was open for two weeks and two reminders were sent prior to the closing date.

The results were summarised as frequencies and percentages of answers for each question. All authors reviewed the summarised survey results and tabulated the barriers and enablers identified (**Table 1**). This process involved a content analysis using the TDF as the framework to categorise qualitative responses into themes; these responses were sorted into identified barriers and enablers, followed by documenting the source of the behaviour using the BCW (columns 4 and 5) and finally interventions were designed drawing from the implementation science literature.[41,43] Findings were refined through group discussion resulting in consensus, with subsequent operationalisation and prioritisation of strategies.

Results

Twenty-two of 26 dietitians (84.6%) completed the survey. As shown in **Table 2**, more than half of clinicians had previous training in BCA, mostly in skinfold thickness and mid upper arm circumference (MUAC). Few had training in bioelectrical impedance spectroscopy (BIS) devices. The majority of clinicians were aware that skinfold calliper, BIS, PG-SGA physical exam, hand grip dynamometer and tape measure devices were available for use in their department. More clinicians felt confident using PG-SGA physical exam and tape measures with fewer feeling confident using the BIS, MUAC and handgrip devices and

techniques. As seen in **Figure 1**, the PG-SGA physical exam was the most common assessment reported to be performed, followed by the use of tape measures. The majority of clinicians reported that they never used skinfold measurement, BIS, MUAC or handgrip measures.

Dietitians' attitudes to use of BCA in routine practice were categorised into barriers and enablers (Table 1). Eight of the 22 staff (36.4%) reported feeling that BCA measurements were more relevant for research or not appropriate in their area of work (TDF domain ~ Social/professional role and identity). Over half of the staff (59.1%) noted that BCA was not in their daily routine, they felt they were not able to accurately perform measurements (27.3%) and that they wouldn't have time to complete them (18.2%) (Belief about capabilities). Some respondents (13.6%) felt measurements would not benefit their practice (Belief about consequences), and that there was a lack of procedures to perform measurements in departmental policies (31.8%) (Environmental context and resources). Six dietitians (27.3%) mentioned it would not fit their schedule, and seven dietitians found it 'too much of a hassle' to find reference values and report the results. Twelve dietitians (54.5%) did not know how to schedule access to the devices, four (18.2%) believed they did not have access to BCA devices and did not know how to get them to the ward and six (27.3%) did not know where devices were kept.

However, positively, 16 dietitians (72.7%) reported that they would like to learn more about incorporating BCA (Optimism) and 15 (68.2%) would like to apply it to their practice. Two thirds (n=14, 74%) of dietitians reported they felt it would make their practice more interesting and under half (n=10, 45%) thought it would improve their practice. Twelve dietitians (55%) felt more training would prompt them to perform assessments, and 14 (64%) responded they would like the help of the clinical experts within the department (Reinforcement). Approximately half of the dietitians (n=10, 45%) noted they would need to change their practice regarding assessment of nutritional status (Behavioural regulation).

Table 1 shows the mapping of the identified barriers and enablers (columns 2 and 3) to the TDF domains (column 1). Interventions and how these can be operationalised, drawing from the literature[41,43] are in columns 5 and 6. Barriers to use of BCA within our department were identified in all TDF domains of: Knowledge; Skills; Social/ professional role and identity; Beliefs about capabilities; Beliefs about consequences; Goals; Memory, attention and decision processes; Environmental context and resources; Social influences; Intentions; Emotion; Optimism; Reinforcement and Behavioural regulation. Enablers included: Skills; Beliefs about consequences; Goals; Environmental context and resources; Social influences; Intentions; Optimism; Reinforcement.

Through the detailed mapping process, these are summarised in and operationalised in column 6 of Table 1. They can broadly be grouped as: 1. Professional development strategy, 2. Body composition assessment clinical champion project, and 3. Departmental integration process.

Discussion

This study aimed to understand the attitudes, beliefs, and practices of clinicians in a tertiary hospital dietetics department regarding patients' BCA practices to inform a process of integrating these practices into routine clinical care. Most dietitians rarely used BCA with their patients in a systematic way. Barriers and enablers existed in many of the same TDF domains. Many dietitians felt unsure of their skills, when and how to systematically use these BCA techniques, and some questioned their benefit for particular clinical areas (e.g. neonatal care) and/or outside of research projects. However, many dietitians were optimistic about the potential this process would provide to enabling evidence-based practice and noted it would add to the strength of assessments, recommendations, and ability to detect malnutrition and other wasting syndromes, and to clinically relevant improvements within the delivery of medical nutrition therapy.

To our knowledge, this is the first study to investigate barriers and enablers to systematic adoption of BCA techniques into routine dietetic clinical practice. While many papers have promoted the use of BCA to detect malnutrition,[10,15,17,27,30,31] and specific studies described the application of these techniques in clinical areas (e.g. elderly;[32] liver failure;[44-46] oncology;[47,48] renal disease;[49] and respiratory disease[26]) none have applied this across a hospital dietetics department.

To our knowledge, only one study, by Reijnierse et al (2017), documented barriers to BCA application in practice.[37] These were explored before and after a Dutch health professional training program on detection and management of sarcopenia.[37] Barriers included lack of availability of equipment, lack of knowledge, time constraints, and lack of collaboration with/awareness of other health professionals.[37] When Reijnierse's study was repeated in a similar sized cohort of Australian and New Zealand health professionals (n=250), as previously found, a lack of diagnostic tools was the main reason for not diagnosing sarcopenia.[50] Lack of sarcopenia awareness and lack of motivation among health-care professionals were also common barriers.[50] In addition to most of these, our study identified additional barriers relating to clinicians' beliefs about the applicability of the techniques, personal ability to undertake the assessments and confidence in their abilities to incorporate these into their daily practice. Our more extensive suite of barriers may have resulted from a more profession-specific/department-wide assessment rather than training attendees of varied professions.[37,50]

Moreover, applicability issues also relate to BCA validity issues when used with acutely or chronically ill patients. American Society for Parenteral and Enteral Nutrition's (ASPEN) recent systematic review showed minimal studies that have provided data on BCA in clinical populations. Out of BIA, DXA and ultrasound, DXA and CT scanning were recommended as 'gold standard', but the authors indicated that more research is required on the validity of BCA in specific patient populations.[30]

Acknowledging the need for addressing all "bottlenecks" (barriers) in each phase of the implementation to ensure diagnosis and management of sarcopenia in daily practices, Reijnierse et al (2017) highlight the need to draw on the implementation science literature in delivering effective interventions.[37] They highlight that this requires many factors such as acquisition of diagnostic measurement devices, reorganisation of care, collaboration between healthcare professionals, perceived needs and benefits of innovation and organizational factors.[37] Accordingly, we have adopted an implementation science approach to ensure we systematically select interventions that align with identified barriers and enhance existing enablers.[40-42]

Following the operationalisation of the evidence-informed strategies to overcome the identified barriers and enablers, our team will progress the overarching interventions of upskilling (professional development strategy), modelling and reducing fear of change (clinical champion project) and embedding as usual practice (departmental integration) the use of BCA.[41,43] The details that will be incorporated into these strategies are in the final column of Table 2. We will repeat our departmental survey in mid-2020 to re-assess adoption of, (perceived) competency in, and attitudes of clinical dietitians towards the utilisation of BCA devices within our department.

A study strength included the use of implementation science methodology and frameworks (KTA, TDF, BCW)[40-42] to map and inform our strategy. Many solutions may appear 'common sense' but the systematic assessment and rigour provided by the process provides confidence in the findings and interventions. The survey revealed numerous barriers and enablers to the adoption of BCA in routine clinical care. A greater understanding and/or a wider selection of barriers may have been identified through more qualitative approaches (e.g. focus groups, interviews). However, the methodological approaches were pragmatically chosen to be administered and analysed within routine practice without additional funding. The barriers and enablers identified may reflect specific local departmental issues and may not be generalisable to all sites. However, it is likely that many of these issues are common to other Australian and international sites, as highlighted by Reijnierse[37] and Yeung[50] and colleagues. Study limitations include potential reporting bias or answers reflecting social desirability despite being an anonymous due to the small team size plus lack of data on time burden for dietitians of performing measurements, booking devices, and carrying devices to clinics or wards. We also lack data on objective clinical practice change, resultant clinical outcomes, and cost-effectiveness. Another limitation is the potential impact of knowledge and practice loss with staff turnover; however this was attempted to be circumvented with handover and orientation processes.

Conclusions

In summary, malnutrition is associated with poorer clinical outcomes in hospitalised patients. BCA devices can be a useful addition to routine clinical care to detect muscle loss that can otherwise be undetected in current malnutrition screening and assessment processes. However, we identified numerous health professional, team, and organisational barriers to the systematic adoption of these processes. Through a process of barrier analysis and intervention mapping within an implementation science framework we have designed three-pronged strategy of dietitian upskilling, embedding and evaluating, and management-endorsement and support to facilitate adoption of practices that will support evidence-based care for these patients. We aim to successfully implement BCA into routine dietetic practise in our hospital department. Future research is required to investigate the validity for each disease, health care setting and age category, as well as to show the impact on clinical practice, clinical outcomes and health economics.

List Of Abbreviations

BCA Body Composition Assessment

BCW Behaviour Change Wheel

BIS Bioelectrical Impedance Spectroscopy

DXA Dual Energy X-ray Absorptiometry

FTE Full Time Equivalents

GLIM Global Leadership Initiative on Malnutrition

KTA Knowledge to Action

MUAC Mid Upper Arm Circumference

MUST Malnutrition Universal Screening Tool

MST Malnutrition Screening Tool

PG-SGA Patient-Generated Subjective Global Assessment

SGA Subjective Global Assessment

TDF Theoretical Domains Framework

Declarations

Ethics approval and consent to participate

The study was declared as Exempt from Review – Not Research according to the Human Research Ethics Committee of Mater Research Institute – UQ Human Research Ethics Committee (Project ID: EXMT/MML/58778). All methods were carried out in accordance with relevant guidelines and regulations. All participants who completed surveys were informed their completion implied consent.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

All authors have participated sufficiently in the article to take public responsibility for the content. Chloe Jobber was responsible for collecting and analysing data, interpreting results, writing the manuscript. A/Prof Shelley Wilkinson (corresponding author) and Dr Barbara van der Meij were responsible for study design, project coordination, data interpretation and manuscript preparation. Elyssa Hughes was responsible for collecting and analysing data, and reviewing the manuscript. Fiona Nave was responsible for collecting data, coordinating the project, and reviewing the manuscript.

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Tables

Table 1. Intervention mapping and operationalising after sorting of barriers and enablers to TDF domains from the dietitian's surveyed.

TDF domain (and definition) (26)	Survey identified Barriers	Survey identified Enablers	BCW Intervention components (25)	Definition of intervention with examples of Behaviour Change Techniques (27)	S c
Knowledge - An awareness of the existence of something	Unsure of clinical areas BCA would benefit 75% (n=12) unsure who to use on; 69% (n=11) unsure when to do; 69% (n=11) unsure what to do; 62.5% (n=10) unsure how to interpret;		*Psychological capability* Education	*Increasing knowledge or understanding:* E.g. *Feedback on the behaviour/ outcome(s) of the behaviour* *Self-monitoring of behaviour/ of outcome of behaviour* *Prompts/cue* *Information about social and environmental consequences* *Information about others' approval* *Imparting skills*	· a B A c h i S f l S · p p a · u c r e p a I f a c
			Training	*Reducing barriers to increase capability or opportunity (beyond education, training and environmental restructuring)* *E.g.*	· c g p a r i
			Enablement	*Social support* *Reduce negative emotions* *Conserve mental resources* *Self-monitoring of behaviour and outcome of behaviour* *Graded tasks* *Adding objects to the environment* *Restructuring the social environment* *Focus on past success* *Verbal persuasion about capability* *Self-reward* *Goal setting (behaviour, outcome)* *Commitment* *Action planning* *Review behaviour and outcome goal(s)*	· i B p P c a g · s V c a u r a r r V r t c · s a c e · p

				Discrepancy between current behaviour and goal *Problem solving* *Pros and cons* *Monitoring of emotional consequences* *Anticipated regret*	(i . r r r p r p p r v
Skills- An ability or proficiency acquired through practice	Don't know how to use 37.5% (n=6); Lack of confidence (and enabler) 25% (n=4); Don't have time to perform 25% (n=4) More than 75% never use: skinfold 100%, BIS 90%, handgrip 95%, MUAC 75% (n=20 responders) 75% (n=12) unsure who to use on; 69% (n=11) unsure when to do; 69% (n=11) unsure what to do; 62.5% (n=10) unsure how to interpret;	Training and awareness in a variety of areas · Had any training in BCA: 55% (n=22), mostly in arm circumference (75%), skinfolds (75%), BIS (42%) and BIS scale (42%). For DXA, only 8%had any training · Had any training in BCA: 55% (n=22), mostly in MUAC (75%), skinfolds (75%), BIS (42%) and BIS scale (42%). For DXA, only 8%had any training · The majority of the team (at least 75%) is aware that skinfold callipers, BIS device, PG-SGA, handgrip, and tape measures are available. A minority is aware of the existence of a BIS scale (n=20) · Confident to use skinfold (5%), BIS (30%), MUAC 70%, PG-SGA 85%, handgrip 50%, tape measure 75% (n=20)	***Reflective motivation*** (Cognitive/ interpersonal skills) Education Persuasion	*Increasing knowledge or understanding* *E.g. as above* *Using communication to induce positive or negative feelings or stimulate action* *E.g. Feedback on the behaviour/ on the outcome(s) of the behaviour,* *Focus on past success,* *Verbal persuasion about capability,* *Persuasive source* *Identity associated with changed behaviour* *Identification of self as role model,* *Information about social and environmental consequences,* *Information about health consequences,* *Salience of consequences,* *Information about others' approva,l* *Social comparison* *Creating expectation of reward* *E.g.* *Feedback on behaviour or* *on the outcome(s) of behaviour,* *Self-monitoring of behaviour or outcome of behaviour,* *Monitoring of (outcome of) behaviour by others without evidence of feedback,* *Situation-specify reward,* *Reward incompatible behaviour,*	A s i i p . (p c t . v a r I p e r a c r

Incentivisation	*Reduce reward frequency,* *Reward alternate behaviour,* *Remove punishment,* *Social reward,* *Self-reward,* *Behavioural contract,* *Commitment,* *Discrepancy between current behaviour and goal*	A t c
	Creating expectation of punishment or cost	
	As above	
Coercion		
Physical capability (physical skills)		
Training		

			Enablement		
Social/ professional role and identity- A coherent set of behaviours and displayed personal qualities of an individual in a social or work setting	N=6 I think these measures are more appropriate for research 67% (n=4) I do not think these measurements are appropriate for my area of work 67% (n=4)		***Reflective motivation*** Education Persuasion Incentivisation Coercion	*As 'Skills'*	
Beliefs about capabilities- Acceptance of the truth, reality, or validity about an ability, talent, or facility that a person can put to constructive use	37.5% (n=6) I don't think I could perform these measures accurately I do not have time to perform these measurements 25% (n=4)		***Reflective motivation*** Education Persuasion Incentivisation Coercion	*As 'Skills'*	
Beliefs about consequences- Acceptance of the truth, reality, or validity about outcomes of a behaviour in a given situation	I think these measures are more appropriate for research 67% (n=4) Don't think these measurements would benefit my practice/tell me anything new/useful 30% (n=3) I do not expect these measurements to change my practice 11% (n=2)	N=19 overall Leverage for nasogastric tubes 26% (n=5) Leverage for pre-surgical provision of enteral/parenteral nutrition 26% (n=5) Assist in persuading patients to increase intake/supplements 63% (n=12) Assist in motivation (i.e. to continue on weight loss journey) 79% (n=15) Ability to more accurately assess energy requirements 89% (n=17) Ability to provide objective measures/ evaluations of dietetic interventions 84% (n=16) Assist in identifying malnutrition 58% (n=11) Would make practice more interesting 74% (n=14) Would improve my practice 53% (n=10) With training and time, they (BCAs) could become routine (n=1)	***Reflective motivation*** Education Persuasion Incentivisation Coercion	*As 'Skills'*	
Goals- Mental representation of outcomes or end states that an individual wants to achieve	62.5% (n=10) unsure how to interpret 75% unsure who to use on 69% unsure when to do 69% unsure what to do	I would like to learn more about body composition assessment (n=16) I would like to apply measurement of body composition to my practice (n=15) Make results more meaningful in practice (n=1)	***Reflective motivation*** Education Persuasion Incentivisation Coercion	*As 'Skills'*	

		Applicable in some patient groups (n=1)			
Memory, attention and decision processes- The ability to retain information, focus selectively on aspects of the environment and choose between two or more alternatives	Not in my daily routine 81% (n=13) Too much time to do 46% (n=6) I forget to do 31% (n=4) Hassle to find reference ranges 54% (n=7) Difficulties – practicalities (n=1)	Great that we will have support to routinize (n=1)	***Psychological capability*** Education Training Enablement	*As 'Knowledge'*	
Environmental context and resources- Any circumstance of a person's situation or environment that discourages or encourages the development of skills and abilities, independence, social competence, and adaptive behaviour	N=10 overall We do not have procedures or forms to report these measurements 70% (n=7) N=15 overall I don't have access to the devices I need to perform body composition assessment 27% (n=4) I don't know where these devices are kept 40% (n=6) I don't know how to book these devices 80% (n=12) I know where these devices are kept but I don't know how to get them to the ward 27% (n=4)	If you can get access to the peapod for routine assessments that would be great 10% (n=1)	***Physical opportunity*** Restrictions Environmental restructuring	*Using rules to reduce the opportunity to engage in the target behaviour (or to increase the target behaviour by reducing the opportunity to engage in competing behaviours)* *Changing the physical or social context*	
Social influences- Those interpersonal processes that can cause an individual to change their thoughts, feelings, or behaviours	N=13 overall My peers do not perform these measurements, so why should I? 31% (n=4) I think they are burdensome to patients 8% (n=1)	I feel this would add value to Dietitians and patient care in relevant populations	***Social opportunity*** Restrictions Persuasion	*As above*	
Intentions- A conscious decision to perform a behaviour or a resolve to act in a certain way	N=18 overall I never think of doing these measurements when I see or evaluate a patient 39% (n=7) Not in my daily routine 81% (n=13)	I would like to know more about what technology we have available and where it would be applicable. I would certainly consider integrating into practice if and where appropriate. I would like to add these measurements to my daily routine	***Reflective motivation*** Education Persuasion Incentivisation Coercion	*As ' Skills'*	
Emotion-	N=14	Keen to get started	***Automatic motivation***	*As above*	

A complex reaction pattern, involving experiential, behavioural, and physiological elements, by which the individual attempts to deal with a personally significant matter or event	Don't want to break device 13/% (n=2) Feel stressed about the time required 43% (n=6)		Persuasion Incentivisation Coercion Environmental restructuring Modelling Enablement		
Optimism- The confidence that things will happen for the best or that desired goals will be attained	N=19 Unsure if it'll be burdensome to patients 8% (n=1) Unsure how perceptive the patients will be 7% (n=1)	I am ready – bring it on (n=1) Would improve my practice (n=10) Will make practice more interesting (n=14) May increase patients' motivation to see me to get results (n=1)	***Reflective motivation*** Education Persuasion Incentivisation Coercion	*As 'Skills'*	
Reinforcement- Increasing the probability of a response by arranging a dependent relationship, or contingency, between the response and a given stimulus	N=18 Nothing that prompts me 22% (n=4)	More training would prompt me (n=12) Body comp team makes this possible (n=14) Integrate into WARs	***Automatic motivation*** Persuasion IncentivisationCoercion Environmental restructuring Modelling Enablement	*As above*	
Behavioural regulation- Anything aimed at managing or changing objectively observed or measured actions	N=18 Happy with the way I assess nutritional status 22% (n=4) Would need to change practice 39% (n=7) I would need to change my practice regarding assessing nutritional status 56% (n=10)	Happy to practice if measurements will improve patient care (n=1)	***Psychological capability*** Education Training Enablement	*As 'Knowledge'*	

BPI, Best Practice Investigation; WAR, Work Area Resource, Dept, Department; PD, professional development; BCA, Body Composition Analysis; TDF, Theoretical Domains Framework, Ax: assessment, DXA: Dual X-ray Absorptometry

Table 2. Dietitian's prior training, awareness of available devices and confidence in performing body composition assessments.

% (n)		Dietitians
Response rate		84.6 (22)
Previous training in BCA use	Yes	54.5 (12)
	No	45.5 (10)
Previous training in BCA devices	Skinfold callipers	40.9 (9)
	Mid-upper arm circumference (MUAC)	40.9 (9)
	Bioelectrical impedance spectroscopy (BIS)	22.7 (5)
	Dual x-ray absorptiometry (DXA)	4.5 (1)
Knowledge of available of devices and procedures in department	PG-SGA physical exam	86.4 (19)
	BIS	81.8 (18)
	Tape measures	77.3 (17)
	Skinfold callipers	68.2 (15)
	Handgrip	68.2 (15)
	Bioelectrical impedance scale	40.9 (9)
Rating of confidence in using BCA devices or undertaking procedures (extremely / reasonably confident)	PG-SGA physical exam	77.3 (17)
	Tape measures	68.2 (15)
	MUAC	63.6 (14)
	Handgrip dynamometer	45.5 (10)
	BIS	27.3 (6)
	Skinfold callipers	4.5 (1)

BCA – body composition assessment; BIS - Bioelectrical impedance spectroscopy; DXA - dual x-ray absorptiometry; MUAC- mid upper arm circumference; PG-SGA – patient generated subjective global assessment; REE – resting energy expenditure

Figures

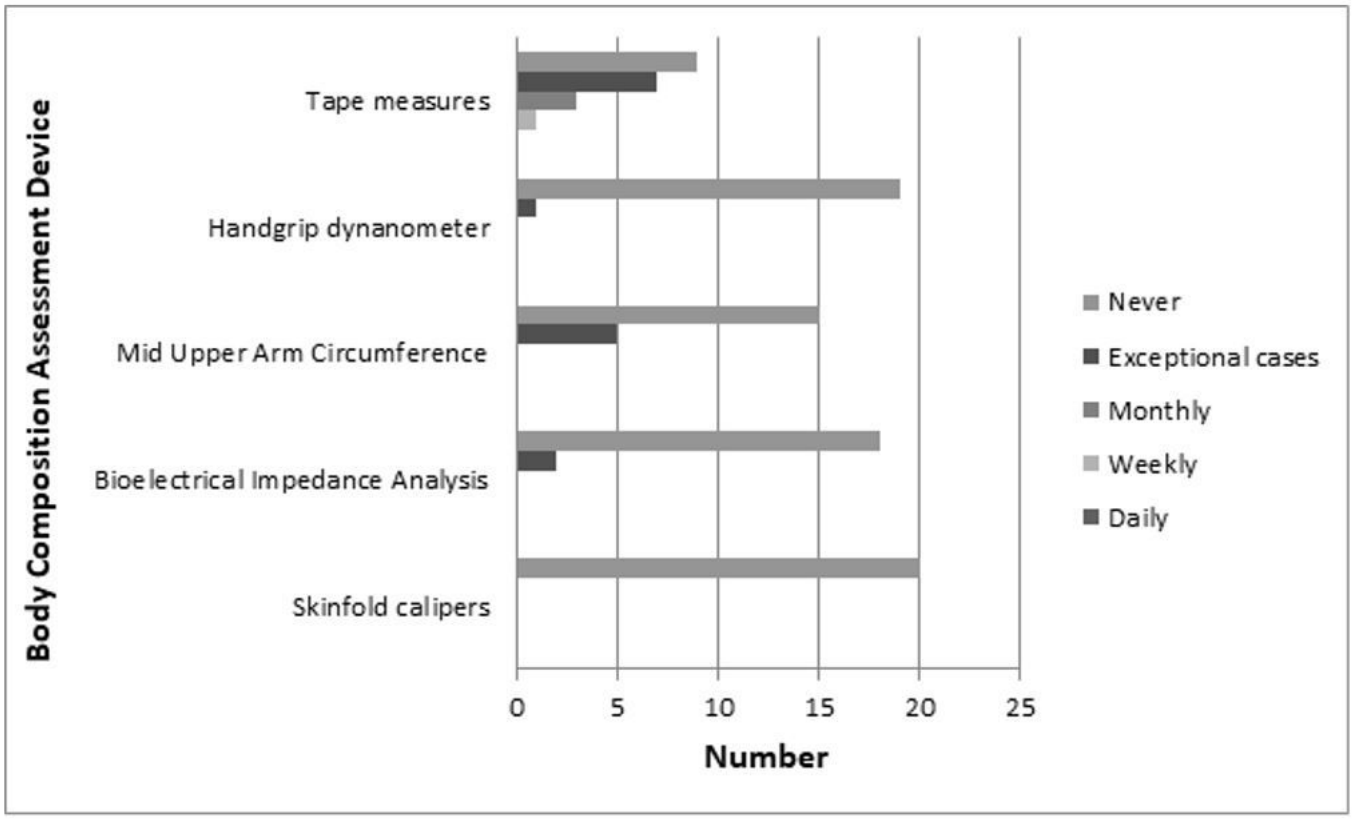

Figure 1

Frequency of reported device use by dietitians in routine clinical care.

Supplementary Files

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