Determining the effect of dietetic intervention on fat free mass in chemotherapy patients at a rural chemotherapy day unit.

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Abbreviations

Fat Free Mass – FFM.

Malnutrition Screening Tool – MST.

Patient-Generated Subjective Global Assessment - PG-SGA.

Weight – Wt.

Height – Ht.

European perspective into cancer – EPIC

International Physical Activity Questionnaire – IPAQ

Body Mass Index - BMI

Definitions

Sarcopenia: Low muscle strength and low muscle quantity or quality. Severe sarcopenia is low muscle strength, low muscle quantity or quality and low physical performance.

Cachexia: Accelerated loss of skeletal muscle in the context of a chronic inflammatory response and was considered to be a syndrome consisting of combinations of anorexia, weight loss, metabolic alterations and inflammatory state and anaemia.

FFM: The sum of lean body mass and bone mineral compartments. This is defined as body mass minus all extractable fat.

Lean Body Mass: The sum of body water, total body protein, carbohydrates, non-fat lipids, and soft tissue mineral

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Abstract

Aim

Patients undergoing chemotherapy lose fat free mass (FFM) through treatment. Adequate fat free (muscle) mass (FFM) in cancer patients contributes to wellbeing by reducing chemotherapy complications and improving survival. Evidence demonstrating the optimum method to counteract this loss of muscle is limited. Protein is important in stimulating muscle synthesis and maintenance. Studies associate muscle growth with regular, consistent protein consumption, rather than total protein intake. This study, conducted in a Western NSW chemotherapy centre, aimed to determine if consuming 25-30g protein at three main meals per day during chemotherapy maintained or improved FFM over a six month period.

Methods

This quasi-experimental study was conducted in rural NSW. All new chemotherapy patients (palliative or curative) over a three-month period (September to November 2018) were invited to participate. Measurements of FFM and body fat were obtained using BodyMetrix^{TM} ultrasound. Data from multiple twenty-four hour food recalls, bodyweight, a malnutrition screening tool and a current nutrition assessment tool were collected. Outcome measures were assessed at baseline, prior to the first chemotherapy cycle, then at one month, three months and six months from baseline. Prior to their first cycle of chemotherapy, participants were educated on how to consume 25 to 30 grams of protein at each main meal, with instructive written information provided. Dietary assessment and intervention occurred during each chemotherapy cycle. Nutritional supplementation was used when participants were unable to meet their protein requirements through oral diet. The primary outcome measure was a change in FFM from baseline to six months. The secondary outcome measures were protein amounts per meal and per day, energy intake and weight.

Results

Thirteen participants were recruited (five female, eight male), of which nine were classified as palliative and four as curative. All patients had different cancer diagnoses and chemotherapy regimens. The percentage of participants that maintained or improved fat free mass from baseline to six months was 91%, but this could not be directly attributed to the targeted 25 grams of protein per main meal. Participants did obtain overall adequate protein and energy intakes over the intervention period and a positive correlation between protein intake (as a proportion of required) and change in FFM in the subsequent time period was found.

Conclusion

This study was unable to conclude that achieving main meal protein targets of 25g contributed to the maintenance or improvements seen in FFM. However this study does support early dietetic intervention contributing to adequate protein and energy intakes in relation to fat free mass in this population of chemotherapy patients.

Implications for practise

This study provides further support for dietetic intervention in chemotherapy patients, in terms of early intervention and ensuring adequate protein and energy are consumed.

Keywords

Protein, Body composition, Cancer, Chemotherapy/antineoplastic therapy, Muscle mass

Executive Summary

Problem statement

Chemotherapy patients lose muscle mass during treatment. Loss of muscle mass increases side effects of chemotherapy and patients with low muscle mass appear to have the worst survival compared to patients without low muscle mass. Maintenance of fat free mass (FFM) is important to reduce side effects of chemotherapy, physical impairment, post-operative complications and mortality. Further information is required to ascertain the optimal way to maintain fat free mass through nutrition intervention.

Conclusions from this study

While this study was unable to demonstrate that main mean protein intakes of 25g were able to maintain or improve fat free mass, it did support current evidence that patients should obtain adequate protein amounts per day. This study also supports current evidence that early nutrition intervention is beneficial.

Implications of this study:

- Loss of muscle mass can lead to increased side effects from chemotherapy and increased hospitalisations, mortality and morbidity.
- This study provides encouraging data on current practice in terms of protein requirements for patients.

Recommendations for practice

- This study highlights that Dietitian assessment, consultation and intervention conducted earlier in the treatment cycle than current practice, resulted in patients obtaining adequate energy and protein to maintain or improve FFM during their chemotherapy. A focus on nutrition at the start of chemotherapy should therefore be prioritised in routine chemotherapy treatment.
- To purchase the Sozo® by Impedimed® bioimpedance spectroscopy device for our WNSWLHD cancer centres to enable routine measurements of FFM, by all clinical staff. Use of the BodyMetrix ™ ultrasound tool places extra burden on the Dietitian to obtain a measurement of FFM.

Recommendations for further research

- This study provides encouraging results, in terms of protein dosage per main meal, however the study requires a larger number of participants to provide conclusive evidence this maintained or improved patient's FFM. It is advised that Dietetic practice outlined in this study continues at Daffodil Cottage. This will enable data collection to continue. After 12-24 months of obtaining data, a retrospective study could be conducted to confirm the current encouraging findings, with a view to informing practice in other cancer centres.
- To strengthen the results of the study a change in the physical activity questionnaire is required, so that changes in FFM from physical activity change can be accounted for. 24 hour food recalls should also be completed on either day one, two or three post chemotherapy, as evidence exists the days post chemotherapy are when patients consume the least during a chemotherapy cycle.

Methods

All new chemotherapy patient from September to November 2018 were invited to participate in the study. At baseline, one month, three months and six months information was collected on weight, height, FFM, fat mass, physical activity, malnutrition screening score, patient-generated subjective global assessment score, protein intake per main meal and total protein and energy intakes calculated using a 24 hour recall dietary assessment method. Participants were educated and provided with written information on how to achieve 25-30g protein per main meal prior to their first cycle of chemotherapy. Dietitian consultation and advice continued at each cycle for the intervention period.

Findings

Thirteen participants were recruited (five female, eight male), of which eleven had complete data sets. Ninety one percent completing participants maintained or improved FFM from baseline to six months. However statistical analysis was unable to ascertain this was due to main meals reaching the protein target of 25 grams. The participants however overall obtained adequate protein and energy intakes over the intervention period.

Introduction

In 2016 the European Society of Parenteral and Enteral Nutrition (ESPEN) released guidelines on nutrition in cancer patients. This guideline highlighted that it is the loss of skeletal muscle that predicts chemotherapy toxicity, post-operative complications, physical impairment and mortality. They recommended the goal of nutritional care should be maintenance or gain of muscle mass. Evidence on the most effective method to achieve this is scarce in oncology patients.

This study was conducted at Daffodil Cottage a rural cancer chemotherapy centre in Bathurst, NSW.

Current practice at Daffodil Cottage Cancer Care Service is based on the current, Australian evidence based practice guidelines and professional consensus. The current recommendation is to conduct malnutrition screening using a validated and reliable tool such as the Malnutrition Screening Tool (MST), on the first day of treatment, and repeated at each clinic visit or weekly. If the patient scores two or more they are referred to a Dietitian. The Dietitian completes a nutrition assessment using a validated assessment tool called the Patient-Generated Subjective Global Assessment (PG-SGA).

Nutrition intervention focuses on the patient having adequate energy and protein each day in accordance to the Dietitian's Association of Australia (DAA) Guidelines for the nutritional management of patients receiving radiation therapy and/or chemotherapy and DAA guidelines for the nutritional management of cancer cachexia. As the Australian guidelines are 2013 and 2008 respectively, international guidelines should be followed. Daffodil Cottage is different to other cancer centres, as the Dietitian has the ability to see all chemotherapy patients, unlike other cancer centres where radiation and/or chemotherapy/radiation clients take priority, often leaving the Oncology Dietitian with minimal capacity to see chemotherapy patients. This difference in service delivery has enabled this study to be conducted.

Studies are required to determine the most effective way to maintain or improve muscle mass in oncology patients. This study aims to determine if there is a relationship between daily protein intake and distribution of protein to FFM. All patients who attended Daffodil Cottage for their first line of chemotherapy between September 2018 and November 2018 were invited to participate in the study. The patients were advised how to consume 25-30g protein per main meal.

It is envisaged that the result from this study will change practice at Daffodil Cottage Cancer Centre. The hypothesised findings are; intervention will commence at the start of chemotherapy, muscle mass will be measured regularly and nutrition intervention will target specific doses of protein rather than an overall aim to eat more protein.

Background

Cancer is a leading cause of morbidity and mortality in Australia (Cancer Council, 2019). In 2013, 1699 people were diagnosed with cancer in Western NSW Local Health District, with 621 deaths attributable to cancer (Cancer Institute NSW, 2013). The European Society of Parenteral and Enteral nutrition (ESPEN) released updated guidelines for oncology nutrition in 2016. The guidelines highlighted that the loss of muscle mass in cancer patients with or without loss of fat is the main factor that predicts risk of physical impairment, post-operative complications, chemotherapy toxicity and mortality (Arends *et al.*, 2017).

Loss of muscle mass is common in oncology patients undergoing treatment. Approximately 16% of breast cancer, 33% of cholangiocarcinoma, and 40.3% of hepatocellular cancer patients lose muscle mass during chemotherapy (Aversa *et al.*, 2017). The prevalence of muscle loss can range from 5% to 89% in different cancer types (Rier, Jager, Sleijfer, Maier, & Levin, 2016).

A recent study investigating the loss of skeletal muscle during systemic chemotherapy in patients with foregut cancer (includes oesophagus, stomach, pancreas, liver and bile ducts) showed that patients had significant reductions in skeletal muscle area [-6.1cm^2 (3.9%)/100 days] as measured by computed tomography (Daly et al., 2018).

Loss of muscle mass is detrimental to a cancer patient undergoing treatment. Lower muscle mass is associated with tumour progression, increased chemotherapy toxicity, and poor survival (Yip et al., 2015). It has been demonstrated in patients affected by head and neck cancer (Sealy et al., 2019), foregut cancer (Daly et al., 2018), colon cancer (Blauwhoff-Buskermolen et al., 2016), breast cancer (Prado et al., 2009), diffuse large B-cell lymphoma, ovarian and lung cancer (Pin, Couch, & Bonetto, 2018) a reduced tolerance to chemotherapy treatment, worsening survival.

Computed tomography (CT) and Magnetic resonance imaging (MRI) are the gold standard for measuring muscle mass in oncology patients (Prado & Heymsfield, 2014). Ultrasound can also be used to measure FFM. It is non-invasive, portable and demonstrates a high degree of accuracy and reliability in a variety of populations (Mourtzakis & Wischmeyer, 2014). However, validation and reliability studies have not been published in cancer patients. Ultrasound estimates fat free mass (FFM) and body fat from the estimation of total body water. Unlike bio impedance scales (another popular choice in clinics), ultrasound is not affected by subcutaneous fat thickness, loose connective tissue or hydration status (Wagner, 2013).This is advantageous in the rural oncology setting, as patients are travelling large distances, they have multiple appointments when in clinic, and fasting for lengthy periods is not advised in this patient group.

Oncology populations can have a high incidence of muscle loss due to a variety of factors. Although age, reduced physical activity and an increase in pro inflammatory cytokines contribute to cancer-related muscle wasting the main cause is thought to be an increase in muscle protein breakdown (Rier et al., 2016). The cancer itself and cancer treatments can have an impact on a person's nutritional intake too, due to side effects such as taste changes, nausea, vomiting and anorexia (Lee, Leong, & Lim, 2016). This can lead to a loss of fat and muscle tissue. Lastly medications such as the chemotherapy agents themselves and corticosteroids often used in the oncology setting can increase muscle protein breakdown. (Rier et al., 2016).

The strong link between reduced muscle mass and increased chemotherapy toxicities and mortality, suggests preservation of muscle mass is a key strategy to improve life for cancer patients. More studies are required to assess the best nutrition intervention to optimize maintenance of muscle mass (Arends et al., 2016).

Studies show muscle gain is possible in oncology patients. A study by Dijk et al., (2015) of cachectic pancreatic patients looking at whole body protein breakdown, synthesis and net protein balance showed that ingestion of a large bolus (35g) of whey protein generated a higher response of muscle protein synthesis than a smaller bolus of 10 or 20g. However information is lacking as to the dose, amount, and type of protein. Paddon-Jones et al., 2009 have determined that sarcopenia, can be reversed in the elderly population if they consume 25-30g protein per main meal. A review paper by Schoenfield and Aragon (2018) provided a guide for protein intakes per meal to cover muscle building in younger and older men. They suggested a target of 0.4g/kg/meal across 4 meals to reach 1.6g/kg/day. Another review paper highlights 25-30g high biological value protein per main meal to prevent FFM loss in healthy older adults (Bauer et al, 2013). There is limited published research as to the most effective way to maintain muscle mass in chemotherapy patients.

Evidence exist that early nutrition intervention should be the focus to prevent refractory cachexia and muscle loss as the window for anabolism is more likely open (Muscaritoli, Molfino, Gioia, Laviano & Fanelli., 2011; Prado *et al.*, 2013). Prado et al., (2013) conducted a study to observe the clinical course of skeletal muscle wasting in advanced cancer. They found that muscle was stable in 44.8% of all intervals, loss in 39.8% of intervals, and gain in 15.4% of intervals. It appeared that the gain and or maintenance of muscle was determined by whether the patient had stable disease or partial response to treatment. They surmised that nutrition therapy would be more successful in the initial phase of disease, when anabolism is more likely to occur (Prado *et al.*, 2013).

Current Australian dietetic guidelines for oncology patients outline a process to follow. Firstly malnutrition screening should be conducted on all new oncology patients and during chemotherapy visits (Isenring et al., 2013). Referral to a Dietitian occurs if the patient has a score of two or higher. The patient will then have an assessment by the Dietitian using a Patient Generated- Subjective Global Assessment Tool (PG-SGA). This tool determines a score for nutritional triage and provides a subjective measure of muscle loss. PG-SGA is more specific for cancer patients assessing symptoms relating to cancer that can affect nutritional intake. Subjective methods of nutritional assessment do not supply information about body composition and changes in short periods of time (Halpern-Silveira et al., 2010). Body mass index (BMI) and body surface area (BSA) (calculated in oncology to determine chemotherapy doses) do not provide information on muscle mass either.

There are a variety of dietary intake assessment methods, including weighed food records, diaries, 24 hour food recalls, and food frequency questionnaires. Each method has respective advantages and disadvantages in relation to other methods. The use of multiple 24 hour dietary recalls on non-consecutive days increases the ability of the result to reflect usual eating patterns. In addition, they are less of a burden on patients as some of the other dietary intake assessment methods (Ralph, 2011). Dietary intake can vary across the cycle of chemotherapy, Mardas, Madry and Stelmach-Mardas (2016) noted mean energy intake was lowest on the day of chemotherapy and highest three days before treatment. Therefore, timing of 24 hour dietary recalls is an important factor in this population.

The effectiveness of nutrition interventions in cancer patients have traditionally been measured by a change in weight, PG-SGA, protein and energy intakes (Baldwin *et al.*, 2012; & Lee *et al.*, 2016). Unfortunately, nutrition interventions for chemotherapy have been inconsistent in the demonstration of improvements in weight (Baldwin et al., 2012). One such study provided a variety of dietetic interventions to advanced gastrointestinal, non-small cell lung cancer or mesothelioma cancer patients undergoing chemotherapy for six weeks. This study did not show nutrition intervention to have an impact on weight (Baldwin et al., 2011). Measurement of muscle is suggested as a better way to examine the effectiveness of nutrition interventions in further studies. The study by Baldwin et al (2011) did not present the patients' Body Mass Index (BMI) at the beginning of the study, or report muscle mass, therefore it is not known if the patients were obese/overweight on commencing chemotherapy. If the study participants had measurements of FFM completed, they may have observed the nutrition intervention led to favourable muscle mass stability despite the participants losing weight. Change in weight status lacks sensitivity to body composition.

Current demographics of cancer patients, like the general population, now include higher rates of obesity at diagnosis. Sarcopenic obesity is where a patient has a BMI ≥ 30kg/m^2, but who also have defined low muscle mass. Sarcopenic cancer patients have been shown to have higher rates of morbidity and mortality (Yip et al, 2015). Prado et al., (2008) showed that 15% of obese (defined as BMI ≥ 30kg/m^2) cancer patients were sarcopenic.

Another example of where weight is a limiting measure, is in breast cancer patients. Studies show breast cancer patients typically gain weight during their treatment, but however lose muscle mass (Freedman et al., 2004).

Further research is required to determine if nutrition interventions, and specifically protein intake focused interventions, can have an impact on FFM rather than weight status. The current literature is not clear. Current studies use a variety of terminology to describe low muscle mass, such as malnutrition, cachexia or sarcopenia, however they all mean something slightly different. Protein is expressed in a variety of ways, and the amount and types differ with each study. There is no standard consensus on the approach to measure muscle mass. A variety of devices are used to measure muscle mass, with values and cut off points expressed in different ways. This made it difficult when researching literature that outlined specifically, fat free mass, whole protein and protein timing only. This research topic is an investigation of the most effective dietary way to maintain or improve muscle mass in chemotherapy patients. It will determine if chemotherapy patients consuming 25-30g of protein per main meal, maintain or improve fat free mass.

Study Aim

To determine if consuming 25-30g of protein per main meal resulted in maintenance or increased fat free mass in a rural cohort of chemotherapy patients over a six month period.

Objectives

The primary objective of this quasi-experimental pre/post intervention study was to determine if consuming main meal protein targets of 25g maintained or improved fat free mass from baseline to six months.

The secondary objectives were:

1) Investigate the relationship between total protein intakes and fat free mass (FFM).
2) Investigate the relationship between Patient-Generated Subjective Global Assessment (PG-SGA) Scores to FFM.
3) Investigate the relationship between weight and FFM.

Methods

Study Design

A quasi experimental pre/post intervention study was conducted at a rural chemotherapy outpatient facility. Patients aged 18 years or over with a new cancer diagnosis receiving chemotherapy (with or without immunotherapy) were included in the study over a six month period. Exclusion criteria were patients who do not wish to partake in the study and patients with cancer recurrence receiving second line chemotherapy. The research was conducted at Daffodil Cottage located at Bathurst Health Service, Howick Street Bathurst NSW 2795.

Data Collection

All the data collection was by a Dietitian over four time points: prior to first chemotherapy, at one month post first chemotherapy, three months and six months. Age, diagnosis, chemotherapy protocol and number of comorbidities were obtained from the outpatient database. The chemotherapy protocol was grouped as neoadjuvant/adjuvant or palliative. See Figure 1 for data collected. The nutritional status was assessed through the use of PG-SGA. A global score is obtained based on loss of weight, decreased intake, functional capacity, increased metabolic needs and physical examination. This score indicates the need for different levels of intervention. A higher score suggests higher nutritional risk. The PG-SGA also provides a nutritional classification as nourished (SGA A), moderately or suspect of being malnourished (SGA B) and severely malnourished (SGA C) (Bauer, Capra, & Ferguson, 2002). Body weight and height was obtained with the Seca 286 wireless ultrasonic measuring station. Weight was measured in kilograms (kg) to the nearest 0.00kg and height in centimetres (cm) to the nearest 0.0cm. Participants were weighed once (repeated if implausible) and wearing shoes and light clothing. FFM and fat mass was obtained using Bodymetrix^{TM} ultrasound tool. Both reported to the nearest 0.0kg. This measurement was repeated according to clinical judgement. This information was entered into an excel spreadsheet.

The Dietitian conducted a multiple pass 24 hour food recall at each time point. The information was analysed using Foodworks Version 9, Xyris Software (Australia) Pty Ltd to obtain protein per meal, protein total per day, and energy total per day. Individual protein requirements were calculated based on 1.2g/weight in kg/day. If a patient was considered overweight/obese, adjusted body weight was used for calculations. Protein intake collected from the 24 hour recall was calculated as a proportion of protein requirements. To attain protein requirement the proportion was defined as ≥95%.

The European perspective into cancer (EPIC) physical activity questionnaire was used initially to assess physical activity levels the 12 months prior to diagnosis, then the International Physical Activity Questionnaire (IPAQ) was used at each time point to assess their self-reported physical activity for the seven days prior to assessment. The results of the questionnaires were scored against the Australian Physical Activity and Sedentary behaviour. Guidelines for adults and older Australians. The participants were scored as being either above, at (moderate) or below (sedentary) the guidelines. This was entered into a word table.

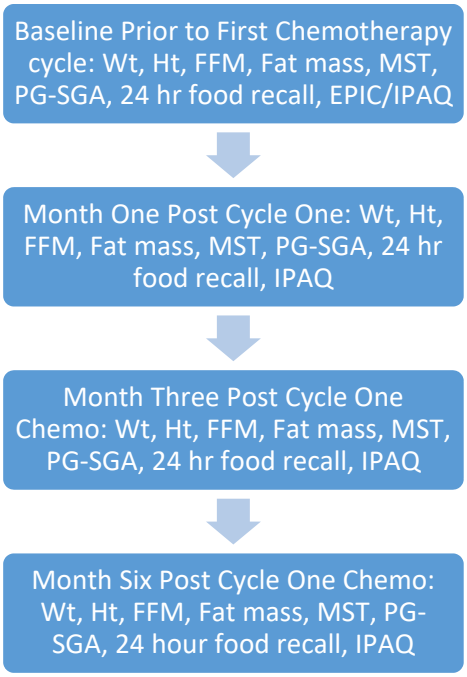


Figure 1 Flow Chart of Data Collection

Intervention

Patients were educated at the initial dietetic consult on sources of protein, aiming for high biological value sources containing leucine. Information was provided on the sources of protein and amount of 25-30g per main meal. Patients were also advised and provided with written suggestions to have protein containing snacks to ensure 1.2g/kg/day was achieved. If patients were not meeting overall protein requirements at review appointments, patients were provided with nutritional supplement powders, drinks or puddings. Written instructions were provided on dose and times of nutritional supplement. This information was personally tailored to aim to achieve 25-30g per main meal.

Study outcome

Primary outcome:

1. To determine the association between the number of main meals where protein achieved 25g (range 0-3) against the change in FFM from baseline to six months, and from baseline to one month, one month to three months, and three months to six months.

Secondary outcomes:

2. To determine the relationship between changes in FFM and changes in weight from baseline to six months, baseline to one month, one month to three months and three months to six months
3. To determine the relationship between PG-SGA at each time point i.e. baseline, one month, three months and six months and change in FFM.
4. To determine the relationship between protein intake as a proportion of protein required against the change in FFM for the subsequent time period. E.g. baseline protein intake against FFM change from baseline to 1 month.

Statistical Analysis

Means and standard deviations (SD) were calculated for continuous data (e.g. age, weight, BMI, Fat Free Mass (FFM), energy (kj), total protein (g)). For categorical data, data are described using proportions (e.g. % MST ≥ 2). Data are presented on the 13 participants. Statistical analysis of time trends was restricted to the 11 participants with complete data sets. The whole data set for the 13 participants was used for statistical analysis where baseline data was included e.g. correlation to baseline.

Repeated measures analysis of variance (ANOVA) was completed for continuous data to examine the overall trend over time from baseline to six months. Planned repeated contrasts compared data between adjacent time points (e.g. from baseline to one month, one month to three months etc.). A Cochran's Q test was completed for the analysis over time of the Malnutrition Screening Score (MST), with participants being grouped as MST score under two or two or higher as per Bauer, Capra, & Ferguson, (1999). A Friedman's test was completed for Patient Generated Subjective Global Assessment (PG-SGA) scores to explore changes over time. The PG-SGA was grouped as 0-1 no dietetic intervention required; 2-3 patient and family education required by nurse, Dietitian or other clinician; 4-8 requires intervention by a Dietitian; and 9+ a critical need for improved symptom management and/or nutrient intervention options (Bauer, Capra, & Ferguson, 2002).

The associations between the number of main meals where the required amount of protein (i.e. 25 grams) was achieved and the amount of FFM (kg) lost between time points (e.g. baseline to one month, or baseline to six months) were explored using the Spearman's non-parametric correlation. A Spearman's correlation was also completed between protein intakes as a proportion of protein required against the change in FFM for the subsequent time period (e.g. baseline protein intake against FFM change from baseline to one month). The self-reported physical activity questionnaire was subjectively scored against the Australian Physical Activity and Sedentary behaviour Guidelines for adults and older Australians (Department of Health, 2014). The physical activity levels were assessed as; Above, Moderate or Sedentary.

A decrease in at least 1 kg of FFM was considered a substantial loss as per the literature (Prado et al., 2013).

All analyses were conducted using appropriate statistical software (IBM SPSS version 25) and the p value of significance set at 0.05.

Ethics

Ethics was approved by the Greater Western Human Research Ethics Committee, project number LNR/18/GWAHS/27

Results:

Recruitment and data collection occurred between September 2018 and June 2019.

At total of 13 participants were included in the study. Thirty eight percent were female and 62% were male. 69% were palliative and 31% curative. See Table 1 for an outline of chemotherapy regimens and cancer diagnosis.

Demographics

Demographic characteristics of the cohort are shown in Table 1. Mean (± SD) age of the group was 62 (± 11) years.

Table 1 Participant demographics including Age, Sex, Cancer type, Chemotherapy regimen, and Number of Comorbidities for the 13 chemotherapy participants in a pre-post dietetic intervention study.

ID	Age (yrs)	Sex		Cancer	Treatment	Number of Comorbidities
1	44	F	Palliative	Pancreatic	Folfirinox	5
2	57	M	Palliative	B lymphoma	RCHOP/RDHAP	0
3	67	M	Palliative	Prostate	Docetaxel	0
4	70	M	Palliative	Lung	Carbo/gem	1
5	63	F	Palliative	Lung	Carbo/gem	1
6	48	M	Palliative	Rectosigmoid	Folfox	1
7	72	M	Curative	Follicular lymphoma	RCHOP	1
8	80	M	Curative	Large cell lymphoma	RCHOP	3
9	58	F	Curative	Colon	CAPOX	6
10	76	M	Palliative	Pancreatic	Gemcitabine	4
11	70	M	Curative	Rectal	Capecitabine	3
12	54	F	Palliative	Gallbladder	Capecitabine	3
13	52	F	Palliative	Endometrial	Carboplatin/paclitaxel	0

Footnote: Participant four and 12 had incomplete data sets

Analysis of data for whole participants and for the completers

Statistical analysis were restricted to the 11 participants who had complete data from all four time points of the study for time comparisons. For other analyses e.g. correlations, all available data from the 13 participants was used. One participant died during the study, and another participant was unable to attend the last data collection within the six-month timeframe. Table 2 summarises data for all outcome measures over the four time points. Weight declined over the six-month period for the 11 participants who completed the study. Weight declined from 84.2kg to 82.7kg, with significant weight loss occurring from baseline to one month. Completers of the study had a mean FFM of 16.4kg at baseline, this dropped to 16.1kg at one month and returned to baseline at six months.

Energy intake (kj) declined by 886kj from baseline to one month, then increased from one month to three months by 577kj and again by 544kj to 9376kj at six months. Protein intake (g) improved from baseline to one month by 5.8g, and one month to three months by 8.4g, with a slight decrease at six months. However this was an overall improvement from baseline to six months (91g-97.6g).

The percentage of participants with a Malnutrition Screening Tool (MST) score above two, warranting a Dietitian assessment was 18.2% at baseline, increasing to 27.3% and 36.4% at one month and three months and reducing to 18.2% again at the six-month point. The percentage of participants requiring Dietetic intervention based on the Patient Generated Subjective Global Assessment (PGSGA) score was 36.4% at baseline, 72.8% at one month, 63.6% at three months and 45.5% at six months.

Table 2 Pre and post dietetic intervention study in chemotherapy patients. Summarized data of whole sample and of participants with complete data sets for each time point of the study.

	Baseline N=13	1 month N=13	3 months N=12	6 months N=11	change over time
Weight (kg), mean (SD)					
whole sample	85.5 (18.3)	83.7 (19.1)	85.9 (18.7)	82.7 (13.5)	
completers (n=11)	84.2 (15.2)	82.3 (15.4)[b]	82.4 (15.0)	82.7 (13.5)	F(3,8) = 3.43 p = 0.072
BMI, mean (SD)					
whole sample	29.3 (7.0)	28.7 (7.3)	29.2 (7.7)	27.5 (3.9)	
completers (n=11)	28.0 (4.2)	27.3 (4.3)[a]	27.4 (4.3)	27.5 (3.9)	F(3,8) = 3.27 p = 0.080
MST ≥2, % (n)					
whole sample	30.8 (4)	23.1 (3)	33.3 (4)	18.2 (2)	
completers (n=11)	18.2 (2)	27.3 (3)	36.4 (4)	18.2 (2)	Q=1.32, df=3 p=0.724
PGSGA, % (n)					
whole sample					
no intervention (0-1)	7.7 (1)	7.7 (1)	7.7 (1)	7.7 (1)	
pt and family education (2-3)	46.2 (6)	15.4 (2)	23.1 (3)	38.5 (5)	
dietitian intervention (4-8)	30.8 (4)	30.8 (4)	15.4(2)	15.4 (2)	
critical need (9+)	15.4 (2)	46.2 (6)	53.8 (7)	38.5 (5)	
completers (n=11)					F_r=3.92, df=3 p=0.271
no intervention (0-1)	9.1 (1)	9.1 (1)	9.1 (1)	9.1 (1)	
pt and family education (2-3)	54.5 (6)	18.2 (2)	27.3 (3)	45.5 (5)	
dietitian intervention (4-8)	27.3 (3)	36.4 (4)	18.2 (2)	18.2 (2)	
critical need (9+)	9.1 (1)	36.4 (4)	45.4 (5)	27.3 (3)	
FFM (kg), mean (SD)					
whole sample	16.5 (3.2)	16.3 (3.6)	16.7 (3.6)	16.4 (3.6)	
completers (n=11)	16.4 (3.2)	16.1 (3.6)	16.2 (3.4)	16.4 (3.6)	F(3,8) = 0.67, p = 0.593

	Baseline N=13	1 month N=13	3 months N=12	6 months N=11	change over time
Energy (kj), mean (SD)					
whole sample	8677 (4337)	8663 (3311)	8847 (2572)	9376 (3089)	
completers (n=11)	9141 (4562)	8255 (3456)	8832 (2697)	9376 (3089)	F(3,8) = 0.17, p = 0.913
Protein (total), mean (SD)					
whole sample	88.1 (42.1)	99.5 (33.4)	102.6 (35.2)	97.6 (25.6)	
completers (n=11)	91 (43.7)	96.8 (35.8)	105.2 (35.7)	97.6 (25.6)	F(3,8) = 0.35, p = 0.790
# main meals achieving minimum protein, % (n)					
whole sample					
0 meals	30.8 (4)	7.7 (1)	8.3 (1)	9.1 (1)	
1 meal	46.2 (6)	15.4 (2)	33.3 (4)	45.5 (5)	
2 meals	15.4 (2)	69.2 (9)	58.3 (7)	27.3 (3)	
3 meals	7.7 (1)	7.7 (1)	0 (0)	18.2 (2)	
completers (n=11)					F_r=3.89, df=3 p=0.274
0 meals	36.4 (4)	9.1 (1)	9.1 (1)	9.1 (1)	
1 meal	36.4 (4)	18.2 (2)	27.3 (3)	45.5 (5)	
2 meals	18.2 (2)	63.6 (7)	63.6 (7)	27.3 (3)	
3 meals	9.1 (1)	9.1 (1)	0 (0)	18.2 (2)	

Footnote. SD, Standard Deviation. F, Repeated measures ANOVA. n, number. [a] p= <0.05 [b] p=<0.01. F_r. Friedman's test. df, degrees of freedom. Q, Cochran's Q test

Fat Free Mass Outcomes

Table 3 illustrates fat free mass (FFM) changes for individual participants, four participants lost FFM over the six-month period, however only one of these participants had a significant (>1kg) change in FFM from baseline to six months. Four participants increased FFM from baseline to six months. However participant eight's FFM from baseline is likely an error. Participant is an 80-year-old male and is unlikely to have gained 2.3kg from baseline to one month. Three participants had a stable FFM from baseline to six months.

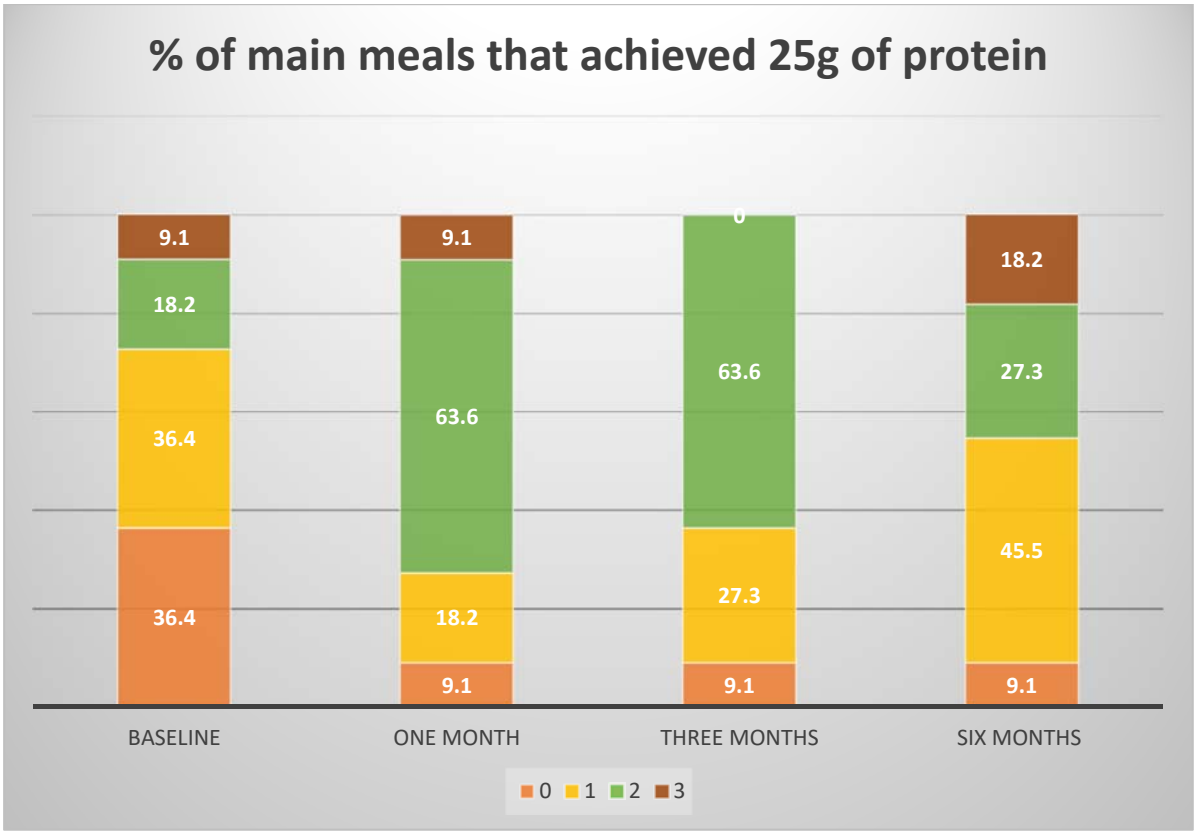
Table 3 Pre and post dietetic intervention in chemotherapy patients. Change in FFM at each different time point for individual participants measured to 0.1kg.

ID	FFM_bl	FFM_1	FFM_3	FFM_6	Δ bl to 1	Δ 1 to 3	Δ 3 to 6	Δ bl to 6
1	11.9	11.9	10.8	11.9	.0	-1.1	1.1	.0
2	19.2	18.3	17.3	17.0	-.9	-1.0	-.3	-2.2
3	16.2	15.7	16.7	16.2	-.5	1.0	-.5	.0
4	14.1	13.6	n/a	n/a	-.5	n/a	n/a	n/a
5	13.9	13.7	14.0	13.6	-.2	.3	-.4	-.3
6	17.7	16.6	17.1	17.9	-1.1	.5	.8	.2
7	19.5	18.7	18.3	18.7	-.8	-.4	.4	-.8
8	21.2	23.5	22.7	23.6	2.3	-.8	.9	2.4
9	12.2	11.1	11.8	12.2	-1.1	.7	.4	.0
10	15.8	15.3	15.6	15.0	-.5	.3	-.6	-.8
11	18.8	18.6	19.3	20.7	-.2	.7	1.4	1.9
12	20.8	21.0	21.8	n/a	.2	.8	n/a	n/a
13	13.7	13.9	14.5	13.9	.2	.6	-.6	.2

Footnote. bl, baseline. FFM, fat free mass. Δ, change. ID, participant number. n/a, measurement not obtained.

Results of the Spearman correlation indicates that there was a significant positive association between changes in weight from baseline to one month and change in FFM at the same time points, (r_s= 0.71, p <0.05, n=13). The weight change from one month to three months and change in FFM from one month to three months also showed a high positive correlation, (r_s=0.78, p <0.05, n=12). There was a negative correlation between PG-SGA score at six months and change in FFM (r_s=-0.67, p <0.05, n=11).

Food diary analysis outcomes



Footnote; 0=0 meals 1= one meal 2 = two meals 3 = three meals

Figure 2 Pre post dietetic intervention study in chemotherapy patients. Proportion of main meals that achieved 25g of protein at baseline, one month, three months and six months.

Figure 2 demonstrates the percentage (%) of main meals that met the 25g of protein target. 36.4% participants did not achieve any meals of 25g or more of protein at baseline. This improved down to 9.1% of participants at six months. 9.1% of participants met target protein of 25g at three main meals at baseline. This improved to 18.2% at six months.

When comparing participants who improved or maintained their FFM to the number of main meals achieving target protein of 25g, there was no statistically significant difference found. There was a moderate correlation (r_s= 0.51, p=0.08, n=13) between the number of main meals where protein was achieved at one month, compared to change in FFM from baseline to one month. However, this was not statistically significant.

Table 4 illustrates individual participant data across the four time points for the number of main meals that met the target of 25g of protein, FFM (kg) and score from the physical activity questionnaire. The participants self-reported physical activity levels are assessed as; Above, Moderate or Sedentary compared to the Australian Physical Activity and Sedentary behaviour Guidelines for adults and older Australians. Out of the four participants that lost FFM, only one was considered a significant loss (>1kg) highlighted in red.

Physical Activity Questionnaire outcomes

Table 4 Number of main meals achieving target protein, FFM and Physical Activity Score for Individual Participants for pre post dietetic intervention study in chemotherapy patients

	Baseline			1 month			3 months			6 months		
ID	**MM protein**	**FFM (kg)**	**PA**	**MM protein**	**FFM (kg)**	**PA**	**MM protein**	**FFM**	**PA**	**MM protein**	**FFM (kg)**	**PA**
1	0	11.9	S	2	11.9	S	2	10.8	S	1	11.9	M
2	1	19.2	A	0	18.3	S	2	17.3	S	2	17.0	A
3	3	16.2	S	2	15.7	S	2	16.7	A	2	16.2	M
4	1	14.1	S	2	13.6	S	n/a	n/a	n/a	n/a	n/a	n/a
5	2	13.9	S	1	13.7	M	2	14.0	M	2	13.6	S
6	1	17.7	S	1	16.6	A	2	17.1	A	2	17.9	M
7	1	19.5	S	2	18.7	S	1	18.3	S	1	18.7	S
8	2	21.2	S	2	23.5	S	2	22.7	S	3	23.6	S
9	1	12.2	A	2	11.1	S	0	11.8	S	0	12.2	A
10	0	15.8	A	2	15.3	S	1	15.6	A	1	15.0	S
11	0	18.8	S	2	18.6	M	2	19.3	S	1	20.7	S
12	1	20.8	A	2	21.0	A	1	21.8	M	n/a	n/a	n/a
13	0	13.7	S	3	13.9	S	1	14.5	S	1	13.9	S

Footnote. MM, Main meal. FFM, Fat free Mass. PA, Physical Activity. S, Sedentary. A, Active; Above Exercise Guidelines. M, Moderate; Met the Exercise Guidelines. , *Lost >1kg of FFM.* , *Lost <1kg of FFM.* , *Maintained or improved FFM. n/a, not applicable (deceased or unable to attend appointment).*

The self-reported physical activity levels do not appear to relate to the change in FFM in these results. No statistical analysis was completed on physical activity levels and FFM. Participant 13's FFM increased initially then decreased, still with overall gain 0.2kg, changed from achieving exercise above the guidelines prior to initial chemotherapy, then remained sedentary throughout the six months.

Total protein intake analysis outcomes

To explain the overall maintenance of FFM, daily protein intake versus participants protein requirements were calculated from the 24hour recall at baseline, one, three and six months. The comparison between daily protein intake versus requirements can be seen in Table 5.

Table 5 Achieved protein intake as a proportion (%) of daily protein requirements for pre and post dietetic intervention study in chemotherapy patients.

ID	Baseline	1 month	3 months	6 months
1	107	131	123	128
2	72	16	97	128
3	215	110	165	128
4	127	153	8888	8888
5	112	66	82	130
6	75	108	201	120
7	89	101	110	102
8	129	97	98	103
9	82	112	68	74
10	58	140	112	77
11	82	160	117	116
12	49	118	80	8888
13	61	131	85	59

Footnote; Criteria: ≥95% achieved highlighted in green.

Figure 3 illustrates the correlation between protein intake as a proportion of protein required against the change in FFM for the subsequent time period. E.g. baseline protein intake against FFM change from baseline to one month. There was a modest, but significant correlation between these two variables (r_s=0.34, p = <0.05, n = 13).

Figure 3 Relationship between protein intake as a proportion of required protein and change in FFM for subsequent time period for pre and post dietetic intervention study in chemotherapy patients.

All of the individual participant figures can be seen in Appendix 3.

Discussion

In this population of chemotherapy patients, adequate intakes of protein and energy were obtained overall across the six month period. This may explain how only one of the 11 participants lost a significant amount of FFM. There was also a small but significant correlation between the protein intake consumed as a proportion of a patients calculated requirements compared to the change in FFM for the subsequent period. Caution is required when interpreting these results however, as this study obtained dietary intake values from 24 hour food recalls at four different time points across the six months of chemotherapy. The 24 hour food recall was obtained the day prior to chemotherapy. Dietary intake is highest three days prior to chemotherapy and lowest the day of chemotherapy (Mardas, Madry & Stelmach-Mardas., 2016). This could explain the participants' intakes of energy and protein being adequate overall.

This study due to a small sample size was unable to demonstrate an intake of 25g of protein at main meals maintained or improved FFM in first line chemotherapy patients at a rural oncology centre. Ultimately the interpretation of the data should be done with caution. However, it is encouraging that in this cohort, the majority of patients maintained or improved fat free mass, with dietetic support ensuring adequate protein and energy intakes. Like Prado et al, 2013 highlighted from their study, this study provides further support for studies investigating nutrition intervention prior to initial cycle of chemotherapy, rather than waiting for patients to decline nutritionally in the first month. It strengthens the evidence that measurements of muscle mass rather than weight should be used to determine the effectiveness of nutrition interventions.

Loss of muscle mass (fat free mass) is common in oncology patients (Rier et al., 2016). In the review paper by Rier et al., 2016 it was outlined prevalence of low muscle mass in metastatic respiratory tract cancers to be as high as 87% in males, metastatic colorectal as high as 71%, and palliative pancreas 89%. In this cohort, which included two metastatic lung cancer patients, two metastatic colorectal cancer patients and two palliative pancreatic patients had 36% of the completers have a reduction in muscle mass. 9% only to be considered a significant loss of muscle (>1kg). This study showed that this population of chemotherapy patients, overall were able to maintain FFM from baseline to six months. 36 % of the 11 completers had gains in fat free mass.

Protein intakes of 25-30g per main meals have been recommended to gain muscle in elderly sarcopenic patients and in younger and older men (Bauer et al., 2013; Paddon-Jones & Rasmussen., 2009; Schoenfield & Aragon., 2018). However, investigation of specific amounts of protein per meal and the effect on muscle mass in chemotherapy patients is not currently in the literature. This study was unable to provide evidence that participants who consumed a minimum 25g of protein per main meal maintained or improved FFM due to the small sample size. This is one of the challenges when conducting research with participants in a rural area. This study did show with dietetic support patients improved the number of meals achieving the target protein of 25g across the study period. At baseline participants that achieved the target for two or three main meals was 27.3%, 63.6% at three months and 45.5% at six months.

Evidence exists for early nutrition intervention; however, data is still needed to define the optimal time to initiate nutrition support (Arends et al., 2016). This pre post dietetic intervention study supports the evidence that early nutrition is required. Currently malnutrition screening is used to identify patients that may be struggling nutritionally. The results of this study showed that if the Malnutrition Screening Tool (MST) was relied upon at baseline to identify patients at nutritional risk, only 18.2% would have been referred to the Dietitian, whereas the Patient-Generated Subjective Global Assessment identified at baseline 36.4% of patients required dietetic intervention. From baseline to one month, is it further evident a patient's risk of nutritional deterioration increases as weight statistically declined from baseline to one month ($p = <0.01$), FFM declined 0.3kg, and PG-SGA scores indicating dietetic intervention required rose to 72.8%. The percentage of patients identified as requiring a referral to a Dietitian using the MST was only 27.3% at one month. Reliance on the MST in this cohort of patients would not have identified all of the patients requiring dietetic intervention. Dietitian assessment and intervention prior to the first cycle of chemotherapy could have potentially reduced the impact of the first chemotherapy cycle on FFM. Further studies will be required to determine the effect of dietetic intervention prior to cycle one chemotherapy compared to usual care.

Nutrition interventions for chemotherapy have been inconsistent in the demonstration of improvements in weight (Baldwin et al., 2012). This study used fat free mass as the outcome measure instead of weight, to overcome the factors affecting weight in chemotherapy patients, but also because cancer patients are resembling current Australians at diagnosis, having higher rates of being overweight or obese (Yip et al., 2015). The stable FFM despite weight loss reported in this study was likely due to patients in this group achieving improved protein intakes overall. This is one of the first studies to report FFM as the outcome measure instead of weight. Weight is not a good indicator of body composition and it is recommended measurements of muscle mass be the outcome measure to ascertain effectiveness of nutrition interventions (Arends et al., 2016).

Strengths & Limitations:

This study was conducted in a community dwelling, rural cohort, providing real world data on nutrition interventions and chemotherapy patients rather than in a tightly controlled, but in unrealistic laboratory research conditions. A limitation of the study was the limited number of participants; however, this was excellent for the potential number of patients for recruitment. A total of 16 potential patients were available during the recruitment period. The recruitment period was limited by funding requirements to complete the study and produce a report within a 12 month timeframe. Another limitation was not having a non- intervention group. This decision was based on ethical considerations. All chemotherapy patients at Daffodil Cottage have access to nutrition therapy as part of their treatment, therefore it was considered unethical to conduct the present study in a randomized controlled setting.

A limitation was not using the gold standard of measuring body composition in oncology patients. As discussed previously this was unable to be achieved due to the researcher not having training to interpret computed tomography images. Ultrasound was practical and already in use at Daffodil Cottage Cancer Centre.

The physical activity questionnaires were self-reported, therefore patients did not tend to provide an accurate assessment of their physical activity in terms of compared to current definitions of vigorous and moderate exercise. A statistical analysis was not completed on the physical activity categories and the relationship to FFM.

Conclusion

This study did not show achieving protein intakes of 25g of protein per main meal maintained or improved fat free mass in chemotherapy patients. However, this study did not disprove the current practice of patients obtaining adequate protein/energy intake throughout their chemotherapy and supports early dietetic intervention in chemotherapy patients.

Recommendations for clinical dietetic and chemotherapy management

- To continue current dietetic practice at Daffodil Cottage as per study outline with some minor improvements for a period of at least 12-24 months to obtain an adequate number of participants. This data could then be used in a retrospective study to ascertain if patients achieved the target protein per main meal, did they maintain or improve FFM.
- To purchase the Sozo® by Impedimed® bioimpedance spectroscopy device scales to enable measurements of FFM by nursing staff and lessen the burden on the Dietitian.

Recommended changes to current study for future research

- An addition of 24-hour food recall in the days post a cycle of chemotherapy
- An objective rather than subjective measure of physical activity.

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Appendix One: Participant information and consent forms

PARTICIPANT INFORMATION SHEET & CONSENT FORM

STUDY TITLE: Determining the effect of dietetic intervention on lean body mass in chemotherapy patients at a rural chemotherapy day unit.

INVESTIGATOR: Julie Quade, Senior Oncology and Palliative Care Dietitian, Daffodil Cottage, Bathurst Health Service. Western NSW Local Health District Phone 0263305349

PROJECT SPONSOR: Andrew Muldoon, Community & Allied Health Manager, Bathurst Health Service, Bathurst NSW 2795

INTRODUCTION:
You are invited to take part in a research study into the effect of nutrition counselling on muscle mass in patients having chemotherapy. You have been invited to take part in this research because you are going to be having chemotherapy at Daffodil Cottage. This Participant Information Sheet (PIS) will tell you about what is involved in the study and help you decide whether or not you wish to take part. Please read this information carefully. If there is anything you do not understand or if you feel you need more information about anything, please ask. Before you make a decision, please feel free to talk things over with a relative, a friend or your own doctor.

STUDY PROCEDURES:
If you agree to participate in this study, you will be asked to sign the Participant Consent Form. You will then be asked to undergo the following procedures:

1) The Dietitian will require muscle and fat measurements. An ultrasound will be used to measure these. To measure the Dietitian will place a very small amount of ultrasound gel on your thigh, hip, waist and tricep area for ~ 5-10 seconds in each place, until the ultrasound takes a measurement of your fat and muscle. It is necessary to do this on your bare skin. This will be done a total of 4 times during the 6 months. See below:

Before Chemo	1 month after starting chemo	3 months after starting chemo	6 months after starting chemo

Ultrasound measurements do not routinely happen on chemotherapy patients at Daffodil Cottage now.

2) As part of the study, you will have access to the Daffodil Cottage Dietitian throughout your time at Daffodil Cottage. We encourage patients to maintain weight whilst having chemotherapy, however sometimes side effects of treatment may make it hard for you to want to eat and keep weight on. The Dietitian will help problem solve

the reasons why you may be losing weight, and help you overcome these. The Dietitian will be providing advice on how to keep your muscle during treatment. This may or may not include access to nutritional supplement drinks. The Dietitian usually sees patients that have already lost weight before chemo, however all new chemotherapy patients participating in this project will have access to the Dietitian from the start of their treatment. Dietitian sessions will occur as often as required.

3) As part of the study, knowledge of your physical activity levels are needed. When you are measured with the ultrasound, you will be asked some questions about your physical activity levels too. This is additional to usual care.
4) The researcher will be collecting information from your medical record relevant to this study such as cancer diagnosis, other illnesses you may have, the treatment you are having, Height, Weight, your age, and gender.
5) This study will occur from your first initial chemotherapy education session, until 6 months post your first chemotherapy treatment. Ultrasound measurements will take ~10-15 minutes. Dietitian consults will take ~ 60minutes for the first one, then ~ 20-30 minutes after. These usually will occur when you are attending chemotherapy treatment or attending Daffodil Cottage for other appointments.

COSTS
Participation in this study will not cost you anything, nor will you be paid.

VOLUNTARY PARTICIPATION
Taking part in any research is entirely voluntary. You do not have to take part in it. If you do decide to take part you can withdraw at any time without having to give a reason. Please be assured that, whatever your decision, it will not affect your routine treatment, your relationship with those treating you or your relationship with Daffodil Cottage, and staff.

ALTERNATIVES TO PARTICIPATION
Participation in this study is not your only option. Your other options may include usual care (see diagram on page 4 for more details). This means that you will have access to the Dietitian at Daffodil Cottage if required. You will be screened monthly during your chemotherapy, to see if you have lost weight, or have a poor appetite. If you do, a referral to the Dietitian will occur. You will not have your muscle mass measured with ultrasound, however regular monitoring of your weight will continue as per usual care. This study differs from standard treatment by measuring your muscle mass with ultrasound and seeing a Dietitian at the start of chemotherapy regardless if you have lost weight or have a poor appetite. You can discuss your options with the researcher before deciding whether or not to take part in the study.

WHAT ARE THE BENEFITS OF TAKING PART?
There are no specific benefits to participating however the data from this study will be used to inform Dietetic services at Daffodil Cottage.

WHAT ARE THE RISKS OF TAKING PART?
There are no anticipated risks of participating in this study.

CONFIDENTIALITY
All the information collected about you for the study will be treated confidentially. Your data will be stored under password protection on the researchers work computer at Daffodil Cottage only. Only the researcher will have access to your ultrasound data. The information about your diagnosis, treatment, Height, Weight, other illnesses, age, gender, are all obtained from the Daffodil Cottage database used by the health professionals involved in your care. If you consent to take part in this study your cancer care records may be inspected by the Human Research Ethics Committee to check that the research has been carried out appropriately. By signing the consent form you are giving permission for this to

be done. All details obtained by those named will remain confidential. A report of this study may be submitted for publication but individual participants will not be identifiable.

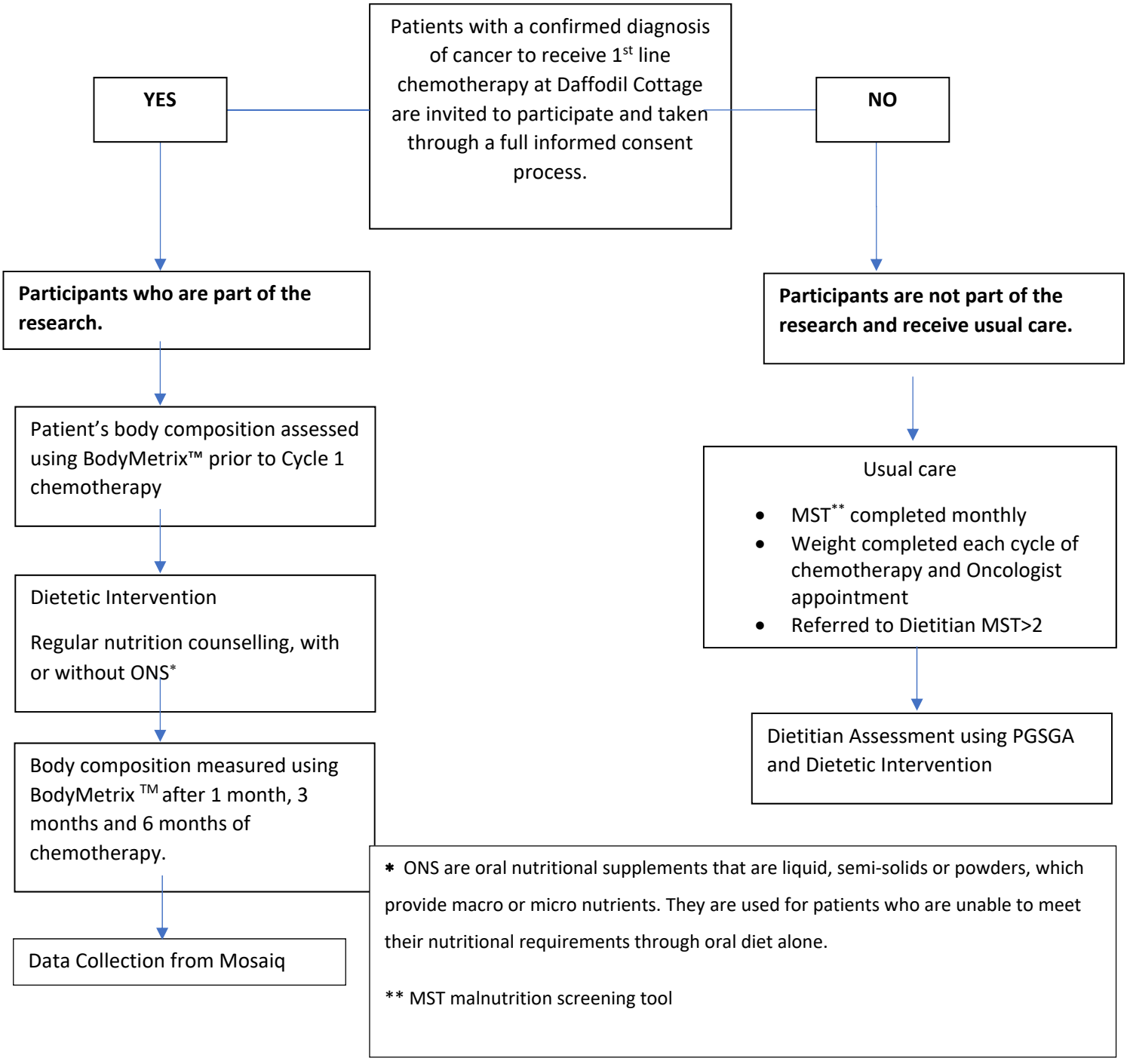
FURTHER INFORMATION

When you have read this information Julie Quade Senior Oncology & Palliative Care Dietitian at Daffodil Cottage will discuss it with you further and answer any questions you may have. If you would like to know more at any stage, please feel free to contact Julie on 63305349. This information sheet is for you to keep.

You can nominate to be sent a copy of the study summary at the end. If you request a copy this can be mailed to you.

This study has been approved by the Greater Western Human Research Ethics Committee. If you have any concerns or complaints about the conduct of the research study, you may contact the Executive Officer of the Ethics Committee, on (02) 6330 5889.

Figure 1 Flow chart of study design depicting usual care for chemotherapy patients at Daffodil Cottage (right) and that of study participants (left)



Determining the effect of dietetic intervention on lean body mass in chemotherapy patients at a rural chemotherapy day unit.

PARTICIPANT CONSENT FORM

I, ……..…….……[name]

of……[address]

have read and understood the Information for Participants for the above named research study and have discussed the study with …… ……...

- I have been made aware of the procedures involved in the study, including any known or expected inconvenience, risk, discomfort or potential side effect and of their implications as far as they are currently known by the researchers.

- I understand that, during the course of this study, my medical records may be accessed by Julie Quade Senior Oncology & Palliative Care Dietitian, by regulatory authorities or by the Ethics Committee approving the research in order to verify results and determine that the study is being carried out correctly.

- I freely choose to participate in this study and understand that I can withdraw at any time.

- I hereby agree to participate in this research study.

Name (Please Print): ..... .

Signature: ..... **Date:** .....

Name of Person who conducted informed consent discussion (Please Print):

……

Signature of Person who conducted informed consent discussion:

Signature: ..... **Date:** .....

Appendix Two: Participant Initial Dietary Information Sheet

Health
Western NSW
Local Health District

Name:_____

Date: _____

Dietitian:_____

How to gain muscle

To make muscle or to keep your muscle there are two important things to do:

1) **Eat protein regularly**
2) **Use your muscles**

How to eat enough protein

Where do I get protein from?
Protein is found in many foods - some foods have more protein than others, and some have protein of better quality.

Animal foods have large amounts of protein. The protein is of high quality so it is easy for the body to use. These foods include:

- meat
- poultry
- fish
- eggs
- dairy products – milk, cheese, yoghurt, custard, ice cream

Plant foods have smaller amounts of protein. They contain lower quality protein, so it is harder for the body to use. Plant foods that contain protein include:

- bread and breakfast cereals
- biscuits and crackers
- rice and pasta
- legumes
- nuts
- starchy vegetables such as potato

Most people will get protein from both animal and plant foods each day.

To build muscle you need a moderate amount of high quality protein at each meal. The Dietitian will tell you how much per meal to aim for.

What does that look like? These are just suggestions. The Dietitian will help you come up with your own versions.

Breakfast

- 2 large eggs with 40g cheese in omelette with veggies as desired
- Smoothie: 1 cup milk, 100g yoghurt, fruit of choice
- Chia pudding: 1 cup milk ¼ cup chia, vanilla, maple syrup and fruit
- Ricotta on fruit toast
- Porridge with fortified milk
- Greek yoghurt breakfast bowl (100g greek yoghurt, 50g almonds, 50g granola, berries)

Lunch AND Dinner ideas

- Macaroni and cheese
- Quiche
- Rocket, pear, parmesan, walnut salad
- Toasted ham and cheese sandwich
- Pumpkin soup with red lentils example recipe: http://www.taste.com.au/recipes/red-lentil-pumpkin-soup/4e76dd38-6c38-4545-8053-929bc66581f2
- 1 bowl Minestrone soup with cannellini beans and bacon
- 1 bowl pea and ham soup
- Sandwiches with: curried egg/lettuce or tuna/salmon and mayonnaise or chicken and mayo, or roast beef and pickles etc.
- 2 pieces of toast with peanut butter
- Chickpea curry (coconut cream)
- At least 100g Meat, chicken, pork, fish and veggies
- Tuna bake
- Crumbed fish and veggies

Snacks:

- Milkshake
- Nuts/seed mix
- Yoghurt
- Chia pudding
- Peanut butter on toast
- Hummus with biscuits

- Cheese and biscuits

During cancer treatment you may be finding it hard to eat enough protein.

If foods taste metallic or bitter try:

- Using plastic utensils
- Gargle lemon juice in water before eating
- Chewing on sugar free gum/lollies

If you have gone off red meat try:

- Eggs, chicken, fish, legumes, soy products

If you cannot tolerate dairy try:

- Lactose free dairy or soy products or adding a protein powder to almond milk. Dairy free protein powders e.g. pea protein, soy protein isolate

If you simply do not feel like eating you may need to have protein from drinks. Try:

- Sustagen hospital formula 1 serve has 13.8g protein
- Fortisip compact protein has 18g protein in 125ml serve
- Ensure plus has 12.5g protein per 200ml serve
- Resource 2.0 with fibre has 18g protein per 200ml serve
- Fortified milk (2Tbs skim milk powder to 200ml full fat milk) has 10g protein per serve.

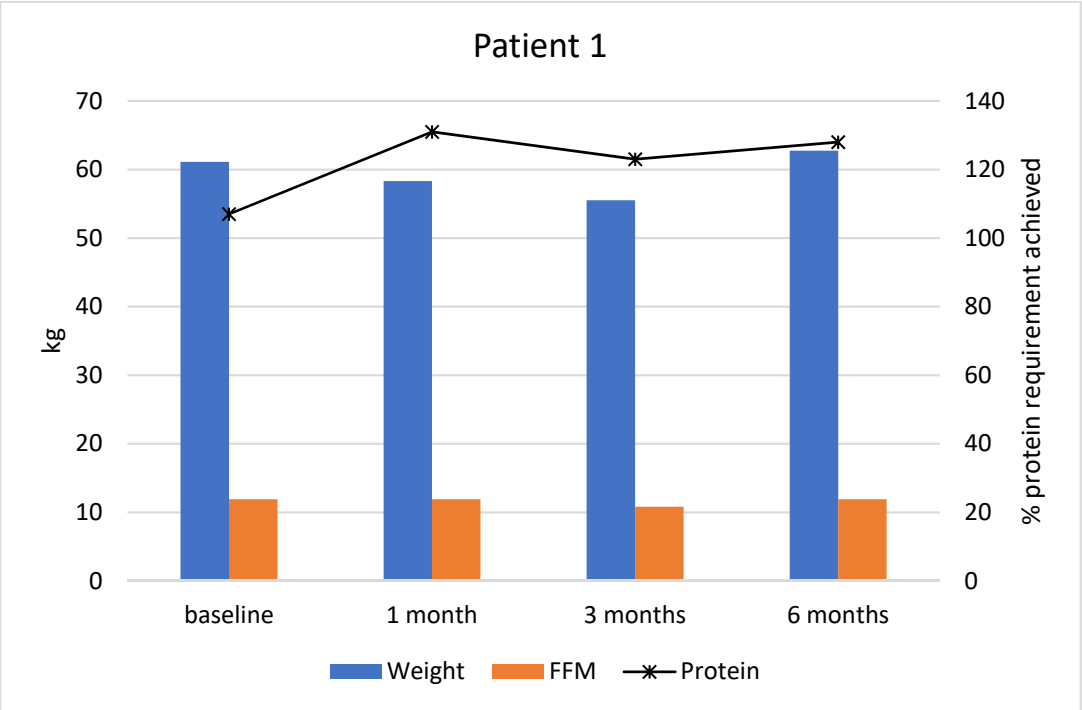
- Add 2 serves beneprotein (14g powder has 12 g protein) to 1 cup fluid e.g. juice or soft food

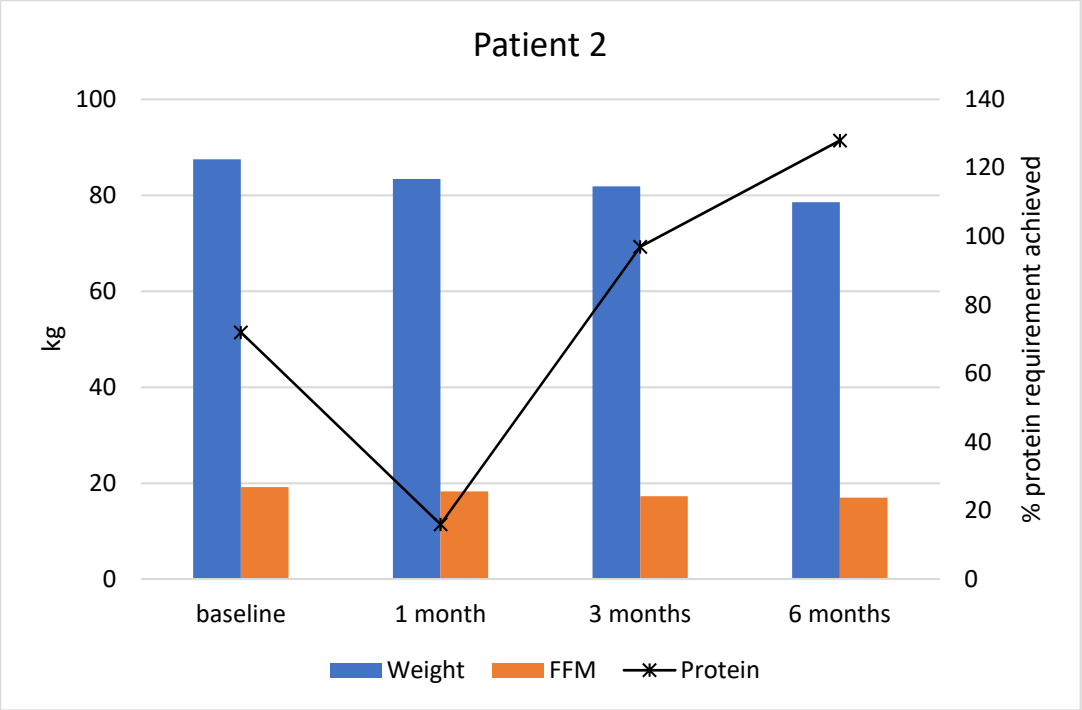
How much do I have to use my muscles to build them up?

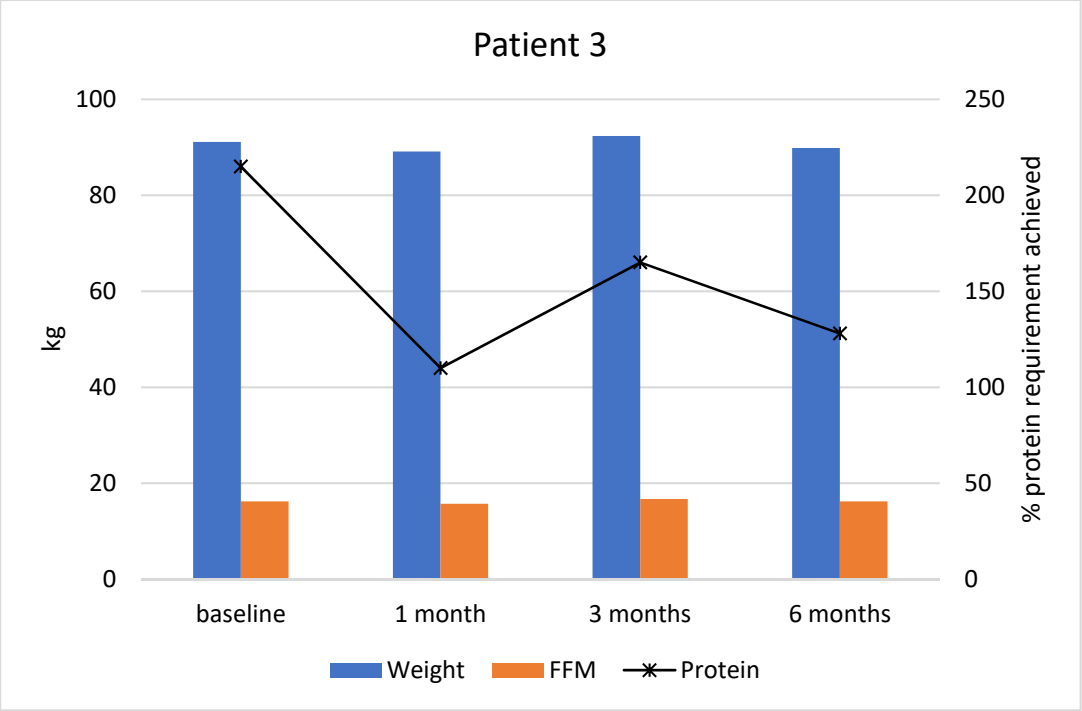
- 150min per week of moderate intensity aerobic exercise (e.g. brisk walking) and 2-3 sessions/week moderate intensity resistance exercise.

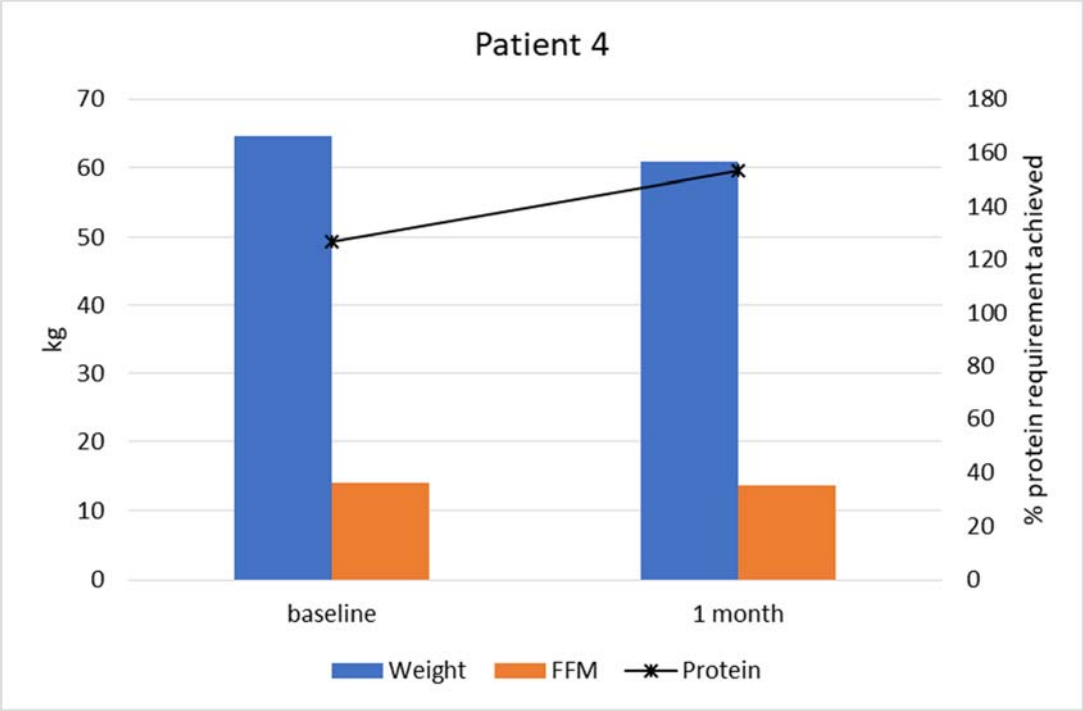
- Be careful if you have not done exercise for a while, it is best to see a qualified exercise physiologist to help with knowing what exercise is best for you.

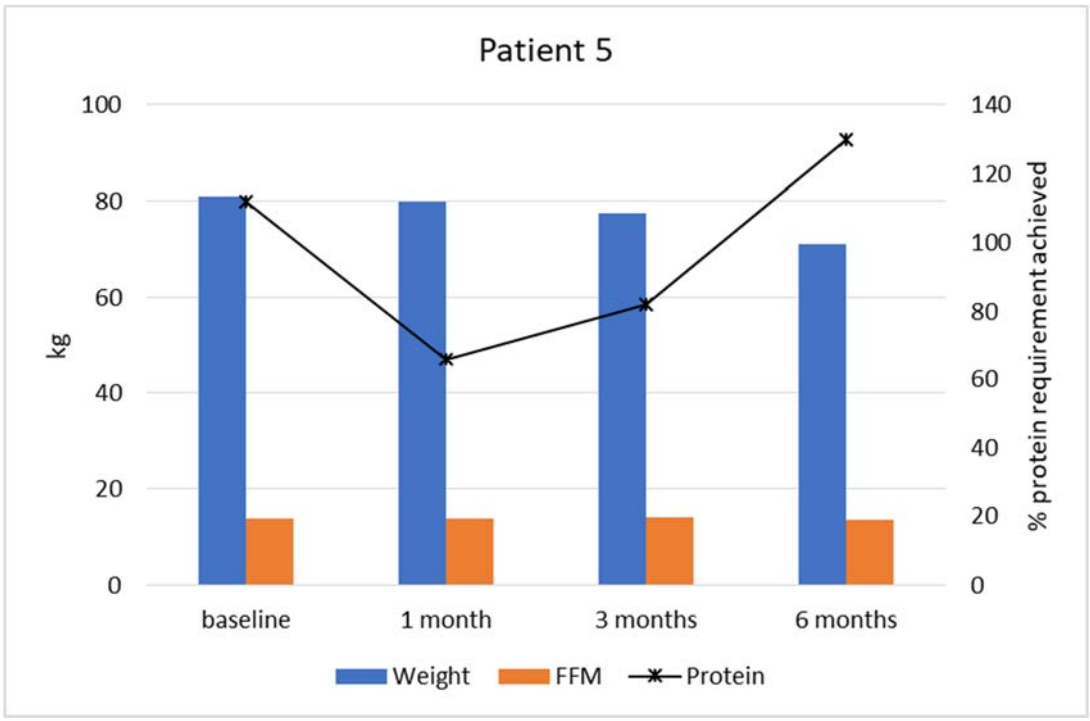
Appendix Three Individual participants changes in weight, FFM and % of protein meeting requirements






Patient 3
100
80
60
40
20
0
kg
250
200
150
100
50
0
% protein requirement achieved
baseline
1 month
3 months
6 months
Weight
FFM
Protein


Patient 4
70
60
50
40
30
20
10
0
kg
180
160
140
120
100
80
60
40
20
0
% protein requirement achieved
baseline
1 month
Weight
FFM
Protein


Patient 5
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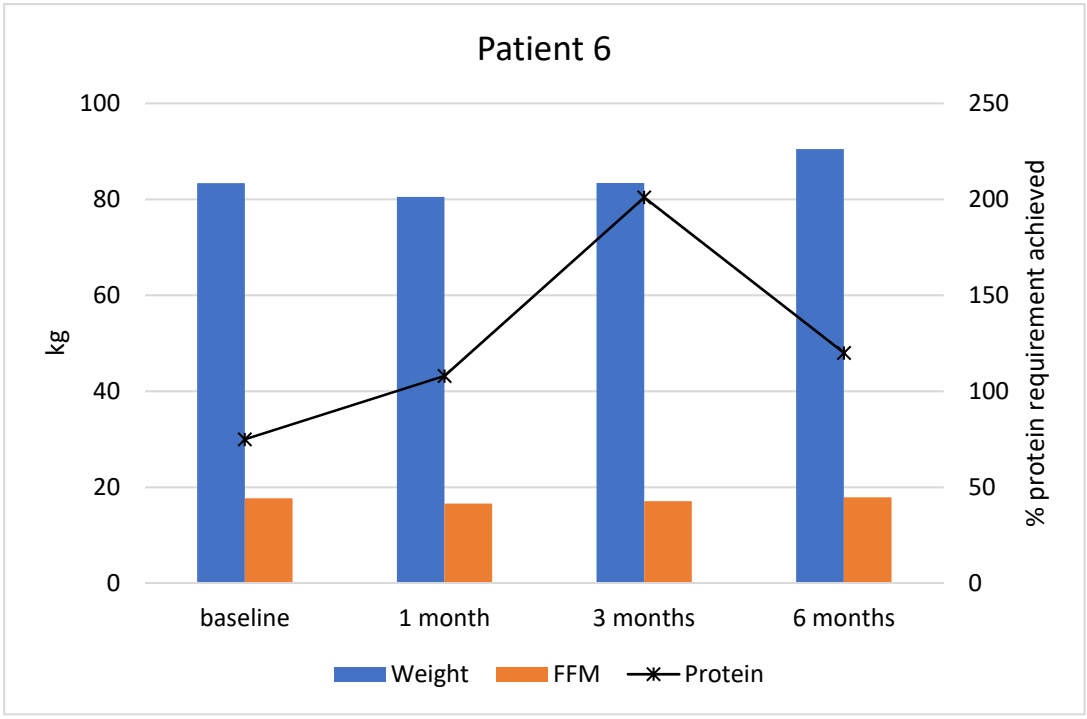
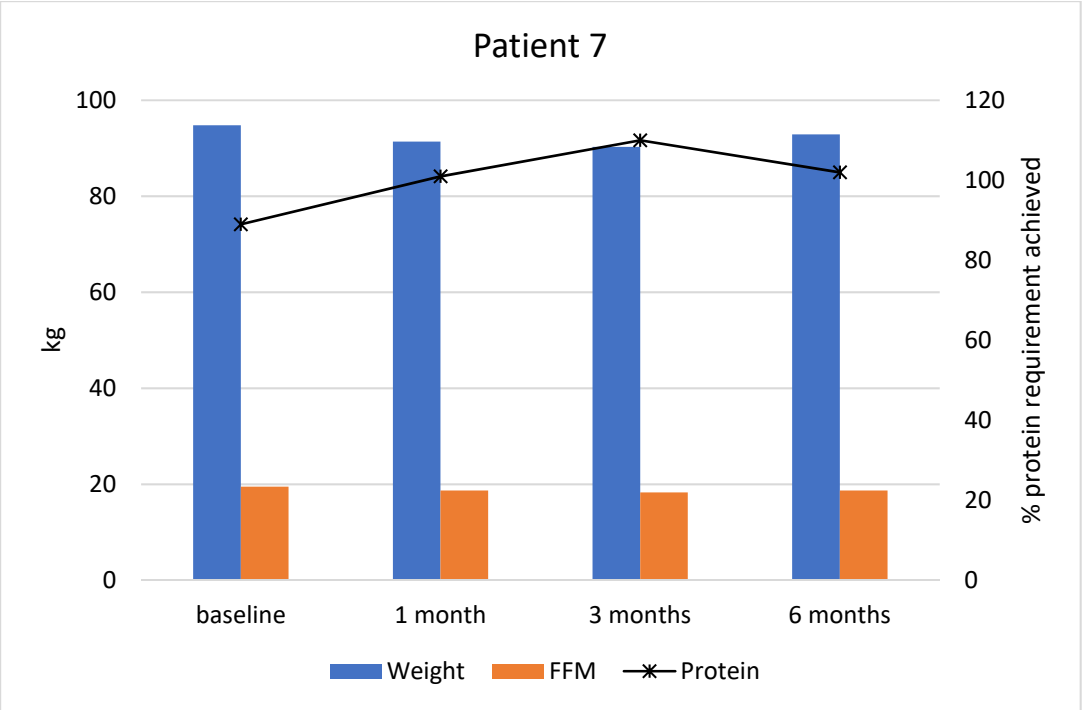
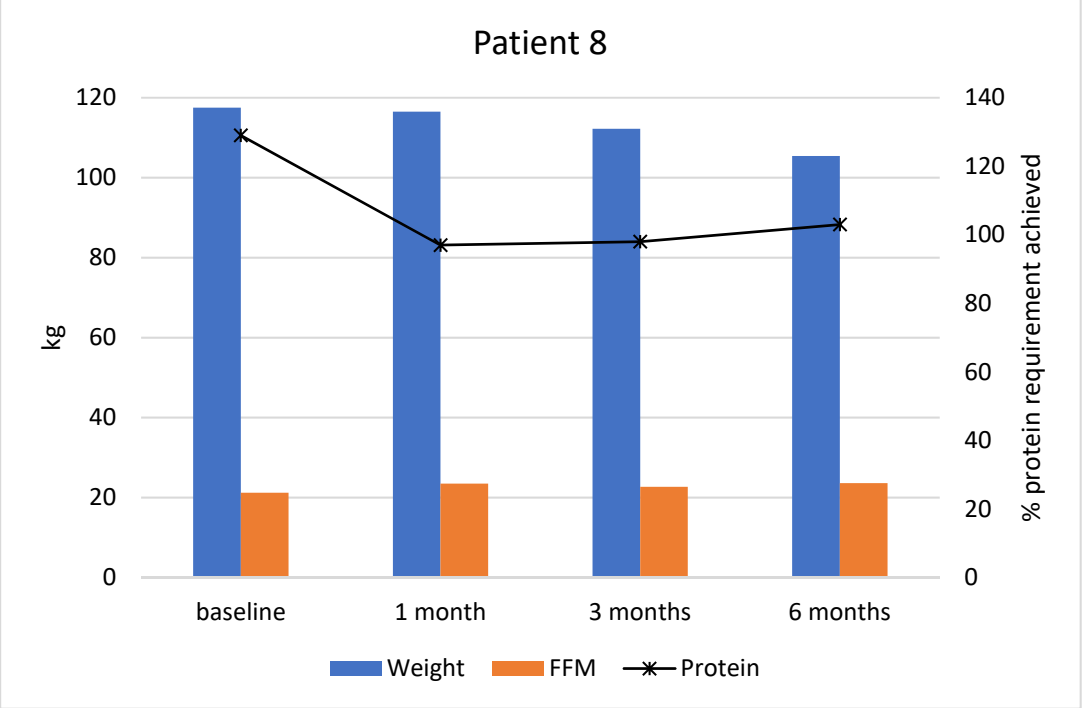
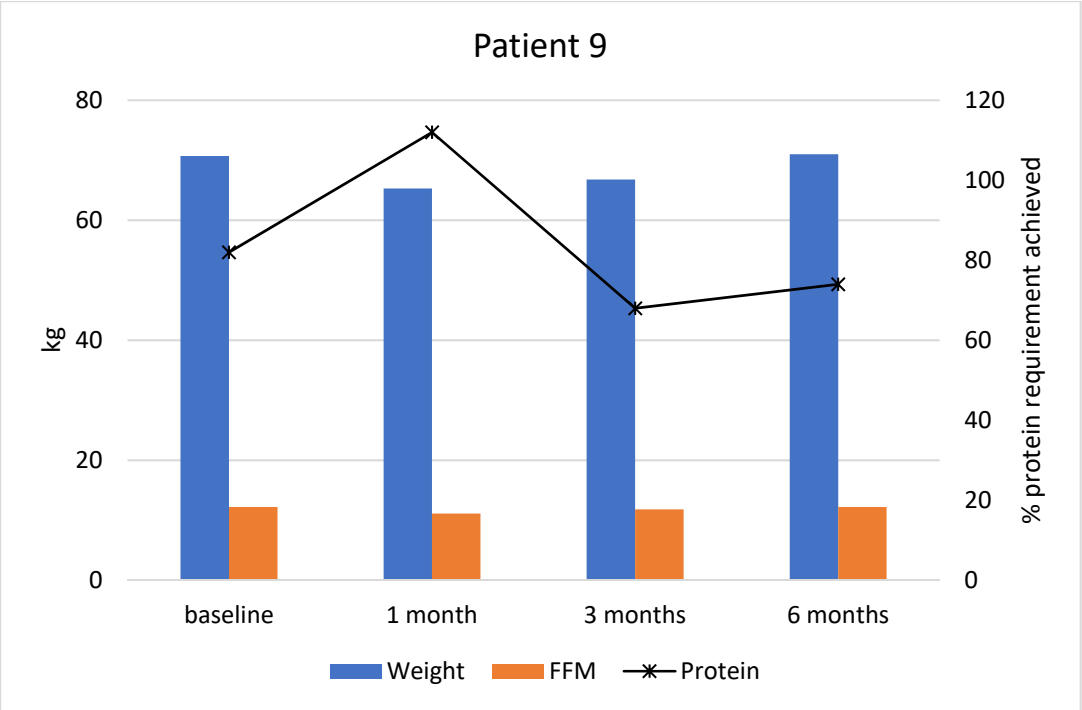
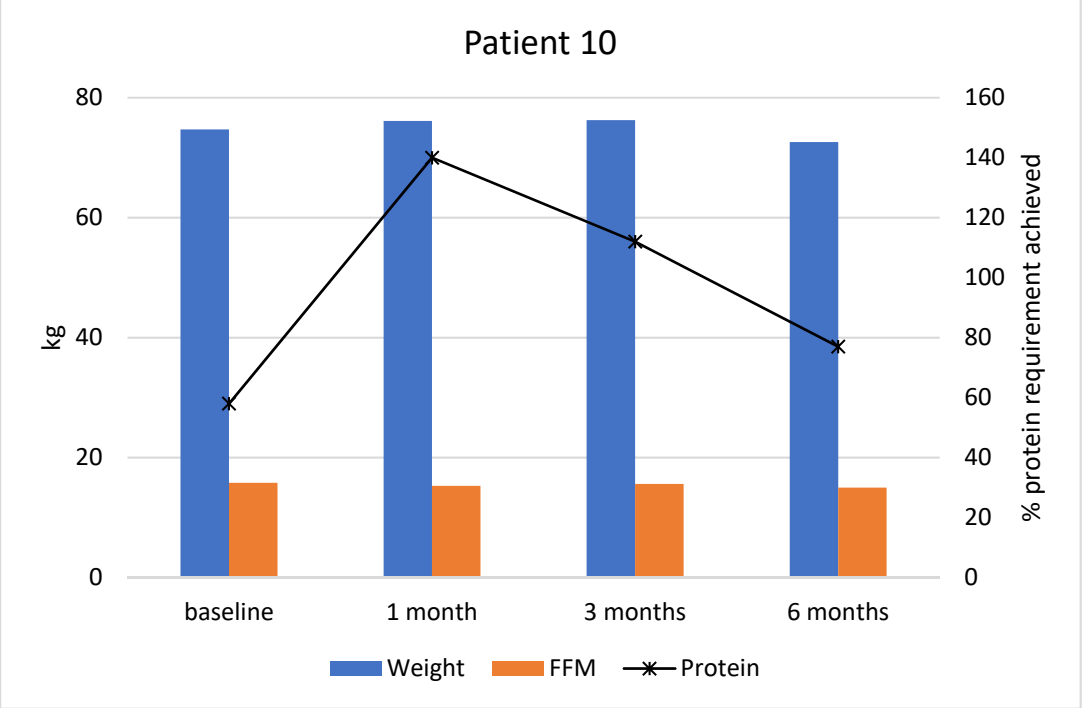
80
60
40
20
0
kg
140
120
100
80
60
40
20
0
% protein requirement achieved
baseline
1 month
3 months
6 months
Weight
FFM
Protein

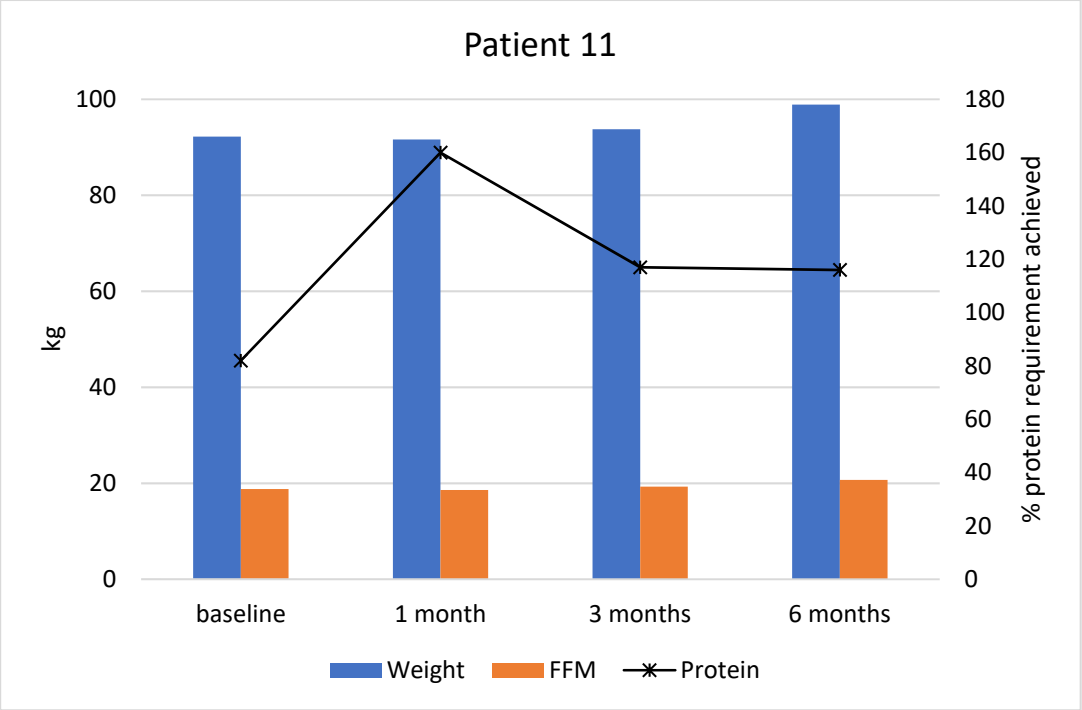

Patient 6
100
80
60
40
20
0
kg
250
200
150
100
50
0
% protein requirement achieved
baseline
1 month
3 months
6 months
Weight
FFM
Protein

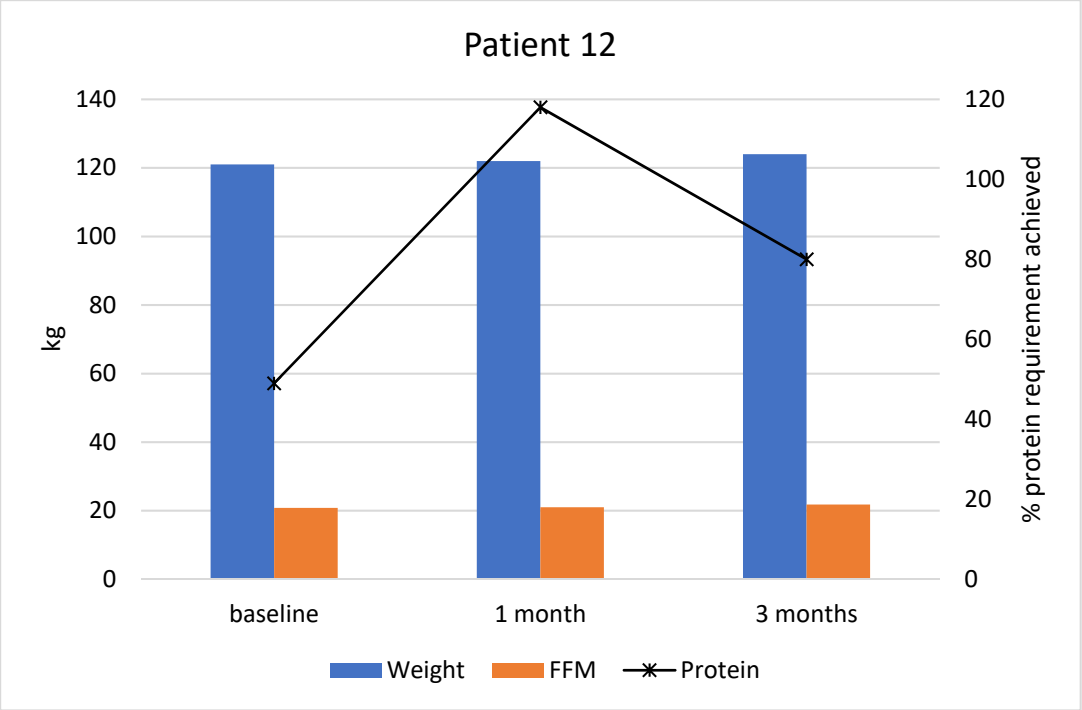

Patient 7
100
80
60
40
20
0
kg
120
100
80
60
40
20
0
% protein requirement achieved
baseline
1 month
3 months
6 months
Weight
FFM
Protein

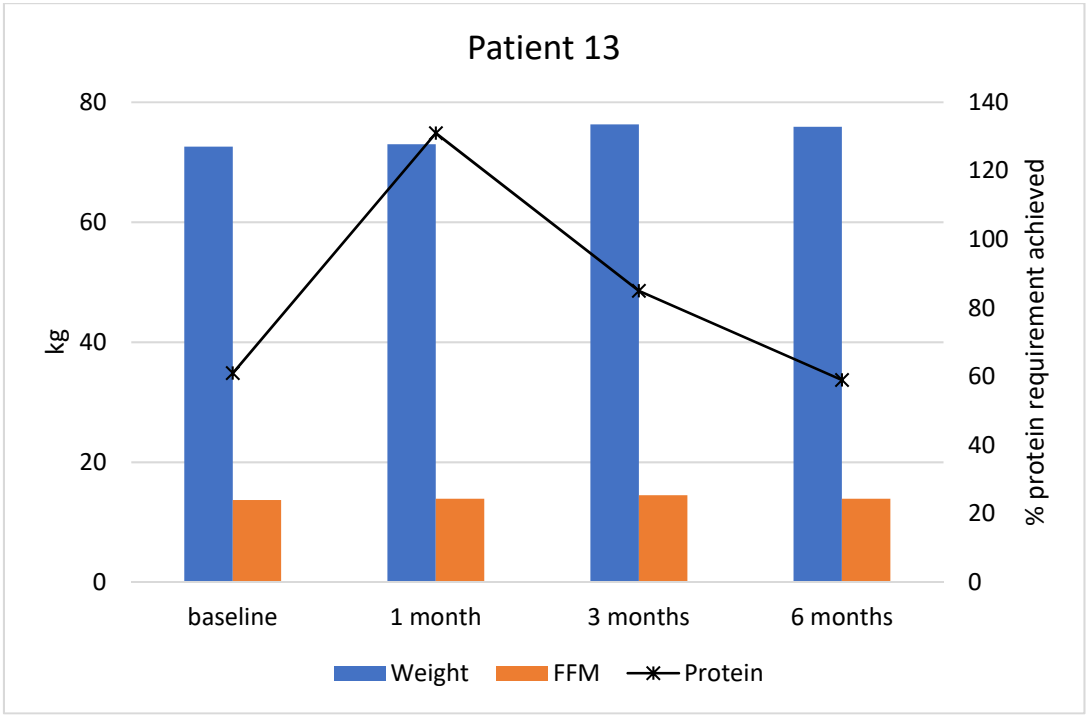

Patient 8
120
100
80
60
40
20
0
kg
140
120
100
80
60
40
20
0
% protein requirement achieved
baseline
1 month
3 months
6 months
Weight
FFM
Protein


Patient 9
80
60
40
20
0
kg
120
100
80
60
40
20
0
% protein requirement achieved
baseline
1 month
3 months
6 months
Weight
FFM
Protein


Patient 10
80
60
40
20
0
kg
160
140
120
100
80
60
40
20
0
% protein requirement achieved
baseline
1 month
3 months
6 months
Weight
FFM
Protein


Patient 11
100
80
60
40
20
0
kg
180
160
140
120
100
80
60
40
20
0
% protein requirement achieved
baseline
1 month
3 months
6 months
Weight
FFM
Protein


Patient 12
140
120
100
80
60
40
20
0
kg
120
100
80
60
40
20
0
% protein requirement achieved
baseline
1 month
3 months
Weight
FFM
Protein


Patient 13
80
60
40
20
0
kg
140
120
100
80
60
40
20
0
% protein requirement achieved
baseline
1 month
3 months
6 months
Weight
FFM
Protein