The Nottingham-Ice cream project: Dietary intake, food waste and ice cream solutions



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Abbreviations

BAPEN	British Association for Parenteral and Enteral Nutrition
BCAA	Branched Chain Amino Acid
BDA	British Dietetics Association
BMI	Body mass Index
CFS	Clinical Frailty Scale
ESPEN	The European Society for Enteral and Parenteral Nutrition
HCOP	Health Care of Older People
LOS	Length of Stay
MPB	Muscle Protein Breakdown
MPS	Muscle Protein Synthesis
MRES	Masters in Research
MUAC	Mid Upper Arm Circumference
MUST	Malnutrition Universal Screening Tool
NUH	Nottingham University Hospitals
ONS	Oral Nutritional Supplements
QMC	Queens Medical Centre
QoL	Quality of Life
SD	Standard deviation
UK	United Kingdom

Chapter 1: Introduction

1.1 Malnutrition

The term 'malnutrition' has no universally accepted definition. It has been used to describe "*a state of nutrition in which a deficiency or excess (or imbalance) of energy, protein and other nutrients causes measurable adverse effects on tissue/body form (body shape, size and composition) and function and clinical outcome"'* (Elia, 2003). Malnutrition encompasses individuals who are under- or over nourished. This project will present a focus on malnutrition as undernutrition.

Malnutrition is an under-recognised and undertreated issue faced by health systems and its patients. It is both a cause and consequence of ill health. Malnutrition is common in the hospital setting with prevalence in United Kingdom (UK) reported to be between 13 – 40%. Unfortunately, during hospitalisation patients may experience a further decline in nutritional status (Rinninella et al., 2018 and Elia and Stratton, 2000).

1.2 Causes of malnutrition

Older adults are generally defined as people aged 65 years and over (Weiner and Rabbani, 2010). Older adults constitute a population group with a high risk of malnutrition. Approximately three million adults are affected by malnutrition (Elia and Russell, 2009). Nutritional inadequacy in older adults can be attributed to one or more factors; treatment related, physiological, social and psychological (Table 1.0). Ageing is usually associated with a physiological decline in food intake regardless of presence of chronic illness and disease resulting from physiological changes; alternations in neurotransmitters and hormones central to appetite stimulation and satiation (referred to as *anorexia of ageing)* (Landi et al., 2016 and Morely, 2002). Other common causes of malnutrition include illness resulting in increased nutrient requirements, increased nutritional loss, and poor nutrient absorption (Demling and DeSanti, 2001).

Table 1.0 The main causes of malnutrition in older people			
Treatment	Physiological	Social	Psychological
Medication Side effects Polypharmacy Surgery Increased requirements Chemotherapy Side effects Radiotherapy Side effects	Dysphagia Pain Anorexia Nausea Vomiting Diarrhoea Malabsorption Constipation Sore mouth/ throat/ dry mouth Gastrointestinal obstruction Dental health Wound/pressure sores/burns Infection	Inability to shop Inability to cook Financial Food insecurity Deprivation Hospitalisation Ward smells Ward routine Hospital food Unable to feed self Culture	Related to diagnosis Bereavement Loneliness Depression Unmotivated Anxiety Diagnosis e.g. Alzheimer's Impaired cognition

1.3 Consequences of malnutrition

Malnutrition is the root of many negative health outcomes; it affects every system in the body. Negative outcomes include increased muscle loss, impaired wound healing (Mechanick, 2004), higher infection and complication rates (DiMaria-Ghalili, 2002 and Chandra, 1997), length of stay (LOS) (Braunschweig, Gomez and Sheean, 2000) and increased morbidity and mortality (Allison, 1992).

1.4 Identification of malnutrition

In order to prevent or reverse negative clinical outcomes associated with malnutrition, it is crucial patients are identified promptly. The diagnosis of malnutrition or its risk requires a comprehensive assessment. The first step in the management of malnutrition is to identify those at risk and affected. Identifying malnutrition in older adults is crucial. Many nutrition screening tools have been developed. Nevertheless, there is no universal gold standard (Abd et al., 2017 and Cascio and Logomarzino 2018). The Malnutrition Universal Screening Tool (MUST) (Figure 1.0) is the most widely used screening tool by hospitals in the UK; used in 82%, including by

Nottingham University Hospitals (NUH) NHS Trust (Russell and Elia 2014). The MUST incorporates three independent variables; Body Mass Index (BMI), weight loss history and disease state. Ideally, electronic scales should be used to obtain an accurate weight for a patient. However, in practice it is not always possible to weigh the patient (e.g., the patient is too frail, limited staff, limited scales on the ward) therefore, calculation of BMI is often reliant on nursing staff estimates or patient recall, this has been found to be inaccurate (Maskin et al., 2010). Mid Upper Arm Circumference (MUAC) may be used instead of weight. MUAC is the circumference of the upper arm, measured at the mid-point between the tip of the shoulder and the tip of the elbow. When MUAC <23.5 cm, BMI is likely to be <20 kg/m^2 and MUAC >32.0 cm, BMI is likely to be >30 kg/m^2. There is a strong positive relationship between BMI and MUAC, and actual BMI (using actual weight) and estimated BMI (using MUAC) (Houghton and Smith, 2011). MUST score equal to 0, 1 or ≥ 2 depict low, medium and high risk of malnutrition

respectively (British Association for Parenteral and Enteral Nutrition (BAPEN), 2003).In the UK nutritional screening of all hospital inpatients is recommended on admission and to be reassessed on a weekly basis as part of routine care (National Institute for Health and Care Excellence (NICE), GC32, 2006 and NICE, QS24, 2012). Patients with a MUST score ≥ 2 should be referred to the dietitian for malnutrition diagnosis and tailored dietetic intervention (Figure 1.1).

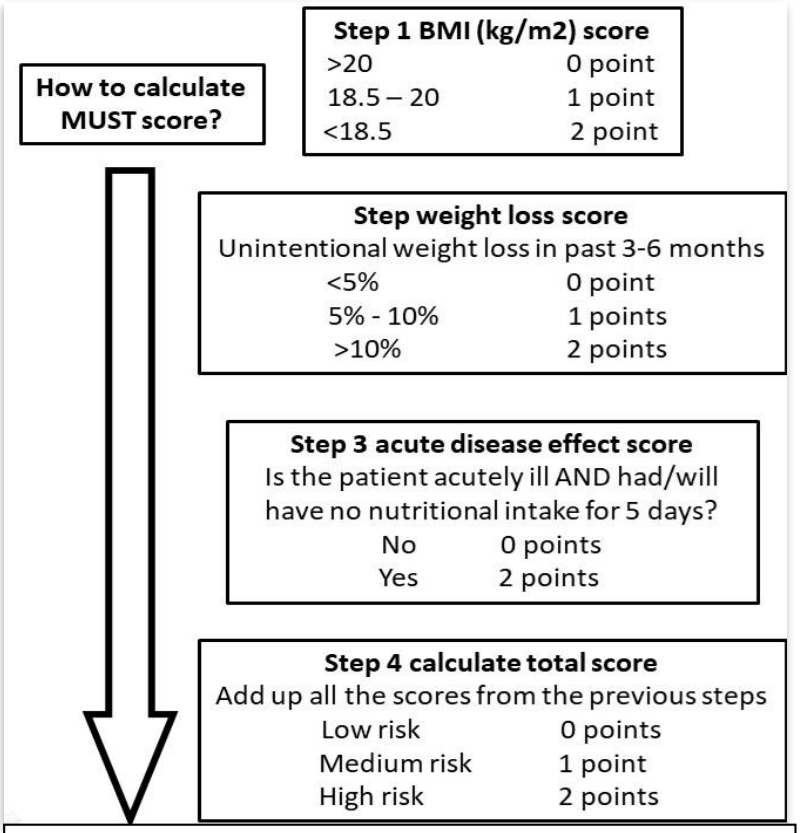
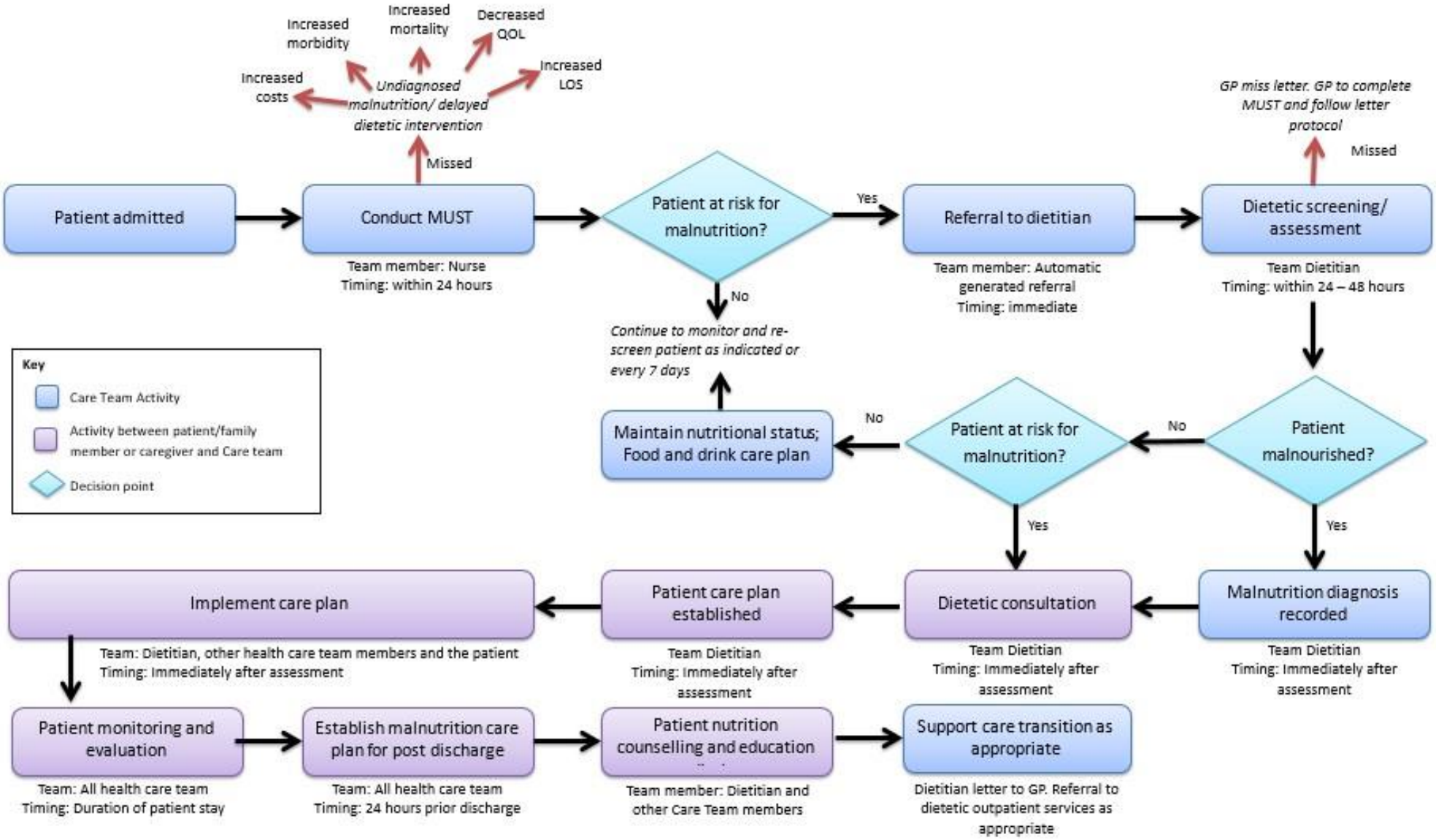


Figure 1.0: Nutrition Screening using the MUST Tool (BAPEN, 2003).

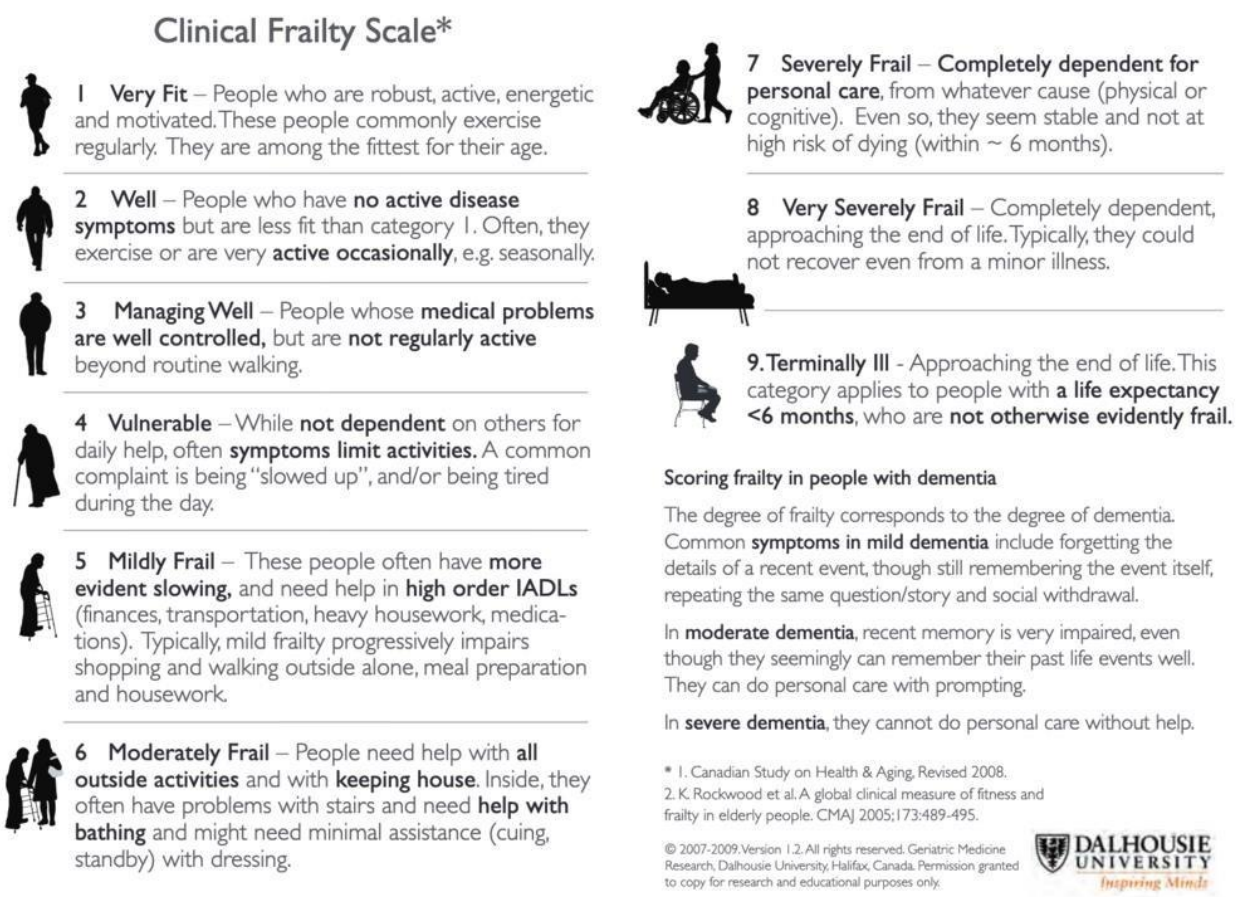
Figure 1.1: Malnutrition hospital decision tree



1.5 Frailty and the Clinical Frailty Score

Malnutrition is associated with increased risk of frailty (Wei et al., 2018). Frailty is a clinically recognised state conceptually defined as a progressive physiological decline in physiologic reserve and function across multiple organ systems and increased vulnerability to disease and death (Chen, Mao and Leng, 2014 and Fried et al., 2005). Frailty has been associated with higher body fat mass and fat percentage, with low muscle mass and bone density (Xu et al., 2020). Clinical Frailty Score (CFS) is a good predictor of mortality after proximal femur fracture (Narula et al., 2020). The CFS is a judgement-based frailty tool that evaluates specific domains including comorbidity, function and cognition to generate a frailty score (Figure 1.2). The CFS is a well-validated scale that evolved from the Canadian Study of Health and Ageing. The aim of CFS is to identify patients at risk for adverse outcomes due to frailty to enable implementation of preventative strategies. The CFS can be undertaken by any trained healthcare professional including doctors, nurses, health care assistants, with training support. CFS has not been widely validated in younger populations (below 65 years of age), or in those with a learning disability (Rockwood et al., 2020).

Figure 1.2: The CFS



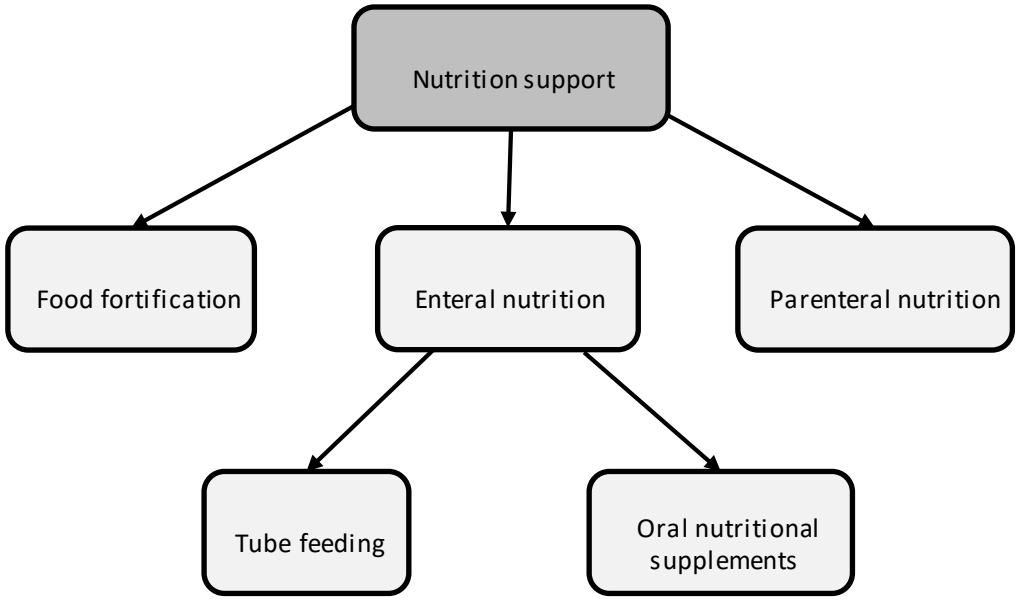
1.6 Diagnostic criteria

There is a fundamental lack of consensus on diagnostic criteria for malnutrition in clinical settings. The Global Leadership Initiative on Malnutrition (GLIM) provides criteria to categorise patients as malnourished. The framework comprises of three phenotypic (BMI, weight loss, and reduced muscle mass) and two aetiological criteria (reduced food intake/impaired nutrients assimilation and inflammation). A combination of one of each criterion needed to make a diagnosis of malnutrition (De van der schueren et al., 2020)

1.7 Managing malnutrition

Nutrition support is a method used to improve or maintain nutritional intake. It includes food fortification, oral nutritional supplements (ONS) tube feeding and parenteral nutrition (Loch, 2006) (Figure 1.3). Enteral nutrition referrers to all forms of nutrition support that imply the use of "dietary foods for special medicinal purposes.'" It encompasses ONS (also known as sip feeds) as well as tube feeding via nasogastric, nasoenteral or percutaneous tubes. *"ONS are sterile liquids, semi-solids or powders, which provide macro and micro nutrients"* (BAPEN, 2016). When the gut is functioning but nutrition cannot be taken normally by mouth, nutritionally complete feed may be provided via tube (Enteral tube feeding) (NICE, 2006). Enteral tube feeding is more commonly used in patients with neurological conditions or stroke of whom usually have impeded swallow. Parenteral nutrition, the delivery of nutrition intravenously (NICE, 2006), is used if the patient's gut cannot absorb nutrients. Enteral tube feeding and parenteral nutrition will not be discussed in this project. ONS are one of the preferred methods for managing malnutrition as it uses the gut and is less expensive and invasive than tube feeding or parenteral nutrition.

Figure 1.3: Nutritional support (Loch et al., 2006)



Dietitians have a key role in preventing and treating malnutrition (Stratton, Smith and Gabe, 2018). Dietitians provide evidence-based advice on the most appropriate oral nutritional support options for the patient (Gandy, 2019). As there is no blanket solution to treating malnutrition, each dietetic care plan should be individualised.

Some oral nutritional support recommendations from the European Society for Parenteral and Enteral Nutrition (ESPEN) guideline on clinical nutrition and hydration in geriatrics to improve nutritional intake are shown below (Volkert, Beck and Cederholm et al., 2019):

- Older persons with malnutrition or at risk of malnutrition and with eating dependency in institutions as well as at home shall be offered mealtime assistance in order to support adequate dietary intake (Recommendation 12).
- Older persons with malnutrition or at risk of malnutrition should be encouraged to share their mealtimes with others in order to stimulate dietary intake and improve quality of life (QoL) (Recommendation 14).
- Older persons with malnutrition or at risk of malnutrition should be offered fortified food in order to support adequate dietary intake (Recommendation 20).
- Older persons with malnutrition or at risk of malnutrition should be offered additional snacks, and/or finger food, in order to facilitate dietary intake (Recommendation 21).
- Older persons with malnutrition or at risk of malnutrition and signs of oropharyngeal dysphagia and/or chewing problems shall be offered texture-modified, enriched foods as a compensatory strategy to support adequate dietary intake (Recommendation 22).
- Older persons with malnutrition or at risk of malnutrition with chronic conditions shall be offered ONS when dietary counselling and food fortification are not sufficient to increase dietary intake and reach nutritional goal (Recommendation 24).

Systematic reviews and meta-analysis have shown positive benefits of ONS in the treatment of malnutrition. ONS can increase energy intake, protein intake and weight in hospitalised patients (Stratton, Hébuterne and Elia, 2013 and Milne et al., 2009). ONS have found to reduce hospital complications and readmissions to hospital. In turn, this may reduce health care costs (Stratton et al., 2013 and Milne et al., 2009). Low compliance to ONS limits their effectiveness. Unfortunately, low compliance is reported often in older adults (Miller, Daniels *et al.,* 2005 and Bruce et al., 2003)

1.8 Muscle protein synthesis in older adults

Muscle proteins are in a dynamic equilibrium between their respective rates of synthesis and breakdown (Breen and Philips, 2011). Muscle protein synthesis (MPS) is the process of building muscle mass and muscle protein breakdown (MPB) is the degradation of muscle mass. The balance between MPS and MPB is known as net protein balance. Protein ingestion and resistance exercise both stimulate MPS. Unfortunately, ageing

is accompanied by a blunted anabolic response to MPS (Wall et al., 2015). Muscles of older adults are less sensitive to lower doses of amino acids than young adults. Older adults may require higher quantities of protein to stimulate MPS (Breen and Philips, 2011). It has been postulated that 25-30g of a high quality protein is required to reach the level for maximal MPS in older adults (Mamerow, et al., 2014; Paddon-Jones and Leidy, 2014; Thalacker-Mercer and Drummond, 2014 and Deutz and Wolfe, 2013).

1.9 Leucine

Leucine is one of the three essential branched chain amino acids (BCAAs), (other BCAAs are isoleucine and valine). Among BCAAs, leucine has the most direct effects on MPS (Wolfe, 2017). Studies have suggested that leucine supplementation is able to enhance MPS in older adults (Bukhari et al., 2015; Wall et al., 2013, and Casperson et al., 2012). To achieve maximal stimulation of MPS the dose of leucine needed has been estimated to be ~3–4 g/meal, which corresponds to ~25–30 g protein/meal (Volpi et al., 2013).

1.10 Vitamin D

Vitamin D is essential for maintaining healthy bones and teeth. The biological function of vitamin D is to maintain normal blood levels of calcium and phosphorus. Vitamin D aids absorption of calcium, helping to form and maintain strong bones (Khammissa et al., 2018). Evidence suggests that a large population of older adults are vitamin D deficient (Hirani et al., 2010), especially in malnourished inpatients (Merker et al., 2019). Vitamin D deficiency is associated with increased risks for cancer, cardiovascular and infectious diseases, and mortality (Chowdhury et al., 2014; Garland et al., 2014; and Zittermann and Prokop, 2014). For this reason, all older adults should consider taking a daily supplement containing 10mg of vitamin D (Scientific Advisory Committee on Nutrition, 2016).

1.11 Project objectives

The objective of this Masters in Research (MRes) project is to explore the role of a new high protein, fortified ice cream, compared to standard ONS as a dietary supplement in older patients with hip or spine fractures. The project includes two unique studies. The first study evaluates the hospital catering service, specifically investigating energy and protein intake, food waste and ONS compliance in older adults on a trauma and orthopaedic (T&O) ward. Older T&O patients are reported to have low dietary intake and compliance to ONS but further research is warranted to support this. The second study explores the acceptability and compliance of a high protein, fortified ice cream, compared to a standard milkshake ONS used in the nutritional management of patients with hip and spine fractures at NUH NHS Trust. The findings will shed an important light on the acceptability of using a high protein ice cream for the management of malnutrition in older adults with hip or spine fractures.

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Chapter 2:

4.5 Tonnes of Food Wasted Across a Hospital Ward: A Service Evaluation of Dietary Intake and Food Waste

Aims:

- The aim of this service evaluation is to explore the catering service on one T&O ward at NUH by evaluating whether patients are meeting the British Dietetic Association's (BDA) Nutrition and Hydration Digest (The *Digest*) for energy (kcal) and protein (g) intake. Additionally, to evaluate ONS compliance and mealtime food waste in older T&O patients.

Hypothesis:

- Older trauma and orthopaedic patients will not meet the *Digest's* energy (kcal) and protein (g) standards. Compliance to ONS will be low (i.e. < 80% consumed). A significant amount (e.g. 40%) of food will be wasted that could have provided significant energy and protein.

Objectives:

- To identify the average daily energy (kcal) and protein (g) intake in older adults on a trauma and orthopaedic ward
- To evaluate the percentage (%) compliance to ONS
- To evaluate the percentage (%) plate waste
- To calculate the weight (kg) of food wasted daily from one trauma and orthopaedic ward at lunch and dinner.

2.1 Abstract

Introduction: Malnutrition is a debilitating condition in hospitalised older people. There has been limited studies exploring dietary intake and oral nutritional supplement (ONS) compliance in these people. The purpose of this service evaluation was to observe daily energy and protein intake, plate waste and ONS compliance and to report food waste at ward level.

Methods: Three-day dietary (food-only) intake and plate waste of 19 older (≥ 65 years) people on a hospital trauma and orthopaedic (T&O) ward were assessed. Patients were categorised as 'nutritionally well' or 'nutritionally vulnerable' as per British Dietetic Association's (BDA) Nutrition and Hydration Digest criteria. Dietary intake was calculated by a Dietitian and compared with adjusted BDA standards to exclude energy and protein from drinks. Ward plate and food trolley waste were weighed after lunch and supper for five days. Thirty three ONS from 11 patients were collected before disposal and weighed.

Results: Mean (standard deviation, (SD)) age of the patients was 84 years (9 female, and 10 male) with the most common injury hip fracture (68.4%). Mean intake for 'nutritionally well' (*n = 5)* was 1592 (257) kcal/day and 65.7 (8.5) g/day protein and 'nutritionally vulnerable' (*n*= 14) 643 (354) kcal/day and 24.8 (14.0) g/day protein. Plate waste for 'nutritionally well' was 4.1 (5.8) % at main meals and 1.7 (3.4) % at pudding and for 'nutritionally vulnerable' 53.1 (26.6) % at main meals and 38.6 (32.2) % at pudding. Compliance to ONS was 28.3 (38.8) %. The combined mealtime plate waste weighed 6.2 (1.2) kg/day and food-trolley waste 6.2 (0.9) kg/day. This equates to approximately 4526kg/year (4.5T) of waste.

Conclusions: Energy and protein intake and compliance to ONS in older T&O patients is sub-optimal. Food waste is high and urgently needs addressing. Further, interventions are warranted to improve dietary intake in hospital and to explore the acceptability of alternative ONS food/drink styles.

2.2 Introduction

Malnutrition is a significant clinical, public health and economical problem. Despite improvement in standards of medical care and public health initiatives, the frequency of malnutrition remains of concern. An estimated 29% of hospital adult inpatients in the UK are malnourished. Additionally, the estimated cost of malnutrition annually is £23.5 billion (Elia, 2015). Malnutrition is associated with many adverse outcomes including increased LOS, complication rates, morbidity and mortality and decreased quality of life. Moreover, hospitalisation leads to further deterioration in nutritional status (Laur, McCullough and Keller, 2015). Malnutrition is largely preventable and treatable, yet it is often overshadowed by other health concerns such as obesity.

The prevalence and cost of malnutrition is greatest amongst older people (≥ 65 years old) with as many as 56.2% of older adults in hospital at risk of malnutrition (Pirlich et al., 2021). Inevitably, malnutrition in older adults will continue to rise with respect to the ageing population.

Changes associated with the process of ageing precipitate malnutrition (Landi et al., *1999)*, including decreased appetite, physical activity, taste acuity, smell, deteriorating dental health and swallowing and chewing difficulties (Gariballa and Sinclair, 1998). Bone mass, muscle mass and muscle strength also decrease with age, with losses occurring as early as the fourth decade of life (Waters, Baumgarter and Garry, 2000 and Chen et al., 2014).

Malnutrition and frailty often coexist. Frailty increases risk of falls (Clegg et al., 2013) and subsequently hospitalization (Joseph et al., 2015). Frailty is associated with increased risk of falls (Clegg et al., 2013). Falls account for the most frequent accident in older people (Public Health England, 2019). Every year one in three older people suffer a fall that can cause serious injury or even death (Age UK, 2010). Improvement in nutritional status has been shown to reduce risk of falls (Nevens et al., 2012). Malnutrition in T&O patients is reported in those with lumbar spine and pelvis fractures, 47.4%, and proximal femur, 36.4%. These fractures are typical of the older people (Ihle et al., 2017). In older people with hip fractures in hospital, nutritional status has shown to be a predictor in postoperative complications (Aderinto and Brenkel, 2004).

Inadequate dietary intake is a key contributor in the complex aetiology of sarcopenia and frailty and is the single most probable important aetiological factor in disease-related malnutrition (Cruz-Jentoft et al., 2010). Patients are becoming increasingly malnourished through their hospital stay yet often nutritious and appealing food is uneaten. The combined effect of decreased dietary intake and increased nutritional requirements from acute and chronic illness will precipitate malnutrition in already vulnerable patients (Cederholm et al., 2017).

Dietary intake is complex and can be influenced by several factors in hospital such as rigid meal times, nonessential interruptions, ward smells, inability to self-feed, busy and noisy environments and limited menu choice (Naughton et al., 2021). Hospitals are required to meet the nutritional needs of patients to ensure best practice. The BDA's the *Digest* criteria provides evidence-based guidelines for the provision of nutrition in hospitals (BDA, 2017). The *Digest* provides energy and protein standards (Table 2.0) for patients who are 'nutritionally well' or 'nutritionally vulnerable." Standards have been derived from the Department of Health Dietary Reference Values and BAPEN recommendations.

Table 2.0 : The Digest Nutrient standards and definitions for Adults (BDA, 2017)			
Nutrient (/day)	Nutritionally Well	Nutritionally Vulnerable	Provided
Energy (kcal)	1840 – 2772kcal		Daily
Protein (g)	56 *	66 – 83	Daily
'Nutritionally well'	Normal nutritional requirements and normal appetite or those with a condition requiring a diet that follows healthier eating principles. *The lowest energy target is based on the estimated average requirement (EAR) for women aged ≥ 75 years and the highest target based on the EAR for men aged 19 - 59 years*.		
'Nutritionally vulnerable'	Normal nutritional requirements but with poor appetite and/or unable to eat normal quantities at mealtimes; or with increased nutritional needs. *The energy target range is based on requirements of 1.3 to 1.5 times resting energy expenditure for an individual weighing 75 kg*		
*For females of the same age bracket the Reference Nutrient Intake (RNI) is 45 g			

The provision of good nutritional care rarely seen as a priority. In the '2019 Inpatient Survey' 15% of patients reported they did not receive the help they required when eating (Care Quality Commission, 2021). In Australia 18% and 22% of hospital inpatients requiring assistance at meals received no help at all and were interrupted at meal times respectively (Young et al., 2016 and Gosney 2003).

The nutritional content of a meal becomes meaningless if patients do not eat what is presented to them. The measurement of plate waste, i.e. served food that remains uneaten by patients, is an important indicator of consumption. Quite simply, nutritional requirements cannot be met when patients fail to eat their meals as served. However, there is no mandatory framework for NHS hospital plate waste and it is not measured nationally (Department of Health and Social Care, 2020). Much research on dietary intake is limited to comparison studies of nutrient intake pre and post introduction of protected meals or specific dietetic intervention (Porter, Ottrey and Huggins, 2017).

Food waste has significant environmental and economic impacts. The NHS is the second biggest provider of meals in the UK public sector, serving 141 million inpatient meals. Annually £633 million is spent on inpatient food provision (NHS Digital, 2019). An estimated 18% of food in hospital is wasted (1 in 6 meals) (Jones, 2017) and between 2018 and 2019, 14 million kilograms of unserved meals were thrown away (NHS Digital, 2019). Decomposing food waste releases methane gas, a potent greenhouse gas. It is estimated that food and catering services in the NHS produces 1,543 ktCO2e- each year, contributing towards 6% of total admissions (NHS, 2020). The NHS food supply chain is pivotal in helping the government meet its commitment to reduce greenhouse gas emissions to net zero by 2050. Decreased food waste will also have significant cost savings as currently, food waste costs the UK healthcare sector £230 million annually (NHS Digital, 2019).

Many hospitals including, NUH NHS Trust record levels of food waste less than 10% (Sonnino and McWilliam, 2011). However, research shows that over 60% can be wasted (Sonnino and McWilliam, 2011) and food waste is greatest at point of consumption (Kantor et al., 1997).

ONS are recommended for those who are malnourished or at risk of malnutrition (Stratton, Green and Elia, 2003). Dietitians in hospitals usually prescribe ONS to patients who are nutritionally vulnerable to help meet nutritional needs as per Trust guidelines (Figure 1.0). ONS have been shown to have positive benefits in increasing nutritional status in undernourished older people (Travers et al., 2018 and Stratton et al., 2003). Studies in older adult inpatients have reported average consumption of ONS at approximately 55% (Miller et al., 2005 and Lawson et al., 2000). Compliance with ONS is lower in those with a lower BMI (Lawson et al., 2000) and in older people (Miller et al., 2005 and Bruce et al., 2003) reported to be as little as 37% compliance (Gosney, 2003). Unfortunately, poor consumption of ONS limits their effectiveness, wastes money for the NHS and has environmental costs.

As per NUH NHS Trust's "Clinical Audit Service Evaluation Procedure Guidelines", this project was registered at the Trust as a service evaluation project under the remit of healthcare evaluation; "a review of data and/or information with the intention of improving patient care." The catering team should provide food to patients that they enjoy and with minimal waste. This was therefore a service evaluation of the service they provide. Since no intervention was undertaken or collection of data from patients requiring consent, the project was not deemed to be research.

The primary aim of this service evaluation was to evaluate the catering service including to determine the energy and protein available (overall choice) and consumed (overall intake), (Table 2.0) by older adults admitted to one hospital T&O ward. The secondary aims include to evaluate compliance to ONS (amount consumed relative to amount prescribed) and the ward's waste.

Table 2.1: Definitions of dietary terms	
Dietary term	Definition
Overall choice	Amount of energy and protein provided by hospital food as chosen by patients or obtained from outside of hospital and assuming 100% consumption. Does not include beverages or ONS.
Overall intake	Total consumption of energy and protein from hospital meals, snacks, and non-hospital dietary items. Does not include beverages or ONS.

2.3 Methods

Dietary assessment (food only and food waste data was collected from one T&O ward at Queens Medical Centre (QMC), Nottingham, between November and December 2021. The proposed project was discussed informally with the Chairman of the Medical School Ethics Committee at the University of Nottingham. The project did not require ethical approval or informed written consent from the patients as data was collected within routine NHS professional healthcare role and for the purpose of quality improvement, however the study was conducted in accordance with good clinical practice principles and NUH Trust and such procedures were followed.

2.3.1 Participants

Patients were excluded from individual dietary and plate waste assessment if they were ≤ 65 years old, were terminally ill/on end of life care pathway or were receiving enteral or parenteral nutrition. Demographic data (sex, age, ethnicity), medical data (CFS, type of fracture, cognitive status), malnutrition score and patient anthropometry from the MUST, (weight (kg), body mass index (BMI) (kg/m^2), MUAC (cm), and height (m)), were collected from electronic medical records, medical notes or bedside charts, for patients included in dietary analysis. The MUST scores were calculated by trained ward staff. Patients were categorised nutritionally vulnerable if they had a MUST ≥ 1, had reduced oral intake (e.g. consumed below 50% of requirements over the three days) or presented with risk factors that either increased dietary requirements or reduced oral intake (e.g. acute disease, swallowing problems, chewing problems, immobility neuropsychological problems). Patients were deemed nutritionally well if they had a MUST 0 and were eating > 50% of meals over the three days and did not present any risk factors.

2.3.2 Dietary assessment

Nutritional intakes were assessed via three-day observational dietary histories. For the purpose of this data collection, a dietary assessment tool was developed for recording dietary intake and plate waste. One dietitian was present three days a week for four weeks on the ward to record dietary intake. Three-day observational dietary histories were recorded for one bay per week (total four bays). The dietitian was present in the bay for the duration of breakfast, lunch and dinner to record dietary intake. Meal times were;

breakfast 8:30am, lunch 12pm and supper 5pm. Additionally, the dietitian visited the ward at least once between breakfast and lunch, and lunch and dinner to monitor additional snacks. Percentage of each food item or snack consumed was estimated. Dietary intake and plate waste data was recorded by hand on the dietary assessment tool. The nutritional content of hospital food items was determined from a pre-analysed menu provided by the catering department and then used to estimate energy and protein intakes. Manufacturer package labels were used to obtain the energy and protein in snacks from obtained from outside the hospital.

Main meal (breakfast and first course only of lunch and supper) and pudding (only available as a second course at lunch and supper) patient plate waste was visually estimated (%) by the dietitian. Energy and protein from beverages and ONS were not included within three-day dietary histories to allow an assessment of the adequacy of the food first approach. Data was entered into an Excel spreadsheet. The average energy and protein intake and plate waste was determined for three days.

2.3.3 Energy and protein requirements

'Overall choice' and 'overall intake' were compared against the *Digest* nutritional standards (Table 2.1). The target range for energy is 1840-2772kcal and protein 45 (females) – 56g (males) for 'nutritionally well' patients and 1840-2772kcal and 66 – 83g protein for 'nutritionally vulnerable' patients. The *Digest* beverages should provide 184kcal and 14 g protein for 'nutritionally well' and 264kcal and 13g protein for 'nutritionally vulnerable.' Total daily energy and protein intake targets set by the '*The Digest*' were adjusted accordingly to account for inability of a dietitian to record beverage intake. 'Nutritionally well' patients should be aiming for 1656 - 2588kcal and 31 (females) – 42g (males) protein and 'nutritionally vulnerable' 1576 – 2508kcal and 53 – 70g protein. Overall, intake was considered adequate if it met 100% of the *Digest Standards.*

2.3.4 ONS consumption

In February 2022, it became mandatory at QMC for all patients with neck of femur hip fractures to be prescribed the ONS Fortisip Compact Protein twice daily, unless contraindicated. Between February and March 2022 Fortisip Compact Protein bottles were collected by one dietitian from patients' bedsides before usual disposal by ward staff. Fortisip Compact Protein bottles visible on the ward were collected at sporadic intervals. The remaining liquid (ml) in the bottles was weighed to the nearest 0.00g on a set of calibrated digital scales. Data was entered into an Excel spreadsheet and average consumption and waste calculated.

2.3.5 Ward level food waste

At the end of lunch and supper food waste from the food trolley and the patient's plates were collected in separate bin bags by the kitchen staff. The bags of food waste were then weighed to the nearest 0.00kg on set of calibrated scales. Data was entered into an Excel spreadsheet to determine the average waste.

2.3.6 Statistical analysis

Anonymised data was analysed using SPSS version 17.0. Descriptive statistics in terms of means and standard deviations were used to describe the demographic and medical characteristics of the participants.

Unpaired *t tests* were used to determine any significant differences between the energy and protein content of nutritional standards and 'overall intake' and 'overall choice,' and between nutritionally vulnerable and nutritionally well for 'overall intake' and 'overall choice.' Unpaired *t tests* were also used to determine differences between mealtime weighed food waste. Plate waste at each meal was analysed using one way ANOVA.

2.4 Results

2.4.1 Demographics

Three-day dietary histories were collected from 19 different older T&O patients. Patients were approximately equally divided by gender, with a slight majority of male participants (*n* = 10 males, 52.6%). The mean age was 84 ± 9.0 years (range 70 -98 years). The average length of stay was 27 ± 16.3 days (range 7 – 62 days).

The ethnicity was available for 78.9% (*n* = 15), of which 100% were White British.

The majority (*n*=10, 52.6%) had an Abbreviated Mental Test 4 Score of 4, followed by 0 and 2 (*n* = 3, 15.8%), 1 (*n* = 2, 10.5%) and 3 (*n* = 1, 5.3%). 15.8% (*n* = 3) had a documented dementia diagnosis.

The most common fracture was to the neck of femur (*n* = 13, 68.4%). Other fractures included wrist and shoulder (*n* = 1, 5.3%), trochanter (*n* = 1, 5.3%), radius (*n* = 1, 5.3%), ankle (*n* = 1, 5.3%), and tibia/fibular (*n* = 1, 5.3%). One patient was admitted due to dislocated hip rather than fracture. A CFS was available for 78.9% (*n* = 15). Forty percent (*n* = 6) had a score of 5, 33% (*n* = 5) a score of 6, 13% (*n* = 2) a score of 4, and 7% (*n* = 1) had a score of 2 and 7.

2.4.2 All-cause mortality

Two nutritionally vulnerable patients (10.5%) died in hospital. A further four patients (21.1%) died within three months of initial admission of which three were nutritionally vulnerable and one nutritionally well.

2.4.3 Anthropometry

An initial weight was available in 73.7% (*n* = 14) patients, which was estimated for the majority (*n* = 13, 92.9%). The remaining patients (*n* = 5) had a MUAC. The average weight was 67.1 ± 22.9 kg (range 34 – 128kg). The mean BMI for patients who had a weight was 23.8 ± 5.9 kg/m^2 (range 15.11 – 39.5 kg/m^2). Forty percent (*n* = 2) had a MUAC < 23.5cm suggesting a BMI is likely < 20kg/m^2 and 60% (*n* = 4) between 24 – 28cm suggesting BMI is likely between 20 – 30 kg/m^2. Height was estimated in all patients. Average height was 1.67 ± 0.12m (range 1.5 – 1.88m).

2.4.4 Prevalence of malnutrition risk

All patients had 'MUST' completed at least once during their admission. The overall prevalence of malnutrition risk using 'MUST' was 47.3% (*n* = 9) comprising 26.3% (*n* = 5) at medium risk and 21.1% (*n* = 4) at high risk. Assessment of nutritional status using the 'MUST' was completed in 63.2% (*n* = 12) on day one of admission whilst 26.3% (*n* = 5) were assessed on day 2 and 5.2% (*n* = 1) days three and four.

A subsequent MUST before discharge was available in 89.5% (*n* = 17). MUST remained stable in 64.7% (*n* = 11). MUST decreased by a score of one in 17.6% (*n* = 3), of which 66.7% (*n* = 2) were deemed at low risk of malnutrition. MUST increased by a score of one in 11.8% (*n* = 2) and four in 5.9% (*n* = 1) all of which were new incidences of malnutrition risk. The majority of patients were classified as nutritionally vulnerable (73.7%, *n* = 14). Energy and protein from hospital main meals, and snacks (including non-hospital) are shown in Table 3.0. The average nutritional intake for nutritionally well and vulnerable was highest at lunch. The majority of nutritionally vulnerable (*n* = 10, 71.4%) and nutritionally well (*n* = 4, 80%) consumed snacks (e.g. biscuits, cupcake or sweets) on at least one of the three days.

2.4.5 'Overall choice' and the *Digest* standards

Table 2.2 shows the mean energy and protein provision and consumption for nutritionally well and vulnerable patients. There was no significant differences ($p \geq 0.05$) observed for 'overall energy' and 'protein choice' between 'nutritionally well' and 'nutritionally vulnerable.'

Sixty percent (*n* = 3) of 'nutritionally well' met the lower end of the *Digest* energy standards. The higher end of the energy standards was not met. All 'nutritionally well' met protein standards. 'Overall energy choice' was lower ($p \leq 0.05$) than the highest standard and higher ($p \geq 0.05$) than the lowest standard. 'Overall protein choice' for 'nutritionally well' males and females was significantly higher than standards ($p \leq 0.05$).

The lower end of the *Digest* standards for energy was met by 35.7% (*n* = 5) of 'nutritionally vulnerable.' The higher end of the energy standards was not met. The average 'overall protein choice' was within the standard range. The lower end of the protein standards was met by 71.4% (*n* = 10) of which 30% (*n* = 3) met the higher end of the protein standards. 'Overall energy and protein choice' was significantly ($p \leq 0.05$) lower than the higher end of the standards but not significantly ($p \geq 0.05$) higher than the lower end of the standards.

2.4.6 'Overall intake' and *Digest* standards

There was a significant difference ($p \leq 0.05$) observed for 'overall energy' and 'protein intake' between 'nutritionally well' and 'nutritionally vulnerable.'

Sixty percent of 'nutritionally well' patients met the lower end of the energy standards and 100% protein standards. 'Overall energy intake' was lower ($p \leq 0.05$) than the highest standard and higher ($p \geq 0.05$)

than the lowest standard. 'Overall protein intake' for 'nutritionally well' males and females was significantly higher ($p \leq 0.05$) than standards.

No nutritionally vulnerable patient's 'overall intake' met energy or protein standards. 'Overall energy' and 'protein intake' for nutritionally vulnerable patients was significantly lower than standards ($p \leq 0.05$).

Table 2.2: Mean (SD) three day energy (kcal) and protein (g) provision and consumption for nutritionally vulnerable and nutritionally well patients.

Nutritionally vulnerable (*n* = 14)						
	Overall choice		**Overall intake**		**Waste (%)**	
	Energy (kcal)	**Protein (g)**	**Energy (kcal)**	**Protein (g)**	**Main meals**	**Puddings**
Breakfast	186.4 (94)	5.8 (2.9)	117.6 (72.0)	3.72 (2.6)	36.0 (38.4)	n/a
Lunch	696.1 (213.7)	28.2 (10.0)	293.7 (206.2)	13.1 (9.0)	54.4 (25.5)	47.6 (32.3)
Supper	486.6 (138.5)	21.5 (6.9)	200.8 (163.7)	7.7 (6.4)	69.1 (28.4)	29.5 (39.9)
Snacks	131.9 (155.7)	1.4 (1.5)	31.3 (44.7)	0.2 (0.36)	n/a	n/a
Total	1501.0 (341.9)	56.9 (13.3)	643.4 (353.6)	24.8 (14.0)	53.1 (26.6)	38.6 (32.2)
Nutritionally well (*n* = 5)						
	Overall choice		**Overall intake**		**Waste (%)**	
	Energy (kcal)	**Protein (g)**	**Energy (kcal)**	**Protein (g)**	**Main meals**	**Puddings**
Breakfast	217.8 (145.7)	5.8 (3.4)	179.3 (123.9)	4.9 (3.1)	6.7 (8.2)	n/a
Lunch	766.4 (90.4)	33.4 (5.8)	743 (84.3)	32.9 (6.7)	2.6 (5.2)	3.4 (6.8)
Supper	576.2 (61.8)	28 (5.4)	560.4 (69.4)	27.2 (5.8)	3 (6)	0
Snacks	109.5 (97.7)	0.8 (0.6)	109.5 (97.7)	0.8 (0.6)	n/a	n/a
Total	1669.9 (288)	67.9 (6.2)	1592.1 (257.0)	65.7 (8.5)	4.1 (5.8)	1.7 (3.4)
Nutritionally well + Nutritionally vulnerable (*n* = 19)						
Total	1545.4 (322)	59.8 (12.6)	893 (533)	35.6 (33.8)	40.2 (42.3)	28.9 (30.4)

2.4.7 Plate waste

The average plate waste (%) is shown in Table 2.2. 'Nutritionally vulnerable' on average had a higher plate waste across all meals than 'nutritionally well' ($p \leq 0.05$). Plate waste was greatest at main meals compared to puddings for both patient groups. 'Nutritionally well' wasted 4.1% of main meals and 1.7% of puddings, whilst 'nutritionally vulnerable' patients wasted over 50% of their main meals and over 33% of their puddings. On average main meal plate waste was greater than pudding waste in 'nutritionally well' ($p \geq$

0.05) and 'nutritionally vulnerable' ($p \leq 0.05$). Main meal plate waste was greatest at breakfast for 'nutritionally well' ($p \geq 0.05$) and supper for 'nutritionally vulnerable' ($p \leq 0.05$).

2.4.8 Ward waste

Food waste was measured over five days. The average weighed waste is shown in Table 2.3. There was no significant difference ($p \geq 0.05$) between main meals for patient waste and food trolley waste, or between food trolley waste and patient waste. The total waste from lunch and supper can be extrapolated to 86.8kg a week or 4526kg a year (4.5 Tonnes).

Table 2.3: Mean (SD) ward waste (kg) from the patients and food trolley at lunch and supper

Meal time	Ward patient waste (kg) (SD)	Food trolley waste (kg) (SD)	Total waste (kg) (SD)
Lunch	3.2 (1.3)	3.7 (0.8)	6.9
Supper	3.0 (1.0)	2.5 (0.4)	5.5
Total	6.2 (1.2)	6.2 (0.9)	12.4

2.4.9 ONS compliance

Thirty-three Fortisip Compact Protein bottles were collected from 11 neck of femur fracture patients. Compliance was 28.3 (38.8)% (i.e. the quantity consumed as a proportion of the quantity provided). This equates to 84.9kcal and 5.1g protein per supplement. Under one third, 27.3% (nine), of the supplement drinks had less than 50% of the supplement drink leftover, whilst the remaining supplements had more than half left, of which 79% (19 bottles) had 100% supplement drink left. Five (15.2%) of the all supplement drinks had been fully consumed.

2.5 Discussion

This service evaluation project investigated whether older T&O patients meet BDA nutrient standards and are compliant to ONS, as well as exploring the ward's food waste. To our knowledge this is the first observational study exploring three-day dietary intakes specifically in older T&O patients and food waste these patients.

Although, hospital menus have been developed and analysed to meet BDA standards food provision does not suffice all T&O patients. The results obtained demonstrate 'nutritionally well' are likely able to meet the adjusted daily energy and protein nutrient standards only through the meals provided and supplemented with additional snacks. This is in contrast to 'nutritionally vulnerable'. All 'nutritionally well' patients met daily protein standards however, as provision from 'overall choice' was lower than standards

for 40%, 'overall intake' was consequently lower. Food provision met energy for 71.4% and protein for 100% of 'nutritionally vulnerable', but no patient consumed enough to meet nutritional standards. Current food provision strategies and systems need to be re-evaluated as not all patients are able to meet their nutritional needs even if provided with sufficient food.

The percentage of patients meeting standards through dietary intake in this study was considerably higher for 'nutritionally well' and lower for 'nutritionally vulnerable' than previously reported. Previous studies have reported between 14.8% (Pullen et al., 2017) to 36% (Beavan et al., 2018) and 28.4% (Pullen et al., 2017) to 63% (Beavan et al., 2018) 'nutritionally well' meeting energy and protein standards respectively, and 8.3% (Pullen et al., 2017) to 60% (Beavan et al., 2018) and 16.7% (Pullen et al., 2017) to 70% (Beavan et al., 2018) 'nutritionally vulnerable' meeting energy and protein standards respectively. In these studies above, age ranged between 22 – 98 years, data was collected from 24 – 25 inpatients wards and inclusion criteria was stricter (e.g. patients excluded if they did not order three hospital meals, or were receiving therapeutic diets). The differences in the results of these studies could account for observed differences towards percentage of patients that met recommendations. Additionally, 'nutritional vulnerable' were defined by a low MUST only. As per BDA definition, appetite, quantity of food consumed and disease state should be considered. Exclusion of these criteria may have resulted in lower observed dietary intakes for 'nutritionally well' as 'nutritionally vulnerable' patients may have been miscategorised as 'nutritionally well'.

In this study population, the average daily energy and protein intake from food for all T&O patients was 893kcal and 35.6g (excluding ONS) respectively. This is slightly higher than previously reported energy intakes of 714kcal in older T&O patients (Taib et al., 2021). Where both energy and protein intake has been recorded, geriatric orthopaedic rehabilitation patients had mean averages of approximately 900kcal and 30g protein per day. However, these intakes include contribution by ONS limiting comparability to the present study (Rosenberger et al., 2019).

Low protein intakes at meals are not adequate to stimulate MPS. Older adults need to consume 25-30g of protein at each of their three meals a day to stimulate MPS (Mamerow et al., 2014; Paddon-Jones and Leidy, 2014 and Thalacker-Mercer and Drummond, 2014 and Deutz, and Wolfe, 2013). In older T&O inpatients normal limb function and mobility is disrupted. The associated decline in inactivity induces rapid loss of muscle mass (MPS < MPB) (Howard et al., 2020). Poor muscle reserves have profound negative impacts for a patient including increased mortality (Iida et al., 2021).

Mean plate waste has previously been reported at approximately 25% in a study of geriatric orthopaedic patients on rehabilitation wards (Bannerman et al., 2016). This current study reports higher plate waste; 40% and 29% at main meals and puddings respectively. There are many reasons why plate waste in hospitals is higher than other settings. Low appetite has been found to account for 40% of all patients' reasons for leaving food (Hong and Kirk, 1995). Lower findings from the previous study could be

attributed by choice to exclude patients on a texture-modified diet of whom plate waste tends to be higher (Razalli et al., 2021). Hospital plate waste is associated with reduced nutritional intakes.

Of concern was the fact that no nutritionally vulnerable patients met energy or protein standards despite sufficient provision. Older T&O patients, specifically hip fracture patients, are at risk of decline in muscle mass and function secondary to the combination of increased inflammatory burden and muscle disuse (Chen et al., 2014). Meeting energy and protein requirements is critical to ensure maintenance of muscle integrity, good wound healing and improved rehabilitation. The reasons for poor hospital dietary intake were not explored in this service evaluation. Qualitative research is warranted to explore factors impacting food choices and dietary intake in hospital.

For older patients who have poorer appetites, overly large portion sizes are reported as a problem in several studies; however, there are challenges faced with meeting nutritional requirements by reducing portion sizes. Increasing meal frequency with smaller meals does not increase food intakes in older patients (Dunne and Dahl, 2008). Food fortification is recommended by NICE may help to overcome this barrier (NICE, 2006). Food fortification involves increasing the energy density of existing meals by adding energy-rich foods (e.g. adding cream and butter to soups). At NUH NHS Trust meals are not fortified. The feasibility and acceptability of food fortification should be explored more widely among hospitals catering divisions, including NUH NHS Trust, as research has shown food fortification to significantly increase energy intakes (Pritchard et al., 2014) and decrease plate waste in hospitals (Allison et al., 2000). It is also possible that there is a lack of nutritional guidance for food choice, specifically 'nutritionally vulnerable', and patients are quite simply not always offered full choice available (Naithani et al., 2008). It is the responsibility for all health care professions to facilitate patients with respect to making appropriate food choices. To enable this, staff should receive dietetic-led training and hospital food and drink care plans specific to patient group.

ONS are widely recommended for supporting those who are malnourished or at risk of malnutrition. Patients need to comply with ONS to have the desired effects. ESPEN recommend ONS offered to a malnourished older person to provide at least 400kcal/day including 30g or more protein/day (Volkert et al., 2019). This study demonstrated that compliance to ONS is low, 28% (85kcal, 5g protein per supplement), which is consistent with previously published results in older adults in hospital (Gosney, 2003 and Lawson et al., 2000). In this service evaluation only one supplement style was collected (milkshake) as this is routine prescription for hip fracture patients at NUH NHS Trust. As personal choice can improve compliance the comparability of these findings have limited application to other supplement styles (e.g. to yogurt-style, Juice-style, mousse-style) (Norris, 2012).

Collecting dietary intake data in the hospital environment can be challenging. This study observed dietary intake at main meals and specific time points in between meals over three days for each patient. Three-day dietary histories provides greater insight of typical dietary intake in hospital than 24 hour recalls. Dietary provision from beverages were not recorded due to limited capacity of the study team. Energy and protein rich beverages such as milk, Horlicks and hot chocolate may have been offered to patients to increase

overall dietary intake. Ideally, patients would have been observed constantly over the day to capture all food and drink items consumed. Additionally, plate waste and food intake were based on visual estimations and recorded as percentage rather than weight. Visual estimations methods introduce problem of subjectivity into the assessment, although, inter-observer reliability was reduced as data was collected by the research dietitian only. Weight by measure may be considered a more accurate measure of intake and waste. Visual estimation by dietitians have been highly correlated with weighed food intake (Kawasaki et al., 2016) but limits of agreements have been found to be wide. There are still some inaccuracies with visual estimation that can reduce the statistical significance. Digital photography to record dietary intake and food waste may be a more appropriate and accurate method allowing unrushed estimates to be made later and could be considered in future studies (Winzer, Luger and Schindler, 2018). Additionally, comparing nutritional intake against individual requirements in addition to *Digest* standards would have provided a more thorough and valid assessment of the nutritional adequacy of older T&O patients.

2.6 Conclusion

This service evaluation project supports findings of other studies that energy and protein intake in older T&O patients in hospital is inadequate. High levels of plate waste highlight that more action is required to support adequate intake and reduce the environmental burden. ONS are used to provide additional nutrients however, on average less than a third of the bottle is consumed. Further studies are urgently needed to investigate the effectiveness of targeted interventions including alternative forms of ONS to support dietary intakes, particularly for elderly rehabilitation patients.

2.7 Improving NUH food provision service

The majority of patients had hip fractures. Low dietary intake data was shared with the Acute Adult Dietetic Team and T&O staff. Subsequently, this helped to trigger the development of the Femoral Fragility fracture Nutritional pathway in February 2022 whereby all patients with Femoral fragility fractures are prescribed ONS as part of routine care to improve overall energy and protein intake (explained in study 3). ONS compliance data was collected in March 2022 after the implementation of the Femoral Fragility fracture Nutritional pathway. Compliance to ONS was highlighted to be low. These findings lead to innovation of a high protein, fortified ice cream to see if this would improve dietary intakes in patients with femoral fragility fractures. Additionally, multiple education sessions were delivered across Spring 2022 to T&O Nursing staff by myself and the dietetics department sharing and addressing these issues as well as providing practical solutions. During the study I reported any suggestions on how to improve the catering service received from the ward staff to the chief dietetic and catering technician so that they could be taken forward to the "Nutrition Strategy Group". Suggestions included providing a hot pudding at dinner, not only at lunch, and developing a visual menu for patients with dementia. Finally, a copy of this report will be shared with the chief dietetic and catering technician

who is involved in menu development and oversees food waste at NUH. A meeting can then be arranged on how to reduce food waste (e.g. enhancing meals with additional energy through food fortification).

2.8 Post-study reflection

This is the first time I have observed the whole duration of all meal times. The experience has been eye opening. The NHS are clearly understaffed and this is having a significant negative impact to patients. There are not enough staff to help those who require mealtime assistance meaning patients are missing out on vital energy and protein to help with recovery. Supper felt especially rushed as for some patients their meal was taken away before they had a chance to finish it or have the opportunity to start it, it appeared kitchen staff were keen to get their job finished with. The experience has also made me reflect on my own dietetic practice when interpreting food charts and the importance of detail. There was one case where the food chart stated a 'nutritionally vulnerable' patient managed "75% main meal" and "all pudding," rather than detailing individual food components. Complete meal targets should have provided the nutritionally vulnerable patient with a minimum of 800kcal and 25g protein. In fact the patient was only having two scoops of mash potato (188kcal,1.1 g) and one ice cream (51kcal, 1g).

The main challenges faced was with data collection of ONS and weighed food waste. For patients prescribed ONS I left yellow boxes with instructions on for the ONS to be placed in before disposal so that I was able to weigh what was left over at the end of the day and monitor weekend compliance. I also communicated this with to the ward manager and ward staff. However, the majority of the time I would return to the ward to find either the boxes had been binned, the ONS not in the boxes or the boxes used for storage of other items (e.g. face wipes, tissue paper, food). To overcome these challenges I could have asked the patient, if able, to record their own compliance to ONS. Secondly, patient plate waste and food waste from the food trolley is usually collected in the same bin bag. For the purpose of the study, I asked the kitchen staff to dispose of the patient plate waste and food trolley waste in different bin bags to enable me to weigh them separately. Unfortunately, on multiple occasions this was not adhered to, especially at the end of the day when some of the kitchen staff were rushing to leave. Additionally, sometimes the waste bags were collected for disposal before I had a chance to weigh them.

If this study was to be repeated, I would suggest aiming to record energy and protein intake from beverage as well. It was not feasible to be for myself to be on the ward from when the patient woke up until when they went to bed. Ideally, a larger study team would be required to help collect data and divide out workload. Additionally, to determine the accuracy of my estimates of energy and protein consumed by a patient I would have ideally weighed the food components at the start and end of the meal to work out exact proportions and done this in a small sample of patients.

2.9 Conflicts of interest

Author declares no conflict of interest

2.10 References

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Chapter 3:
The N-ICE CREAM study

Comparison of the taste and acceptability of a new ice cream based nutritional supplement (Nottingham-Ice cream) with standard hospital milkshake oral nutritional supplement in older people in hospital who have suffered a broken bone

Aims: To design and conduct a study:

- To evaluate the acceptability of using Nottingham-Ice cream (N-ICE CREAM) with standard ONS; Fortisip Compact Protein in patients with fractures requiring ONS as part of routine care.
- To determine whether N-ICE CREAM could be use in the nutritional pathway for older people who present to hospital with a hip fracture or spine fracture requiring ONS as part of routine care.

Hypothesis:

N-ICE CREAM will be just 'as accepted,' if not more accepted than the milkshake ONS.

Primary objectives

- To determine the patient's acceptability to N-ICE CREAM and the milkshake ONS.
- To determine the most preferred product.

Secondary objectives

- To determine the compliance to milkshake ONS and N-ICE CREAM.
- To assess the patients attitudes towards milkshake ONS and N-ICE CREAM.
- To investigate the feasibility of having N-ICE CREAM at home.

3.1 Abstract

Introduction: Older patients with hip or spine fractures are extremely frail and clinically complex vulnerable to malnutrition. Prescription of oral nutritional supplements (ONS) as part of routine care at NUH NHS Trust is recommended for these patients to improve dietary intake. Unfortunately, compliance to ONS is often low. There is promising but limited research exploring the potential of ice cream as a nutritional intervention. The purpose of this study was to compare the acceptability of new high protein, fortified, ice cream called Nottingham-Ice Cream (N-ICE CREAM) with standard ONS.

Methods: A single centre randomised controlled crossover trial was conducted. Fifty older (≥ 65 years) patients with hip or spine fractures, at low or medium risk of malnutrition and requiring ONS as routine care, recruited from the trauma and orthopaedics (T&O) ward were included. Patients received both two days worth of N-ICE CREAM and the milkshake ONS but in different orders; Group A, N-ICE CREAM first; Group B, milkshake ONS first. Compliance was recorded. Acceptability (hedonic characteristics), attitudes and preferability of each product was measured using questionnaires.

Results: Mean (standard deviation, SD) age of the patients was 80.6 (7.7) (82% female and 18% male), with the most common injury hip fracture (96%). From the responses recorded the majority (n = 21, 67.7%) preferred N-ICE CREAM. Mean compliance to N-ICE CREAM was greater in both Groups (Group A (n = 22) 69.9 (30.0) % and Group B (n = 26) 56.3 (39.3)%) compared to the milkshake ONS (Group A (n = 22) 43.4 (4.7) % and Group B (n = 26) 53.6 ± (40.2) %). This was only of statistical significance in Group A ($p < 0.05$). Mean hedonic ratings (1 = dislike a lot to 7 = like a lot) for all characteristics were higher for N-ICE CREAM with an overall impression score of 5.8 compared with 4.6 for the milkshake ONS. Confidence in consuming both products decreased with increasing length of time. Both had an overall confidence score of 2.9 (1 = very unconfident to 5 = very confident).

Conclusions: N-ICE CREAM is more accepted and preferred by older patients with a hip or spine fracture compared to standard milkshake ONS. N-ICE CREAM presents as a promising alternative/option for patients in the nutritional management of hip and spine fractures. Further, research is needed to explore the most suitable time for N-ICE CREAM administration and long-term compliance, as well as clinical outcomes.

3.2 Introduction

Falls and fragility fracture are a common and serious health issue faced by older adults (Public Health England, 2019). Older adults admitted to hospital with fragility fractures represent over four million hospital bed days per annum in England alone (Tremi et al., 2010) incurring a cost of £4.4 billion annually to the UK (NICE, 2018). Older adults who have a fragility fracture are often extremely frail, clinically complex and vulnerable to malnutrition (Murphy et al., 2000). Fragility fractures are highly prevalent in the bones of the spine (vertebrae), hip (proximal femur) and wrist (distal radius) (NICE, 2012). Hip fractures are the leading cause of accident-related mortality in older people, with 70,000 to 75 000 hip fractures occurring annually (NICE, 2016) and 63% of these patients malnourished on hospital admission (Riemen and Hutchison, 2016). Mortality rate is high in older patients with hip fractures; approximately 10% die within one month and a third within twelve months (NICE, 2011). Demographic projections reveal UK annual incidence of fragility fractures will rise with respect to an ageing population (NICE, 2016). The increasing number of fragility fractures depict a considerable and significant pressure on patients, carers and hospital services.

Nutritional status is likely to deteriorate following a fracture requiring hospital admission due to a reduction in dietary intake, increased resting energy expenditure and increased requirements for protein and micronutrients, related to bone repair, physiotherapy and surgery wound healing (Laur, McCullough, and Keller, 2015). Specifically the catabolic response to a hip fracture can last up to three months post-surgery (Paillaud et al., 2000). Adequate nutrition is imperative in this period in improving post fracture recovery, optimising function, improving health outcomes and preventing subsequent fractures. Unfortunately, dietary intake is often sub-optimal in older adults in hospital with fractures. Protein recommendations are not met by patients in hospital with hip fracture (Hoekstra et al., 2011; Botella-Carretero et al., 2010 and Pedersen, 2005) and hospitalised older patients in general (Weijzeb et al., 2020 and Scheutz et al., 2019). Unpublished findings from NUH NHS Trust have reported the average three-day dietary intake for nineteen older trauma and orthopaedic (T&O) patients at 893kcal of energy and 36g protein. The European Society for Clinical Nutrition and Metabolism (ESPEN) recommend protein intakes of ≥1.5 g/kg/day for patients with severe injury and 1.2-1.5 g/kg/day for patients at risk of malnutrition due to chronic conditions (e.g. frailty) (Deutz et al., 2014). An older female weighing 60kg with a hip fracture therefore may have protein requirements of 90g a day. Evidently, this patient group does not suffice nutritional requirements despite malnutrition a strong independent risk factor for recurrent fractures. Diminished muscle mass and strength associated with malnutrition contributes towards functional decline, disability, frailty, falls and increases mortality (Xu et al., 2022). Only a minority of patients with hip fractures will completely regain their previous abilities (Royal College of Physicians, 2019). Loss of independence in activities of daily living including walking and shopping as result of functional decline leads to older adults requiring long-term care after hip fracture and decreased QoL (Amarilla-Donoso et al., 2020).

Dietary counselling, mealtime assistance, food fortification, texture modified meals/drinks and prescription of oral nutritional supplements (ONS) contribute towards the management of malnutrition (Raynaud-Simon, Revel-Delhom and Hebuterne, 2010 and Volkert et al 2006). The aim of ONS's are to increase dietary intake when diet alone is unable to meet daily nutritional requirements. There are many ONS styles (milkshake, juice, yogurt, smoothie, mousse, soup), formats (liquid, powder, pudding, pre-thickened) volumes, energy densities and flavours available. Benefits of consuming ONS include increasing overall energy and protein intake, improvements in long-term functional status and decreased postoperative complications, hospital stay and healthcare costs (Travers et al., 2018 and Stratton, Green and Elia, 2003). Habitually reported poor dietary intake in hip fracture patients has been acknowledged by ESPEN who in May 2018 recommended, "older patients with hip fracture shall be offered ONS postoperatively." This is regardless of nutritional status (Volkert et al., 2019). In February 2022, this recommendation became integrated into routine care NUH NHS Trust and was extended to the management of spinal fractures due poor dietary intakes in these patients . As part routine care, older patients with femoral fragility fractures and vertebrae fractures are prescribed a milkshake-style ONS called Fortisip Compact Protein (FSCP) twice a day to provide an additional 600kcal and 36g protein a day. Good adherence is a primary determinant of the effectiveness of ONS (Lester et al., 2022). However, this presents as a significant challenge in older people. Compliance to ONS has been reported at 37% in heterogeneous groups of older adult patients (Gosney, 2003) and at 14.9% in older orthopaedic patients (Lawson et al., 2000). Specific to NUH NHS Trust, compliance to ONS in older patients with femoral fragility fractures is 28%. Taste, flavour and texture are key influences of ONS compliance; poor flavours and overt sweetness have been reported as reasons for dislike of ONS. Approximately, 56% of older patients prescribed ONS do not like them of which 25% disliked the taste (Gosney 2003). There is a need for an ONS which patients enjoy and are easy for them to of which ice cream has strong possibility of accomplishing.

Ice cream presents as a unique approach to improve dietary intake. The administration of ice cream in the acute setting is a highly empirical practice, for instance at QMC 35% (n=36) and 43% (n=47) inpatients from one T&O ward ordered ice cream at lunch and dinner respectively over four days. There are over 140 ONS available in the UK market but none ice cream style. There is promising but limited research exploring the potential of ice cream as a nutritional intervention. Ice cream has proven successful in improving QoL (Casas et al., 2012) and shown favourable among oncological patients with 88% reporting they would rather eat ice cream that conventional nutritional supplements (Wright, Marks and McDougall 2008). Unfortunately, standard ice cream available on the market including hospitals ice cream is low in energy and protein (e.g. at NUH NHS Trust one serving of ice cream contains 51kcal and 1g protein).

This study builds upon a previous ice cream service improvement project conducted at NUH NHS Trust, whereby ortho-geriatric patients showed an increase in energy intake by 41% for those consuming a high energy and protein ice cream (Taib et al., 2021). The ice cream used in the previous trial was a different

recipe. Nottingham-Ice cream (N-ICE CREAM) used in the present study was made at a local dairy farm and is a new recipe.

N-ICE CREAM; a vanilla flavoured ice cream fortified with vitamin D and leucine. N-ICE CREAM was developed under strict conditions at a local dairy cow farm; the DreamyCow Farmhouse, and by personnel with appropriate food safety qualifications. The DreamyCow have been producing and supplying their own ice cream since 2007 to local businesses. The Research dietitian (aka myself) was involved in the initial and final development of N-ICE CREAM. The primary stages of the product development involved adding different quantities of whey protein and leucine to the DreamyCow's vanilla base mix. An informal taste test these different samples were then trialled amongst the HCOP Research team and T&O ward staff. An agreement was then made on which whey protein and leucine content to use for final development based on taste. Tubs of NICE CREAM (approximately 80g) were transported in a temperature controlled van from the DreamyCow Farmhouse production site to NUH NHS Trust, QMC Campus. N-ICE CREAM was then transferred to the HCOP Research freezer and stored under strict regulated food conditions.

No study has compared the use of an ice cream based ONS with routinely prescribed hospital nutritional supplements in older patients with hip or spine fractures.

The hypothesis investigated in this study was that an ice cream based nutritional supplement called Nottingham-Ice Cream (N-ICE CREAM) would be just 'accepted,' if not more accepted than standard ONS (Fortisip Compact Protein) in older adults admitted to hospital with femoral fragility fractures or vertebrae fractures. This study aimed to assess the acceptability of using N-ICE CREAM in hospital setting.

3.3 Methods

3.3.1 Study design

The N-ICE CREAM study was single-centre and of a randomised, controlled crossover design.

Ethical approval was granted by Harrow Research Ethics Committee (REC) and all amendments were also approved. Written informed consent was gained from all patients or agreement was sought from their designated representatives. The study was undertaken as part of a MRes programme at the University of Nottingham. The study was conducted in accordance with Good Clinical Practice principles and was sponsored by NUH NHS Trust.

3.3.2. Study population

Older adults (≥ 65 years) admitted to QMC, Nottingham with fractures requiring ONS as routine care during admission only were recruited. Exclusion criteria were as follows: < 65 years old, length of stay < 4 days, scheduled for total parenteral nutrition or tube feeding, MUST Score ≥ 2, clinically unstable (e.g. in terminal condition/end of life situation), swallowing difficulties, medical of dietary contraindication to any

feed ingredients (e.g. with known allergies or intolerance to any ingredients in N-ICE CREAM or FSCP), significant renal impairment (chronic kidney injury stages three or four), any contraindication against nutritional therapy (includes paralytic ileus< inborn errors of metabolism of nutrients contained in N-ICE CREAM or FSCP), and could not give informed consent.

3.3.3. Study protocol

Patients were screened for eligibility on weekday mornings by a member of the Health Care of Older People (HCOP) Research team.

Study numbers were assigned to consenting patients and an online computer system called 'Sealed Envelopes' was used to randomly allocate patients into one of two groups in a 1:1 ratio:

- Group A received one tub of N-ICE CREAM twice a day (one 80g tub comprising 155kcal, 15.4 g protein) for two days, and then crossed over to one milkshake supplement twice a day (one bottle comprising 125ml, 300kcal and 18g protein) for two days.
- Group B received milkshake supplement followed by N-ICE CREAM.

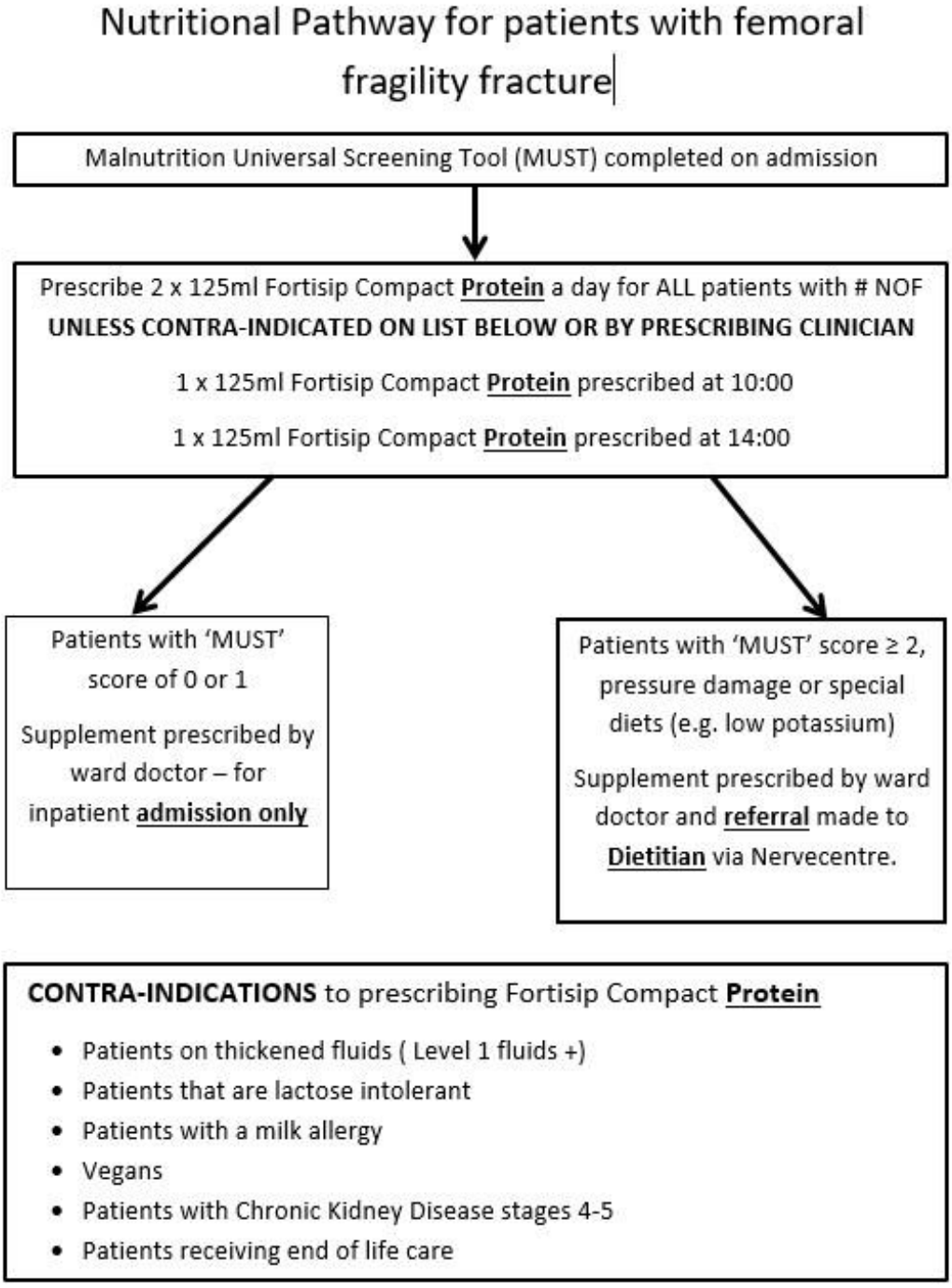
The total intervention time was four days.

Patients were recruited pre-operatively and post-operatively with the trial starting post-operatively. Neither group could be blinded to the intervention. There was no washout period. The HCOP Research team were responsible for administering N-ICE CREAM to the patients. For the first two weeks N-ICE CREAM was given at 10am and 2pm however, an amendment was made to the study protocol to allow flexibility in administering N-ICE CREAM at the patients discretion. In the absence of the Research team (e.g. on weekends, or staff illness) the milkshake ONS was given to patients as per hospital protocol (Figure 3.0). The milkshake ONS was administered to the patients by ward nurses and healthcare assistants. Milkshake flavours included vanilla, banana, mocha, strawberry, berries, red fruits and peach-mango.

3.3.4 Nutritional Analysis

Nutritional analysis was completed by Eurofins (Eurofins Scientific, 2021). The nutritional composition of N-ICE CREAM per 100g consisted for 194kcal of energy, 19.2g protein, 23.15g carbohydrates of which 15.3g total sugar and 2.9g total fat. N-ICE CREAM, was fortified with 200 IU Vitamin D, 1.5g Leucine /100g however, this was not analysed due to limited budget.

Figure 3.0: Nottingham University Hospitals Trust Standard Operating Procedure for the nutritional management for patients with femoral fragility fracture



3.3.5 Sample size calculation

A convenience sample size of 50 participants was proposed, based on the time available for the MRes and limited funding for the development of the ice cream. Nether-the-less, sample sizes of between 20 and 30 are recommended sample sizes for a pilot study and thus by recruiting 50 patients (25 crossover in each arm), would allow meaningful quantitative and qualitative data to be collected (Julious, 2005 and Kieser and Wassmer 1996).

The recruitment period occurred between June 2022 to August 2022.

Baseline data from all patients enrolled in the trial were recorded to determine sample characteristics.

The study visits and enrolment were carried out by delegated members of the HCOP Research team.

Primary outcomes

3.3.6 Acceptability assessment

Patients with capacity were asked to complete one questionnaire on acceptability for each product after trying it for two days. The questionnaire was developed by the Research dietitian. Each product was rated for five hedonic characteristics (appearance, smell, taste, aftertaste and texture) and for overall impressions. The questionnaire collected quantitative interval data using a 6-point hedonic scale (1= dislike a lot, 2 = dislike moderately, 3 = dislike a little, 5 = like a little, 6 = like moderately, 7 = like a lot) recorded patients' ONS ratings. This scale was modified from the 9-point Natick Hedonic Scale (Peryam and Pigrim, 1957) used frequently in food science to compared different foods. The neutral response option was removed as studies show that inclusion of a neutral option significantly increases the number of people expressing no opinion when they do (Johns 2005 and Krosnick et al., 2001). Qualitative feedback on acceptability from the patient was also recorded.

3.3.7 Preference assessment

Patients who completed both arms of the trial where asked to complete a single closed-ended dichotomous questioned questionnaire asking them to decide whether they preferred N-ICE CREAM or the milkshake ONS. Responses were also recorded from patients lacking capacity as appropriate. The questionnaire was developed by the Research dietitian

Secondary outcomes:

3.3.8 Attitudes assessment

Patients with capacity were asked to complete one questionnaire about their confidence levels towards having each product at least once a day for a period of two, four and twelve weeks, in addition to a question about what the maximum number of servings a day they could manage on a daily basis. The questionnaire

was developed by the Research dietitian. The questionnaire collected quantitative interval data using a 4-point confidence scale (1 = very unconfident, 2 = unconfident, 4 = confident, 5= very confident)

3.3.9 Compliance assessment

Compliance was calculated in either one of three ways: (i) dividing the weighed amount of product left over (g) by the prescribed weight (g) (ii) the patients self-reported consumption of serving (e.g. 0%, 25%, 50%, 75% and 100%) (iii) The ward's staff estimated recall on behalf of the patient.

3.3.10 N-ICE CREAM feasibility questionnaire

After trialling N-ICE CREAM patients were asked to complete one feasibility questionnaire about having N-ICE CREAM at home including freezer use and storage. The questionnaire was developed by the Research dietitian. The questions were closed-ended thus yielded quantitative data.

3.3.11 Statistical analysis

Descriptive statistics in terms of means and standard deviations were used to describe demographic and clinical characteristics of the patients. Anonymised data was analysed using SPSS version 17.0. In SPSS paired samples *t-tests* were completed to compare the differences between N-ICE CREAM compliance and milkshake ONS compliance within groups and unpaired *t tests* were used to determine any significant differences between groups. Data were considered statistically significant when $p \leq .05$. Data were securely stored and retained by the principle investigator at QMC HCOP Department.

3.4 Results

A total of 226 participants were screened, of whom 54 patients were recruited to the study (Figure 3.1). Reasons for exclusion (n = 172) included not meeting inclusion criteria (n= 148), decline to participate (n=18) and other (n =6). Twenty-seven patients were randomised to Group A and Group B. Four patients were withdrawn from Group A; developed dysphagia (n = 1), MUST reassessed to be too high (n = 1), x-ray confirmation showing no fracture (n =1) and discharged before any intervention started (n=1). Fifty patients were thus included in the baseline demographic and clinical characteristics analysis.

Demographic and clinical characteristics of the patients are shown in Table 3.0. Mean (standard deviation, ±) age was 80.6 ± 7.7 years (range: 68 – 101 years, 82% female and 18% male). The most common fracture in both Groups was neck of femur (Group A; 95.7%, n = 22 and Group B; 96.3%, n = 26). The proportion of patients with low (0) or medium (1) MUST scores was similarly matched between groups; in Group A, 87% (n=20) were at low risk of malnutrition and 13% (n =3) at medium risk of malnutrition, and in Group B, 82.5% (n = 22) were at low risk of malnutrition and 18.5% at medium risk of malnutrition.

Figure 3.1: Patients recruitment flowchart. Modified CONSORT flow diagram

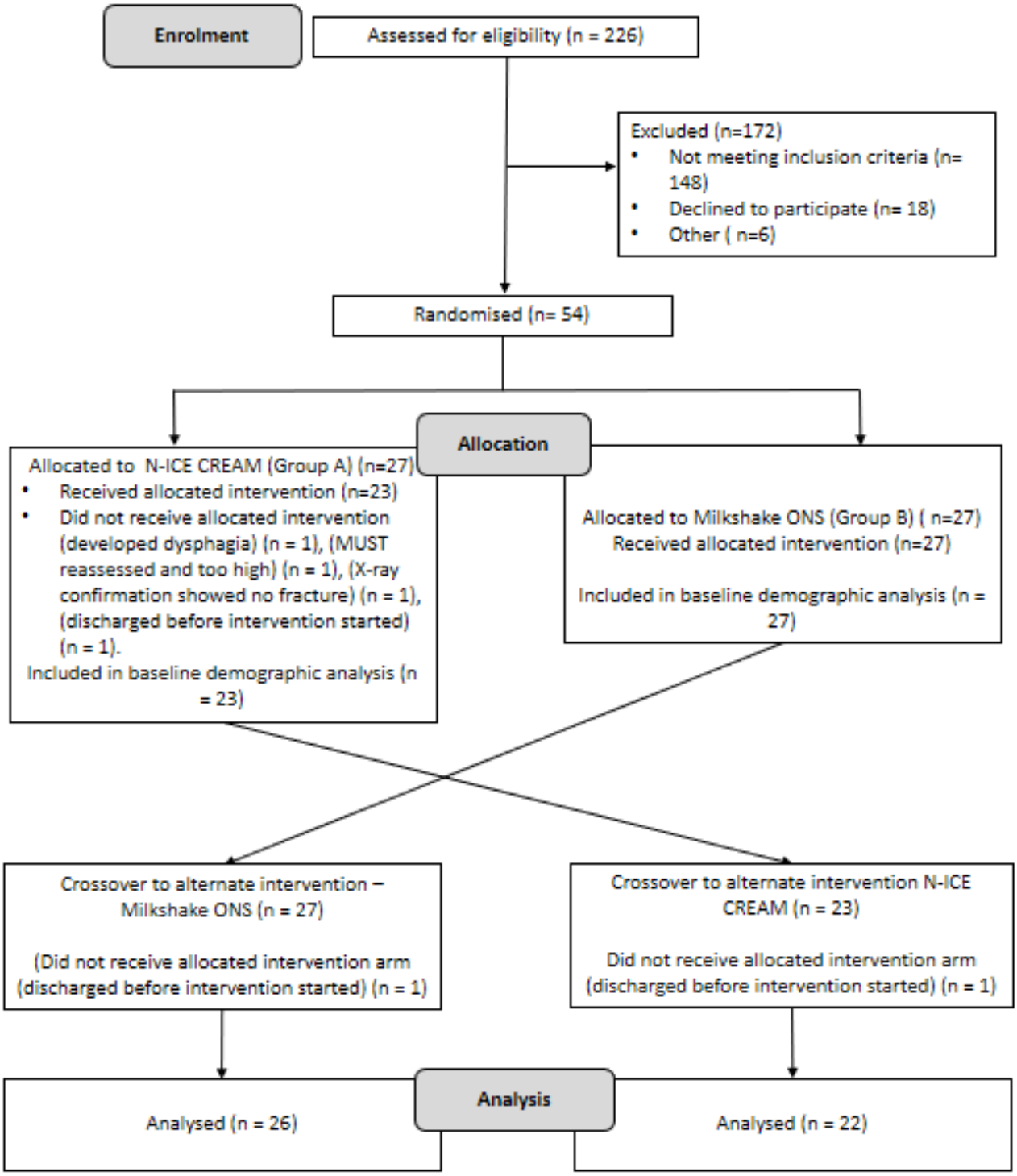


Table 3.0: Demographic and clinical characteristics of the patients included in the study			
	Group A	**Group B**	**Total**
	n =(23)	(n = 27)	(n = 50)
Sex			
Male, n (%)	4 (17.4)	5 (18.5)	9 (18.0)
Female, n (%)	19 (82.6)	22 (81.5)	41 (82.0)
Age, (years), Mean ± SD	80.5 ± 7.9	80.8 ± 7.8	80.6 ± 7.7
Without Capacity, n (%)	6 (26)	5 (18.5)	11 (22.0)
Ethnicity			
White British, n (%)	17 (73.9)	18 (66.7)	35 (70.0)
Any other White Background, n (%)	0 (0.0)	1 (3.7)	1 (2.0)
Unknown, n (%)	6 (26.1)	8 (29.6)	14 (28.0)
Social			
Lives alone (no carers), n (%)	14 (60.9)	12 (44.4)	26 (52.0)
Lives alone with carers, n (%)	1 (4.3)	1 (3.7)	2 (4.0)
Lives with partner, n (%)	5 (21.7)	9 (33.3)	14 (28.0)
Lives with family, n (%)	3 (1.3)	3 (11.1)	6 (12.0)
Nursing home or care home, n (%)	0 (0.0)	2 (7.4)	2 (4.0)
Fracture type			
Neck of femur fracture, n (%)	22 (95.7)	26 (96.3)	48 (96.0)
Fractured C5/C6, n (%)	1 (4.3)	0 (0.0)	1 (2.0)
Periprosthetic hip, n (%)	0 (0.0)	1 (3.7)	1 (2.0)
Clinical Frailty Score			
	(n = 17)	(n = 22)	(n = 39)
1, n (%)	0 (n =0)	4.8 (n =1)	2.6 (n =1)
2, n (%)	5.9 (n =1)	14.3 (n =3)	10.5 (n=4)
3, n (%)	23.5 (n = 4)	28.6 (n=6)	26.3 (n=10)
4, n (%)	35.3 (n =6)	14.3 (n=3)	23.7 (n = 9)
5, n (%)	17.6 (n=3)	28.6 (n=6)	23.7 (n = 9)
6, n (%)	11.8 (n=6)	4.8 (n=1)	18.4 (n = 7)
7, n (%)	5.9 (n =1)	4.8 (n=1)	5.3 (n=2)
Anthropometry			
	(n = 23)	(n = 27)	(n = 50)
Height (cm), Mean ± SD	160.0 ± 0.07	164.7 ± 0.09	162.5 ± 0.09
	(n = 3)	(n = 2)	(n =5)
MUAC (cm) Mean ± SD	25.2 ± 4.1	25.8 ± 0.8	25.4 ± 3.2
BMI (kg/m^2) from MUAC, Mean ± SD	20 - 30	20 - 30	20 - 30
	(n = 20)	(n=25)	(n=45)
Weight (kg), Mean ± SD	61.8 ± 13.4	65.4 ± 13.9	63.8 ± 13.8
BMI (kg/m^2) from weight, Mean ± SD	24.4 ± 4.5	23.9 ± 4.3	24.1 ± 4.4
MUST Score from (n = 50)			
0, n (%)	20 (87.0)	22 (81.5)	42 (84.0)
1, n (%)	3 (13.0)	5 (18.5)	8 (16.0)

SD = standard deviation

3.4.1 Primary outcome

3.4.1.1 Compliance to N-ICE CREAM and the milkshake ONS

Compliance data to N-ICE CREAM and the milkshake ONS is shown in Table 3.1 and Table 3.2. N-ICE CREAM compliance data for Group A was complete; however, for the milkshake ONS compliance data was incomplete for five patients representing seven milkshake ONS bottles. The available data was included in analysis. Reasons for incomplete data included being discharged before finishing the milkshake ONS intervention arm (n=1) and having the milkshake ONS bottles discarded by the ward staff but the patient or staff unable to recall how much had been consumed (n =5). In total data on compliance to 88 tubs of N-ICE CREAM and 81 milkshake ONS bottles was collected. In Group B, compliance data to N-ICE CREAM was missing from seven patients representing 14 N-ICE CREAM tubs. Reasons for incomplete data included transfer to another hospital (n = 2) and discharge from hospital (n = 5) before finishing the N-ICE CREAM intervention arm. Data about the milkshake ONS was missing from two patients whereby the milkshake ONS had been disposed of by the ward staff, representing two bottles of the milkshake ONS. In total data on compliance to 90 tubs of N-ICE CREAM and 102 milkshake ONS was ascertained.

One patient from each group was excluded from final analysis due to only trialling one product. There was no statically significant difference ($p > 0.05$) between mean compliance to N-ICE CREAM between Groups; Group A (n = 22) 69.9 ± 30.0 % and Group B (n = 26) 56.3 ± 39.3% and no statistically significant difference ($p > 0.05$) between mean compliance to the milkshake ONS between groups; Group A (n = 22) 43.4 ± 4.7% and Group B (n = 26) 53.6 ± 40.2%. Patients in Group A consumed statistically significantly more ($p < 0.05$) N-ICE CREAM than the milkshake ONS; however, no statistically significant difference ($p > 0.05$) was detected between N-ICE CREAM and the milkshake ONS compliance in Group B. Compliance percentage ranged from 0% to 100% for both products (Table 3.2). Ten patients (20.8%) consumed all of both N-ICE CREAM and milkshake ONS. A further seven (14.6%) consumed all N-ICE CREAM and six (12.5%) milkshake ONS. A higher proportion (n = 8, 16.7%) of patients did not consume any milkshake ONS compared to N-ICE CREAM (n = 2, 4.2%).

As shown in Table 3.1, on average the milkshake ONS increased energy intake more in both groups. However, this was not significantly greater than the N-ICE CREAM ($p > 0.05$). Group A ingested more protein from the NICE CREAM and Group B from the milkshake ONS; however, neither of statistical significance ($p > 0.05$). Between groups, there were no statistically significant differences ($p > 0.05$) for energy and protein from NICE CREAM and energy and protein from the milkshake ONS.

3.4.1.2 Product preference

From 31 responses recorded 67.7% (n = 21) preferred N-ICE CREAM to milkshake ONS. Two of these responses were recorded from patients with dementia of whom both preferred the N-ICE CREAM**.**

Table 3.1: Mean (± SD) Compliance to and additional mean (± SD) energy and mean (± SD) protein provision from N-ICE CREAM and Milkshake ONS

	N-ICE CREAM			Milkshake ONS		
	Compliance (%)	Additional daily Energy (kcal)	Additional daily Protein (g)	Compliance (%)	Additional daily Energy (kcal)	Additional daily Protein (g)
Group A	69.9 ± 30.0	217 ± 91	21.5 ± 4.5	43.4 ± 4.7	260 ± 256	15.6 ± 15.2
Group B	56.3 ± 39.3	175 ± 122	17.3 ± 6.1	53.6 ± 40.2	322 ± 237	19.3 ±14.2
Overall	62.5 ± 35.7	194 ± 111	19.3 ± 11	49.9 ± 41.5	293 ± 248	17.6 ± 14.8

There was no statistically significant difference ($p > 0.05$) between mean compliance to N-ICE CREAM between Groups. Patients in Group A consumed statistically significantly more ($p < 0.05$) N-ICE CREAM than the milkshake ONS; however, no statistically significant difference ($p > 0.05$) was detected between N-ICE CREAM and the milkshake ONS compliance in Group B.

No statistically significant difference between average additional energy and protein within groups and between groups.

Table 3.2: Mean amount of N-ICE CREAM and milkshake ONS consumed by patients

	N-ICE CREAM		Milkshake ONS	
Amount of product consumed (%)	n	Mean proportion of patients (%)	n	Mean proportion of patients (%)
76 - 100	20	41.7	16	33.3
51 - 75	7	14.6	4	8.4
26 - 50	8	16.7	8	16.6
< 25	13	27.1	20	41.7

3.4.2 Secondary outcomes

3.4.2.1 Acceptability

A total of 144 and 164 ratings were collected across all five hedonic ratings (Figure 3.2) for N-ICE CREAM and the milkshake ONS respectively. From all ratings collected for N-ICE CREAM, 87.5% were positive (7 = like a lot, 6 = like moderately, 5 = like a little) and 12.5% were negative (3 = dislike a little, 2 = dislike moderately, 1 = dislike a lot). For the milkshake ONS, 62.8% were positive and 37.2% negative.

N-ICE CREAM was the most often highly rated for all hedonic characteristics (Table 3.3) thus the overall impression score was greater (5.8 for N-ICE CREAM and 4.6 for the milkshake ONS). The most highly rated hedonic characteristic was texture for N-ICE CREAM (6.1) and appearance for the milkshake ONS (5.7). The lowest rated hedonic characteristic for both was the aftertaste (5.5 for N-ICE CREAM and 3.8 for milkshake ONS).

Taste, the most important factor to affect compliance was rated 5.9 and 4.2 for N-ICE CREAM and milkshake ONS respectively. Almost all hedonic characteristics for both products had mean rating scores greater than four. The only exception was aftertaste for the milkshake ONS (but the overall impression of this product was rated at 4.6).

From a total of 32 responses 87.5% showed a positive attitude towards the taste of N-ICE CREAM (9.4% rated "like a little", 28.1 "like moderately" and 50% "like a lot") and 12.5% a negative attitude (6.3% "dislike a little", 3.1% "dislike moderately" and 3.1% "dislike a lot"). From a total of 34 responses 52.9% showed a positive attitude towards the taste of the milkshake ONS (8.8% "like a little", 20.6% "like moderately" and 24% "like a lot") and 47.1% a negative attitude (11.8% "dislike a little", 11.8% "dislike moderately" and 23.5% "dislike a lot).

Figure 3.2: Hedonic ratings for N-ICE CREAM and Milkshake ONS.

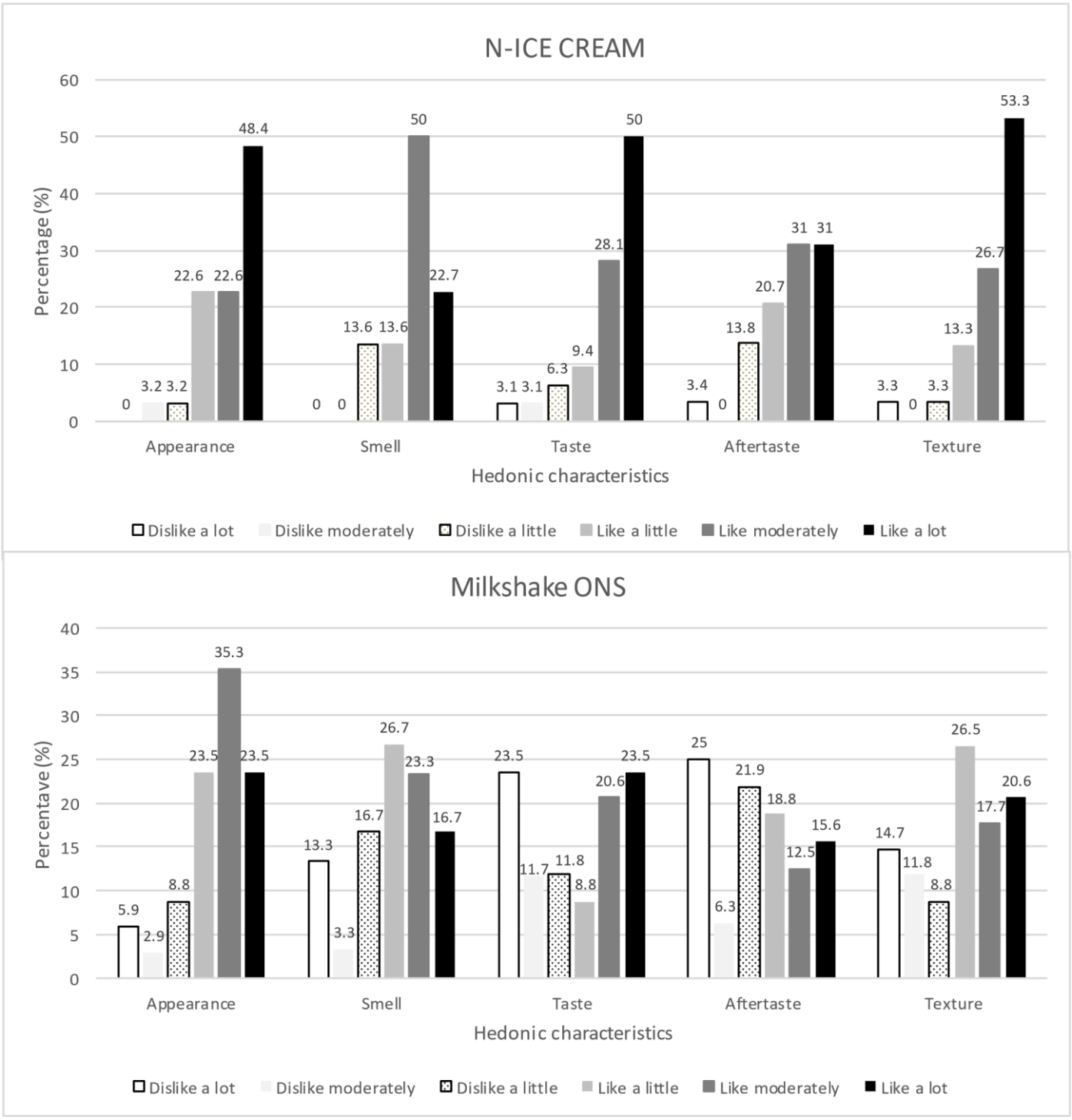


Table: 3.3: Hedonic ratings and overall impression: mean (range).											
Product	N	Appearance	N	Smell	N	Taste	N	Aftertaste	N	Texture	Overall impression
N-ICE CREAM	31	6.0 (2-7)	22	5.7 (3-7)	32	5.9 (1-7)	29	5.5 (1-7)	30	6.13 (1-7)	5.8
Milkshake ONS	34	5.7 (1-7)	30	4.6 (1-7)	43	4.2(1-7)	32	3.8 (1-7)	34	4.5 (1-7)	4.6
Hedonic rating scale: 1 = dislike a lot; 2 = dislike moderately; 3 = dislike a little; 5 = like a little; 6 = like moderately; 7 = like a lot.											

3.4.2.2 Confidence

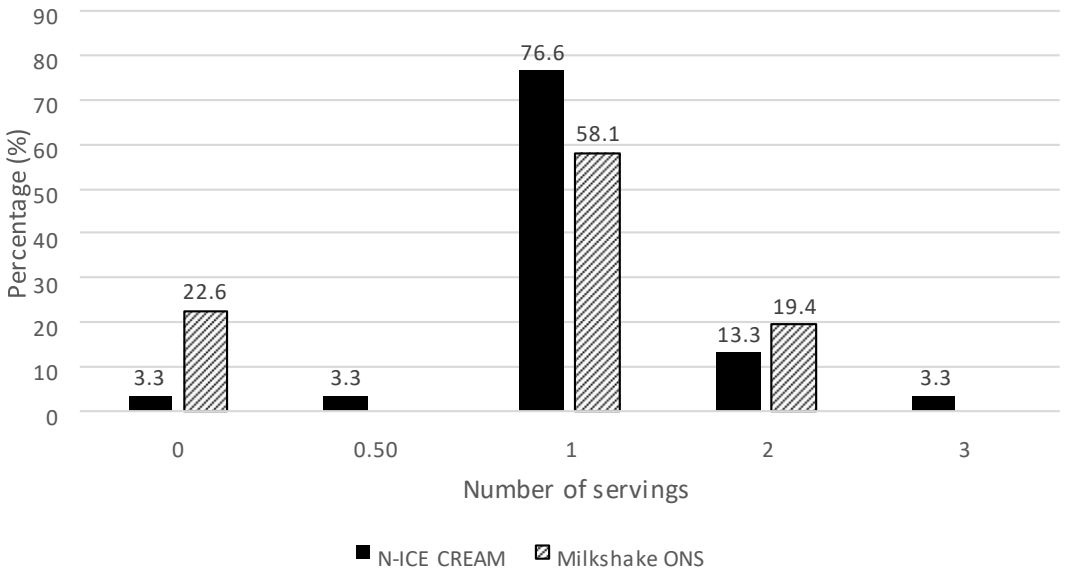
Overall 58.1% (n = 56) and 60.8% (n = 58) responses were negative (very unconfident= 2, unconfident = 1) towards N-ICE CREAM and the milkshake ONS respectively.

A confidence score for each respective time point was calculated (Table 3.4). Almost all confident rating scores were below 3.5 apart from a score of 4 (confident) towards having the milkshake ONS for two weeks. There was a negative correlation between length of time and confidence (i.e. patients felt less confident about having the products for a longer period). Both products had an overall confidence score of 2.9 representing a negative response.

The most commonly reported answer to the maximum number of servings a patient could feel they would be able to consume on a daily basis was one; N-ICE CREAM (76.6%, n = 23) and the milkshake ONS (58.1%, n = 18). Just over one fifth (22.2%) and 3.3% felt that they would not be able to manage any servings a day of milkshake ONS and N-ICE CREAM respectively (Figure 3.3).

Table 3.4: Confidence ratings and overall confidence: mean (range).							
Product	N	Two weeks	N	Four weeks	N	Twelve weeks	Overall confidence
N-ICE CREAM	33	3.4 (1-5)	33	3.0 (1-5)	31	2.3 (1-5)	2.9
Milkshake ONS	31	4.0 (1-5)	32	2.5 (1-5)	32	2.1 (1-5)	2.9
Confidence scale: 1 = very unconfident; 2 = unconfident; 3 = neutral, 4 = confident; 5 = very confident							

Figure 3.3: A bar chart to show the maximum number of servings a patient would be able to consume daily



3.4.2.3 The feasibility of having N-ICE CREAM at home

Table 3.5 shows full results from the feasibility at home questionnaire. All (n = 32) but one patient had a freezer at home. The majority of patients did not share their freezer with anyone else (64.5%, n = 20), had three freezer shelves/drawers (41.4%, n = 12) and consumed food from their freezer every day (53.3%, n = 16). Just over three quarters of patients (76.7%, n =23) reported usually having ice cream in their freezer. When asked if they would be prepared to store N-ICE CREAM in their freezer 83.3 (n = 25) said yes and 23.7% (n =7) no. Free-text comments for reasons not to store N-ICE CREAM included "not enough storage space," "usually dairy free at home," and "don't usually have ice cream." The most accepted ice cream storage tub size was 125ml (61.3%, n =19) with patients expressing it was most convenient to have the ice cream already portioned out. The favourite flavour was vanilla (64.5%, n =20) followed by strawberry (6.5%, n =2) and salted caramel (6.5%, n = 2). Less commonly reported favourite ice cream flavours included banana (3.2%, n = 1), chocolate (3.2%, n = 1), coffee (3.2%, n = 1), lemon (3.2%, n = 1), lemon and ginger (3.2%, n = 1), mint (3.2%, n = 1) and Neapolitan (3.2%, n = 1).

Table 3.5: Results of the N-ICE CREAM feasibility questionnaire :(%, (n)).	
	Percentage (%)
1) Do you have a freezer at home?	
Yes	97 (n = 32)
No	1.0 (n =1)
1b) If no, would you consider buying a freezer to store N-ICE CREAM?	
Yes	
No	100 (n =1)
2) How many people do you share your freezer with?	
0	64.5 (n =20)
1	29.0 (n = 9)
2	6.5 (n =2)
3) How many shelves/drawers does your freezer have at home?	
1	6.9 (n =2)
2	10.3 (n=3)
3	41.4 (n=12)
4	31.0 (n=9)
5 +	10.4 (n=3)
4) How often do you consume food from your freezer?	
Every day	53.3 (n = 16)
Every other day	30.0 (n = 9)
Two times a week	13.33 (n =4)
Once a week	3.3 (n=1)
5) Do you normally have ice cream in your freezer?	
Yes	76.7 (n =23)
No	23.3 (n = 7)
6) Would you be prepared to stored N-ICE CREAM in your freezer?	
Yes	83.3 (n = 25)
No	23.3 (n = 7)
7) What size ice cream tubs would you rather keep in your freezer?	
125ml	61.3 (n =19)
500ml	22.6 (n=7)
1 litre	9.7 (n =3)
2 litre	6.5 (n =2)
8) How often does your freezer need defrosting?	
Not sure	38.7 (n = 12)
Once a month	0.0 (n = 0)
Once every three months	3.2 (n = 3)
Once a year	22.6 (n = 7)
Every few years	3.2 (n=1)
Self-defrosting	22.6 (n=7)
9) What is your favourite flavour ice cream?	
Vanilla	64.5 (n = 20)
Strawberry	6.5 (n = 2)

Banana	3.2 (n =1)
Chocolate	3.2 (n =1)
Mint	3.2 (n =1)
Lemon	3.2 (n =1)
Lemon and Ginger	3.2 (n =1)
Coffee	3.2 (n =1)
Salted Caramel	6.5 (n =2)
Neapolitan	3.2 (n =1)

3.4.2.4 Feasibility of N-ICE CREAM as an ONS

The timing of N-ICE CREAM administration and its consumption period were the most problematic factors hindering its feasibility. Initially, N-ICE CREAM was offered at 10am and 2pm in line with standard milkshake ONS timings and study protocol. However, it became apparent that patients felt it was too early to have ice cream at 10am. The milkshake ONS could be left open by the patient's bedside for up to 24 hours in contrast to the N-ICE CREAM where it had to be consumed before melting (within approximately 20 minutes). It became apparent that there needed to be increased flexibility around times when N-ICE CREAM could be administered. In view of this, study protocol was amended to allow administration of N-ICE CREAM at any time of the day. Time of day was usually agreed with the patient; however, avoided at least one hour before meals (to not affect appetite at meal times) and after six o'clock in the evening (out of Research team working hours). Common reasons for the Research team being unable to provide N-ICE CREAM to the patient included; sleeping, having physiotherapy, on the commode and off the ward for a scan or seeing visitors.

3.5 Discussion

This study investigated the acceptability of N-ICE CREAM with a standard ONS milkshake in older patients with hip or spine fractures. To our knowledge, this is the first study directly comparing a high protein, fortified, ice cream with standard ONS in these patients. The results of this study proved the hypothesis that N-ICE CREAM would be just as 'accepted' if not more than standard milkshake ONS.

Compliance was highest to N-ICE CREAM in both groups. However, this difference was only statistically greater in Group A. There is a paucity of literature on compliance to ONS in older adults specifically those with fractures. Adherence to ONS is critical for a successful outcome (Travers et al., 2018 and Stratton et al., 2003). In a Cochrane review of protein and energy supplementation in older adults (>65 years) mean compliance was 66% (range 50 - 85%) (Milne et al., 2009*)*. Our study is consistent in reporting low compliance in older adults, compliance to N-ICE CREAM (62.5%) and the milkshake ONS (49.9%). Regarding older adults with a hip fracture compliance has been reported at 14.9% (Lawson et al., 2000) and 28% (own MRes findings). Reasons for higher compliance in our study could be explained by the exclusion of malnourished patients and patients at high risk of malnutrition of whom ONS compliance

tends to be lower (Lawson et al., 2005). Factors impeding N-ICE CREAM compliance observed by the Research team included patients falling asleep, feeling full from mealtimes, timing of administration (e.g. too early to have ice cream) and being seen by another medical staff member or taken off the ward (e.g. for a scan) before finishing the N-ICE CREAM. Observed barriers to the milkshake ONS compliance included patients forgetting it was on their bedside, being unable to reach or self-feed the milkshake. Similarly, nausea, pain, confusion (i.e. patients with dementia) and disliking the taste were reasons for poor compliance to both products. Negative comments made about N-CE CREAM and the milkshake ONS included the taste being "too sweet." High sweetness may lead to limited adherence (Lambert et al., 2014 and Gosney, 2003). Furthermore, studies have shown patients may have disregarded the importance or ONS with as many as 80% of patients viewing ONS as a snack food rather than a medicine (den Uijl et al., 2015).

Texture and appearance were N-ICE CREAM's highest rated hedonic characteristics and appearance and smell were the milkshake ONS's. Aftertaste was ranked lowest for both products. This is unsurprising as the milkshake ONS was fortified with iron, chromium, calcium and zinc which can cause a metallic taste (Methven et al., 2010) and the leucine in the N-ICE CREAM is known to elicit a bitter taste (Delompre et al., 2019). The mean overall acceptability score (5.8) for N-ICE CREAM did indicate overall likability by patients and was higher than for standard milkshake ONS (4.6). Some patients even asked where they could buy N-ICE CREAM.

The majority of patients preferred N-ICE CREAM (67.7%). Preference to a 'higher' protein ice cream (160kcal, 3.2g protein) over conventional standard ONS has reported in one other study where 88% of oncological patients expressed they would rather eat the ice cream (Wright et al., 2008). Higher compliance and preference to N-ICE CREAM could be explained by the choice of ingredients. The acceptability for long-life milkshake style ONS has been compared to supplements prepared freshly with milk, with preference to the freshly prepared milk supplements (Darmon et al., 2008 , Rahemtulla et al., 2005 and Auty, Standing and Humphrey, 1983). During heat-treatment of ONS products, unfavourable aroma compounds and mouthfeel sensations are generated from the processing of dairy proteins (Bull, Hong and Khutoyanskiy, 2017). N-ICE CREAM was made from fresh milk at a local dairy farm. Previous literature has criticised suitability of using fresh milk-based supplements in hospital due to associated preparation time, resources and storage time (only a few days for fresh vs 12 months for long life). N-ICE CREAM could overcome part this issue as there are no preparation logistics in hospital and the storage life of was thirteen months. The only additional resource required is a freezer.

Flavour is a key determinant of ONS acceptance, yet few studies have focused on ONS taste. Taste/flavour fatigue, a taste driven loss of desire to consume a particular food (The McGraw-Hill Companies, 2002), can occur due to repetitive and excessive consumption of ONS. Taste/flavour fatigue may impede adherence to ONS prescription (Nieuwenhuizen et al., 2010). Older patients with hip or spine fractures should be prescribed the milkshake ONS twice daily on admission until discharge. There was usually a delay with the clinical team prescribing the milkshake ONS, perhaps resultant of lack of awareness on the nutritional

pathway for the management of hip or spine fractures due to its recent implementation at NUH NHS Trust. Most patients were recruited early on during their stay therefore, it was unlikely patients would have experienced taste fatigue with the milkshake ONS before the study initiation. There was only one flavour of N-ICE CREAM available (vanilla) whereas nine different milkshake ONS flavours that could have been offered to the patients. Studies have shown greater compliance to ONS when varying flavour rather than type. In one study nearly one-fifth (19%) of patients were reported to have stopped the trial due to flavour fatigue (Bolton et al., 1992). It is possible that N-ICE CREAM compliance may have been higher if there was a variety of flavours as a consequence of decreased taste/flavour fatigue. Despite studies showing flavour having greater impact over ONS style, the confidence rating for both products decreased as theoretical prescription time increased. Patients initially felt confident (4) and closer to neutral (3.4) about having milkshake ONS and N-ICE CREAM respectively for at least once a day for two weeks. However, by twelve weeks patients felt closer to unconfident. Furthermore, the majority of patients felt one tub/bottle would be the maximum number of product they could manage daily. Some patients even felt that they would not be able to consume any N-ICE CREAM (3.3%) or milkshake ONS (22.6%) if required to at home. It is evident from this that taste fatigue would affect long-term compliance. To reduce taste fatigue and support adherence consideration should be given providing a patient with a variety of different ONS types and styles (Hubbard, Elia and Holdoway, 2012).

In the latest ESPEN guidelines, it is recommended that all older individuals with a hip fracture receive 400kcal/day including 30g or more protein/day (Volkert et al., 2019). Originally, the planned study N-ICE CREAM sample size was to be 103g per serving (200kcal and 20g protein) to meet energy recommendations; however, due to limited resources smaller ice cream tubs were used containing 80g per serving. N-ICE CREAM could only provide a maximum of 308kcal/day and 30.8g protein hence was unable to meet ESPEN energy recommendations. In general patients consumed a greater quantity of protein from N-ICE CREAM (19.3 ± 11g vs 17.6 ± 14.8g) and energy from the milkshake ONS (293 ± 248kcal vs 194 ± 111kcal) although, no statistically significant differences could be detected. Seventeen (35.4%) and 16 (33.3%) of the 48 patients met protein intake of at least 30g from the N-ICE CREAM and the milkshake ONS respectively. Eighteen (37.5%) met ESPEN energy recommendations through the milkshake ONS consumption. In the previous pilot study at NUH NHS Trust the study ice cream ONS lead to an increase in energy intake by approximately 290kcal, again not enough to suffice ESPEN recommendations. Protein was not recorded (Taib et al., 2021). Future research should explore whether it is possible to meet energy recommendations from N-ICE CREAM by either providing larger serving sizes or by reformulating the recipe to improve energy density.

One of the main aims of this study was to determine whether N-ICE CREAM is practical to use in hospital. Unfortunately, catering would not permit the storage of N-ICE CREAM in ward freezers. Therefore, the HCOP Research team had to purchase a freezer. In routine practice nursing staff and health care assistants deliver ONS to patients; however, as N-ICE CREAM was stored in the HCOP Research office the Research team were responsible for this. Consequently, N-ICE CREAM could not be distributed outside of the Research team's working hours (e.g. after six in the evening and on the weekends). The maintenance of

what would be standard care with N-ICE CREAM with the least interference by the Research team would have resulted in yielding representative real-practice data. If nursing staff were able to deliver N-ICE CREAM compliance may have been higher as ward staff would be able to communicate more effectively with the patient. Conversely, compliance may have been lower due to limited staff and increased burden. One disadvantage of N-ICE CREAM was that it had to be consumed within a short time frame before spoilt. The milkshake ONS could be left opened for up to 24 hours and consumed at a time and pace to the patient's convenience. Finding an optimal time to distribute the N-ICE CREAM became problematic. For a large majority of cases patients were sleeping when the Research team tried to distribute N-ICE CREAM. Patients would either express they would rather sleep or even if woken up and N-ICE CREAM accepted they would soon fall back asleep leaving N-ICE CREAM untouched and melted. Solutions to this include providing N-ICE CREAM to patients to have with their pudding at mealtimes and at afternoon build-up round. Alternatively, as the traditional hospital ice cream is very low in energy and protein, N-ICE CREAM could perhaps replace this. As N-ICE CREAM was not administered after six in the evening we are unable to comment on the suitability of providing it as a pre-bed snack. Usually patients required two functioning hands when consuming N-ICE CREAM; one to stabilise the tub and the other to self-feed. Some patients sustained a wrist or arm fracture in the trauma of their fall. For several of these patients eating the ice cream proved a challenging experience and assistance from ward staff was usually required. Adapted cutlery would have eased the eating experience but there was only one adapted spoon between the three T&O wards. Whereas, these patients could quite comfortably hold the milkshake ONS with one hand and drink it unaided.

Our study has limitations. First, it was only a small, short-term evaluation. The small sample size limits conclusions about compliance and acceptability. Additionally, the results from this study have reduced generalisability to other settings due to the nature of it being single centre and predominantly white British and female population; taste preferences may differ by gender (Corbin, 2006) and culture (Monterosa et al., 2020). However, having a heterogeneous population (all but one patient experienced a hip fracture) does enable direct comparison to similar studies.

No standard method exists for measuring compliance to ONS. This study relied on self-reported estimates when unable to weigh the product. Self-reported data is easy to obtain; however, has disadvantages which may compromise the reliability and validity of the measurement. When people report their own experiences they are often bias (i.e. due to inaccurate recall) (Coughlin, 1990) and may be either consciously or unconsciously influence by social desirability bias (Latkin et al., 2017). In addition, some patients were confused between hospital ice cream and N-ICE CREAM and between build-up round milkshakes and the study milkshake ONS reducing validity.

Our study used an adapted hedonic scale. The hedonic scale has been the most commonly used scale for testing acceptability of foods (Lim, 2011). The categorical nature of the hedonic scale and it's restricted

choices make it convenient and easy for researchers and study participants to use. However, hedonic scales have not yet been validated for clinical use.

The sole comparison was between N-ICE CREAM and one milkshake style ONS of which is used in standard care for the nutritional management of hip fractures, thus disregarding alternative ONS available in hospital options, such as juices, mousses, soups and yoghurts . However, studies have shown that older adults have a predilection toward milk-style ONS (Darmon et al., 2008) and as such, the milkshake ONS used in the study provides the most rigorous comparison.

Need for further work

There are still numerous gaps in the knowledge about the role of an ice cream as an ONS. Primarily the outcomes were also limited as clinical outcomes and cost were not explored. Due to the potential impact ONS has on appetite (i.e. satiety), they are usually prescribed between meals. ONS intake has some displacement effect on food from meals (Fiatarone et al., 2000); however, there are limited studies exploring the effect of ONS timing in hospital on this. One study on older females with a lower BMI found a significantly reduced energy intake at the evening meal after high energy ONS was taken late afternoon, but a net increase in total energy intake per day. No patients in this study were malnourished or at high risk of malnutrition, thus studies are needed to explore the acceptability to N-ICE CREAM in these patients. Given the short-term nature of our study, research is warranted to explore long-term compliance to N-ICE CREAM and the optimal timing of administration. Falls and fractures are the most common reason for patients with dementia to be admitted to hospital (Voisin et al., 2009). Prevalence of hip fracture patients with dementia is 19%. In our study population eleven (22%) of patients had dementia. This small sample size was not enough to allow for meaningful sub-group analysis. Although no published literature, many online dementia carer support groups have expressed their patients/family/friends with dementia enjoy and are able to tolerate ice cream well (Alz.org, 2022 and The Caregiver Calling, 2022). With regard to this, NICE CREAM may have wider benefits to all dementia patients but validation is first required through larger studies. The study was conducted in the summer months thus it will be interesting to repeat this study to determine whether there may be a seasonal distinction between the amount with which N-ICE CREAM is consumed.

3.6 Conclusion

This study demonstrates N-ICE CREAM is more accepted and preferred by older patients with a broken hip or spine compared to standard milkshake ONS. Hedonic characteristics and overall impression were highly rated for N-ICE CREAM. The results suggest N-ICE CREAM is a promising alternative/option for patients in the nutritional management of hip and spine fractures.

3.7 Post-study reflection

This my first time submitting an ethics proposal. I was surprised with how many documents were required and with how long the process took. I started writing the ethics proposal in January 2021 and aimed to

start recruitment in May. However, it was not until mid-June I got approval for the study. I had support from the HCOP team with recruitment and roll-out of the trial but overall, I was the main leader. I feel proud that we recruited target number and with how I lead the trial.

One of main challenges was with recruiting the patients. I thought that recruitment would be a simple process and that patients would be engaged with the idea of ice cream! Recruiting older people often takes longer than recruiting young people for reasons including impaired vision, hearing and cognition. A barrier to recruiting patients in his study included a lack of knowledge on the importance of nutrition for recovery, feeling too tired or poorly to participate, or misunderstanding the objective and requirements of the study. The patient information sheet found in the appendices was too long and overwhelming for some of the patient's deterring them from taking part. Some patients also thought that I was trying to sell them N-ICE CREAM and despite reassuring them that I was not, they still felt sceptical to participate. The questionnaires developed for this study were relatively easy to complete. However, many patients refused to complete them due to feeling unwell, tired and fed up.

If to repeat this study, I would also put forward to the ethics committee a condensed patient information sheet in the form of a poster to help with recruitment. Ideally, a larger study team would be required to allow flexibility in distributing N-ICE CREAM across the day.

3.8 Conflicts of interest

Author declares no conflict of interest

3.9 References

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Chapter 4

What next?

The findings from these studies highlight dietary intake and compliance to ONS in older T&O patients is low, specifically those with hip fractures. The narrow focus on improving energy and protein intake in older hip fracture patients through traditional prescription of ONS is challenged by the final study comparing a new high protein, fortified, ice cream, N-ICE CREAM, with a standard ONS milkshake. The study found higher compliance and greater acceptability and preference for N-ICE CREAM. N-ICE CREAM presents as a promising nutritional intervention to manage malnutrition. What yet is unknown is the clinical benefits of N-ICE CREAM and whether its protein quality and quantity is enough to improve recovery and reduce hospital associated complications such as acute sarcopenia. With respect to the ageing population incidence of falls and fractures resulting in hospital admission are expected to rise alongside malnutrition putting an immense pressure on the health care services.

I have been successful in my application for the "Pre-doctoral Bridging the Gap Programme" funded by the National Institute for Health and Care Research and collaborated with the University of Nottingham. The award will allow me one day a week of protected time from November 2022 to October 2023 out of clinical practice as a dietitian to refine my PhD proposal titled " Can a high protein, fortified, Ice cream attenuate acute sarcopenia in older adults in hospital with a hip fracture," to undertake systematic review training, a literature review, an ethics application and form a patient participation involvement group. Acute sarcopenia to-date has not yet been explored in patients with hip fractures. These patients are particularly vulnerable given poor dietary intake as highlighted from my MRes project. Provisional studies proposed for the PhD project included two randomised controlled crossover trial investigating the effect of N-ICE CREAM and standard ONS (matched for protein quantity) on plasma amino acids in healthy older adults (study one) and in older hip fracture patients (study two). The final provisional study is a prospective observational study exploring the effect of hospitalisation on muscle mass, strength and function and on dietary intake. Patients would have measurement of muscle mass, strength and function at baseline, one week after surgery, weekly after surgery and at six weeks follow-up. The study would also aim to capture dietary intake for the first fourteen days of inpatient stay, as long-term intakes has not yet been studied. Next year I will apply for PhD funding including British Geriatrics Society and the National Institute for Health and Care Research, with the aim to undertake research as described.

Appendices

Appendix one: Health Research Authority approval Letter

Professor Opinder Sahota
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07 June 2022

Dear Professor Sahota

HRA and Health and Care

Study title:	**Comparison of the taste and acceptability of a new ice cream based supplement (Nottingham-Ice cream) compared to standard hospital milkshake in older people in hospital who have suffered a broken bone: A randomised controlled crossover trial**
IRAS project ID:	**313933**
Protocol number:	**TBC**
REC reference:	**22/LO/0363**
Sponsor	**Nottingham University Hospitals (NUH) NHS Trust**

I am pleased to confirm that **HRA and Health and Care Research Wales (HCRW) Approval** has been given for the above referenced study, on the basis described in the application form, protocol, supporting documentation and any clarifications received. You should not expect to receive anything further relating to this application.

Please now work with participating NHS organisations to confirm capacity and capability, in line with the instructions provided in the "Information to support study set up" section towards the end of this letter.

How should I work with participating NHS/HSC organisations in Northern Ireland and Scotland?

HRA and HCRW Approval does not apply to NHS/HSC organisations within Northern Ireland and Scotland. If you indicated in your IRAS form that you do have participating organisations in either of these devolved administrations, the final document set and the study wide governance report (including this letter) have

been sent to the coordinating centre of each participating nation. The relevant national coordinating function/s will contact you as appropriate.

Please see IRAS Help for information on working with NHS/HSC organisations in Northern Ireland and Scotland.

How should I work with participating non-NHS organisations?

HRA and HCRW Approval does not apply to non-NHS organisations. You should work with your non-NHS organisations to obtain local agreement in accordance with their procedures.

What are my notification responsibilities during the study?

The standard conditions document "*After Ethical Review – guidance for sponsors and investigators*", issued with your REC favourable opinion, gives detailed guidance on reporting expectations for studies, including:

- Registration of research
- Notifying amendments
- Notifying the end of the study

The HRA website also provides guidance on these topics, and is updated in the light of changes in reporting expectations or procedures.

Who should I contact for further information?

Please do not hesitate to contact me for assistance with this application. My contact details are below.

Your IRAS project ID is **313933**. Please quote this on all correspondence.

Yours sincerely,

Kelly Rowe

Approvals Manager

Email: approvals@hra.nhs.uk

Copy to: Ms Jennifer Boston, Nottingham University Hospitals NHS Trust

List of Documents

The final document set assessed and approved by HRA and HCRW Approval is listed below.

Document	*Version*	*Date*
IRAS Application Form [IRAS_Form_21042022]		21 April 2022
Non-validated questionnaire [Acceptibility_Questionnaire_V1.0]	V1.0	30 March 2022
Non-validated questionnaire [Attitudes_Questionnaire_V1.0]	V1.0	30 March 2022
Non-validated questionnaire [Preferability_Questionnaire_V1.0]	V1.0	30 March 2022
Non-validated questionnaire [Feasibility_Questionnaire_V1.0]	V1.0	05 April 2022
Other [Student_Research_Supplementary_Declaration__Form_A_1.0]	V1.0	10 March 2022
Other [N-ICE_CREAM_Protocol_tracked_V2.0]	V2.0	17 May 2022
Other [N-ICE_CREAM_Protocol_clean_V2.0]	V2.0	17 May 2022
Other [Amendments table]	V1.0	17 May 2022
Participant consent form [N-ICE_CREAM_study_InformedConsentForm_tracked_V2.0]	V2.0	17 May 2022
Participant consent form [N-ICE_CREAM_study_InformedConsentForm_clean_V2]	V2.0	17 May 2022
Participant consent form [N-ICE_CREAM_Consultee_Declaration_form_tracked_V2.0]	V2.0	17 May 2022
Participant consent form [N-ICE_CREAM_Consultee_Declaration_form_clean_V2.0]	V2.0	17 May 2022
Participant consent form [N-ICE_CREAM_Verbal-Consultee_Consent-Confirmation-Form_tracked_V2.0]	V2.0	17 May 2022
Participant consent form [N-ICE_CREAM_Verbal-Consultee_Consent-Confirmation-Form_clean_V2.0.]	V2.0	17 May 2022
Participant information sheet (PIS) [N-ICE_CREAM_study_PIS_tracked_V2.0]	V2.0	17 May 2022
Participant information sheet (PIS) [N-ICE_CREAM_study_PIS_clean_V2.0]	V2.0	17 May 2022
Participant information sheet (PIS) [N-ICE_CREAM_study_PCIS_tracked_V2.0]	V2.0	17 May 2022
Participant information sheet (PIS) [N-ICE_CREAM_study_PCIS_clean_V2.0]	V2.0	17 May 2022
Summary CV for Chief Investigator (CI) [CVShortSahota2022]	1.0	14 April 2022
Summary CV for student [Kirandeep K Marsh CV 2022]	V1.0	25 April 2022
Summary CV for supervisor (student research) [AA CV 2021]	V1.0	10 September 2021

Information to support study set up

The below provides all parties with information to support the arranging and confirming of capacity and capability with parti cipating NHS organisations in England and Wales. This is intended to be an accurate reflection of the study at the time of issue of this letter.

Types of participating NHS organisation	Expectations related to confirmation of capacity and capability	Agreement to be used	Funding arrangements	Oversight expectations	HR Good Practice Resource Pack expectations
This is a single site study sponsored by the participating NHS organisation therefore there is only one site type.	The single participating NHS organisation of this type is also sponsoring the research. You should work with your sponsor R&D office to make arrangements to set up the study. The sponsor R&D office will confirm to you when the study can start following issue of HRA and HCRW Approval.	This is a single site study sponsored by the participating NHS organisation therefore no agreements are expected.	No Organisation Information Document has been provided and so relevant conversations should be held with between the research team and the relevant R&D office to understand study funding arrangements.	In line with HRA/HCRW expectations a Principal Investigator should be appointed at participating NHS organisations of this type.	Where an external individual who does not already hold an NHS employment contract will be conducting any of the research activities that will be undertaken at this site type then they would be expected to hold an Honorary Research Contract. External staff holding preexisting NHS employment contracts, or staff only undertaking the following activities, should obtain a Letter of Access. Questionnaires. This should be issued be on the basis of a Research Passport (if university employed) or an NHS to NHS confirmation of preengagement checks letter (if NHS employed).

Appendix two: Research and Innovation Approval Letter

Dear Professor Sahota,

Study Title: The N-ICE CREAM Study

Chief Investigator: Prof. Opinder Sahota

Sponsor Reference Number: 22HC002

Following on from the Site Initiation Visit on 16 Jun 2022, I can hereby confirm that Nottingham University Hospitals NHS Trust has **green light to commence recruitment for the above study.**

Any SAE's or non-compliances related to the study must be reported to the PI, CI and RDSAE@nuh.nhs.uk within 24 hours of becoming aware of them. The relevant forms can be found here: https://www.nuh.nhs.uk/guidanceresearchers

Please see the attached monitoring plan for your records. Please could I ask that you sign and return the attached risk assessment.

We look forward to working alongside you and your team. Please do not hesitate to contact us if you have any queries.

Kind regards,

Matthew Sanderson

Senior Research Governance Facilitator

Research & Innovation

Governance and Quality Team, R&I

Queens Medical Centre

C Floor, South Block, Derby Road, NG7 2UH

researchsponsor@nuh.nhs.uk – *For sponsorship enquiries*

R&I@nuh.nhs.uk – *For general enquiries*



The University of Nottingham
UNITED KINGDOM · CHINA · MALAYSIA

Nottingham University Hospital NHS
NHS Trust

ORAL NUTRITIONAL SUPPLEMENT "HEDONIC RATING SCALE" ACCEPTIBILITY QUESTIONNAIRE

Patient Study ID: ..... Initials: .....

Product: _____

Please answer the following questions based on the product you trialled for the last 2 days.

Please circle the response that best reflects your view

1) How much do you like the APPEARANCE of this product?



Dislike a lot | Dislike moderately | Dislike a little | Like a little | Like moderately | Like lot

2) How much do you like the SMELL of this product?



Dislike a lot | Dislike moderately | Dislike a little | Like a little | Like moderately | Like lot

3) How much do you like the TASTE of this product?



Dislike a lot | Dislike moderately | Dislike a little | Like a little | Like moderately | Like lot

4) How much do you like the AFTERTASTE of this product?



Dislike a lot | Dislike moderately | Dislike a little | Like a little | Like moderately | Like lot

5) How much do you like the MOUTHFEEL/TEXTURE of this product?



Dislike a lot | Dislike moderately | Dislike a little | Like a little | Like moderatelv | Like lot

Appendix four: ORAL NUTRITIONAL SUPPLEMENT ATTITUDES QUESTIONNAIRE

The University of Nottingham
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Nottingham University Hospital NHS Trust

ORAL NUTRITIONAL SUPPLEMENT ATTITUDES QUESTIONNAIRE

Patient Study ID: ..... Initials: .....

Product_____

This questionnaire has been developed to gain an understanding on your views on using the product received.

Please answer the following questions based on the product that you trialled for the last 2 days.

Please circle the response that best reflects your view.

1) How confident are you that you could drink/eat this product every day for the following time periods:

2 weeks

1	2	3	4
Very unconfident ☹☹	Unconfident ☹	Confident ☺	Very confident ☺☺

1 months

1	2	3	4
Very unconfident ☹☹	Unconfident ☹	Confident ☺	Very confident ☺☺

3 months

1	2	3	4
Very unconfident ☹☹	Unconfident ☹	Confident ☺	Very confident ☺☺

2) What is the maximum volume you think you could consume of this product daily?

Please tick <u>one</u> box only

1 x serving	
2 x servings	
3 x servings	
More than 4 servings daily	

THANK YOU FOR TAKING THE TIME TO COMPLETE THIS QUESTIONNAIRE

The University of Nottingham
UNITED KINGDOM · CHINA · MALAYSIA

Nottingham University Hospital NHS Trust

NOTTINGHAM-ICE CREAM FEASIBILTY AT HOME QUESTIONNAIRE

Patient Study ID: ..... Initials: .....

Please circle the response that best reflects your view

1) Do you have a freezer at home?

Yes No

1b) If no, would you consider buying a freezer to store high protein Nottingham - Ice cream?

Yes No

2) How many people do you share your freezer with?

0 1 2 3 4+

3) How many shelves/drawers does your freezer at home have?

1 2 3 4 5 +

4) How often on average do you consume food from your freezer?

Every day	Every other day	Two times a week	Once a week	Once a fortnight	Once a month or less

5) Do you normally have ice cream in your freezer?

Yes No

6) Would you be prepared to store high protein Nottingham- ice cream in your freezer?

Yes No

7) What size ice cream tubs would you rather keep in your freezer?



125ml single tubs | 500ml tubs | 1 litre tubs | 2 litre tubs

8) How often does your freezer need defrosting?

Not sure	Once a fortnight	Once a month	Once every three months	Once a year	Every few years

9) What is your favourite flavour ice cream?

Vanilla	Strawberry	Banana	Chocolate	Other.....

Appendix six: ORAL NUTRITIONAL SUPPLEMENT PREFERABILITY QUESTIONNAIRE

The University of Nottingham
UNITED KINGDOM · CHINA · MALAYSIA

Nottingham University Hospital NHS Trust

ORAL NUTRITIONAL SUPPLEMENT PREFERABILITY QUESTIONNAIRE

Patient Study ID: ..... Initials: .....

Product_____

This questionnaire has been developed to gain an understanding on which product you preferred.

Please circle the response that best reflects your view.

1) Which food/drink product did you prefer?



FORTISIP COMPACT PROTEIN (MILKSHAKE)



N-ICE CREAM (ICE CREAM)

THANK YOU FOR TAKING THE TIME TO COMPLETE THIS QUESTIONNAIRE

Appendix seven: Patient Information Sheet

The N-ICE CREAM study

Comparison of the taste and acceptability of a new ice cream based supplement (Nottingham-Ice cream) compared to standard hospital milkshake in older people in hospital who have suffered a broken bone: A randomised controlled crossover trial

For participants ages 65 years and over

IRAS Reference: 313933

Participant Information Sheet; Version 2.0 Dated 17/MAY/2022

Contact details

Principle Investigator: Professor Opinder Sahota

Investigator

Name: Opinder Sahota

Professor of Ortho-Geriatric Medicine and Consultant Physician

Contact: 01159 249 924 Ext 66325

Investigator 2

Name: Kirandeep Marsh

Dietitian and **Masters in Research Student**

Contact: 01159 249 924 Ext 83955

Invitation

You are being invited to take part in a research study.

The N-ICE CREAM study aims to compare the acceptability of a new high protein ice-cream with standard build-up milkshakes given to people with broken bones whilst in hospital. You have been given this information sheet as you are eligible to take part in this study.

This a feasibility study meaning we are testing to see if our new ice cream is accepted by people in hospital and if the study is possible to do on a larger scale.

The study is part of a Masters in Research (educational) programme at the University of Nottingham.

Before you decide it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with friends, relatives and your GP if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

1. What is the purpose of the study?

Malnutrition simply means 'poor nutrition'. Malnutrition can occur when a person's diet lacks essential nutrients such as energy and protein. A few signs of malnutrition include unintentional weight loss, a lack of interest in eating and drinking, feeling tired all the time and feeling weak. Malnutrition has many negative effects on health such as; increased risk of illness and infection, increased risk of falls and slower wound healing. Malnutrition is common in older people who have broken (fractured) their bones. These people need more energy and protein to help their body recover and often have a low appetite in hospital.

Oral nutritional supplements (ONS) are specially made foods and drinks to contain energy, protein, vitamins and minerals. They are available as milkshakes, juices, smoothies, soups, yogurts and mousses. They help people finding it difficult to eat enough to get the nutrition they need. They are typically used to add-on to the diet and are not intended as a food replacement. Research shows they may help improve recovery after breaking a bone.

Research shows that people with broken bones in hospital do not eat enough. As part of routine care, they are given a 'build-up' milkshake called Fortisip Compact Protein. However, not all people in hospital like the taste of them.

We have noticed that people in hospital like ice cream. Unfortunately, the ice cream in hospital is low in energy and protein. There is no build-up ice cream. We have teamed up with a local dairy farm to produce 'Nottingham Ice-cream' (N-ICE CREAM). N-ICE CREAM is a vanilla ice cream rich in energy and protein similar to the build-up milkshake. We have also added Vitamin D and an additional special protein called leucine to the N-ICE CREAM. Vitamin D helps make our bones stronger and leucine help makes our muscles stronger.

We will invite people in hospital with a broken bone currently taking the build-up milkshake to take part in our taste study. Those who agree to take part the trial, will be allocated into one of two groups. Participants will get to try both N-ICE CREAM and the build-up milkshake style, but just in different orders.

Group One will have N-ICE CREAM twice a day for two days followed by the build-up milkshake twice a day for two days.

Group Two will have build-up milkshake for twice a day for two days followed by N-ICE CREAM twice a day for two days.

Participants will have an equal chance of being in each group.

We want to find out if participants prefer the build-up milkshake (Fortisip Compact Protein) or N-ICE CREAM (the ice cream). The results will be later compared to see if one is preferred more.

The aim of the build-up milkshake and N-ICE CREAM is to improve overall energy and protein intake to help with recovery.

2. Who has reviewed this study?

Research in the NHS is usually looked at by an independent group called a Research Ethics Committee, to protect your safety, rights, well-being and dignity. This study has been reviewed and given a favourable opinion by the Research Ethics Committee.

The study has also been reviewed and approved by the Health Research Authority and the Research & Innovation department of Nottingham University Hospitals NHS Trust. The Nottingham University Hospitals NHS Trust will act as the 'Sponsor' (i.e., the lead NHS hospital) for this research

3. Why have I been asked to take part?

You have been asked to participate as you are aged 65 years or over, have a broken (fractured) bone and require buildup milkshake for the duration of your hospital stay.

Do I have to take part in this study?

No. It is up to you to decide whether or not to take part.

If you decide to take part you will be given this information sheet to keep and be asked to sign a consent form to confirm that you understand what is involved when taking part in this study. If you decide to take part you are free to leave the study at any time and without giving a reason.

If you withdraw, we will still keep records relating to the treatment given to you, as this is valuable to the study. A decision to withdraw at any time, or a decision not to take part, will not affect the quality of care you receive.

4. What do I have to do?

A member of the research team will check to see if you are suitable to participate in the study. With your permission, a researcher will explain the study to you in more detail and if appropriate, a member of your family. You will have at least 24 hours to consider the information and decide if you would like to take part.

If you agree to take part, a member of the research team will ask you to sign a consent form. You will have an equal chance of being allocated to receive either the build-up milkshake (Fortisip Compact Protein) or N-ICE CREAM (the ice cream) first. The team of doctors and nurses team overseeing your care will be informed of which group you have been allocated to.

Then the researcher will obtain information about you, and your hospital admission. You will be able to try both N-ICE CREAM and the build-up milkshake. You will be randomly assigned to receive either N-ICE CREAM or build-up milkshake first.

The expected duration of trial will be four days.

Over the four days the research team will aim to record how much of the product you have consumed.

Once you have finished trying the first product (day two) a member of the research team will visit you the ward. You will be asked to complete two short questionnaires the product you have just tried. Once you have finished the second product (day four) a member of the research team will visit you on the ward and ask you to complete the same two questionnaires.

The research team will also ask you which product you preferred and to complete a questionnaire about the practicality of having N-ICE CREAM at home.

After the trial finishes you will to receive continue to receive the build-up milkshake (Fortisip Compact Protein) as part of routine care as appropriate.

If you do decide to take part in the study, you must report any problems you have to your nurse, doctor or research team. There is also a contact number given at the end of this information sheet for you to phone if you become worried at any time. In the unlikely event of an emergency occurring during the conduct of the study, we may contact your nominated next of kin.

5. What are the possible benefits?

If you do take part in the study, you will receive supplements to help improve energy and protein intake.

Whether the research is successful or not you'll have also contributed to knowledge on the nutritional management of people in hospital with broken bones, and this may help us to treat future people with broken bones better.

6. What are the disadvantages?

One disadvantage of taking part in the study is that you may not like the taste of the N-ICE CREAM . Additionally, you will have the inconvenience of completing the questionnaires and having a member of the research team visiting you on the ward.

Uncommon reported side effects related to the build-up milkshake include nausea, vomiting and feeling of fullness which may also be experienced by the N-ICE CREAM.

7. What will happen to my data?

All the information about your participation in this study will be kept confidential. We will keep all information about you safe and secure.Data stored will be made non-identifiable and anonymised using a unique Participant ID number.

If you consent to take part in this study, the records obtained while you are in this study as well as related health records will remain strictly confidential at all times. The information will be held securely on paper, and electronically at your treating hospital under the provisions of the General Data Protection Regulation and the Data Protection Act. Your name will not be passed to anyone else outside the research team or the sponsor, who is not involved in the trial. You will be allocated a trial number, which will be used as a code to identify you on all trial forms.

If you withdraw consent from further study treatment, your data will remain on file and will be included in the final study analysis.

In line with Good Clinical Practice guidelines, at the end of the study, your data will be securely archived 5 years. Arrangements for confidential destruction will then be made.

We will need to use information from your medical records for this research project. This information will include your:

- Initials
- NHS number
- K number
- Name
- Date of birth
- Contact details
- Gender
- Race

People will use this information to do the research or to check your records to make sure that the research is being done properly. People who do not need to know who you are will not be able to see your name or contact details. Your data will have a code number instead.

Once we have finished the study, we will keep some of the data so we can check the results. We will write our reports in a way that no-one can work out that you took part in the study. You can stop being part of the study at any time, without giving a reason, but we will keep information about you that we already have.
We need to manage your records in specific ways for the research to be reliable. This means that we won't be able to let you see or change the data we hold about you.

Nottingham University Hospitals NHS Trust will use your name, NHS number and contact details to contact you about the research study, and make sure that relevant information about the study is recorded for their care, and to oversee the quality of the study. Individuals from Nottingham University Hospitals NHS Trust and regulatory organisations may look at your medical and research records to check the accuracy of the research study. The only people in Nottingham University Hospitals NHS Trust who will have access to information that identifies you will be people who need to contact you or audit the data collection process. The people who analyse the information will not be able to identify you and will not be able to find out their name, NHS number or contact details.

You can find out more about how we use your information:

- at www.hra.nhs.uk/information-about-patients/
- our GDPR leaflet available on request from researchsponsor@nuh.nhs.uk; or by the following link www.nuh.nhs.uk/gdpr
- by asking one of the research team
- by emailing the Data Protection Officer for NUH at dpo@nuh.nhs.uk,
- by ringing the Data Protection Officer for NUH on 0115 924 9924 (extension 63975)

Informing your General Practitioner (GP)

Your GP will not be required to be informed of your participation in this study.

8. What happens when the study is finished?

There will be no further contact from the research team when the study stops. You will continue to receive the build-up milkshake as part of routine care unless otherwise contraindicated.

If you wish to see the results, or publication, please ask the research team.

9. What happens if new information becomes available?

Sometimes during the course of a trial, new information becomes available on the study being undertaken. If this happens, we will tell you about it and discuss it with you whether you want to or should continue in the study. If

you decide to withdraw, we will make arrangement for your care to continue. If you decide to continue in the study you will be asked to sign an updated consent form.

On receiving new information, we might consider it to be in your best interests to withdraw you from the study. If so, we will explain the reasons and arrange for your care to continue. If the study is stopped for any other reason, you will be told why and your continuing care will be arranged.

What will happen if I don't want to carry on with the study?

You are free to withdraw from the study at any time. The research team will ask you for your reasons for leaving, but you are not obliged to give reasons. Withdrawing from the study will not affect the care you receive.

After withdrawal you will receive no further contact from the research team. This information will be recorded in you medical notes and in the study documentation. Any data collected up to the point of withdrawal will be kept and will be used in the final analysis.

10. What if there is a problem?

If you have a concern about any aspect of this study, you should ask to speak with the researchers who will do their best to answer your question. If you remain unhappy and wish to complain formally, you can do this through the NHS Complaints Procedure.

Details can be obtained from the hospital or you can contact the Patient Advice and Liaison Service (PALS) telephone 0800 183 0204.

In the event that something does go wrong and you are harmed during the research study there are no special compensation arrangements. If you are harmed and this is due to someone's negligence then you may have grounds for a legal action for compensation but you may have to pay your legal costs. The normal NHS complaints mechanisms will still be available to you.

11. Further Information

You are encouraged to ask any questions you wish before, during or after your treatment. If you have any questions about the study please speak to your study dietitian or doctor who will be able to provide you with up to date information about the study and procedure(s) involved. If you require any further information or have any concerns while taking part in the study please contact your study dietitian or doctor (both are listed at the top of this document).

If you wish to read the research on which this study is based, please ask your study team, nurse or doctor.

If you decide you would like to take part then please read and sign the consent form. You will be given a copy of this information sheet and the consent form to keep. A copy of the consent form will be filed in your medical notes, and one will be filed with the study records.

You can have more time to think this over if you are at all unsure.

Kirandeep Marsh (Dietitian and Masters in Research Student)

TEL EXT: 01159 249 924 Ext 83955 (Health Care of Older People Research Office)

EMAIL: Kirandeep.marsh2@nuh.nhs.uk

Thank you for taking the time to read this information sheet and to consider this study.

Appendix eight: Personal Consultee Information Sheet

The N-ICE CREAM study

Comparison of the taste and acceptability of a new ice cream based supplement

Personal Consultee Information Sheet

(Nottingham-Ice cream) compared to standard hospital milkshake in older people in hospital who have suffered a broken bone: A randomised controlled crossover trial **The N-ICE CREAM study:** Comparison of the taste and acceptability of a new ice cream based supplement (Nottingham-Ice cream) compared to standard hospital milkshake in older people in hospital who have suffered a broken For participants ages 65 years and over

bone: A randomised controlled crossover trial. IRAS Reference: 313933

Participant Information Sheet; Version 2.0 Dated 17/MAY/2022 For

participants ages 65 years and over Principle Investigator:

Professor Opinder Sahota IRAS Reference: 313933

Personal Consultee Information Sheet: Version 2.0 Dated 17-MAY-22

Chief Investigator: Professor Opinder Sahota



Research & Innovation

Contact details

Investigator

Name: Opinder Sahota

Professor of Ortho-Geriatric Medicine and Consultant Physician

Contact: 01159 249 924 Ext 66325

Investigator 2

Name: Kirandeep Marsh

Dietitian and **Masters in Research Student**

Contact: 01159 249 924 Ext 83955

The N-ICE CREAM study aims to compare the acceptability of a new high protein ice-cream with standard build-up milkshakes given to people with broken bones whilst in hospital. You have been given this information sheet as you are a relative/friend of someone who is eligible to take part but unable to make the decision for themself.

This a feasibility study meaning we are testing to see if our new ice cream is accepted by people in hospital and if the study is possible to do on a larger scale.

This study is part of a Masters in Research (educational) programme at the University of Nottingham.

PART 1 tells you the purpose of this study and what will happen to your relative/friend they takes part.
PART 2 gives you more detailed information about the conduct of the study.

PART 1

1. Invitation

We feel that your relative/friend is unable to decide for himself/herself/themself whether to participate in this research. To help decide if they should join the study, we would like to ask your opinion whether or not he/she/they would want to be involved. We would ask you to consider what you know of their wishes and feelings. Please let us know of any advanced decision they may have made about participating in research or the proposed treatment.

To help with making this decision, it is useful for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with other family members if you wish.

Ask us if there is anything that is not clear, or if you would like more information. Take your time to consider your relative/friend's view on participating.

2. What is the purpose of the study?

Malnutrition simply means 'poor nutrition'. Malnutrition can occur when a person's diet lacks essential nutrients such as energy and protein. A few signs of malnutrition include unintentional weight loss, a lack of interest in

eating and drinking, feeling tired all the time and feeling weak. Malnutrition has many negative effects on health such as; increased risk of illness and infection, increased risk of falls and slower wound healing. Malnutrition is common in older people who have broken (fractured) their bones. These people need more energy and protei n to help their body recover and often have a low appetite in hospital.

Oral nutritional supplements (ONS) are specially made foods and drinks to contain energy, protein, vitamins and minerals. They are available as milkshakes, juices, smoothies, soups, yogurts and mousses. They help people finding it difficult to eat enough to get the nutrition they need. They are typically used to add-on to the diet and are not intended as a food replacement. Research shows they may help improve recovery after breaking a bone. Research shows that people with broken bones in hospital do not eat enough. As part of routine care, they are given a 'build-up' milkshake called Fortisip Compact Protein. However, not all people in hospital the like taste of them.

We have noticed that people in hospital like ice cream. Unfortunately, the ice cream in hospital is low in energy and protein. There is no build-up ice cream. We have teamed up with a local dairy farm to produce 'Nottingham Icecream' (N-ICE CREAM). N-ICE CREAM is a vanilla ice cream rich in energy and protein similar to the build-up milkshake. We have also added Vitamin D and an additional special protein called leucine to the N-ICE CREAM. Vitamin D helps make our bones stronger and leucine help makes our muscles stronger.

We will invite people in hospital with a broken bone currently ta king the build-up milkshake to take part in our taste study. Those who agree to take part the trial, will be allocated into one of two groups. Participants will get to try both N-ICE CREAM and the build-up milkshake style, but just in different orders.

Group One will have N-ICE CREAM twice a day for two days followed by the build-up milkshake twice a day for two days.

Group Two will have build-up milkshake for twice a day for two days followed by N-ICE CREAM twice a day for two days.

Patients will have an equal chance of being in each group.

We want to find out if participants prefer the build-up milkshake (Fortisip Compact Protein) or N-ICE CREAM (the ice cream). The results will be later compared to see if one is preferred more.

The aim of the build-up milkshake and N-ICE CREAM is to improve overall energy and protein intake to help with recovery.

3. Why has my relative/friend been invited?

Your relative/friend has been invited to participate as he/she/them is aged 65 years or over, has a broken (fractured) bone and requires build-up milkshake for the duration of their hospital stay.

4. Does my relative/friend have to take part?

No. We are seeking your advice of your relative/friend's wishes about participating in this study. If you decide that your relative/friend would have no objection to taking part, we will ask you to read and sign a declaration form and we well then give you a copy to keep. We will keep you fully informed during the study so you can let us know if you have any concerns or you think your relative/friend should be withdrawn (leave) the study.

Your relative/friend can withdraw from the study at any time without giving a reason. This will not affect the care they will receive. We will use the information obtained up until that point for data analysis. A decision to withdraw at any time, or a decision not to take part, will not affect the care your relative/friend will receive.

5. What will happen to my relative/friend if they take part?

A member of the research team will check to see if your relative/friend is suitable to participate in the study. A researcher will explain the study to you and gather as much information as possible to understand the views of your relative/friend. There will be at least 24 hours to consider the information to participate in the study.

If your relative/friend participates in the study, a member of the research team will ask you to sign/complete a declaration form. Then the researcher will obtain information about your relative/friend and their hospital admission. The information will include an assessment of your relative/friend's general health. Once this information has been collected, your relative/friend will then be allocated by chance (randomly) into one of the two groups as described above in question 2.

The team of doctors and nurses overseeing your relative/friend's care in hospital will be informed of which group your relative/friend has been allocated to.

A member of the research team will monitor how much of the build-up milkshake and N-ICE CREAM they are consuming and to see how they are doing.

6. What does your relative/friend have to do?

A member of the research team will first check to see if your friend/relative is suitable to participate in the study. If your relative/friend participates in the study they will be randomly allocated into one of the two groups to see which treatment they will receive first. They will be given N-ICE CREAM for two days and build-up milkshake for two days. A member of the research team will monitor how much they have consumed. The expected duration of the trial will be four days.

8. What are the alternatives for treatment?

There are many different types of the build-up milkshake. If your relative/friend does not want the build-up milkshake and is not eating well then they may get referred to the ward dietitian who will be able to provide further advice.

9. What are the side effects of any treatment received when taking part?

If your relative/friend participates in the study, any problems related to the study will be reported to the research team by your relative/friend's nurse or doctor. There is also a contact number given at the end of this information sheet for you to phone if you become worried at any time. In the unlikely event of an emergency occurring during the conduct of the study, we may contact you or another relative or friend.

Uncommon reported side effects related to the build-up milkshake include nausea, vomiting and feeling of fullness which may also be experienced by the N-ICE CREAM.

10. What are other possible disadvantages and risks of taking part?

One disadvantage of taking part in the study is that your relative/friend may not like the taste of the N-ICE CREAM. Additionally, they will have the inconvenience of having a member of the research team visiting them on the ward to monitor how much product they have consumed.

11. What are the possible benefits of taking part?

If your relative/friend participates in the study, they will receive supplements to help improve energy and protein intake.

Whether the research is successful or not your relative/friend will have also contributed to knowledge on the nutritional management of patients in hospital with broken bones, and this may help us to treat future patients better.

12. What happens when the research study stops?

There will be no further contact from the research team when the study stops. Your relative/friend will continue to receive the build-up milkshake as part of routine care unless otherwise contraindicated.

13. What if there is a problem?

If you or your relative/friend have a concern about any aspect of this study, do ask to speak with the researchers who will do their best to answer your question. If you remain unhappy and wish to complain formally, you can do this through the NHS Complaints Procedure.

Details can be obtained from the hospital or you can contact PALS (Patient Advice and Liaison Service) telephone 0800 183 0204. In the event that something does go wrong and your relative/friend is harmed during the research study there are no special compensation arrangements. If they are harmed and this is due to someone's negligence then there may have grounds for a legal action for compensation but your relative/friend may have to pay their legal costs. The normal National Health Service complaints mechanisms will still be available to them.

14. Will information about my relative/friend taking part in this study be kept confidential?

Yes. All the information about your relative/friend's participation in this study will be kept confidential. Details are included in Part 2.

This completes Part 1 of the Information Sheet.

If based on the information in Part 1 you do not see your relative or friend object to participating in this study, please continue to read the additional information in Part 2.

PART 2

16. What if new information becomes available?

Sometimes during the course of a clinical trial, new information becomes available on the study being conducted. If this happens, we will tell you and your relative/friend about it and discuss whether to continue in the study. If your relative/friend is withdrawn, we will make arrangements for your relative/friend's care to continue. If it is decided to continue in the study you will be asked to sign an updated declaration form.

On receiving new information, we might consider it to be in your relative/friend's best interest to withdraw your relative/friend from the study. If so, we will explain the reasons and arrange for their care to continue. If the study is stopped for any other reason, you and your relative/friend will be told why and their continuing care will be arranged.

17. What will happen if my relative/friend doesn't want to carry on with the study?

Your relative/friend is free to withdraw from the study at any time. The research team will ask for reasons for leaving, but you and your relative/friend are not obliged to give any reason. After withdrawal your friend/relative would receive no further contact from the study teams; this information will be recorded in their medical notes and in the study documents. Withdrawing from the study will not affect the care your relative/friend will receive. As part of routine care your relative/friend will continue to receive the build-up milkshake after the trial finishes. Any data collected up to the point of withdrawal will be kept and will be used in the final analysis.

18. Will my relative/friend's part in this study be kept confidential?

If your relative/friend takes part in this study, the records obtained while they are in this study as well as related health records will remain strictly confidential at all times. The information will be held securely on paper and electronically at the Nottingham University Hospitals NHS under the provisions of the General Data Protection Regulation and other relevant UK legislation. Your relative/friend's name will not be passed to anyone else outside the research team, or the sponsor, who is not involved in the trial. They will be allocated a trial ID number, which will be used as a code to identify them on all trial forms.

All information collected about your relative/friend for the study will be kept strictly confidential and stored securely in accordance with ethical and regulatory requirements. Data stored will be made non-identifiable and anonymised using a unique Participant ID number. If your relative/friend withdraws from further study treatment, their data will remain on file and will be included in the final study analysis. In line with Good Clinical Practice guidelines, at the end of the study, your relative's/friend's data will be securely archived 5 years. Arrangements for confidential destruction will then be made

19. Use of Personal Data in Research

We will need to used your relative's/friend's information from their medical records for this project. This information will include their;

- Initials
- NHS number
- K number
- name
- date of birth
- contact details
- gender
- race

People will use this information to do the research or to check your records to make sure that the research is being done properly. People who do not need to know who your friend/relative is will not be able to see their name or contact details. Their data will have a code number instead.

Once we have finished the study, we will keep some data so that we can check the results. We will write our reports in a way that no-one can work out that your relative/friend took part in the study. Your relative/friend can stop being part of the study at any time, without giving reason, but we will keep information about them that we already have.

We need to manage their records in specific ways for the research to be reliable. This means that we won't be able to let you or your relative/friend see or change the data we hold about them. You can find out more about how we use your friends information:

- at www.hra.nhs.uk/information-about-patients/
- our GDPR leaflet available on request from researchsponsor@nuh.nhs.uk; or by the following link www.nuh.nhs.uk/gdpr
- by asking one of the research team
- by emailing the Data Protection Officer for NUH at dpo@nuh.nhs.uk,
- by ringing the Data Protection Officer for NUH on 0115 924 9924 (extension 63975)

Nottingham University Hospitals NHS Trust will use your relative's/friend's name, NHS number and contact details make sure that relevant information about the study is recorded for their care, and to oversee the quality of the study. Individuals from Nottingham University Hospitals NHS Trust and regulatory organisations may look at their medical and research records to check the accuracy of the research study. The only people in Nottingham University Hospitals NHS Trust who will have access to information that identifies your relative/friend will be people who need to audit the data collection process. The people who analyse the information will not be able to identify your relative/friend and will not be able to find out their name, NHS number or contact details.

20. Informing your relative/friend's General Practitioner (GP)

Your relative's/ friend's GP will not be required to be informed of their participation in this study.

23. What will happen to the results of this clinical trial?

The results of the study will be available after it finishes and will usually be published in a medical journal or be presented at a scientific conference. The data will be anonymous and none of the patients involved in the trial will be identified in any report or publication. Should you or your relative/friend wish to see the results, or the publication, please ask the research team.

24. Who is organising and funding this clinical trial?

The Nottingham University Hospitals NHS Trust will act as sponsor (i.e., the lead NHS hospital) for the research. .

25. Who has reviewed the study?

All research in the NHS is looked at by an independent group of people called a Research Ethics Committee, to protect study participants' safety, rights, well-being and dignity. This study has been reviewed and given a favourable opinion by the NHS by an independent Research Ethics Committee.

The study has also been reviewed and approved by the Research & Innovation department of Nottingham University Hospitals NHS Trust.

26. Contact for further information

If you or your relative/friend have any questions about the study, please speak to the research team, who will be able to provide you with up to date information about the study. If you or your relative/friend wish to read the research on which this study is based, please ask the research team.

If you decide your relative/friend would have not objected to participating in this study, then please read and sign the declaration form. You will be given a copy of this information sheet and the declaration form to keep. A copy of the form will be filed in your relative/friend's notes, one will be filed with the study records.

You can have more time to think this over if you are at all unsure.

Kirandeep Marsh (Dietitian and Masters in Research Student)

TEL EXT: 01159 249 924 Ext 83955 (Health Care of Older People Research Office)

EMAIL: kirandeep.marsh2@nuh.nhs.uk

Thank you for taking the time to read this information sheet and to consider this study

Appendix nine: Participant Consent Form



Nottingham University Hospitals NHS
NHS Trust

The University of Nottingham
UNITED KINGDOM · CHINA · MALAYSIA

Participant Consent Form

Version: 2.0 Date 17/05/2022

The N-ICE CREAM study: Comparison of the taste and acceptability of a new ice cream based supplement (Nottingham-Ice cream) compared to standard hospital milkshake in older people in hospital who have suffered a broken bone: A randomised controlled crossover trial.

Principal Investigator: Professor Opinder Sahota

Screening number: ..... Initials: .....

Patient initial each box

1. I confirm that I have read and understand the information sheet dated 17/MAY/2022 (version V2.0) for the above study and have had the opportunity to ask questions and have these answered satisfactorily. ☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time without my medical care or legal rights being affected. ☐
3. I understand that my medical records may be looked at by authorised individuals from the Sponsor for the study and the UK Regulatory Authority where it is relevant to my taking part in the study in order to check that the study is being carried out correctly and for auditing purposes. I give permission for these individuals to have access to my records. ☐
4. I understand that even if I withdraw from the above study,the data already collected will be retained and used in analysing the results of the trial. . ☐
5. I consent to the storage including electronic, of personal information for the purposes of this study. I understand that any information that could identify me will be kept strictly confidential and that no personal information will be included in the study report, presentations or other publication. ☐
6. I agree to take part in the study. ☐

Name of the patient *(Print)*	date	Patient's signature
Name of person receiving consent *(Print)*	date	Signature

Original to be retained and filed in the site file. 1 copy to patient, 1 copy to be filed in patient's notes,

Appendix ten: Personal Consultee Declaration Form



The University of Nottingham
UNITED KINGDOM · CHINA · MALAYSIA

Nottingham University Hospitals NHS
NHS Trust

Personal Consultee Declaration Form

The N-ICE CREAM study: Comparison of the taste and acceptability of a new ice cream based supplement (Nottingham-Ice cream) compared to standard hospital milkshake in older people in hospital who have suffered a broken bone: A randomised controlled crossover trial

Chief Investigator: Professor Opinder Sahota

Screening number ..... Initials.....

Please initial each box

1. I, (name)_____ confirm that I have been consulted about (potential participant's name)_____ participation in this research project. I have read and understand the information sheet dated 17/MAY/2022 (version 2.0) for the above study and have had the opportunity to ask questions and had them answered satisfactorily. ☐
2. I understand that my relative/friend will be randomly allocated to receive either two days of N-ICE CREAM followed by two days of milkshake drink or two days of milkshake drink followed by two days of N-ICE CREAM. ☐
3. I understand that the participation of my relative/friend is voluntary and that they are is free to withdraw at any time without their medical care or legal rights being affected. ☐
4. I understand that my relative/friend's medical records and any information collected for the study may be looked at by authorised individuals from the Sponsor for the study and the UK Regulatory Authority in order to check that the study is being carried out correctly and for auditing purposes. I give permission for these individuals to have access to my relative/friend's records. ☐
5. I understand that even if my relative/friend withdraws from the above study or is withdrawn, the data already collected will be retained and used when analysing the results of the study. ☐
6. I understand that any personal information, including electronic, for the purposes of this study will be stored securely. Any information that could identify my relative/friend will be kept strictly confidential and that no personal information will be included in the study report, presentations or other publication ☐
7. In my opinion my relative/friend would have no objection to taking part in the study. ☐

_____ _____ _____
Name of consultee *(Print)* date Signature

Relation to potential participant: _____

_____ _____ _____
Name of person taking consent *(Print)* date Signature

Original to be retained and filed in the site file. 1 copy to patient, 1 copy to be filed in patient's notes.

Appendix eleven: Research Skills in Nutrition Module Overview

Taught material included.

- What is data?
- How to present and analyse qualitative data
- How to present data effectively
- Statistics: Analysing relationships and comparing groups
- Systematic Review process
- Introduction to Nutrtional Assessment
- Dietary Assessment using Nutritics
- Anthropometry
- Use of Biomarkers in Nutritional Assessment Epidemiology

Assessments

- Coursework one
  - Component 1: Statistics (20%) [Grade 91%]
  - Component 2: Nutritional Assessment Presentation (50%) [Grade 77.9%]
- Coursework two:
  - Epidemiology (30%) [81.5%]

Appendix twelve: British Dietetics Abstract submission

Over 4.5 Tonnes of Food a Year Wasted from the Ward: A Service Evaluation of Dietary Intake and Food Waste in Older Hospitalised Trauma and Orthopaedic Patients

K Marsh[1,2], A. Avery[1] and O. Sahota[2],

1. School of Biosciences, Nottingham University 2. Department for Health Care of Older People, Nottingham University Hospitals NHS Trust.

Corresponding Author: Kirandeep Marsh, Kirandeep.marsh2@nuh.nhs

Introduction: Malnutrition is a debilitating condition in older hospitalised people and is associated with many adverse outcomes including longer length of hospital stay and increased mortality[1]. A limited number of studies have explored dietary intake and compliance to oral nutritional supplements (ONS) in these people. The National Health Service (NHS) is the second biggest provider of meals in the UK public sector yet limited literature reports on hospital food waste[2] The purpose of this service evaluation was to observe daily energy and protein intake, plate waste and ONS compliance and to report food waste at ward level.

Methods: Data collection was undertaken between November – December 2021. Patients were categorised as
'nutritionally well' or 'nutritionally vulnerable' as per British Dietetics Association's (BDA) Nutrition and Hydration Digest criteria. Three-day observational dietary intake of 19 older people (≥ 65 years) hospitalised on a trauma and orthopaedic (T&O) ward was assessed. Dietary intake was calculated by a Dietitian from a pre-analysed menu and manufacture package labels. Individual plate waste was visually estimated. Dietary intake was compared with the BDA standards, adjusted to exclude energy and protein from drinks. Ward patient plate and food trolley waste was weighed after lunch and supper for five days. Thirty-three ONS from
11 patients were collected before disposal and weighed between February – March 2022. The project was deemed not to require ethical approval or informed written consent from the patients as data was collected within routine NHS professional healthcare role and for the purpose of quality improvement, however patient confidentiality was maintained as per trust guidelines.
Results: The mean age of patients were mean age 84 ± 9 years (10 males, 9 females) with the most common injury a hip fracture (68.4%). Mean (standard deviation, SD) daily intake for 'nutritionally well' was 1592 (257) kcal and 65.7 (8.5) g protein and 'nutritionally vulnerable' (*n*=14) 643 (354) kcal and 24.8 (14.2) g protein. .
Plate waste for 'nutritionally well' was 4.1 (5.8)% at main meals and 1.7 (3.4)% at pudding and for 'nutritionally vulnerable' 53.1 (26.6)% at main meals and 38.6 (32.2)% at pudding. Compliance (amount consumed relative to amount prescribed) to ONS was 28.3 (38.8)%. The combined daily mealtime plate waste weighed 6.2 (1.2) kg and food trolley waste 6.2 (0.9) kg. This equates to approximately 4526kg/year (4.5T).
Discussion: The only standards met were protein by 'nutritionally well' (*n* = 5). The results from this study indicate that energy and protein intake and compliance to ONS is sub-optimal. Although, previous research is limited, similar studies have highlighted this[3,4]. Clinical outcomes from ONS depend on patient adherence; however, this presents as a significant challenge in older T&O patients. There is a need for an ONS in which patients accept and enjoy. Food waste is high, it represents a lost nutritional opportunity and has significant economic and environmental consequences which urgently needs to be addressed to enable preventative measures. Due to the small sample size these results cannot be generalised to a large population.

Conclusions: Inadequate nutritional intake and low compliance to ONS remains a key concern within older T&O patients. These findings highlight the need for interventions to improve dietary intake in hospital and to explore the acceptability of alternative ONS food/drink styles.

References

1. Ernst, A., Wilson, J., Ahn, J., Shapiro, M, *et al*. (2018). Malnutrition and the Orthopaedic Trauma Patient: A Systematic Review of the Literature. Journal of Orthopaedic Trauma, 32 (10), 491-499.

2. Department of Health and Social Care (2020) Report of the Independent Review of NHS Hospital Food. 3. Rosenberger, C., Rechsteiner, M., Dietsche, R, *et al.* (2019). Energy and protein intake in 330 geriatric orthopaedic patients: Are the current nutrition guidelines applicable? Clinical Nutrition ESPEN, 29, pp.86-91. 4. Lawson, R., Doshi, M., Ingoe, *et al* (2000). Compliance of orthopaedic patients with postoperative oral nutritional supplementation. Clinical Nutrition, 19 (3), pp.171-175

Appendix thirteen: British Geriatrics Society abstract submission (accepted as a poster)

4.5 Tonnes of Food Wasted Across a Hospital Ward: A Service Evaluation of Dietary Intake and Food Waste - K Marsh1,2; A Avery1; O Sahota2.

1. School of Biosciences, Nottingham University; 2. Department of Health Care of Older People, Nottingham University Hospitals NHS Trust.

Introduction: Malnutrition is a debilitating condition in hospitalised older people. There has been limited studies exploring dietary intake and oral nutritional supplement (ONS) compliance in these people. The purpose of this service evaluation was to observe daily energy and protein intake, plate waste and ONS compliance and to report food waste at ward level.

Methods: Three-day dietary (food-only) intake and plate waste of 19 older (≥ 65 years) people on a hospital trauma and orthopaedic (T&O) ward were assessed. Patients were categorised as 'nutritionally well' or 'nutritionally vulnerable' as per British Dietetics Association's (BDA) Nutrition and Hydration Digest criteria. Dietary intake was calculated by a Dietitian and compared with adjusted BDA standards to exclude energy and protein from drinks. Ward plate and food trolley waste were weighed after lunch and supper for five days. Thirty-three ONS from 11 patients were collected before disposal and weighed.

Results: Mean age of the patients were 84 ± 9 years (9 female, and 10 male) with the most common injury hip fracture (68.4%). Mean (standard deviation, SD) intake for 'nutritionally well' was 1592 (257) kcal/day and 65.7(8.5) g/day protein and 'nutritionally vulnerable' (n= 15) 643 (354) kcal/day and 24.8 (14.0) g/day protein. Plate waste for 'nutritionally well' was 4.1 (5.8)% at main meals and 1.7 (3.4)% at pudding and for 'nutritionally vulnerable' 53.1 (26.6)% at main meals and 38.6 (32.2)% at pudding. Compliance to ONS was 28.3 (38.8)%. The combined mealtime plate waste weighed 6.2 (1.2) kg/day and food-trolley waste 6.2 (0.9) kg/day. This equates to approximately 4526kg/year (4.5T).

Conclusions: Energy and protein intake and compliance to ONS in older T&O patients is sub-optimal. Food waste is high and urgently needs addressing. Further, interventions are warranted to improve dietary intake in hospital and to explore the acceptability of alternative ONS food/drink styles.

Appendix fourteen: European Geriatric Medicine Society Conference 2022 (abstract poster displayed 28/09/2022)

Over 4.5 Tonnes of Food a Year Wasted from the Ward: A Service Evaluation of Dietary Intake and Food Waste in Older Hospitalised Trauma and Orthopaedic Patients

Nottingham University Hospitals NHS Trust

K Marsh[1,2], A. Avery[1] and O. Sahota[2],

1. School of Biosciences, Nottingham University 2. Department for Health Care of Older People, Nottingham University Hospitals NHS Trust.

1 INTRODUCTION

Malnutrition is a debilitating condition in older hospitalised people and is associated with many adverse outcomes including longer length of hospital stay and increased mortality.

A limited number of studies have explored dietary intake and compliance to ONS in these people.

The NHS is the second biggest provider of meals in the UK public sector yet limited literature reports on hospital food waste.

The purpose of this service evaluation was to observe daily energy and protein intake, plate waste and ONS compliance and to report food waste at ward level.

2 METHODS

Data was collected from older (≥ 65 years) T&O patients on one a T&O ward.

Patients categorised as 'nutritionally well' or 'nutritionally vulnerable' as per BDA Nutrition and Hydration Digest criteria.



Three-day observational dietary intake and plate waste (%) of 19 patients was visually estimated.



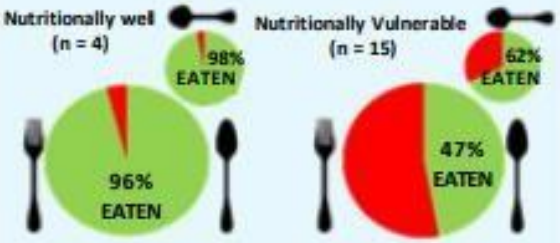
Ward food waste from patients and food trolley weighed (kg) at lunch and dinner for five days.



33 ONS were collected and weighed (g) from 11 patients before disposal.

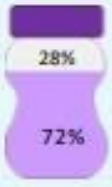
3 RESULTS

Mean age 84 ± 9 years (10 males, 9 females) with the most common injury a hip fracture (68.4%)



1592 ± 257 kcal
65.7 ± 8.5g protein

643 ± 354kcal
24.8 ± 14.2g protein



28% compliance (amount consumed relative to amount prescribed)



Patient waste = 6.2kg/day
Food trolley waste = 6.2kg/day



Approximately 4526kg of food wasted from the ward each year

4 DISCUSSION

Energy and protein intake and compliance to ONS is sub-optimal

Clinical outcomes from ONS depend on patient adherence; however this is as a significant challenge in older T&O patients.

There is need for an enjoyable and acceptable ONS.

High food wastes represents a lost nutritional opportunity and has significant economic and environmental consequences which urgently needs to be addressed to enable preventative measures.

5 CONCLUSION

Inadequate nutrition intake and low compliance to ONS remains a key concern within T&O patients.

There is a need for interventions to improve dietary intake in hospital and explore the acceptability of alterative ONS food/drink styles.

Abbreviations: BDA =British Dietetics Association ONS = Oral nutritional supplements
T&O = Trauma and orthopaedic

Appendix fifteen: Meeting and conferences I have presented my findings

Invited

September 2022 - Pioneering Innovative Food for Seniors, University of Nottingham

September 2022 – Nottingham Annual Osteoporosis Medical update meeting

Oral

December 2022 - British Dietetics Research Symposium. A prospective observational service evaluation of dietary intake, oral nutritional supplement compliance and food waste in older hospitalised trauma and orthopaedic inpatients

November 2022 – International Conference on Nutrition and Food (ICNF). Title: 4.5 Tonnes of Food Wasted Across a Hospital Ward: A Service Evaluation of Dietary Intake and Food Waste

Poster

November 2022 - British Geriatrics Society Autumn Meeting poster presentation, Kirandeep Marsh, Amanda Avery and Opinder Sahota Title: 4.5 Tonnes of Food Wasted Across a Hospital Ward: A Service Evaluation of Dietary Intake and Food Waste

November 2022 - NIHR Nottingham Biomedical Research Centre - poster competition, Kirandeep Marsh, Amanda Avery and Opinder Sahota. Title: 4.5 Tonnes of Food Wasted Across a Hospital Ward: A Service Evaluation of Dietary Intake and Food Waste

September 2022 – European Geriatric Medicine Society, (EuGMS), Kirandeep Marsh, Amanda Avery and Opinder Sahota. Title: 4.5 Tonnes of Food Wasted Across a Hospital Ward: A Service Evaluation of Dietary Intake and Food Waste