

**REVIEW**

# Foodservice systems and mealtime models in rehabilitation: Scoping review

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**Abstract**

**Aims:** To describe current foodservice systems and mealtime care utilized in the rehabilitation setting. A secondary aim was to identify commonly used outcome measures in foodservice research in the rehabilitation setting.

**Design:** A scoping review.

**Data sources:** PubMed, CINAHL, Scopus, Embase, PsycINFO and Cochrane were searched until January 2022.

**Review methods:** The review was conducted according to Joanna Briggs Institute's methodology for scoping reviews. Included studies were conducted in the inpatient rehabilitation setting, adult population  $\geq 18$  years old and provided a description of at least one element of the foodservice system, food and menu, waste and/or eating environment.

**Results:** Of 5882 articles screened, 37 articles were included, reporting 31 unique studies. Most rehabilitation units had cook-fresh production methods (50%), used decentralized bulk delivery methods (67%) had a communal dining room (67%) and had a 3-week menu cycle (71%). Mealtime care was predominantly provided by nursing staff, however few studies reported on specific activities. Nutritional intake was a key outcome measure across included studies (43%), with only six papers reporting on rehabilitation outcomes. Of the intervention studies ( $n = 9$ ), all were aimed at improving nutritional intake through menu or mealtime care modifications; few ( $n = 3$ ) studied changes in rehabilitation outcomes.

**Conclusion:** This scoping review identified a considerable lack of reporting of foodservice and mealtime care systems used in rehabilitation settings in the available literature. Further investigation is required to understand what models of mealtime care are provided to patients and to understand the impact of changes to foodservice and mealtime systems on patient outcomes.

**Patient or public contribution:** No patient or public contribution was necessary for this review.

**KEYWORDS**

foodservices, health services research, mealtimes, model of care, nursing, rehabilitation, scoping review

## 1 | INTRODUCTION

Rehabilitation is the process of 'optimising a patient's self-rated quality of life and degree of social integration through optimising independence in activities, minimising pain and distress, and optimising the ability to adapt and respond to changes in circumstances' (Wade, 2020). Quality nutrition care has long been considered essential for health and recovery and is an essential component of rehabilitation (Butterworth, 1974). Poor nutritional intake and malnutrition remain highly prevalent in the rehabilitation setting, with rates of 30–70% consistently reported since the mid-late 20th century (Arego & Koch, 1986; Marshall, 2016; Strakowski et al., 2002). Consequences of poor nutritional intake include reduced immune function, poor wound healing, deconditioning and extended length of stay, all of which contribute to poorer patient outcomes (Bourke et al., 2016; Marshall et al., 2014; Wells et al., 2020). Further, people commonly require rehabilitation after an acute episode related to chronic disease (e.g. stroke, peripheral vascular disease), highlighting the secondary prevention role of nutrition during rehabilitation. Hospital foodservices play a vital role in providing meals and mealtime experiences during inpatient rehabilitation to optimize nutritional intake and status, promoting better patient outcomes. It is essential to have effective foodservice systems and models of care to support adequate nutritional intake as part of patients' rehabilitation.

## 2 | BACKGROUND

Hospital foodservice relates to all aspects of the provision of food and nutrition to hospital patients, involving food production and distribution, the hospital menu, compliance with nutrition and food safety standards, meal ordering, delivery of main meals and snacks, and the eating environment (Collins et al., 2017; Walton et al., 2012). Production systems utilized in hospitals include 'cook-serve' (where food is cooked on-site and served directly to patients), 'cook-chill' or 'cook-freeze' (where food is prepared in bulk ahead of service, either on- or off-site, and re-thermalized for distribution at time of service) or a combination of both methods (Edwards & Hartwell, 2006; Olney, 2003; Porter & Cant, 2009). Delivery of meals to patients may be centralized (where meals are plated in the kitchen and then delivered to wards) or decentralized (where meal components are distributed to and plated on hospital wards at the time of meal service). Menu design is usually guided by menu standards for the jurisdiction (i.e. local, state or national guidelines) and encompasses decisions around cycle length, choice and variety, number of meals and snacks offered, portion sizes, meal order and meal delivery timing, and suitability for the population's needs (Nutrition and Menu Work Group, 2018). Cost, budgets, available technology, food quality, efficiency of operations and patient satisfaction have been cited as influential factors in designing configurations of foodservice systems (Assaf & Josiassen, 2012; Edwards & Hartwell, 2006) and may constrain the delivery of evidence-based nutritional care

appropriate for all populations. In post-acute inpatient rehabilitation, the configuration of foodservice systems utilized is unclear, therefore warranting further exploration to identify these configurations and evaluate the extent to which they are evidence based.

Mealtime care, covering all activities provided to support, assist and facilitate patients' mealtimes, is a key aspect in achieving optimal nutritional intake and in influencing a positive patient experience (McLaren-Hedwards et al., 2021). This is particularly important in the rehabilitation setting where a high proportion of patients experience barriers to nutritional intake and are dependent on staff to access their food. Eating difficulties in the rehabilitation population have been reported as high as 80% for stroke patients and older adults in rehabilitation, with up to 50% having trouble manipulating food (Westergren et al., 2001; Westergren, Unosson, et al., 2002). It is reported in the literature that competing priorities at mealtimes reduce nursing staff availability to provide appropriate and timely assistance to help patients to eat (Edwards et al., 2016; Xia & McCutcheon, 2006). For this reason, some hospitals have introduced strategies to increase patients' access to mealtime assistance through nursing assistants, healthcare assistants and volunteers (Edwards et al., 2016). The evidence for feeding assistance is largely informed by research in acute care or residential aged care facilities; therefore, it is still unknown how mealtime care is structured and delivered to patients in rehabilitation, in practice.

Whilst there have been several systematic reviews of foodservice and mealtime care delivery across various settings (Dijxhoorn et al., 2019; Edwards et al., 2016), only one review has focused exclusively on the rehabilitation setting (Collins & Porter, 2015). This review determined the effect of various oral nutrition interventions on nutritional intake, however there was no consideration of system-wide interventions, with only food and menu interventions considered (Collins & Porter, 2015). Additionally, rehabilitation wards and/or patients have been included in other reviews examining a specific aspect of care (McLaren-Hedwards et al., 2021), but there has been no review to date that has mapped out all aspects foodservice and mealtime care in rehabilitation. There are key differences in the goals of nutritional care within rehabilitation (e.g. focus on restoring physical and cognitive function, compared to avoiding disease-related malnutrition in the acute hospital setting). As such, there remains a need to map out how foodservice and mealtime care systems are structured and delivered in the rehabilitation setting specifically, and what outcomes are being utilized in the assessment of foodservice and mealtime care research, to inform both research and practice.

## 3 | THE REVIEW

### 3.1 | Aims

The primary aim of this scoping review is to map and review current literature to describe foodservice systems and mealtime models of care in rehabilitation settings and to present the published evidence supporting each configuration. The secondary aim of this scoping

review is to identify frequently utilized outcome measures in food-service and mealtime-based research in rehabilitation settings.

### 3.2 | Design

A scoping review methodology was used to address the aims of the study, to clarify the key characteristics of foodservices and mealtime models of care in rehabilitation and examine how evaluation of these models is conducted (Munn et al., 2018). The scoping review was conducted according to the revised methodology for scoping reviews by Levac and associates (Arksey & O'Malley, 2005; Levac et al., 2010), with the following five steps being undertaken: (1) identify the research question, (2) identify relevant studies, (3) study selection, (4) charting the data and (5) collating, summarizing and reporting the results. Stakeholders were not consulted in this review (sixth step deemed optional by Levac and associates). Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were followed using the extension for scoping reviews (PRISMA-ScR) (Tricco et al., 2018). A protocol was not registered for this scoping review.

### 3.3 | Search methods

The search strategy was drafted by the first author in conjunction with an experienced academic librarian and further refined with the research team. An initial search was conducted to identify key papers in the area and in turn, identify key MeSH terms in PubMed. The search strategy was first constructed in PubMed using the key MeSH terms and then adapted for other databases. The strategy was revised by the research team and commenced in a systematic search of six databases: PubMed, CINAHL, Scopus, Embase, PsycINFO and Cochrane. The search was undertaken by the first author in January 2021 with no date restriction. Table 1 provides the core terms used to develop the search string.

Search strings for databases are included as File S1.

#### 3.3.1 | Inclusion criteria

Primary research studies with empirical data of quantitative, qualitative and mixed methods manuscripts published in a peer-reviewed article, in English, up until January 2022 were considered. Where a

relevant review paper was identified, the reference list was reviewed to identify any additional papers. Similarly, where protocols describing papers relevant to the review were identified, the full publication was included if available. As recommended by JBI methods, inclusion criteria were based on the participants, concept and context described in the following sections.

#### 3.3.2 | Types of participants

Participants comprised any inpatient ( $\geq 18$  years of age) admitted to a rehabilitation ward/unit.

#### 3.3.3 | Concept

The primary concept of interest in this review was the description of foodservice systems and mealtime models of care. The description of foodservice systems was grouped into domains relating to the overall foodservice system (food production, food distribution), the menu (timing of meal orders and service, cycle length, menu items and nutrient composition), waste (production) and the eating environment (the physical and social environment patients' meals are consumed in and type of assistance/care provided to patients). The secondary concept of interest was outcome measures that described foodservice systems and mealtime models of care. Outcomes were categorized as nutritional (e.g. nutritional status, nutritional intake, body composition), foodservice (feedback mechanisms and processes of the foodservice system, e.g. plate waste and satisfaction), rehabilitation (outcomes of rehabilitation services e.g. functional and cognition status), clinical and psychological (e.g. non-nutritional medical and well-being outcomes) or health service (e.g. cost).

#### 3.3.4 | Context

Studies were included if they were conducted in a dedicated inpatient rehabilitation ward or unit. Rehabilitation conducted in the community and outpatient setting (e.g. pulmonary, cardiac) was excluded as patients do not typically receive meals in these settings. Rehabilitation provided in the acute care setting was excluded, due to different goals of care of the foodservice and mealtime care systems. Studies focusing on mental health, drug and

TABLE 1 Terms used to develop search strings

Key term	Synonym terms <sup>a</sup>
Rehabilitation	Convalescence, recovery of function
Hospital	Rehabilitation centre, rehabilitation facility
Subacute care	Post-acute care, progressive patient care, continuing care, long-term care
Foodservices, meal	Menu, food, intake, eating, patient satisfaction, nutrition policy

<sup>a</sup>Synonyms or alternative terms used internationally to describe key terms identified through MeSH headings or international publications.

alcohol rehabilitation, or the paediatric or adolescent population were also excluded.

### 3.3.5 | Screening

The screening of studies was supported by EndNote (Version X9.3.2, Clarivate Analytics, Boston Massachusetts) and Covidence systematic review (Veritas Health Innovation, Melbourne, Australia) software. All search results were compiled into EndNote where duplicates were removed and exported into Covidence to complete title/abstract and full-text screening. All remaining papers were screened independently by AP and a second reviewer (either OW, AY or another dietetics PhD candidate) at both the title/abstract and full-text phase. Conflicts were resolved by team discussion.

## 3.4 | Data abstraction

A data charting form was developed by the first author, components included were based on JBI recommendations and adapted to the aims of this review. Data extracted included title, authors, year published, country of origin, setting, population demographics, aims, methods, inclusion/exclusion criteria, foodservice element, description of foodservice element, intervention details if applicable, outcomes, how outcomes were measured, key findings relevant to the review and limitations. Descriptions of the foodservice systems refer to the standard care provided by the hospitals described in each paper. Data extraction was completed by one reviewer and reviewed by a second reviewer. The research team discussed results and continuously updated the data charting form in an iterative process.

## 3.5 | Quality appraisal

Quality appraisal of included sources of evidence was not conducted as it was not deemed relevant to the objectives of this review.

## 3.6 | Data synthesis

Results were synthesized and reported narratively, according to the concepts reported (foodservice domain and/or outcomes). Where multiple studies were published by the same authors, they were contacted to verify if the studies were conducted at the same location to avoid overrepresentation of those units in the descriptions.

## 4 | RESULTS

A total of 9546 papers were identified through database searches. Of these, 138 articles were included for full-text assessment of

eligibility (refer to PRISMA diagram in [Figure 1](#)). In total, this review yielded 31 studies published across 37 publications dated between 1994 and 2021. Most publications originated from Australia ( $n = 18$ ), followed by the United Kingdom ( $n = 5$ ), Sweden ( $n = 5$ ), Canada ( $n = 4$ ), Japan ( $n = 2$ ), and Denmark, Italy and Greece (each  $n = 1$ ). Geriatric rehabilitation was the primary setting of included studies ( $n = 14$ ), followed by mixed rehabilitation population ( $n = 11$ ), general rehabilitation ( $n = 7$ ), stroke rehabilitation ( $n = 2$ ), orthopaedic rehabilitation ( $n = 1$ ), acquired brain injury rehabilitation ( $n = 1$ ) and spinal cord injury rehabilitation ( $n = 1$ ).

A heterogenous range of study designs were utilized, the most common being observational study designs with cross-sectional ( $n = 8$ ), audit ( $n = 5$ ), cohort ( $n = 2$ ), observational ( $n = 2$ ), longitudinal ( $n = 2$ ) and case series, case-control ( $n = 1$  each) being employed. Nine studies utilized interventional design, and seven utilized qualitative design. Most studies aimed to describe or study associations related to foodservices ( $n = 26$ ), with the mealtime environment ( $n = 11$ ), menus ( $n = 9$ ) and the overall foodservice systems ( $n = 6$ ) being the most studied. Study participants, setting, aims, study design, methods and outcomes are summarized in [Table 2](#). Sample sizes were variable in included studies, ranging from 3 to 313 participants.

## 4.1 | Foodservices and Mealtime Model Description

### 4.1.1 | Foodservice Systems

There were 15 papers which provided a description of the foodservice system covering 20 unique hospital sites ([Table 3](#)), reporting on food production and food distribution systems and timing of meal services. No studies tested changes to or compared differences between foodservice systems. All studies reported that rehabilitation inpatients were provided three main meals; however, frequency of between-meal snacks varied from none to three times per day. The most common meal delivery method in rehabilitation units was bulk food delivery to the ward with decentralized plating ( $n = 8/12$ ), followed by centralized plating in the kitchen and delivery to the bedside ( $n = 4/12$ ). Studies reported using a range of cook fresh ( $n = 5/10$ ), cook freeze ( $n = 3/10$ ) and cook chill ( $n = 2/10$ ) production systems.

### 4.1.2 | Menu and food items

Menu and food item descriptions were provided about 20 rehabilitation sites discussed in 16 publications, which reported on menu cycle length, fortification, energy and protein content of hospital menus, food items provided to patients and texture modification classifications. All studies reporting on menu cycle length reported a three-week menu cycle ( $n = 6/6$ ). Timing of meal choices was provided at point of service ( $n = 2/7$ ), one day ahead of service ( $n = 4/7$ ) or two days ahead of service ( $n = 1/7$ ), with two studies reporting

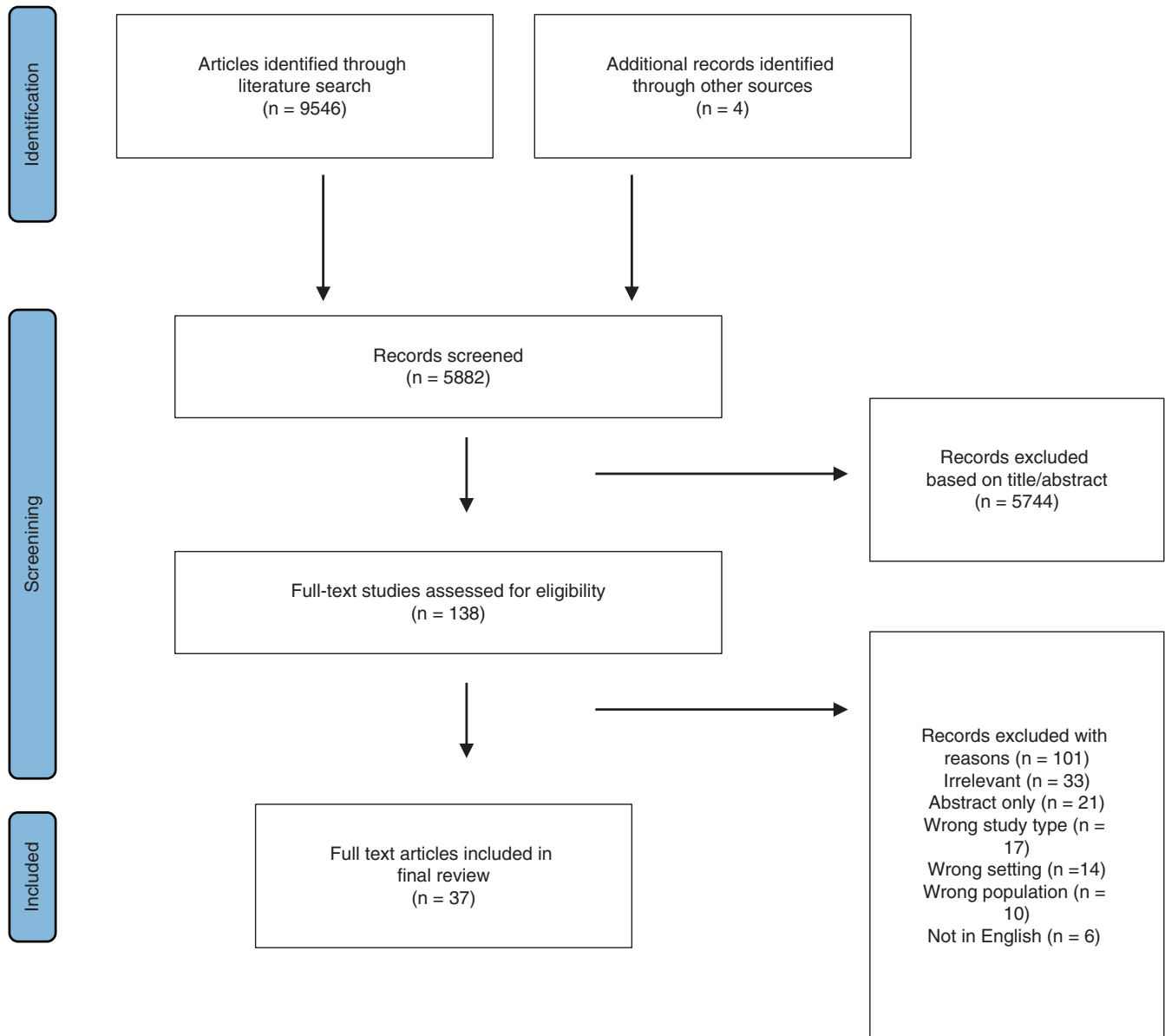


FIGURE 1 PRISMA diagram of search strategy.

that meal orders are placed ahead of service without an indication of timing. Energy and protein content of standard hospital menus ranged from 1550 to 2270kcal and 65–90g protein per day. For ‘high energy and high protein’ menus, the menu content ranged from 2200 to 2650kcal and 80–110g protein. Studies reporting on a menu intervention were meals fortified with either energy and protein ( $n = 4/6$ ), fibre content ( $n = 1/6$ ) or thickened fluids ( $n = 1/6$ ). All interventions aimed to maintain a similar dietary pattern and choices to the standard hospital menu. Nine studies provided a summary of the proportion of patients on special diets (Table 4), suggesting that dietary modification is common in rehabilitation. The most common dietary modification was therapeutic modification of nutrients (e.g. reduction of carbohydrate, sodium, potassium content) prevalent in 10–41% of study participants, followed by texture modification in 2–34.6%, and a diet high in protein and energy in 4.5–29%.

#### 4.1.3 | Waste (production)

There were no papers identified that focused on the management of food waste in rehabilitation.

#### 4.1.4 | Eating environment

The rehabilitation mealtime environment was reported in 20 publications covering 15 unique rehabilitation units. The location of meal consumption was reported for all 15 rehabilitation units, with four sites reporting communal dining room model only, five sites with bedside dining only and the remaining six sites having both bedside and communal dining options available to patients. Where there was a communal dining room model, this was available at all meals in one

TABLE 2 Included study design, setting and patient characteristics

Reference	Methodology	Setting	Population characteristics <sup>a</sup>	Aim
Bannerman et al. (2016)	Audit	Geriatric Orthopaedic Rehabilitation; United Kingdom	N = 175; 62 males and 113 females; age > 65 years	To evaluate food provision and consumption in elderly orthopaedic rehabilitation settings to determine whether nutrition standards are being met
Baptiste et al. (2014)	Semi-structured interview	Geriatric Rehabilitation Unit; Canada	N = 8; 3 males and 5 females; age > 65 years	To explore geriatric patients' perceptions regarding eating at bedside versus in the common dining room
Barton et al. (2000)	Randomized cross-over trial	Geriatric Rehabilitation Unit; United Kingdom	n = 35; 13 males and 22 females; mean age 75-78 years in control and intervention groups	To compare food wastage and intake between the normal hospital menu and one where more energy dense, but smaller portions were provided
Campbell et al. (2013)	Non-randomized control study with three arms	Geriatric and Rehabilitation Unit; Australia	N = 98; 42 males and 56 females; control mean 80.6 ± 6.9 years and intervention mean age 75.8 ± 8.1 years +79.9 ± 2.3 years	To compare three delivery systems of nutrition support to older adult rehabilitation patients and to determine the most effective method based on clinical (weight change, protein and energy intake) and patient-centred outcomes (consumption, quality of life, satisfaction)
Collins et al. (2017)	Parallel controlled pilot study	Geriatric Rehabilitation Unit; Australia	N = 122; 61 males and 61 females; control median age 83 (IQR 75-87) years, intervention median age 84 (IQR 75-88) years	To investigate the effect of a higher energy and protein menu and nourishing mid-meal service intervention has on nutrition-related and clinical outcomes, and patients' satisfaction, and; to estimate the additional cost
Collins et al. (2019)	Secondary analysis of parallel controlled pilot study	Geriatric Rehabilitation Unit; Australia	N = 39; 21 males and 18 females; median age 82 (78-87) years	To explore the longitudinal change in patients' daily energy and protein intake over two weeks and one month of rehabilitation and identify factors associated with change in intake
Domini et al. (2008)	Before and after study, mixed methods	Rehabilitation Unit; Italy	Mean age 67.0 ± 10 in 2002; mean age 53.4 ± 16 years in 2006	To verify over a 5-year period, the catering services quality, checking the effectiveness of the quality improvement interventions undertaken
Dubé et al. (2007)	Observational cohort study	Geriatric Rehabilitation Unit; Canada	N = 32; 11 males and 21 females; 53% aged between 65 and 79, 47% aged >80	To examine the nutritional implications of the interactions taking place between patients and care providers during mealtimes in hospital settings. Specifically, we tested research propositions that the amount and nature of interpersonal behaviours exchanged between patients and providers impact patients' food intake

TABLE 2 (Continued)

Reference	Methodology	Setting	Population characteristics <sup>a</sup>	Aim
Gaff et al. (2015)	Audit	Post-Acute Long-stay hospital (Orthopaedic Rehabilitation); Scotland	N = 58; 12 males and 46 females; age $\geq$ 65 years	To evaluate fluid provision and consumption in elderly patients (>65 years) in a long-stay Scottish hospital and to identify whether current strategies meet the appropriate requirements or whether there is a need for any modifications
Grant (1999)	Audit	Geriatric Rehabilitation Unit; United Kingdom	N = 3; 3 females; age not reported	To audit the use of laxatives on one elderly rehabilitation ward; to assess the average fibre and fluid content of hospital menus over 3 days; and to assess the fibre and fluid intakes of three patients over one day
Iyer et al. (2018)	Cross-sectional	Spinal Cord Injury Centre; Australia	N = 50; 35 males and 15 females; 50% aged between 18 and 50 years, 50% aged >50 years	To explore nutrition knowledge and dietary intake in adults with spinal cord injury (pre and post morbidity), comparing dietary intake to National Guidelines, and; to determine the association between nutrition knowledge and dietary practices, to inform health promotion initiatives in rehabilitation settings to minimize cardiovascular disease risk in spinal cord injury
Jong et al. (2021)	Ethnographic	Subacute wards (general and geriatric rehabilitation); Australia	N/A	To understand and explore staffs' perspectives and experiences of communal dining in subacute care, and the impacts on staff mealtime practice
Kozica-Olenski et al. (2021)	Repeated cross-sectional survey	Rehabilitation (and acute) hospital Australia	N = 40; 25 males and 15 females; mean age 72.6 (13.7) years	To understand patient-reported experience related to mealtime care and food access in the local setting, aiming to evaluate current performance, as well as identify and prioritize future improvement work, in acute and rehabilitation settings
Lorefält et al. (2005)	Case series	Geriatric Rehabilitation Unit; Sweden	N = 10; 4 males and 6 females; mean age 81.7 $\pm$ 3.2 years	To investigate if smaller but energy and protein-enriched meals could improve energy and nutrient intakes in elderly geriatric patients
Markovski et al. (2017)	Prospective observational pilot study	Rehabilitation units (elderly patients); Australia	N = 34; 9 males and 24 females; mean age 79.1 (11.8) years	To investigate the effect of the 'Dining with Friends' programme on energy and protein intake in hospitalized elderly patients, identify whether patient groups at risk of malnutrition could benefit from a communal dining environment and identify patients' preferred environment for meal consumption

(Continues)



TABLE 2 (Continued)

Reference	Methodology	Setting	Population characteristics <sup>a</sup>	Aim
Mathiesen et al. (2021)	Multiphase Pilot trial	Specialized Rehabilitation ward (acquired brain injury); Denmark	N = 17; n = 11 males, n = 6 females; mean age 64.47 (9.19) years	To identify and resolve issues in the existing acoustic environment of a common dining area of a hospital ward; to explore how improvements to the acoustic eating environment, including music playback, affects patients' mealtime experience, behaviour and food intake, and; to examine various musical genres and their appropriateness for eating situations in hospital settings
Monou et al. (2020)	Cross-sectional survey	Rehabilitation Unit; Greece	N = 30; 73.3% men; mean age 53 (17.3) years	To estimate the prevalence of malnutrition in inpatients admitted to a sub-acute rehabilitation unit; to study the association between malnutrition and pressure ulcers; to explore parameters related to development of malnutrition in a rehabilitation setting, and; to estimate the percentage of patients who were offered Oral Nutrition Supplements (ONS) or fortified meals/snacks
Murray et al. (2015)	Cohort study	Inpatient rehabilitation units (stroke patients); Australia	N = 86; 55 males and 31 females; 34% aged 41–64 years, 30% aged 65–75 years, 36% aged >75 years	To measure the average daily beverage intake and hydration status of a cohort of hospitalized patients presenting without dysphagia following stroke to determine whether and to what extent they are at risk of dehydration and adverse health outcomes
Nip et al. (2011)	Cohort study	Stroke Rehabilitation; Australia	n = 100; mean age 69 (15) years	To describe nutritional status and dietary consumption in stroke patients within 2 weeks of hospital admission and before discharge, and by investigating the effects of nutritional and dietary factors on rehabilitation outcomes
O'Hara et al. (1997)	Cross-sectional survey	Continuing Care Units, Geriatric Rehabilitation Units, and Physical Rehabilitation Units; Canada	N = 65; 26 males and 39 females; mean age 66.9 (14.7) years	To identify food, service and patient variables associated with high satisfaction with foodservices in a continuing-care hospital that serves, primarily, geriatric patients and patients undergoing physical rehabilitation
Ogawa et al. (2021)	Case-control	Rehabilitation Wards; Japan	N = 179; 20.1% men and 79.9% women; mean age 86.6 ± 4.5 years	To evaluate skeletal muscle mass changes in patients aged ≥80 years with Vertebral Compression Fracture's (VCF) undergoing rehabilitation, and; to evaluate factors associated with increased skeletal muscle mass in patients with VCFs



TABLE 2 (Continued)

Reference	Methodology	Setting	Population characteristics <sup>a</sup>	Aim
Ottrey et al. (2018)	Ethnographic	Subacute wards (general and geriatric rehabilitation); Australia	N/A	To explore and understand patterns of mealtime culture, environment and social practice from the perspective of staff, volunteers and visitors on the hospital ward
Ottrey et al. (2019)	Ethnographic	Subacute wards (general and geriatric rehabilitation); Australia	N/A	To explore the relationships, roles and responsibilities of staff involved at hospital mealtimes, and their impact on nutrition care
Patch et al. (2003)	Randomized control trial	Rehabilitation Hospital; Australia	N = 63; 17 males and 46 females; mean age for control groups 79 ± 8.0 years +75 ± 10.1 years, mean age for intervention groups 78 ± 7.7 years +76 ± 9.1 years	To assess the efficacy of commercial versus domestically prepared thickened fluids in improving fluid intake for dysphagic patients
Porter et al. (2017)	Pragmatic step-wedged cluster trial	Subacute wards (general and geriatric rehabilitation); Australia	n = 149; Control: n = 82, 33 males and 49 females; mean age 80.5 ± 10.7 years; Intervention: n = 105, 36 males and 69 females, mean age 78.6 ± 12.9 years	To determine if the implementation of Protected Mealtimes (PM) can close the energy deficit of 1900 kJ between estimated requirements and actual energy intake identified in the pilot study for this research
Porter, Wilton, et al. (2016)	Cross-sectional	Subacute wards (general and geriatric rehabilitation); Australia	N = 109; mean age 81.6 ± 8 years	To gain insight into subacute ward practices at mealtimes under usual conditions where no protected mealtimes policy was implemented
Shimizu et al. (2018)	Cross-sectional	Rehabilitation Unit; Japan	n = 188; 71 males and 117 females; mean age 80.6 ± 7.5 year	To clarify the association between Texture-Modified Diet (TMD) intake and decreased skeletal muscle mass, and to identify other factors related to TMD
Sidenvall et al. (1994)	Ethnographic	Rehabilitation and Long-Term Hospital (Geriatric); Sweden	Period 1: n = 18; 5 males and 13 females, mean age 81.5 + 8 years. Period 2: n = 42; 19 males and 23 females; mean age 76 ± 6.5 years	To examine and explain the institutional organization of meals, drawing on Goffman's theory of institutionalized culture, Elias' theory of civilization, Douglas' theory of purity and order and Bourdieu's key concept 'habitus'
Sidenvall et al. (1996)	Ethnographic	Rehabilitation and Long-Term Hospital (Geriatric); Sweden	n = 18; 5 males and 13 females; mean age 81.5 + 8 years	To investigate individual patients' meals in geriatric care with respect both to the intentions of the nursing staff and assessments of patients, as well as to those patients' experiences and the extent to which they expected to be able to influence the meal situation regarding behaviour and table manners, eating competence and diet

(Continues)

TABLE 2 (Continued)

Reference	Methodology	Setting	Population characteristics <sup>a</sup>	Aim
Sidenvall (1999)	Ethnographic	Rehabilitation and Long-Term Hospital (Geriatric); Sweden	n = 42; 19 males and 23 females; mean age 76 ± 6.5 years	To investigate how patients' culturally imprinted values and ideas concerning table manners were expressed in relation to their own deficient ability as well as that of their table mates. Furthermore, the aim was to study the elderly's perceptions of food habits in contrast to food served in the common dining room
St-Arnaud-McKenzie et al. (2004)	Longitudinal	Geriatric Rehabilitation; Canada	n = 32; 11 males and 21 females; mean age 78.8 ± 6.5 years	To study the relationship between hunger and aversion and their respective contribution to food intake; to acquire knowledge on the relationships between each drive and other contemporaneous facets of subjective experience preceding the meal, such as the perception of good physical health, positive mood and pain, and; to study moderators of the relationships between drives and intakes to identify population segments in whom the two drives have the most powerful impact on patients' food intake
Walton et al. (2007)	Audit	Rehabilitation Unit; Australia	N = 30; 14 males and 16 females; mean age 79.2 ± 9.2 years	To calculate the estimated daily energy and protein requirements, and compare these with the provision of foods ordered and consumed by patients; to calculate the contribution of supplements to intakes, and; to identify opportunities for interventions to improve the nutritional care of long-stay inpatient
Walton et al. (2013)	Observational	Rehabilitation Unit (elderly); Australia	N = 30; 14 males and 16 females; mean age 79.2 ± 9.2 years	To describe ward activities which have a positive or negative influence on dietary intakes; to determine the times taken to start and complete meals, and; to make recommendations that would make the ward environment more conducive to eating at mealtimes
Williams et al. (2011)	Audit	Geriatric Orthopaedic Unit; United Kingdom	N = 58; 12 males and 46 females; age > 65 years	To evaluate food provision and consumption in an elderly orthopaedic rehabilitation setting to determine the role different eating occasions play in energy and nutrient intakes in this setting

TABLE 2 (Continued)

Reference	Methodology	Setting	Population characteristics <sup>a</sup>	Aim
Wisten and Messner (2005)	Randomized trial	Geriatric Rehabilitation Units; Sweden	N = 20; Intervention: n = 10; 6 males and 4 females; mean age 74.9 ± 13.6 years. Control: n = 10; 4 males and 6 females; mean age 78.4 ± 8.5 years	To study the effects of a daily consumption of a fruit- and fibre-rich porridge on stool frequency, perceived well-being and the costs for laxatives, when compared with traditional treatment with laxatives, in geriatric patients
Wright et al. (2010)	Cross-sectional survey	Geriatric and Rehabilitation Units (and Residential Aged Care Facilities); Australia	n = 313 (n = 103 geriatric/rehabilitation); 72.1% female; median age 84 (48–102) years	To develop a foodservice satisfaction instrument for residential aged care and geriatric/rehabilitation units
Wright et al. (2013)	Cross-sectional survey	Geriatric and Rehabilitation Units (and Residential Aged Care Facilities); Australia	n = 313 (n = 103 geriatric/rehabilitation), 72.1% female; median age 84 (48–102) years	To conduct a comprehensive analysis of the factors affecting resident satisfaction in the long-term care setting and demonstrate the value of a detailed foodservice satisfaction instrument for quality management

Abbreviations: PM, Protected Mealtimes; ONS, Oral Nutrition Support; TMD, Texture-Modified Diet; VCF, Vertebral Compression Fractures.

<sup>a</sup>Patient characteristics included in table as reported in each study.

study, lunch and dinner only in three studies, with the remaining six studies not reporting which meals were consumed in the dining room. Two studies trialled interventions to the eating environment. One intervention study compared the nutritional intake of patients eating in a communal dining setting with bedside dining (Markovski et al., 2017), and another compared differences in patient's food and fluid intake, experiences and noise level in a multiphase trial of acoustic and music modifications in the communal dining room (Mathiesen et al., 2021).

#### 4.1.5 | Mealtime assistance

Details of mealtime assistance were discussed in 11 papers. Eight of these papers discussed which staff groups were responsible for providing mealtime assistance in 10 unique rehabilitation units. This was reported commonly as a nursing task (n = 8/8), followed by foodservice staff (n = 2/8), healthcare assistants (n = 2/8), volunteers (n = 2/8), dietitians (n = 2/8), orderlies (n = 1/8), visitors (n = 1/8) and other patients (n = 1/8). Staff numbers were only discussed in Dubé et al. (2007) who reported a provider-to-patient ratio of 1:8.9 (95% CI: 8.7–9.2), with providers being noted as nursing staff and orderlies only. Methods for identifying patients' mealtime care needs were not structured and appeared to be made on an ad hoc basis after observation of patients during mealtimes. The type of mealtime assistance was not well reported across the studies and did not appear to demonstrate a structured program of assistance for patients or incorporation of therapeutic activities (i.e. meal preparation, fine motor skills practice). Only two papers provided detail on type of assistance provided in usual care, with assistance being related to menu selection (n = 1), and provision of modified cutlery, special cups and plate guards (n = 1). A study trialling protected mealtime implemented strategies to improve nutritional intake through improved mealtime experiences. This involved identification of patients requiring feeding assistance, increased access to feeding assistance, encouragement provided for patients to eat, ensuring comfortable seating position and ability to reach food items, and bedside trays cleared of non-food items (Porter, Haines, et al., 2016).

## 4.2 | Outcomes

Quantitative outcomes were identified in 30 publications and encompassed nutrition (n = 22), foodservice (n = 19), rehabilitation (n = 6), clinical and psychological measures (n = 5) and health service outcomes (n = 3). Nutritional outcomes included dietary intake of energy (n = 16), protein (n = 16), fibre (n = 2), fluids (n = 4), overall food weight consumed (n = 1), nutritional status (n = 4), weight/weight change/BMI (n = 4), body composition (n = 2) and nutritional knowledge (n = 1). Foodservice outcomes included satisfaction (n = 7), fluid and nutrient provision (protein, energy and fibre) (n = 8), mealtime practices and environment (n = 4) and plate waste (n = 4). Rehabilitation outcomes involved handgrip strength (n = 2),

TABLE 3 Foodservice and mealtime care description

Reference	Foodservice systems			Menu	
	Food production	Food distribution	Meal patterns	timing of meal choice	Menu cycle
Bannerman et al. (2016)	Cook fresh	Centralized plating	3 main meals 3 snacks	Two days ahead of service	3 weeks
	Cook-freeze	Bulk trolley service	3 main meals 3 snacks	Point of Service	3 weeks
	Cook-freeze	Bulk trolley service	3 main meals 3 snacks	One day ahead of service	3 weeks
Baptiste et al. (2014)	—	—	—	—	—
Barton et al. (2000)	—	—	—	—	—
Collins et al. (2017, 2019)	Cook chill	Centralized plating, trolley for mid meals	—	Ahead of service, mid meals ordered at point of service	—
Campbell et al. (2013)	—	Bulk service	—	—	—
Donini et al. (2008)	—	Decentralized plating	3 main meals and 1–2 snacks	—	—
Dubé et al. (2007)	—	—	—	Ahead of service	—
Gaff et al. (2015)	—	—	—	—	—
Grant (1999)	—	—	—	—	3 weeks
Iyer et al. (2018)	Cook fresh	Bulk service	3 main meals, no mid- meal service	Point of service	—
Jong et al. (2021), Ottrey et al. (2018, 2019), Porter et al. (2017), Porter, Wilton, et al. (2016) <sup>c</sup>	—	Centralized plating	3 main meals, 2 mid meals	—	—
Kozica-Olenski et al. (2021)	—	—	—	One day ahead of service	—

			Mealtimes and eating environment		
Menu choice offered	Energy and protein provided	Fluid provision	Mealtimes	Eating environment	Mealtime assistance
Yes	1760kcal and 68g protein <sup>a</sup>	—	Bf: 8 am Lunch: 12.30pm Dinner: 6 pm	—	—
Yes	1251kcal and 41g protein <sup>a</sup>	—	BF: 8 am Lunch: 12.30pm Dinner: 5 pm	—	Care assistants provided help with menu selection; Nursing staff facilitated meal service
Yes	1551kcal and 49g protein <sup>a</sup>	—	Bf: 8 am Lunch: 12 pm Dinner: 5 pm	—	—
—	—	—	—	Breakfast served at bedside Lunch and dinner served in communal dining room, choice to 'opt out' of dining room however not made obvious to patients	—
—	2270kcal and 70.3 g protein <sup>b</sup>	—	—	—	Staff available when assistance required
Yes	7450kJ and 85g protein <sup>b</sup>	—	—	Bedside dining	—
—	—	—	—	—	—
No	~2000kcal and ~90g protein <sup>b</sup>	—	Bf: 8.15am Lunch: 12.15 pm Dinner: 6.00pm	Bedside dining in medical wards Aged care wards had bedside dining	—
—	—	—	—	Communal Dining room	Nursing staff and orderlies present during meal service to perform service and provide assistance (average patient-to-provider ratio: 8.9, 95% CI: 8.7-9.2)
—	—	1 L water jugs offered 1-2×/day, fluids from trolley offered 5-5×/day	—	—	—
—	—	—	—	—	—
—	—	—	—	—	—
—	—	—	Bf: 8.00am Lunch: 12.30pm Dinner: 5.00pm	Communal and bedside dining available	Mealtime assistance was provided to patients by nursing staff and/or volunteers; 92.5% of patients who required assistance received it
—	—	—	—	Communal Dining	No structured program, assistance provided by nursing staff with some support from healthcare assistants

TABLE 3 (Continued)

Reference	Foodservice systems			Menu	
	Food production	Food distribution	Meal patterns	timing of meal choice	Menu cycle
Lorefält et al. (2005)	—	—	3 main meals, 2 mid meals	—	—
Markovski et al. (2017)	—	—	—	—	—
Mathiesen et al. (2021)	—	—	—	—	3 weeks
Murray et al. (2015)	—	—	—	—	—
Nip et al. (2011)	—	—	—	—	—
O'Hara et al. (1997)	—	—	—	—	—
Ogawa et al. (2021)	—	—	3 main meals	—	—
Shimizu et al. (2018)	—	—	—	—	—
Sidenvall (1999), Sidenvall et al. (1994), Sidenvall et al. (1996)	—	Decentralized plating	—	—	—
St-Arnaud-McKenzie et al. (2004)	—	—	—	—	—
Walton et al. (2007) and Walton et al. (2013)	Cook chill	—	—	—	—
	Cook fresh	—	—	—	—
	Cook fresh	—	—	—	—
Williams et al. (2011)	—	Centralized plating	3 main meals, 3 mid meals	—	—
Wright et al. (2010) and Wright et al. (2013)	Cook-freeze	Decentralized	—	One day ahead of service	One week
	Cook-fresh	Decentralized	—	One day ahead of service	One week

Note: Data are derived based on the standard care described in papers, interventions or special diets were not used in descriptions. Some papers included descriptions of multiple rehabilitation sites, each new line represents a unique rehabilitation site.

Where one rehabilitation site was described across multiple publications, these were grouped together to avoid overrepresentation.

<sup>a</sup>Based on patient data.

<sup>b</sup>Based on foodservice data.

<sup>c</sup>Two wards reported on, however unable to distinguish systems used in each to report on separately.

			Mealtimes and eating environment		
Menu choice offered	Energy and protein provided	Fluid provision	Mealtimes	Eating environment	Mealtime assistance
–	2150kcal <sup>b</sup>	–	Bf: 8 am Lunch: 12 pm Dinner: 5 pm	–	–
–	–	–	–	Bedside dining	–
No	–	–	–	Communal and Bedside dining available	–
–	–	1 L water jug 1x/day, 150–250ml drinks provided 6x/day	–	–	–
–	6500kJ and 65 g protein <sup>a</sup>	–	–	–	–
Yes	–	–	–	Bedside dining	–
–	–	–	–	–	–
–	1600kcal and 55 g protein <sup>a</sup>	–	–	–	–
No	–	–	–	Communal dining for all meals	Enrolled nurses responsible for practical work at mealtimes and registered nurses responsible for the 'show'; Special feeding cups, modified cutlery, and plate guards available to promote independence
Communal dining room					
–	10,103kJ +95 g protein <sup>a</sup>	–	–	Bedside dining, communal dining room available for lunch and dinner	Assistance was observed to be provided by nursing staff, foodservice staff, visitors, researchers, and other patients for bedside dining; Mealtime assistance activities not described in detail for communal dining
–	–	–	–	Bedside dining, communal dining room available for lunch and dinner	–
–	–	–	–	Bedside dining	–
–	1760kcal and 68 g protein <sup>a</sup>	–	–	–	–
Yes	–	–	–	–	–
Yes	–	–	–	–	–



TABLE 4 Proportion of included study participants on different hospital diet codes

Reference	Full (%)	High protein high energy (%)	Vegetarian (%)	Texture modification <sup>a</sup> (%)	Therapeutic modification <sup>b</sup> (%)	Combination (%)	Nil by mouth (%)
Collins et al. (2017)	54.1	—	1.6	9.8	34.4	—	—
Collins et al. (2019)	54	—	—	5	41	—	—
Iyer et al. (2018)	84	—	4	2	10	—	—
Markovski et al. (2017)	27	29	—	3	33	9	—
Monou et al. (2020)	84.7	11.5	—	—	—	—	3.8
O'Hara et al. (1997)	35	—	—	15	39	11	—
Shimizu et al. (2018)	65.4	—	—	34.6	—	—	—
Walton et al. (2007)	40	13	—	13	—	34	—
Wright et al. (2010) <sup>c</sup>	72.5	4.5	—	4.8	15.4	—	—

<sup>a</sup>Texture modification refers to soft and bite sized, minced and moist, and pureed according to International Dysphagia Diet Standardization Initiative.

<sup>b</sup>Therapeutic modification refers to sodium, potassium, phosphate, diabetic diets, fluid restriction and other restrictions.

<sup>c</sup>2.9% of participants were not sure of diet code, or item was missing from the survey.

measures of functional ability ( $n = 6$ ), therapy time ( $n = 1$ ) and index of rehabilitation efficiency ( $n = 1$ ). Clinical outcomes were reported in four publications and comprised length of stay, urinary tract infection, dehydration/hypernatraemia, constipation, stool frequency, use of laxative therapy, abdominal discomfort and discharge destination. Psychological outcomes included quality of life ( $n = 1$ ) and psychosocial changes ( $n = 1$ ). Health service outcomes covered cost assessments (cost of implementation and cost efficiency assessment) ( $n = 2$ ). Table 5 displays outcome details of each study and key results.

Three qualitative studies reported over seven papers (Baptiste et al., 2014; Jong et al., 2021; Ottrey et al., 2018, 2019; Sidenvall, 1999; Sidenvall et al., 1994; Sidenvall et al., 1996) and one mixed-methods study (Mathiesen et al., 2021) discussed outcomes related to the eating environment ( $n = 8$ ). Attitudes and perspectives, and actions and behaviours were explored in three studies each, and values and beliefs were explored in two studies. Six publications reported on two separate ethnographic studies investigating mealtime culture, environment and relationships. Two further publications utilized semi-structured interview methods to discuss perspectives on the mealtime environment, specifically the physical location (Baptiste et al., 2014), and the acoustics and presence of background music in the communal dining space (Mathiesen et al., 2021). One of the ethnographic studies collected data from the staff perspective, including all healthcare staff, visitors and volunteers, involved in nutrition care or were present during mealtimes (Jong et al., 2021; Ottrey et al., 2018, 2019). The other ethnographic study examined both patient and staff perspectives, for which the latter involved nursing and orderlies (Sidenvall, 1999; Sidenvall et al., 1994, 1996).

## 5 | DISCUSSION

The aims of this review were to identify the variety of foodservice systems underpinning mealtime care in the rehabilitation setting

and to collate the breadth of outcome measures used in this setting. The findings from the 37 included publications indicated rehabilitation settings utilized a range of different models of care with varying combinations of foodservice systems. No study provided a complete description of the foodservice system and mealtime care, with areas including specific mealtime care activities performed and waste management omitted. Overall, mealtime care appeared to be provided in an unstructured manner on an ad hoc basis, primarily by nursing staff. Most studies were observational descriptive studies ( $n = 28$ ), with few ( $n = 9$ ) focusing on interventions. Importantly, of these intervention studies, all were aimed at improving nutritional intake through menu or mealtime environment and care modifications, with few ( $n = 3$ ) focusing on how these changes impacted patients' rehabilitation outcomes. It remains unclear whether changes to foodservice systems influence rehabilitation outcomes for patients, highlighting a clear gap in the literature.

Health service delivery is typically informed by evidence from the published literature or local 'best practice' guidelines. However, in the rehabilitation setting, the scientific evidence base for foodservice is limited and often extrapolated from other settings or based on expert opinion (Queensland Health, 2020). Most studies (75%) reported the use of decentralized bulk service plating, which is considered best practice in relation to improved nutritional intake with point of service meal ordering and provision (Kelly, 1999; Mahoney et al., 2009; Wilson et al., 2001). The use of hospital menus with variable amounts of choice and ordering 1–3 days ahead of service were not in line with best practice or available evidence from other hospital settings. Latest evidence from the acute care setting indicates visual or spoken order collection at the point of service using electronic systems is associated with better nutritional intake, decreased waste and higher levels of patient satisfaction (MacKenzie-Shalders et al., 2020; Mahoney et al., 2009; Maunder et al., 2015; Ottrey & Porter, 2017). Both production and plate waste are important feedback mechanisms within the foodservice system, with higher rates demonstrating significant implications for the nutritional

TABLE 5 Included studies outcome measures and key outcomes

Reference	Foodservice domain	Outcomes/measures	Results
Bannerman et al. (2016)	Foodservice systems; Menu; eating environment	<i>Nutritional outcomes</i> ; Intake measured through weighed plate waste	Hospital A - provision of 1760kcal 68 g protein and consumption of 1349kcal 51 g protein; Hospital B - provision of 1251kcal 41 g protein and consumption of 990kcal 32 g protein; Hospital C - provision of 1551kcal 49 g protein and consumption of 1087kcal and 35 g protein. Patients consumed on average 74% of food provided to them, regardless of provision amount
Baptiste et al. (2014)	Eating environment	<i>Foodservice outcomes</i> ; semi-structured interviews	Themes related to 'factors influencing dining location', 'benefits of communal dining room', 'benefits of bedroom dining' and 'preferences for dining location'
Barton et al. (2000)	Menu; eating environment	<i>Nutritional outcome</i> ; Intake measured through weighed plate waste	The fortified menu provided 332 kcal ( $p < 0.001$ ) + 2.1 g protein more than the normal menu, and the cooked breakfast menu provided 365 kcal ( $p < 0.001$ ) + 12.8 g protein ( $p < 0.05$ ) more than normal menu. The fortified menu had statistically significant reductions in plate waste of 281 g (27%) compared to 420 g (34%) and 420 (36%) in the normal and cooked breakfast menu, respectively
Campbell et al. (2013)	Foodservice system	<i>Nutritional outcomes</i> ; Intake assessed via dietitian analysis of food charts, weight change <i>Foodservice outcome</i> ; Patient satisfaction assessed via validated questionnaire measuring domains of sensory qualities, perceived benefit and impact <i>Clinical and psychological outcome</i> ; Quality of Life (QoL) assessed using EQ-5D questionnaire; <i>Health service outcome</i> ; Cost-Assessment assessed via time-in-motion method, efficiency determined by comparing food and labour costs with intake (per 100kcal) and consumption (supplement intake minus wastage)	Traditional supplements yielded no significant changes, however when assessed by kcal/kg and percentage of total requirements proved to be more efficacious ( $107 \pm 26$ , $128 \pm 35\%$ ) ( $p = 0.003$ ) compared to mid-meal trolley; MedPass increased overall QoL by 12.4 points ( $p < 0.05$ ), intake was higher than mid-meal trolley ( $109 \pm 28$ , $126 \pm 38\%$ ) ( $p < 0.001$ ); Mid-meal trolley had higher satisfaction, improved QoL on the EQ-Index by 0.31points ( $p < 0.05$ ) and was the most cost efficient ( $\$0.81/100\text{kcal}$ consumed), however patients did not meet energy or protein requirements ( $85 \pm 25$ , $88 \pm 26\%$ )
Collins et al. (2017)	Foodservice systems; menu	<i>Nutritional outcome</i> ; Weight change, energy and protein intake measured via visual estimation of plate waste <i>Rehabilitation outcome</i> ; Hand Grip Strength (HGS) measured with hand dynamometer; functional ability measured via Functional Independence Measure (FIM) tool <i>Foodservice outcome</i> ; Foodservice Satisfaction measured via the Acute Hospital Foodservice Satisfaction Questionnaire (AHFSQ) <i>Clinical outcomes</i> ; Length of Stay (LOS), discharge destination <i>Health service outcome</i> ; Cost of implementation	Weight change - 1.4 vs 1.7 kg ( $p = 0.798$ ); Energy intake - 7217kJ/day vs 7795kJ/day ( $p = 0.218$ ), 105kJ/kg/day vs 132kJ/kg/day ( $p = 0.003$ ); Protein intake - 76g/day vs 80g/day ( $p = 0.598$ ), 1.1 g/kg/day vs 1.4 g/kg/day ( $p = 0.035$ ); HGS - 1.4 kg vs 1.7 kg ( $p = 0.798$ ); Foodservice Satisfaction - high in both groups with no significant difference between groups for food quality ( $p = 0.743$ ), meal service ( $p = 0.559$ ) or staffing and service ( $p = 0.816$ ) scores, however physical environment was significantly higher in the intervention group ( $p = 0.013$ ); Discharge Destination - discharged to higher level of care intervention $n = 23$ , 53.5%; control $n = 20$ , 43.5%, $p = 0.345$ ; Cost of implementation - £4.15/participant/day, consisting of labour (1.25 h/day for 16 participants costing £16.94/day) and food and drink costs (£3.09/participant/day cost difference between a default intervention and standard menu). Linear regression modelling for FIM - $R^2 = 0.098$ , adjusted $R^2 = 0.047$ , SEE = 13.391; and LOS - $R^2 = 0.134$ , adjusted $R^2 = 0.086$ , SEE = 13.844

(Continues)

TABLE 5 (Continued)

Reference	Foodservice domain	Outcomes/measures	Results
Collins et al. (2019)	Foodservice systems; menu; eating environment	<i>Nutritional outcome</i> ; Intake measured via visual estimation of plate waste	Admission vs day 14 (n = 39): 6177 (1879) KJ + 63.7 g vs 7213 (1903) kJ + 76.4 (23) g, ( $p < 0.001$ , $p = 0.003$ , respectively). Admission vs day 14 vs day 28 (n = 12): 6021 (2392) kJ/day + 58.4 (30.4) g vs 048 (2379) kJ/day and 57.3 (24.8) g vs 6431 (2656) kJ/day and 69.4 (32.8) g ( $p = 0.099$ , $p = 0.129$ )
Donini et al. (2008)	Foodservice system; menu; eating environment	<i>Foodservice outcomes</i> ; Objective measures: meal order accuracy, proper distribution of food, route time, food weight, food temperature; plate waste and quantitative/qualitative errors <i>Subjective measures</i> : two questionnaires were verbally administered to patients regarding the place where the meal was eaten, the possibility of having alternatives to the basic menu, opinions about the menu variability, how the meal was served, if timetables were respected, the food quantity, the cooking quality, the food temperature and the hygienic standards, answers were given on a 4-point Likert scale of either true to false or good to bad depending on the question	572 meals (objective) and 591 interviews (subjective) were completed in total over the 5 years- results are reported as 2002 vs 2006 results. <b>OBJECTIVE</b> : Significant reductions in errors for food weight portioned in both regular and therapeutic diets for lunch and dinners in first course (R:16.2% vs 2.5%, T:40.2% vs 5%) and second course (R:17.8% vs 7.5%, T: 50.8% vs 7.5%), increases in errors for regular diets with side dish (16.8% vs 25%), bread (1.3% vs 5%) and fruit (1.3% vs 17.5%). No significant changes in qualitative errors, however substantial differences between 'no respect for timetables' (2.8% vs 39%) and 'improper trolley supply' (87.5% vs 28.3%). Temperature significantly increased for regular diets in the first (39.1°C vs 70.6°C) and second (35.2°C vs 51°C) courses, and in therapeutic diets for first course (32.2°C vs 53.2°C) and second course (38.3°C vs 48.2°C), however significantly decreased in the therapeutic side dish (62°C vs 46.3°C). <b>SUBJECTIVE</b> : Significant increases to proportion of patients satisfied with variability of menus (4.3% vs 44.8%, $p < 0.05$ ), presentation of dishes (22.2% vs 37.9%, $p < 0.05$ ), satisfaction with utensils (9.6% vs 69%, $p < 0.05$ ), optimal food temperature (41.2% vs 75.9%, $p < 0.05$ ), well-cooked food (35.3% vs 58.6%, $p < 0.05$ ), hygienic service (32.2% vs 75.9%, $p < 0.05$ ), and overall rating of day of survey completions food (18.1% vs 48.3%, $p < 0.05$ ) and significant decreases were shown in satisfaction with consideration of place of meals (64% vs 48%, $p < 0.05$ ), timeliness of meal distribution (79.6% vs 72.4%, $p < 0.05$ ), quantity of salt (63.3% vs 41.4%, $p < 0.05$ )
Dubé et al. (2007)	Foodservice system; eating environment	<i>Clinical and psychological outcome</i> ; Interpersonal behaviour - assessment based on the Interpersonal Circumplex Model for bidirectional behaviour between staff and patients was recorded. <i>Nutritional outcome</i> ; Food intake via visual estimation using the Comstock scale Hunger scored on continuous visual analogue scale with sliding rules	N = 1420 meals observed. Meals with more frequent interpersonal behaviours demonstrated more positive deviations from protein and energy intake (0.087, CI 0.013, 0.161, $p = 0.022$ ). Participant's agency score was associated with positive deviations from protein (0.321, CI 0.045, 0.596, $p = 0.023$ ) and energy (6.702, CI 0.864, 12.540, $p = 0.025$ ). Greater communion behaviours shown by both patients and providers resulted in positive deviations from protein intake (0.230, CI 0.050, 0.410, $p = 0.013$ )
Gaff et al. (2015)	Menu	<i>Nutritional outcome</i> ; Intake was measured by deducting any leftover fluids in patients' cups and deducting from the provision amount.	Mean overall fluid provision = 2379 (82) ml, from jugs = 1396 (54) ml, from trolley beverages = 956 (44) ml Mean overall consumption = 1032 (60) ml, from jugs = 514 (36), ml, from trolley beverages = 770 (46) ml

TABLE 5 (Continued)

Reference	Foodservice domain	Outcomes/measures	Results
Grant (1999)	Menu	<i>Nutritional outcomes</i> ; Fluid and fibre content assessed using Englyst and Southgate methods, intake measured via weighed plate waste	Englyst method shows that the normal diet provides adequate fibre, the soft diet does not. No patient met the recommended intake of 18g fibre/day. Fluid intake of two patients was unsatisfactory
Iyer et al. (2018)	Foodservice systems; menu	<i>Nutritional outcomes</i> ; Nutrition knowledge measured through General Nutrition Knowledge Questionnaire-Revised (GNKQ-R), dietary intake assessed via visual estimation of plate waste.	Overall mean GNKQ-R score of 59 (69%) out of 85
Jong et al. (2021)	Eating environment	<i>Foodservice outcome</i> : ethnographic observations and interviews	Themes related to 'benefits to patients', 'logistical and practical limitations' and 'supportive cultural factors'
Kozica-Olenski et al. (2021)	Menu; eating environment	<i>Foodservice outcome</i> ; Mealtime experiences measured using validated mealtime experience tool were administered to patients	3 (8%) had difficulties in food choice, 1 (3%) reported difficulties in organizational barriers, 0 reported difficulties in hunger, 5 (13%) reported difficulties with physical assistance, 3 (8%) reported difficulties with food quality. Rehabilitation patients' highest reported item was 'I have difficulty opening packets and unwrapping food' (n = 13, 32.5%) and 'Choosing the right food is difficult because menu staff do not provide enough information about options' (n = 9, 22.5%)
Lorefält et al. (2005)	Menu	<i>Nutritional outcome</i> ; Intake assessed via 3-day food records	Standard Hospital (SH) menu - average intake of $1864 \pm 513$ kcal/day, $562 \pm 133$ kcal/lunch, $391 \pm 132$ kcal/supper, 70% had intake <80g/p/day, 6 patients had intake below requirements; energy and protein-enriched (EPE) menu - $2562 \pm 490$ kcal/day, $794 \pm 171$ kcal/lunch, $822 \pm 196$ kcal/supper, 90% had intake >80g/p/day; comparison - Daily energy intake higher in EPE menu ( $2562 \pm 490$ kcal/day) than SH menu ( $1864 \pm 513$ kcal/day) ( $p < 0.01$ ) and protein intake was significantly higher in EPE menu ( $-90$ g/day) than the SH menu ( $-75$ g/day) ( $p < 0.05$ )
Markovski et al. (2017)	Eating environment	<i>Nutritional outcome</i> ; Intake measured via visual estimation of plate waste	Intake (CD vs BD): Overall - $2158.3$ kJ ( $813$ ) + $28.2$ (13.3) vs $1723.1$ ( $872.8$ ) + $22.5$ (14.3), difference of $435$ kJ ( $136.4$ , $734$ ) + $5.7$ (1.3, 10.2), $p = 0.006 + 0.01$ ; Dining location preference: dining room 23 (68%), bedside 7 (23%), both 1 (3%), either 1 (3%), unsure 1 (3%)
Mathiesen et al. (2021)	Eating environment; menu	<i>Nutritional outcomes</i> ; weighed plate waste <i>Overall sound pressure level</i> ; <i>Mealtime Behaviour</i> ; social interaction on a 5-point Likert scale from no (1) to lots of interaction (5), influence of intervention on behaviour on a 5-point Likert scale from negative (1) to positive (5), with the midpoint as neutral (4)	Food Intake (Phase 1 vs Phase 2 vs Phase 3): $334.906$ (107.87) g vs $359.7$ (99.83) g vs $338.5$ (100.31) g. Fluid Intake: $282.42$ (60.89) ml vs $327.61$ (143.42) ml vs $342.23$ (89.32) ml. Sound pressure: dB(A) = $64.49$ vs $62.47$ vs $62.9$ , dB(C) = $67.85$ vs $65.53$ vs $66.7$ . Social Interaction: $4.77$ (0.95) vs $4.30$ (1.49) vs $4.6$ (0.84). Behavioural response to intervention: $3$ vs $4.52$ (0.79) vs $4.9$ (0.3). Themes related to 'music panels enhance inter-patient and staff communication', 'acoustic panels enhance physical environment aesthetics and promote 'cosiness' and pleasantness', 'music enhances the physical environment, prolongs meal duration, and the social aspects of the meal activity' and 'patient and staff views on music in hospital settings'

(Continues)

TABLE 5 (Continued)

Reference	Foodservice domain	Outcomes/measures	Results
Monou et al. (2020)	Menu	<i>Nutritional and Foodservice Outcomes;</i> Food intake, nutritional status, nutritional risk parameters and reasons for poor food consumption measured via a modified ESPEN Nutrition Day Questionnaire	Nutritional Status: 33.33% malnourished, 6.67% at risk. Food Intake: 70% of patients consumed almost all their breakfast, 20% consumed half, 10% consumed very little (<1/4) or nothing. 66.7% of patients consumed almost all their lunch, 20% consumed half, 13.3% consumed very little (<1/4) or nothing. 66.7% of patients consumed almost all their lunch, 13.3% consumed half, 20% consumed very little (<1/4) or nothing. 60% of patients consumed food that was not offered by the hospital. Amongst patients consuming little (<1/4) or nothing, 30% declared that they did not like the kind of food offered, 30% that they did not like the smell/ taste, 25% that had anorexia, 5% had problems chewing/ swallowing and 5% that the food offered was not adhering to their religious beliefs
Murray et al. (2015)	Menu	<i>Nutritional outcome;</i> Fluid consumption assessed by recording all beverages consumed <i>Clinical and psychological outcome;</i> Hydration status was assessed via biochemical analysis for blood urea nitrogen (BUN) and creatine ration, a BUN/Cr ratio of >20 was used as the cut-off for dehydration, recorded at day 0 and 7, dehydration-related adverse outcomes of dehydration, hypernatraemia, urinary tract infection and constipation were retrieved from medical notes	Mean fluid intake of who cohort 1504 ml (359 ml). For those with a weight documented only 4 (7.3%) reached required fluid intake, on average participants achieved 67% of their required intake
Nip et al. (2011)	Menu	<i>Nutritional outcome;</i> Nutritional status assessed via Mini-Nutritional Assessment (MNA) and anthropometric indices <i>Nutritional outcome:</i> Nutritional Intake assessed via weighed diet records <i>Rehabilitation outcome;</i> functional ability assessed by the change in Barthel Index (BI) score collected from medical records between admission and discharge, and the Rehabilitation Efficiency index	Nutritional Status - 27% on admission and 13% on discharge classified as well-nourished, overall MNA scores decreased from 21.5 (19.6–24.0) to 19.7 (18.0–23.0) from admission to discharge, $p = 0.005$ . Nutritional Intake - overall intake of 5792 (2883) kJ + 53.6 (20.4) g protein on admission, and for those with data at both time points nutritional intake increased by a mean of 335 kJ + 1.4 g protein per day, however this was not significant ( $p = 0.451$ , $p = 0.285$ ). 10% at both admission and discharge had adequate energy intake, 55% at admission and 61% on discharge met required nutrient intake of protein
O'Hara et al. (1997)	Menu; eating environment	<i>Foodservice outcome;</i> Foodservice satisfaction measured using a hospital department-developed satisfaction survey with 8 items related to aspects of food and foodservices (Q1) presentation of meals, (Q2) taste of food, (Q3) Is hot food hot, (Q4) Is cold food cold, (Q5) temperature of tea/ coffee, (Q6) accuracy of meal trays, (Q7) quantity of food, (Q8) overall satisfaction) All items except Q7 were scored from 1 to 5. For Q1, Q2 and Q3, 1 = very poor and 5 = excellent. For Q4, Q5 and Q6, 1 = never and 5 = always. For Q7, 1 = too much/not enough and 2 = just enough	$N = 40$ was less/not satisfied, and $n = 21$ were very satisfied with the overall foodservices. Individual item scores for less/not satisfied participants' responses: (Q1) $3.9 \pm 0.8$ , (Q2) $3.4 \pm 0.9$ , (Q3) $3.7 \pm 1.1$ (Q4) $3.9 \pm 1.1$ , (Q5) $4.0 \pm 1.0$ , (Q6) $3.8 \pm 1.0$ , (Q7) $0.6 \pm 0.5$ . Individual item scores for satisfied: (Q1) $4.5 \pm 0.6$ , (Q2) $4.3 \pm 0.9$ , (Q3) $4.6 \pm 0.9$ , (Q4) $4.8 \pm 0.7$ , (Q5) $4.6 \pm 0.9$ , (Q6) $4.5 \pm 0.9$ , (Q7) $0.6 \pm 0.5$ . Meal presentation was only item found to predict overall satisfaction explaining 26% of variance ( $F = 17.6$ , $p < .001$ ). Logistic regression identified taste of food (Q2) and cold food cold enough (Q4) as predictors of overall satisfaction

TABLE 5 (Continued)

Reference	Foodservice domain	Outcomes/measures	Results
Ottrey et al. (2018)	Eating environment	<i>Foodservice outcomes</i> ; ethnographic observations and interviews regarding the eating environment	Themes related to the 'system', 'patient-centredness' and the 'disharmonious interrelationship between patient-centredness and system'
Ottrey et al. (2019)	Eating environment	<i>Foodservice outcomes</i> ; ethnographic observations and interviews regarding the eating environment	Themes related to 'defining mealtime roles and maintaining boundaries', 'balancing the need for teamwork and having time and space' and 'effective communication supports role completion and problem-solving'
Patch et al. (2003)	Waste	<i>Foodservice outcome</i> ; Wastage estimated by nutrition assistant using a clear cup calibrated into 10 ml increments	Differences were observed in intake between snack and mealtimes for both the commercial supplement (37.9 + 11 ml and 168.7 + 12 ml, $p < 0.01$ ) and domestically made supplement (17.3 + 10 ml and 167.2 ± 11 ml, $p < 0.01$ ). No significant difference observed between supplement types. A total of 1500 ml of fluids provided to each patient per day, of this 37% was consumed by patients receiving the commercially prepared product and 41% consumed by patients receiving domestically prepared product
Porter et al. (2017)	Eating environment	<i>Nutritional outcome</i> ; Intake measured via visual estimation of plate waste, nutritional status measured via Subjective Global Assessment (SGA) <i>Rehabilitation outcome</i> ; HGS measured with hand dynamometer within 24 h of SGA and intake assessment, functional ability via Functional Independence Measure (FIM) score attained from medical records	<i>Intake</i> - control intake 6532 ± 2328 kJ + 67.0 ± 25.2 vs intervention intake 6479 ± 2486 kJ + 68.6 ± 26.0 g protein. Intake deficits from requirements for control 1392 ± 3037 kJ + 7.1 ± 32.1 g protein and intervention 1116 ± 2967 kJ + 2.6 ± 30.1. <i>Protected Mealtime Fidelity</i> - Positive interruptions (C) $n = 805$ for 18 (5–50) s vs (I) $N = 1016$ for 20 (8–52) s; negative interruptions (C) $n = 579$ for 50 (23–132) s vs (I) $n = 477$ for 54 (23–140) s. Themes related to
Porter, Wilton, et al. (2016)	Eating environment	<i>Foodservice outcome</i> ; Mealtime assistance determined by observers as participants who were unable to complete any aspect of the meal set-up or self-feeding independently, recorded as yes/no per meal service, Interruptions were recorded for each meal service as yes/no, timed with a stopwatch, and categorized as positive if related to encouragement of intake, and negative if hindered food intake. <i>Nutritional outcome</i> ; Food intake was measured using the one-quarter portion method of plate waste analysis	$N = 40$ participants required mealtime assistance, of which 37 (92.5%) received assistance at every meal where it was required and the remaining 3 (7.5%) received assistance only some of the times or none of the times where it was required. $N = 59$ (59%) of participants had positive interruptions for an average time of 6.3 (3–19) min/participant/per day. $N = 80$ (76.2%) of participants had negative interruptions for an average time of 5.4 (2.6–11.3) min/participant/day. Mean intake of 5900 ± 2074 kJ. and 62.9 ± 22.4 g protein meeting 78.7 ± 31.3% of energy requirements and 89.9 ± 39.7% of protein requirements
Shimizu et al. (2018)	Menu	<i>Nutritional outcome</i> ; Nutritional status assessed via BMI and MNA-SF, Nutritional intake assessed by dietitian using food records, body composition assessed via DEXA <i>Rehabilitation outcomes</i> ; functional ability assessed by FIM score	Nutritional Status (well-nourished/at risk/malnourished): Normal - 14 (11.4%)/65 (52.8%)/44 (35.8%), ANT - 1 (2.3%)/17 (39.5%)/25 (58.1%), TMD - 0 (0.0%)/9 (40.9%)/13 (59.1%). Nutritional Intake: Normal - 1346.5 ± 372.3 kcal + 46.3 ± 13.3 g pro, ANT - 1169.3 ± 324.2 kcal + 40.7 ± 11.8 g pro, TMD - 956.8 ± 408.5 kcal + 33.1 ± 13.9 g pro
Sidenvall et al. (1994)	Eating environment	<i>Foodservice outcomes</i> ; ethnographic observations and interviews regarding the eating environment	Themes identified related to 'nursing intentions' for independent and dependent patients, and 'patient experiences' for those who eat with ease, have moderate eating difficulties, and severe eating difficulties

(Continues)

TABLE 5 (Continued)

Reference	Foodservice domain	Outcomes/measures	Results
Sidenvall et al. (1996)	Eating environment	<i>Foodservice outcomes</i> ; ethnographic observations and interviews regarding the eating environment	Themes identified related to 'mind your manners', 'appetite for food' and 'be contented and do not complain'
Sidenvall (1999)	Eating environment	<i>Foodservice outcomes</i> ; ethnographic observations and interviews regarding the eating environment	Themes identified related to 'elderly patients' cultural values', 'nurses and institutionalized culture', 'joint cultural ideas', elderly patients lost habitus', 'nurse' habitus at meals', and 'defective nursing'
St-Arnaud-McKenzie et al. (2004)	Eating environment	<i>Nutritional outcome</i> ; Energy and protein intake measured via visual estimation of leftovers using Comstock scale, nutritional status assessed by Thomas's Protein-Energy Malnutrition Index  <i>Clinical and psychological outcomes</i> ; cognitive status assessed by Mini-Mental State Examination (MMSE) and depression assessed by Geriatric Depression Scale-15. Clinical variables - self-reported appetite (1 = good/normal, 0 = diminished),  <i>Rehabilitation outcomes</i> ; Functional status assessed by the Functional Independence Measure (FIM), severity of impairment assessed by treating team using the Cumulative Illness Rating Scale and use of multiple medications	N = 1477 meals observed. Inverse correlation of hunger and aversion was low ( $r = -0.113$ , $p = 0.001$ ). Hunger and aversion uniquely contributed to food intake ( $p = 0.017$ and $p = 0.032$ , respectively). Protein intake was more sensitive to feelings of hunger and aversion (BIC = -4764). Hunger directly related to perception of being in good physical health ( $r = 0.21$ , $p = 0.001$ ) and in a good mood ( $r = 0.26$ , $p = 0.001$ ). Pain correlated with aversion ( $r = 0.17$ , $p = 0.001$ )
Walton et al. (2013)	Eating environment	<i>Foodservice outcomes</i> ; Eating location recorded as in bed, bedside or at dining room, mealtime assistance recorded as who provided assistance and how many times assistance at meals was provided.  Negative and positive influences were calculated as percentage of each type of influence observed for each meal service.  Meal timings were recorded as time taken from tray delivery to when patient starts to eat, and time taken to eat meals.  Questionnaire was administered to 11 patients, 10 nurses and 1 doctor	Eating location: bedside was most popular at breakfast, dining room most popular at lunch, similar preference for bedside and dining room for dinner. Breakfast was the most negatively influenced meal (40% from difficulty with packaging, 34.5% from medication round, 22% from inappropriate positioning of patient/tray), similar levels of negative influences at lunch and dinner. Nutrition assistants provided the most positive influence at breakfast (14.5%), dietitian at lunch (10%) and visitors at dinner (38%). Occasions of mealtime assistance provided by nursing staff (61), food service assistant (14), visitors (8) researchers (7) and other patients (3). Breakfast took on average 4.5 min ( $\pm 7.9$ ) to commence ( $p = 0.040$ ). Each meal took roughly 20 min to consume. Packages. 40% of patients preferred to eat in a dining room
Walton et al. (2007)	Foodservice systems; menu	<i>Nutritional outcome</i> ; Provision of energy and protein from hospital meals was assessed through recording of food items ordered by patients from the tray tickets and comparison to energy and protein provided as determined through assessment of standard serves nutrient analysis.  Intake assessed via weighed plate waste. All supplements provided to patients were commercially prepared with known weights and nutrient composition, leftover amounts were deducted from that provided to assess consumption	Energy and protein provided 10,103 kJ ( $\pm 2686$ ) + 95 g ( $\pm 32$ ) vs 7029 kJ ( $\pm 2233$ ) + 67 g ( $\pm 25$ ) energy and protein consumed, difference of 3074 kJ + 28 g protein ( $p = 0.000$ ), reflecting ~70% consumed of what was ordered



TABLE 5 (Continued)

Reference	Foodservice domain	Outcomes/asures	Results
Williams et al. (2011)	Foodservice systems; menu	<i>Nutritional outcome</i> ; Provision and consumption of energy and protein was assessed via weighed plate waste over a 24 hr period. Snack consumption and provision was measured via visual observation	1760 (67) kcal +68 (2.6) g protein was provided to patients and 1349 (63) kcal +51 (2.4) g protein was consumed. Breakfast - 397 (15) kcal +9 (0.4) g protein provided and 316 (18) kcal +8 (0.5) g protein consumed. Lunch - 510 (25) kcal +23 (1.1) g protein provided and 380 (26) kcal +17 (1.1) g protein consumed. Dinner - 511 (20) kcal +28 (1.3) g protein provided, and 350 (17) kcal and 20 (1.2) g protein consumed. Snacks - 342 (30) kcal +8 (0.9) g protein provided and 310 (26) kcal +7 (0.8) g protein consumed
Wisten and Messner (2005)	Menu	<i>Clinical and psychological outcome</i> ; Stool frequency and laxative use were recorded by ward staff as per protocol. Discomfort was self-reported following a visual analogue scale from 0 to 10	Days of defaecation without laxatives: 10.7 (SD 4.1) vs 3.2 (5.5) $p = 0.003$ ; Days with defaecation with laxatives (osmotic/stimulant): 0.8 (SD 1.9) vs 5.2 (SD 4.4), $p = 0.009$ . Discomfort: 2.5 (SD 1.8) vs (5.6 (SD 2.6) $p = 0.008$
Wright et al. (2010)	Foodservice systems; menu	<i>Foodservice outcome</i> ; Foodservice satisfaction measured using 61 items on foodservice attributes tested rated on a 5-point Likert scale with a score of 5 representing 'always' and a score of 1 representing 'never'	18 items about foodservices grouped into four factors of 'Meal Quality and Enjoyment' ( $\alpha = 0.91$ ), 'Autonomy' ( $\alpha = 0.64$ ), 'staff consideration' ( $\alpha = 0.79$ ), 'hunger and food quantity' ( $\alpha = 0.67$ ) and an additional 6 items analysed individually. The short version (24 items) explains 64% of variance in foodservice satisfaction
Wright et al. (2013)	Foodservice systems; menu	<i>Foodservice outcomes</i> ; Influence of appetite, timing and amount of meal choice, menu selectivity, menu cycle, production system, meal delivery system and therapeutic diets on foodservice satisfaction	Patient and resident appetite ( $p < 0.01$ ), the amount and timing of meal choice ( $p < 0.01$ ), self-rated health ( $p < 0.01$ ), accommodation style ( $p < 0.05$ ) and age ( $p < 0.10$ ) significantly moderated foodservice satisfaction. High protein/high energy therapeutic diets ( $p < 0.01$ ), foodservice production ( $p < 0.01$ ) and delivery systems ( $p < 0.01$ ) were significant moderators for those with 'fair' self-rated health

Abbreviations: AHFSQ, Acute Hospital Foodservice Questionnaire; BI, Barthel Index; BMI, Body Mass Index; DEXA, Dual Energy X-Ray Absorptiometry; EPE, Energy and Protein Enriched; FIM, Functional Independence Measure; GNKQ-R, General Nutrition Knowledge Questionnaire-Revised; HGS, Handgrip Strength; LOS, Length of Stay; MMSE, Mini-Mental State Exam; MNA-SF, Mini Nutrition Assessment-Short Form; QoL, Quality of life; SGA, Subjective Global Assessment; SH, Standard Hospital.

status of patients, financial and environmental concerns (Edwards & Hartwell, 2003; Williams & Walton, 2011). No studies provided detail on production waste management, highlighting a significant gap in the monitoring of foodservice system sustainability. Integrating sustainable practices into hospital foodservice systems is becoming increasingly important to support both human and environmental health (Carino et al., 2020; Huang et al., 2011). Based on findings in this review, rehabilitation units are providing foodservice systems supported by some evidence-based recommendations, however this is conducted inconsistently. Our findings have international application for facilities delivering rehabilitation care to increase menu choice and reduce timing between meal orders and meal services.

Most rehabilitation units provided both bedside and communal dining, with most of the mealtime care provided by nursing staff. One paper reported on staffing ratios during meal services (Dubé et al., 2007), and there was no clear indication of the type of care provided to patients at mealtimes. Whilst evidence for communal dining is limited, results typically indicate a preference for its use in rehabilitation to promote the return to a homelike

situation, and for its benefits in supporting nutritional intake and socialization (McLaren-Hedwards et al., 2021). The dining location for rehabilitation patients can influence access to mealtime care. The complexity of activities involved in the mealtime process for patients in rehabilitation settings who have physical limitations is highlighted in the literature (Westergren et al., 2001; Westergren, Ohlsson, et al., 2002). There is a clear need for rehabilitation patients to receive supportive mealtime care to promote return of their functioning and independence, however it is unclear if this is being done in practice.

Qualitative studies reviewed identified independence and dignity is paramount to the psychological well-being of patients (Baptiste et al., 2014; Sidenvall et al., 1994, 1996). Furthermore, patients welcome mealtimes that support their limitations without impeding their independence (Jonsson et al., 2021). This review also suggested that mealtime care provided by staff may be mismatched to patients' needs, resulting in completing tasks for patients, rather than supporting patients to complete the tasks themselves (Ottrey et al., 2018). Similarly, review findings identified a lack of clarity in

the description of mealtime care activities, their intended purpose and importantly, the lack of interdisciplinary presence at mealtimes (Bannerman et al., 2016; Barton et al., 2000; Dubé et al., 2007; Kozica-Olenski et al., 2021; Porter, Haines, et al., 2016; Porter, Wilton, et al., 2016; Walton et al., 2013). Communication between disciplines in coordinating patients' care is an essential practice, however this review identified no studies reporting on interprofessional practice or communication to support mealtime care. There is a need to clearly define the role of nursing and other staff groups at mealtimes regarding their involvement in more structured, routine provision of mealtime care, communication of patient care needs, and ensuring mealtime care practices are in line with rehabilitation goals of care.

Mealtime experiences were explored across multiple studies included in this review, from both staff and patient perspectives (Baptiste et al., 2014; Jong et al., 2021; Kozica-Olenski et al., 2021; Mathiesen et al., 2021; Ottrey et al., 2018, 2019; Porter, Haines, et al., 2016; Porter, Wilton, et al., 2016; Porter et al., 2017; Sidenvall, 1999; Sidenvall et al., 1994, 1996; Walton et al., 2013). An incongruence between what the system can provide and what patients need has been highlighted as a prominent issue across the qualitative studies. It was reported that patients often felt they needed to adapt to the system, rather than have the system be designed in a way that was best suited towards their needs (Ottrey et al., 2018). Whilst the structure and regimented process-driven work schedule is necessary for smooth and efficient work processes, it can often conflict with person-centred care (Olufson et al., 2021). This is a long-held issue, identified within two ethnographic studies demonstrating that healthcare decisions are largely driven by healthcare professionals rather than patients (Sidenvall, 1999; Sidenvall et al., 1994, 1996), and these system practices have not kept up with the paradigm shift in healthcare towards person-centred care (Ottrey et al., 2018).

Studies were commonly (43%) conducted with the aim of describing or improving nutritional intakes of the rehabilitation population, indicating nutritional intake is a key outcome across foodservice and mealtime care studies in rehabilitation. Included studies from this review demonstrated inadequate nutritional intake in the rehabilitation setting is still highly prevalent, although at varying degrees of inadequacy. Importantly, this review has identified that assessing the efficacy of interventions on overall nutritional intake alone makes it difficult to identify clinically relevant changes to intakes. Studies conducted by Collins et al. (2017), Campbell et al. (2013) and Porter et al. (2017) all showed insignificant differences in overall intake with their interventions, however when intake was evaluated against requirements or with consideration of body weight, results showed significant outcomes. This highlights the importance of the appropriate selection of outcome and evaluation measures to reveal clinically relevant improvements.

Interestingly, there were only two studies that investigated associations between nutritional status and diet modifications on rehabilitation outcomes (Nip et al., 2011; Shimizu et al., 2018), and only three that used rehabilitation outcomes in the evaluation their

intervention (Collins et al., 2017; Mathiesen et al., 2021; Porter, Haines, et al., 2016; Porter, Wilton, et al., 2016). Nip et al. (2011) and Shimizu et al. (2018) both identified significant differences in FIM scores between studied populations, indicating a correlation between FIM and both texture modification and nutritional status, however directionality of the effect was unclear due to the observational nature of the studies. The insignificant differences found between intervention and control phases in both studies by Collins et al. (2017), Porter, Haines, et al. (2016), Porter, Wilton, et al. (2016) and Mathiesen et al. (2021) are likely due to the nature of the interventions being focused on changes to nutritional intake and not directly affect physical functioning. The strong focus on nutritional intake as outcome measures implies that mealtimes are viewed primarily as a method for delivery of nutrients to patients; however, this may be underplaying the therapeutic value of mealtimes beyond their ability to provide nutritional intake, particularly in the context of rehabilitation. There is a need to identify diet and nutrition-related associations with rehabilitation outcomes, such as functionality or goal attainment. Similarly, there is the need to identify and understand from the patients' perspective, how diet and nutrition influence the patient experience and service outcomes, to provide a highly value-based and effective healthcare service. This is needed to understand if foodservice and mealtime care interventions have the capacity to influence rehabilitation outcomes directly or indirectly through improved nutrition-related outcomes.

## 5.1 | Limitations

As this review required included studies to provide a description of the foodservice system or model of mealtime care, there may be additional studies relevant to the topic of rehabilitation foodservice and mealtimes that have been excluded from this review. Additionally, foodservice and quality improvement research is rarely published in peer-reviewed journals, reflected by the considerable number of conference abstracts identified during the search (i.e. 21 potentially relevant studies excluded as only published as a conference abstract). Therefore, it may be important for future foodservice literature reviews to also include a search of the grey literature. The field of nutrition and dietetics is evolving rapidly. The lack of time limits on publication dates for this review allows us to see trends, but it may emphasize issues that may already be addressed. However, considering the topics raised in earlier papers are still often reported in recent papers (e.g. lack of appropriate and/or timely mealtime assistance), it can be concluded that these issues are still apparent in contemporary rehabilitation settings.

## 6 | CONCLUSION

This scoping review has identified there is a paucity of research describing foodservice systems and mealtime care in rehabilitation

inpatient settings. Elements of foodservice systems in rehabilitation appear to align with best practice recommendations, however there is little empirical evidence that supports these. Research is needed to identify and evaluate evidence-based strategies related to all elements of rehabilitation foodservice systems, in particular production waste management and sustainability. Mealtime care is predominantly provided on an unstructured ad hoc basis, with little integration of therapeutic activities reported. The strong focus on nutritional intake across included studies indicates that mealtimes are primarily viewed as a method to deliver nutrients, reinforcing the minimization of the value of mealtimes. Further research is needed to explore the potential therapeutic value of food and mealtimes in rehabilitation to inform innovations in foodservice systems and mealtime models of care, with the inclusion of outcomes aligned to the goals of rehabilitation.

#### AUTHOR CONTRIBUTIONS

AP contributed to the conception of the study, literature search, data extraction, analyses and interpretation of data and drafting and writing of the manuscript. AY and OW contributed to the conception of the study, reviewing data extraction, analyses and interpretation of data, drafting and writing of the manuscript and overall supervision. All authors contributed to the critical revision of the manuscript. All authors have agreed on the final manuscript.

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#### CONFLICT OF INTEREST

No conflict of interest has been declared by the author(s).

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#### DATA AVAILABILITY STATEMENT

Data available within the article or its supplementary materials.

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