

Review

Nutrition Interventions in Aged Care: The Need and Challenges in the Aged Care Context

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Abstract

Malnutrition and frailty are preventable and reversible. However, a significant proportion of aged care residents live with malnutrition and frailty which have associated complications such as increased falls, hospitalizations, infections, and decreased quality of life. Nutrition and dietary interventions can prevent these issues, however, there a few interventions conducted in this setting and no consensus on the most utilized interventions to improve health outcomes. In a crude literature search, we identified 65 nutrition-related randomized controlled trials worldwide in the aged care setting from 2000 to 2024. Most interventions were conducted in Europe and were oral nutrition supplementation or dietary supplements and/or food fortification. With few published studies, progressing nutrition interventions in aged care may be assisted by the mapping and identification of the key barriers and challenges related to engagement and collaboration with stakeholders and participants and the logistics of the aged care environment including staffing workload and kitchen capacity. Nutrition researchers should consider using process evaluations and qualitative research to map barriers and enablers to implementation in hopes to improve future research.



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Keywords

Nutrition research; aged care; vulnerable groups; malnutrition; aged care

1. Introduction to Ageing and Aged Care Context

1.1 Background

As we age our functional, psychosocial, and physical capabilities decline and we are less able to complete activities of daily living, such as grocery shopping or meal preparation. Additionally, changes in brain function, cognition, psychological wellbeing or cardiovascular health for example, may develop into chronic conditions, or require polypharmacy, potentially leading to increased frailty and disability [1]. Similarly, changes to taste, smell and swallowing affects food satisfaction and intake, potentially leading to malnutrition or sarcopenia [2].

Malnutrition and frailty as the result of decreased food intake have been linked to sarcopenia, increased all-cause mortality, increased hospital stay length and readmission, and loss of independence [3-5]. With loss of independence, greater support may be required such as in-home support services or home care packages i.e., meal delivery service, gardening or home cleaning. Or, where greater support is required, re-location to residential aged care facilities (RACF) with higher levels of care. RACF typically have menus designed by or in collaboration with nutrition and dietetic professionals which rotate seasonally and cater for different texture requirements, energy intakes, allergies and intolerances and offer a hot and cold meal option. These menus also need to be suitable for preparation at a large scale and within a defined monetary budget. Research suggests that the mean energy intakes of aged care residents may be 1,000 kJ/day below estimated energy requirements, micronutrients including dietary fibre, calcium, zinc, magnesium, potassium, and folate are not always met and sodium levels may be exceeded by up to three times the adequate intake recommendation [6].

1.2 Malnutrition and Frailty in the Aged Care Population

In 2017-2018 over 1.3 million Australians received aged care services [7] with the government contributing over \$14 billion AUD, and it is predicted that by 2055 almost 10% of the population globally will need aged care. Research suggests between 75% [6] to 93% [8] of this aged care population could suffer from, or be at risk of malnutrition and up to 50% of the residential aged care population is frail and 40% are pre-frail [9]. However, a South Australian study of 516 permanent residents reported a frailty incidence of up to 95% and moderate to high risks of malnutrition (55%) and sarcopenia (90%) [10]. Therefore, frailty prevalence may be significantly underestimated.

Kellett et al. measured malnutrition rates in RACF residents with up to 26% moderately malnourished and up to 7% severely malnourished [11, 12]. In a study by Gaskill, Black [1] of 350 residents, almost half (43%) were moderately malnourished while 6% were severely malnourished. Further, a cross-sectional study by Chatindiara, Allen [8] indicated 48% of the sample size who were admitted to RACF from the community were malnourished or at risk of malnutrition (45%) at entry to RACF.

1.3 Food Choice in Aged Care

Though strategies exist to prevent and treat malnutrition and improve the nutritional status of aged care residents, research suggests that menus may not meet resident's personal wants and needs which may also impact their poor nutrition status. Various qualitative studies exist that aim to determine RACF residents' perception of food choice and satisfaction. Overall, the literature reports residents are unhappy with the food provided and the lack of choice in menus. Bland food, monotonous menus and bulk processed foods are reasons for dissatisfaction among RACF residents [13, 14]. Residents often opt for more 'extra' or discretionary foods [6] which provide little to no nutritive value but are energy dense as opposed to whole foods from the five food groups of the Australian Guide to Healthy Eating. Interestingly, qualitative research indicates RACF residents would like more freedom of choice in the foods provided and greater access to fresh foods including fruits and vegetables compared to processed foods that are unappealing [14], but there may be barriers such as food safety concerns, food preparation requirements and cost, preventing the provision of these foods. Additionally, there is often little consideration for menus that are multiculturally inclusive [15].

Malnutrition and frailty can be prevented and treated through adequate nutrition. However, there is no consensus on what the most successfully implemented or common type of nutrition intervention in aged care is (Part 1), nor is there a deep understanding of some of the barriers and challenges of recruiting and undertaking nutrition interventions in the aged care setting (Part 2).

2. Part 1: Exploring Nutrition Interventions in Aged Care

Nutrition research including dietary intervention trials aimed at improving nutritional status and reducing the risk of chronic disease conditions is an important strategy in aged care populations. However, there is a vague understanding of what type of nutrition interventions have been conducted in the aged care setting and if there are barriers or challenges for undertaking such research.

As nutrition interventions can target and improve poor nutritional status of RACF residents, a crude literature search was undertaken to determine what the most common nutrition interventions and trials were in aged care. The aim was to identify nutritional interventions which have a measure of nutritional status. Cross-sectional or observational studies that report nutrition status but did not modify nutrition provided were not considered 'nutrition interventions' as studies did not introduce a new intervention or modification to improve nutrition status.

The search was conducted on PubMed database in September of 2024 (Table 1) with specified inclusion and exclusion criteria (Table 2). Titles and abstracts were screened independently by one member of the research team. Articles were subsequently eligible for full-text screening if the contents of the abstract detailed a nutrition or diet related intervention (RCT, pilot study, feasibility study) in an aged care facility. Disagreements were resolved through discussion between two researchers.

Table 1 Search strategies to identify nutrition interventions in aged care.

Terms	Results
"Homes for the Aged" [MeSH] AND intervention	493
"Diet" [MeSH] AND "Nursing Homes" [MeSH]	31
"Diet" [MeSH] AND "Homes for the Aged" [MeSH]	21
"Diet, Mediterranean" [MeSH] AND "Nursing Homes" [MeSH]	5
"Feasibility Studies" [MeSH] AND "Homes for the Aged" [MeSH] AND "Nutrition*"	9
"Feasibility Studies" [MeSH] AND "Nursing Homes" [MeSH] AND "Nutrition*"	17
"Pilot Projects" [MeSH] AND "Nursing Homes" [MeSH] AND "Nutrition*"	40
"Pilot Projects" [MeSH] AND "Homes for the Aged" [MeSH] AND "Nutrition*"	16
Total number of studies identified	632

Table 2 Inclusion and Exclusion criteria of search.

Population	Inclusion: Residential aged care Exclusion: All other settings
Location	Include: Worldwide Exclude: Nil
Language	Include: English Exclude: All other languages
Date	Inclusion: Published from year 2000 onwards Exclusion: Published before 2000
Study design	Inclusion: RCT, clinical trials, pilot study Exclude: Unpublished studies, qualitative studies
Type of study	Include: All nutrition interventions including texture modified diets, oral nutrition supplementation, menu change Exclude: Nil
Type of evidence	Include: Peer reviewed full text articles reporting quantitative, qualitative and mixed methods studies Exclude: Grey literature, opinion papers, narrative reviews, conference abstracts, re-reporting of previous results

2.1 Overview of Nutrition Interventions in Aged Care

A total of n = 632 studies published from 2000 to September of 2024 were identified through the search. During the title and abstract screening process, n = 570 records were excluded and n = 95 were screened for full text. After full-text screening, n = 65 records were considered suitable and met the eligibility criteria (Figure 1).

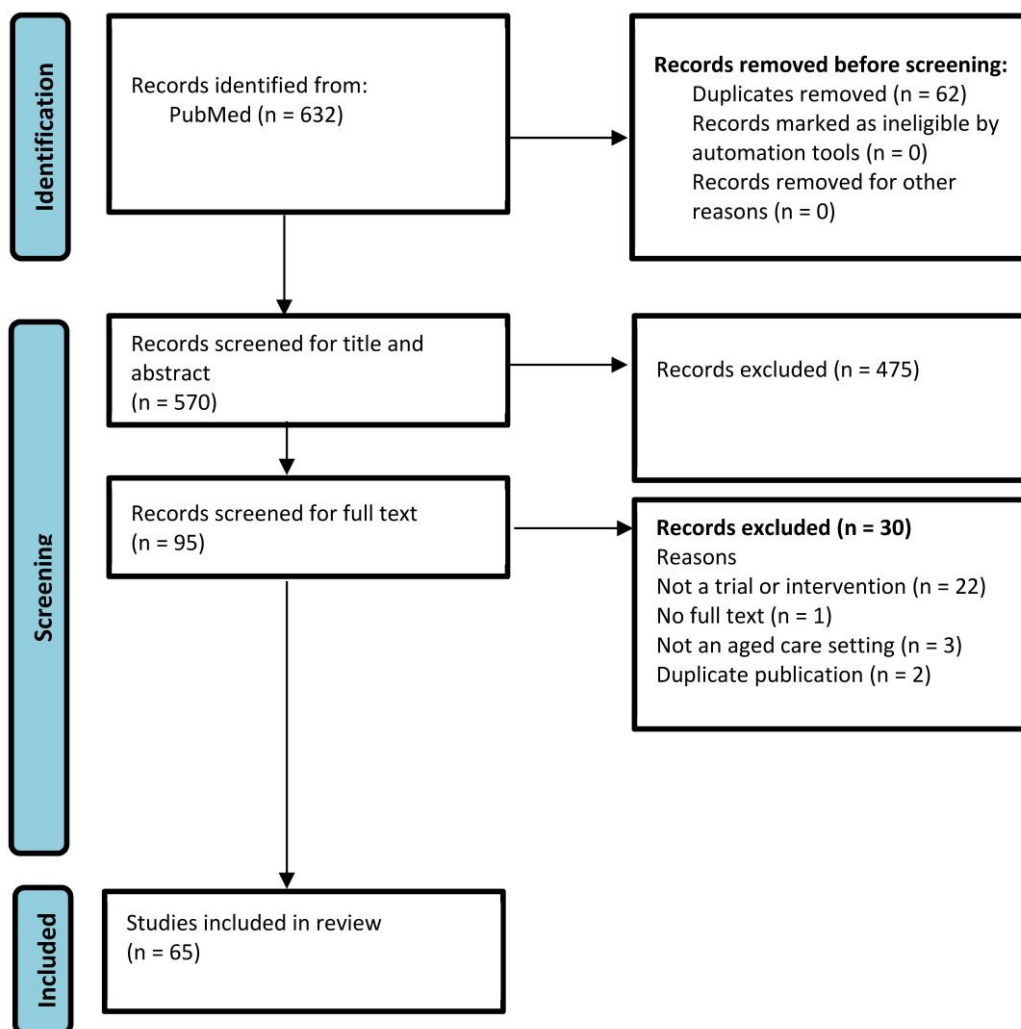


Figure 1 CONSORT diagram of literature review of nutrition interventions in aged care.

2.2 Date of Publication

Between 2000 to 2005 and 2006 to 2010 $n = 13$ and $n = 22$ studies were published, respectively. The remaining studies were published between 2011 to 2015 ($n = 13$), 2016-2020 ($n = 15$) and from 2021 onwards ($n = 2$). No eligible studies were identified from 2024.

2.3 Location of Intervention

Most studies were conducted in Europe or the UK ($n = 31$, 48%) and North America ($n = 17$, 26%). Australia and Asia accounted for $n = 9$ (14%) and $n = 5$ (8%) of the studies, respectively. Only 3 studies (5%) were conducted in South America.

Though the inclusion criteria was specific to aged care and nursing homes, due to including studies worldwide, these settings were also referred to as ‘hostels for the elderly’, ‘sheltered accommodation’ and ‘geriatric hospitals’ in studies. Additionally, some studies included community dwelling participants as part of the cohort.

2.4 Intervention Length and Sample Size

Intervention length varied considerably among studies, ranging from 1 day to 3 years, however, most studies had a length of ≤ 6 months. Similarly, sample sizes differed between studies, ranging from 14 to 7,195 individuals.

2.5 Type of Trial and Nutrition Intervention

Studies included randomized controlled trials, cluster-randomized controlled trials, and pilot studies, some of which had multiple arms.

Most studies ($n = 35$, 54%) were categorized as dietary supplements or food fortification and oral nutrition supplements ($n = 14$, 22%). Changes to meal timing or frequency, targeting food or food groups, texture modified diets and “other” accounted for the remaining 16 (25%) of studies. The “other” studies included multidisciplinary nutritional support [16], meal portioning through a decentralized bulk food portioning system [17], adding monosodium glutamate (MSG) [18, 19] to enhance meal flavour, Tallbinah, - a barley syrup cooked with milk and honey as flavour enhancers [20] and the implementation of a nutrition coordinator [21].

Some studies were a combination of interventions such as a liquid nutrition supplement fortified with vitamins or minerals, or an oral nutrition supplement compared with a high calorie high protein intervention delivered through solid food.

2.6 Oral Nutrition Supplements

Oral Nutrition supplement (ONS) studies included traditional ONS [16, 22-25], liquid experimental formulas (EXP) that were fortified with additional antioxidants [26], B vitamins, selenium and zinc, formulas with oleic and linoleic acid [27] and liquid supplements that were added to foods such as bread, soup and potatoes [28] provided by the aged care facility.

2.7 Dietary Supplements and Fortification

Common supplements introduced in nutrition interventions included zinc, calcium, cholecalciferol, vitamin D, vitamin E, iron, vitamin C, [29-40] amino acid supplements including L-cystine L-theanine amino acids [41], Hydroxymethylbutyrate (HMB), arginine [40, 42, 43] and a multivitamin [44]. Additionally, participants in these studies were supplemented with omega-3 docosahexaenoic acid (DHA) [45], polyphenols [46], probiotics (*Lactobacillus*) [47] or fermented drinks [48], cranberry capsules [49], ginkgo [50], and black chokeberry juice [51]. Fortification studies included additional fibre through oat bran [52, 53], yoghurt and milk powder fortified with calcium and vitamin D [54] and high calorie, high protein products such as brioche buns and cookies [55-58].

2.8 Changing Mealtimes and/or Frequency

The studies that modified mealtimes or frequencies were primarily aimed at improving food intake. One study simulated a family style mealtime with the addition of tablecloths, flower arrangements, choice of meal on the day and served dishes rather than a pre-plated tray [59]. A different study trialed a similar enhanced dining environment experience with music, seasonal

decorations, and tablecloths, but with a buffet style dining program [60]. Finger food [61] and small frequent meals (5 small meals vs 3 traditional main meals) [62] were also among the studies that aimed to improve food intake across the day.

2.9 Targeting Food or Food Groups

Two studies that specifically targeted food or food groups were identified from Australian origin and had a focus on dairy foods. One feasibility study had the aim of providing extra dairy foods to meet 2 serves/day [63] while a cluster-randomised controlled trial aimed to provide extra milk, yoghurt, and cheese [64] to residents to ensure adequate energy, dairy and calcium intake for prevention of malnutrition, hip fractures and falls. Two retrospective sub-studies related to the c-RCT [64] have since investigated the role of these dairy foods on malnutrition and protein insufficiency [65] and serum lipid profiles [66].

2.10 Summary of Findings and Conclusions

A summary of the included papers is in Table S1. Our crude literature search yielded fewer nutrition studies than expected (n = 632 since 2000, n = 65 studies which met our criteria). Additionally, after re-running the search, few papers were identified, indicating a potential lack of progression in this area, or issues with rapid dissemination of study findings. This is typical of RCTs and trials due to the completion of funding after data collection with limited resources and capacity to disseminate results before commencing new studies.

A systematic review of RCTs in Australian nursing homes found 43 interventions from 2000-2018, only two of which were related to nutrition [67]. Most studies were focused on dementia (n = 20), falls prevention (n = 7) and mental health and or psychiatric issues (n = 6) [67]. Similarly, the systematic mapping of RCTs from 1950 to 2009 in care homes found that most studies in this setting were focused on areas other than malnutrition and nutrition [68]. Similarly, the focus of many of the studies included in our review was not directly related to frailty or addressing malnutrition in the aged care setting but included these indicators as an outcome. For example, the studies providing iron and vitamin C supplementation [35], an experimental nutritional formula (EXP) oral supplement [26], L-cystine and L-theanine [41], or a multivitamin and mineral supplement [44] for immune function rather than a focus on improving nutrition status. Similarly, the intervention conducted by Kraft-Bodi, Jørgensen [47] included the provision of a probiotic (*Lactobacillus reuteri*), but for the purpose of reducing the prevalence of oral health (oral *Candida*, saliva plaque, gingival inflammation) in nursing home residents, not for nutrition status or related health outcomes. By our inclusion criteria, these studies are still considered a diet or nutrition intervention, however, they do not explicitly aim to assess or improve nutritional status. Of the 65 studies included, 51 found at least one improvement to a health outcome, 11 found no effect, 2 were protocols only and 1 did not measure any health outcomes. Nutrition markers appear to be secondary outcomes of many studies, rather than a primary outcome. This is despite the aged care setting providing a unique opportunity to intervene in targeting menus and dietary intake. Further, through our search we identified papers which utilize and report results from previously collected datasets of clinical trials as opposed to new and emerging research which further highlights the difficulty of conducting research in this setting and the prompt dissemination of information to inform policy and change.

Most studies in this review were dietary supplements, fortified foods and oral nutrition supplements which indicates these might be the most easily implementable studies in the aged care context. The targeting of whole menus and food groups in research trials seem to be less prevalent in the literature which may be due to issues with recruitment, logistics of the food environment and engaging with the aged care facility. We discuss these potential issues in part two of our review.

3. Part 2: Challenges of Interventions and Nutrition Interventions in Aged Care

The reasons for the limited body of nutritional research in residential aged care are numerous and reflect the many challenges of successfully undertaking studies within this context. Broadly, these challenges can be divided into those relating to:

- 1) Engagement with facilities and care providers.
- 2) Engagement with participating residents.
- 3) Logistical and economic considerations.

Here, we consider each of these groups in turn, examine how they impact nutritional research within residential aged care settings, and discuss how best they can be overcome.

3.1 Engagement and Collaboration with Residential Aged Care Providers

3.1.1 Type of Funding

Residential aged care is provided through a range of models, including state-run public facilities and private for-profit organisations. Approximately three quarters (78%) of aged care services in Australia are funded by the Australian government [7, 69].

Australian Government funded aged care homes, or not-for-profit (NFP) homes receive subsidies to improve the affordability of aged care services. Regulated by the Aged Care Quality and Safety Commission (ACQSC), these facilities provide a range of specialised care services (Aboriginal and or Torres Strait Islander, culturally and linguistically diverse, low socioeconomic status, veterans, care-leavers and LGBTQIA+) and health support (dementia, terminal illness, cultural, spiritual and or ethical food requirements) [69]. Private for-profit organisations, or those that are not funded by the Australian Government do not receive subsidies are regulated by state and territory government and require the full cost by the individual accessing the services.

NFP homes and for-profit homes differ in their revenue structure. The additional revenue from NFP homes is typically re-invested into the organisation whereas private for-profit organisations distribute revenue between various stakeholders (owners, investors, shareholders). The report for the Royal Commission into Aged Care Quality and Safety prepared by the National Ageing Research Institute in 2020 found that Government RACFs and not-for-profit RACF had better resident outcomes compared to for-profit organisations [70]. On average, residents scored higher on questionnaires related to quality of care, consumer choice, general life satisfaction and control, autonomy, self-realisation, and pleasure [70]. Additionally, Government-run and NFP RACFs had lower numbers of concerns or complaints raised. Complaints related to understaffing and staff turnover, questioning staff skill level, food, and catering issues, and feeling lonely and bored [70]. The differences in resident questionnaires and proportion of complaints may indicate a difference in priorities of Government and NFP RACFs when compared to for-profit organisations. Further, a potential difference in the likelihood of taking part in nutrition and dietary research may exist.

3.1.2 RACF Research Involvement

Current Commonwealth funding for research in aged care is awarded by the Australian Research Council (ARC), Medical Research Future Fund (MRFF), National Health and Medical Research Council (NHMRC), the Dementia and Aged Care Services Fund and The Aged Care Centre for Growth and Translation (ACGTR) [71]. However, much less funding is dedicated to aged care research compared to aged health research (non-aged care) [71].

In 2021, The Australian Department of Health commissioned the National Ageing Research Institute (NARI) to identify aged care reforms [71]. There is an increasing recognition that the translation of evidence informed research and policy needs to be integrated into improving the care of older people in the RACF setting. Subsequently, many RACFs have started engaging and partnering with researchers, universities, or creating their own research centres to address research agendas. Resthaven and ECH are two aged care providers that collaborate with a diverse range of research partners, government bodies and consumers and describe a commitment to research excellence to improve current and future reform [72, 73]. Resthaven-funded research, industry collaborations and ARC funding has led to collaborations with COTA SA, Dementia Australia, Geriatrics Training & Research with Aged Care (G-TRAC) Centre, Centre of Research Excellence Frailty and Healthy Ageing, University of Wollongong, Monash University and Flinders University [72]. Additionally, Baptistcare, an aged care provider in Melbourne has several tertiary research partners including Monash University, University of Tasmania, University of Melbourne, and Royal Melbourne Institute of Technology in which various research areas are addressed [74]. The Bolton Clarke Research Institute (BCRI) in Queensland Australia is a high-profile multidisciplinary research institute operating within Australia's largest not-for-profit aged care provider [75]. The BCRI has key priorities relating to person-centred care, co-design, research translation and taking a national approach with research priorities including optimisation of health and wellbeing, combatting loneliness and isolation, addressing mental health, and evaluating the implementation of assistive technology [75]. To our knowledge, none of these research partners or collaborators, have dedicated nutrition and dietetics as a key area of research which could address many of the key issues in aged care such as malnutrition, frailty and declining mental health and quality of life.

The interest from the Department of Health, Royal Commission, and the partnerships between RACF and researchers to improve quality of life for aged-care residents are necessary positive steps. However, challenges still exist. Further, it is unclear whether there is a preference for research collaborations in NFP versus government funded homes, as research agreements need to be signed off on at various levels of management. Research suggests privately-owned RACF may have less flexibility with research involvement as compared to independent NFP facilities, however corporate-wide policy and limited resources may be additional barriers [76].

3.1.3 Staffing Models

Recently, the Royal Commission into Aged Care Quality and Safety report identified substandard care has been experienced by one in three people accessing RACFs or home care services [77]. This substandard care is likely due to poor staffing models as up to 50% of RACF have inadequate staffing. Staffing requirements are typically either mandated minimum levels or appropriate levels (not minimum) and are not regulated. Based on an adaptation of the USA Centers for Medicare and Medicaid Services (CMS) Nursing Home Compare system, over half (58%) of Australians in RACF are

residing in homes with 1- or 2-star staffing levels which is considered an unacceptable number of staff [77]. Alarming, only 1% of homes have 5 stars which is considered best practice. However, the CMS model does not reflect allied health staffing levels [77]. When comparing staffing models to that of British Columbia (Canada), Australia similarly falls short with regards to minutes of allied health services per day. Australian RACF residents on average receive just 8 of the recommended 22 minutes per day indicating substandard allied health staffing in addition to nursing [77]. With low staffing levels according to the CMS and inadequate minutes of allied health services, it is unsurprising that there has been a reduction in the proportion of these employees in RACF. The National Aged Care Workforce Census and Survey in 2016 indicated registered and enrolled nurses decreased by 6.5% and 5.1% respectively compared to 2003 [77]. Similar trends were observed when looking at proportion of allied health professionals and allied health assistants [77]. However, in 2019, the Queensland Government declared the existing minimum nurse-to-patient ratios in hospitals would be expanded into RACFs [77].

Considering the high workload of RACF staff, adding extra 'burden' or responsibility from dietary trials could impact resident care negatively. Potential solutions could include financial compensation through backfilling for time, providing allied health assistants or food service staff to be on site or assist with preparation of food or supplementation depending on the trial and available budget.

3.1.4 Stakeholder Engagement and Building Relationships and Rapport

Engagement with key facility staff and personnel is critical to the success of nutritional research in residential aged care settings [78-80]. Due to their vital role, managers and senior staff can act as champions or facilitators to increase the likelihood of intervention success [81]. Research suggests it is just as important to 'recruit' those in managerial positions and care staff who may have a role in delivering or supporting an intervention. Managers are considered 'gatekeepers' in both the independent living setting and aged care setting. Having engagement with key staff and personnel is critical to implementation success [78-80]. Having open communication and discussions with various stakeholders in the aged care facility will also ensure that the decision for participation is not solely made at the managerial level without dissemination, but that all staff that would be involved directly or affected by an intervention (managers, nursing staff, dietitians, food service and kitchen staff) are aware of the commitments that have been made [80]. Nowson, Jarman [80] identified this as a key issue and discussed that a lack of knowledge and understanding from staff at a facility about a project can act as a stumbling block or block the flow of information. Further, it can cause issues between staff members causing them to lose confidence in the research [80]. Oppositely, when adequate communication between staff and researchers is observed, it can lead to greater implementation success and a willingness to be involved and cooperate [80]. Various strategies and communication avenues should be attempted including telephone calls, email correspondence, staff training, presentations or informative videos, posters and information pamphlets, web pages and teleconferences to appeal to a range of different preferences for information dissemination.

Resistance to change could be addressed through pre-implementation baseline context assessments to understand the organisation's culture, home structure, staffing capacity, and willingness to engage from staff and key stakeholder perspectives [82]. Based on this, context

mapping barriers or potential issues could be identified early on and addressed, resulting in a more tailored implementation plan for an intervention which is likely to be more successful than implementing an intervention without prior stakeholder and organisation consultation [82, 83]. Moreover, knowledge, skills and self-efficacy of staff and stakeholders can compromise intervention success, and result in a low motivation for staff to be involved in research [84]. To combat this, education components or information sessions should be offered to staff or be built into the intervention to ensure all staff have the capabilities to undertake their required duties as part of the research process. Adult learning theory could also be utilised as part of this process to provide a hands-on learning experience.

Additionally, sufficient time is needed to build relationships, negotiate, and plan research within aged care facilities. Even with sufficient time invested into fostering relationships, there is the likelihood of managers declining, or not responding [79]. Declining could be due to a range of reasons including perception of too much burden to engage in research, inadequate facilities or staffing, specific policy against participating in research and structure of the organisation, i.e., is the facility a national group or local authority owned [79].

3.2 Engagement with Aged Care Residents

3.2.1 Finding Suitable Participants

Entry into residential aged care can be triggered by a wide range of support needs. Consequently, there is considerable variation in the physical and cognitive capacity of residents, their nutritional requirements, and their ability to engage with dietary studies. Those in residential aged care also often experience rapidly changing health and care needs, resulting in a population that is highly heterogenous in cross-section, and highly variable when assessed longitudinally. Such heterogeneity must be considered carefully when designing the inclusion criteria for dietary studies. In relation to the participation of an individual in a dietary study, a wide range of factors must be considered. These include the ability to adhere to the dietary intervention being explored which may be impacted by poor dentition, dysphagia, allergies and intolerances, and loss of appetite. It may not be feasible to alter the dietary intervention to address the needs of willing participants.

It is not uncommon for individuals to be wary of researchers especially in the context of an aged care home. Residents themselves or family members may believe that the care provided may be negatively impacted by research or be of no benefit [85]. Further, there may be reluctance to share personal information with researchers needed for the consent process [81]. Consent and information forms should be in layperson terminology, to meet the needs of providing adequate information and fully inform about the study requirements. Though these documents often have requirements by ethics committees to include a range of information which can increase the length, the format and font size of such documents should accommodate for poor eyesight and potentially lower levels of concentration. Further, the use of visual diagrams, tables, and illustrations to convey key messages could be considered to help with the dissemination of complex information.

A reduced ability to communicate due to cognitive and physical impairment can also affect the collection of qualitative outcome measures. However, individuals with mild or severe cognitive impairment may be excluded entirely, or, enrolled in a study by either a legal proxy (next of kin or legal guardians), or staff within the residential facility, i.e., the Director of Nursing or care staff [1, 85]. Effective communication with the families and carers of potential participants is also important,

particularly given the high proportion of those in long-term aged care who experience significant cognitive decline.

Though this area of communication and recruitment for nutrition interventions may be challenging. Qualitative research indicates that many residents are unhappy with the current food provision and available options. Standard 1 of the Aged Care Quality Standards (ACQS) relates to consumer dignity and choice [86]. From the consumer i.e., resident perspective, there should be a sense of ability to make informed choices about their care, including what they are eating. From the qualitative studies that do exist, thematic analyses and evaluation indicate RACF residents have a strong interest in the food provided and are willing to discuss and partake in interviews related to food choice and satisfaction. Due to unhappiness with current food provision and menus, this indicates that residents may be open to active involvement in nutrition interventions.

3.2.2 Informed Consent

Informed consent is a universal requirement for participation in research and an essential element of study ethics. The ability to understand and retain information relating to a research study can be greatly reduced by the cognitive impairment that is common in residential aged care cohorts. In some cases, an individual will be unable to provide informed consent themselves, in which case, third party consent can be sought. Typically, this is provided by next-of-kin or close family members. However, in some circumstances, RACF managers and staff can be utilised to identify suitable participants for research studies [78, 87]. Determining whether an individual is capable of informed consent depends on their cognitive ability, as assessed by a standardised assessment framework include the mini-mental state examination (MMSE), clock drawing test, and Addenbrooke's cognitive examination revised (ACE-R), as dictated by the ethics board [88, 89].

Where longitudinal studies are conducted over protracted periods, participants can experience significant physical or cognitive decline during the study, or changes in wider health, that make their ongoing involvement inappropriate. Identifying such instances relies on close coordination with RACF staff and regular screening assessments throughout the trial period.

3.2.3 Engaging Culturally and Linguistically Diverse Populations and Aboriginal and Torres Strait Islander Australians

Effectively engaging with culturally and linguistically diverse populations (CALD) can be complex with limited research and an underrepresented understanding of the most successful strategies to undertake. Cultural, religious and language barriers can be substantial roadblocks in engaging these populations in aged care research alongside lower levels of health-literacy or understanding of the available services [90-94].

In 2021, there were 36,862 CALD Australians in residential aged care compared to 50,767 who received home care packages and 166,943 consumers accessing home support [69]. Typically, research suggests CALD populations may prefer to be cared for by family members or trusted companions within their own home, as opposed to receiving care externally i.e., aged care services. Results from a qualitative study by Shanley, Boughtwood [91] indicated people from CALD communities may be reluctant to access residential aged care due to safety reasons, unfamiliarity with the services, lack of knowledge regarding their health conditions and the associated implications and upkeeping the cultural norm of remaining at home. Further, in certain countries

and cultures, receiving care assistance from individuals other than family can be viewed highly unfavourably which may deter CALD residents from any forms of research or engagement with researchers [91, 93]. Similarly, low numbers of First Nations elders and Aboriginal and Torres Strait Islander Australians were observed in residential aged care [69]. In 2020-2021, less than 4,000 Aboriginal and Torres Strait Islander Australians received home care services or home care while 22,676 were in residential care in Australia [69]. Aboriginal and Torres Strait Islander Australians have a lower life expectancy and higher rates of disease and dementia compared to Australians of other descent. [95]. Subsequently, Aboriginal and Torres Strait Islander Australians have eligibility to access aged care services at age 50 [95]. But, research suggests they are less likely to engage or access services available, likely due to geographical location and remoteness, financial disadvantage, and an absence in culturally appropriate care services [95]. This highlights the importance of consumer-led research and co-design which is dedicated to finding ways to best engage with Aboriginal and Torres Strait Islander Australians in aged care services to improve health outcomes and improve the representativeness in research [95].

3.3 Logistical and Economic Considerations

A major challenge to undertaking nutritional research in residential aged care is ensuring adequate capacity exists within facilities, particularly in relation to staffing. The ratio of staff to residents is an important consideration in relation to the delivery of care as well as being central to economic management of a care provider.

Furthermore, if a research project requires staff to go above and beyond their usual duties, without adequate compensation then this could cause tension and negative attitudes [76, 87]. Industry-sponsored studies can be planned and budgeted to ensure that the need to backfill staff time, or to employ additional staff members, is addressed. This avoids tension between care responsibilities and duties relating to research projects. In grant-funded academic research studies, it is common for shortfalls to exist in the support available and impact on staff time. It is therefore critical that participating providers and institutions understand this, and that provision is made to prevent the quality of care being impacted.

3.3.1 Staffing and Kitchen Capacity

Various challenges arise when research projects aim to utilise on-site food preparation capacity. Increasingly, the preparation of food on premises, as opposed to delivery of cooked-chilled meals, is favoured to improve food quality. Given the need to prepare food that is appropriate for a wide range of nutritional and consistency requirements, additional capacity to prepare variations relating to study interventions is commonly absent. Research has suggested that that aged care staff (client care staff and catering assistants) may have only up to 6 minutes allocated per resident during mealtimes [14]. This is an important matter when undertaking nutrition interventions that require staff to undertake any training or additional duties considering the mealtimes (breakfast, morning tea, lunch, afternoon tea, dinner, supper, and additional supper) are often meticulously scheduled and inflexible.

Catering for the wide range of nutrition and consistency requirements is also made difficult due to budgetary constraints and the inflexible scheduled mealtimes [14, 96]. Due to the budgetary constraints in RACF and often limited choice of food and beverage items for ordering i.e., a closed

ordering system or pre-defined buying list, collaborators wishing to implement nutrition related interventions should consider dedicating a portion of the research budget to these items or attempt to source food donations from companies.

3.3.2 Implications and Recommendations

Growing recognition of the importance co-designed research.

The principle of co-design is central to the development of appropriate and impactful research. Involving those for whom an intervention is targeting in all stages of the design process helps to ensure that the intervention addresses needs, as opposed to an idea that is primarily of interest to the researchers. Beyond participants themselves, the co-design process should include key stakeholders such as care providers, clinicians, resident families, and other groups who have an interest in ensuring a successful outcome and can provide insight into how best a study can be undertaken. Taking such an approach can greatly improve rates of participation and retention, and the likelihood that a measure will be adopted where it can be shown to be effective.

To achieve this, the establishment of representative steering panels or advisory groups that include those with experience of all aspects of care, both providers and residents, is increasingly seen as an essential component of the study design process. Co-design participants and research participants reportedly find satisfaction in their contributions to science, related to a sense of altruism and improving care or outcomes for future generations [78, 87]. This would be especially integral when considering engaging with CALD communities and Aboriginal and Torres Strait Islander Australians.

Role of process evaluations and qualitative research.

Despite research existing in aged care populations, typically only clinical outcomes are reported. Process evaluations through hybrid clinical-effectiveness trials provide an opportunity to further explain the clinical outcomes and examine implementation outcomes. The Medical Research Council provides guidance on the reporting of process evaluations [97, 98]. Process evaluations address implementation outcomes including fidelity, adoption, appropriateness, barriers, and enablers, and assist with the understanding of intervention success or failure. Corcoran, Nelson [39] discuss the role of fidelity by program leaders and participants in their combined nutrition and exercise program (ENP) as a potential reason as to why there were null findings in outcomes. The program leaders who delivered the intervention were often in a situation with competing demands and were unable to deliver the ENP as intended [39], while the class attendance was 70% in months 1-3 and 66% in months 3-6 meaning the full benefits may not have been experienced by participants [39]. Additionally, the impact of the turnover of program leaders and their background and experience may have been an issue in the implementation of the ENP.

Process evaluations typically include focus groups or semi-structured interviews as a means of qualitative data collection which can provide crucial insight from various stakeholder perspectives. Without process evaluations, researchers cannot be sure that trial outcomes are due to the trial itself, or potential issues with the implementation of the trial at various stages. Supplementary qualitative research to understand barriers and enablers in more detail, and the recruitment process of aged care facilities from multiple stakeholder perspectives.

A recent scoping review of conducting research in aged care highlighted five key factors that influence implementation of interventions or innovations: organisational context, people's attitudes and capabilities, relationships between people, stakeholder engagement and the intervention and its appropriateness [99]. These interconnecting components can greatly impact implementation success and should be addressed in interventions conducted in aged care due to the dynamic nature of this setting. Frameworks and models such as the Consolidated Framework for Implementation Research (CFIR), integrated-Promoting Action on Research Implementation in Health Services Framework (i-PARIHS), Reach, Effectiveness, Adoption, Implementation, and Maintenance (RE-AIM) underpinned by implementation science may be the key to better understand the success and downfalls of interventions in aged care and how best to address barriers to implementation [100].

4. Conclusions

Health issues within RACF such as frailty and malnutrition are common yet treatable. Nutrition interventions and clinical trials therefore should be conducted in aged care facilities despite this being a vulnerable population with implementation and recruitment challenges. Nutrition interventions and clinical trials can be well designed by researchers with sound methodologies, be low burden to the facility, provide likely improvements to health for residents, but still be incompatible at the organisational and staffing level.

Recent commissions from the Australian government have encouraged RACFs to partner with researchers and stakeholders to improve conditions for residents. Engaging management and other staff, clear communication, co-design and implementation, adequate planning time and resource management, especially adequate budget, will improve success of research trials.

4.1 Take Away Points

- There are few randomized controlled trials with a focus on nutrition that exist in the residential aged care setting.
- The most common nutrition interventions in aged care according to our search are dietary supplements or food fortification and oral nutrition supplements.
- The challenges in implementing nutrition interventions can include engagement and collaboration with stakeholders, engagement with aged care providers and logistical and economic variables related to staffing and kitchen capacity.
- Co-design and the role of qualitative research in nutrition interventions are underrepresented and may provide useful insight to improve intervention success.

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Author Contributions

E.L.B. drafted the manuscript and undertook the review. C.R.D., K.J.M. edited and reviewed the manuscript. All authors have critically revised the manuscript and have approved the final version for publication.

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Competing Interests

The authors have declared that no competing interests exist.

Data Availability Statement

Data is available from the corresponding author upon reasonable request.

Additional Materials

The following additional materials are uploaded at the page of this paper.

1. Table S1: Summary of included studies (n = 65).

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