Technology Use in Managing the Nutrition Health of Older Adults:
A Scoping Review

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Abstract

Technology improvements for health care may enable nutritional health management for older adults. Research has yet to map the types of technology utilized to manage nutrition. This scoping review includes research in technology and nutrition to: (1) explain how technology is used to manage the nutrition needs of older adults; (2) describe the types of technology used to manage nutrition. The literature period was 21 years, but 86 percent of the papers retained were published within the past five years. The most common type of technology used is software, which is used to: (1) track, plan, and execute nutrition management and (2) assess technology use. The findings show that software for older adults lacks standardization. The internet of things is a promising area for research, and personal devices emphasize the tablet computer. The results suggest that managing older adult nutrition through technology is not yet a formable research area.

Keywords: Digital health, Gerontology, Literature review, Nutrition, Older adults, Technology.

1. Introduction

The percentage of older adults increases daily worldwide (US Department of Health & Human Services, 2016); however, not all older adults have access to technology. In the US, 25 percent of adults who do not use the internet are 65 years and older (Anderson & Perrin, 2019). Studies show that technology can improve nutrition awareness among older adults (Astell et al., 2014), a population at nutrition risk. Technologies to manage nutrition, such as dietary apps, are not intended to replace nutrition professionals' expertise and social support but enhance the quality and efficiency of nutrition care (Chen et al., 2018). The technology may reduce the risk of age-related health issues, like inactivity and weight loss from improper nutrition (Kaddachi et al., 2018). However, older adults navigate technology differently than other age groups (Magsamen-Conrad et al., 2015). This difference should be considered when adopting new

technology to improve their quality of life (QOL). To date, research has not examined the existing technologies used to manage nutrition of older adults, nor the areas of nutritional concerns that technology can help support.

Physiological changes associated with aging are a primary factor in chronic illness, including cardiovascular, respiratory, neurological, and musculoskeletal disease (Granic et al., 2019). These physiological conditions place older adults at nutritional risk (Dorner & Friedrich, 2018). Age-related changes in taste, smell, and appetite (Somers et al., 2014) can compromise nutrition status and worsen chronic diseases, disabilities, and QOL (Sahyoun, 2017). Appropriate dietary intake can improve biological aging, increase longevity (Burton et al., 2018) and independence, and minimize health care costs (Milte et al., 2015). Health status can vary widely among older adults and using technology to optimize diet quality is critical (World Health Organization, 2019).

A registered dietitian nutritionist (RDN), a food and nutrition expert, can provide evidence-based care to address these barriers. The nutrition care process (NCP) provides a framework for RDNs to provide tailored care (Academy of Nutrition and Dietetics, 2019). The RDN can work with an older adult to identify and treat nutrient deficiencies, achieve an optimal body composition, manage health conditions, and locate food assistance (Saffel-Shrier et al., 2019). Technology can enhance the management of this framework.

The increase in the number of older adults has promoted "aging in place," a practice that allows older adults to live in their community safely, independently, and comfortably (Center for Disease Control and Prevention, 2013). A healthy diet can promote aging in place by preventing or managing chronic disease and optimizing physical functioning and cognition (Parsons et al., 2019). Increasing efforts to support nutrition for older adults include health and meal support programs (Thomas, 2014). Accessing an RDN and nutrition services can be challenging. Barriers include living in remote areas, disabilities, socioeconomic status, and limited transportation or health care services (Goins et

al., 2005). Some older adults do not know the harmful effects of unintended weight loss (Craven et al., 2018). Others face psychosocial barriers, like loneliness, which may influence eating desire, and some are reluctant to be screened for malnutrition (Harris et al., 2019). One-on-one nutrition services and education programs are limited to subsets of older adults (Abruzzino & Ventura Marra, 2015). Technology interventions are promising strategies to overcome these barriers, increase access to nutrition services (Farsjø et al., 2019), and promote aging in place (Pestine-Stevens & Greenfield, 2020).

Technology has been introduced to assess, monitor, and manage the health of older adults (Fallahzadeh et al., 2018). These include digital health, which helps manage and track health (Food and Drug Administration, 2016). Clinicians and older adults can use these technologies, such as sensors in wearable devices, smart homes, mobile and video communications, and social networks (Fallahzadeh et al., 2018). Telehealth, video media to deliver medical care, and education help people in remote rural areas connect with health care providers (McCabe et al., 2001). As a result of the COVID-19 Pandemic, these technologies have become a routine part of health practice (Robbins et al., 2020). Likewise, technology can increase access to nutrition information, but their use to deliver nutrition care to older adults is limited.

Providing older adults services via technology is efficient, convenient, and cost-effective. Technology reduces wait time and is accepted by older adults (McCabe et al., 2001). Exploring older adult use of technology would be beneficial in promoting the management of a nutrition care plan. The primary objective of this review is to examine and map extant research on the use of technology to manage nutrition for and by older adults. The secondary objective is to describe the extant research's technology and nutrition focus areas. This exploration will provide a snapshot of existing technologies being used and could help incorporate technologies into the overall nutrition care plan of older adults.

2. Methods

We performed a scoping review of scholarly literature based on the PRISMA-ScR guidelines (Tricco et al., 2018) and the PRISMA model (Moher et al., 2009) to organize the information. Since the field of digital health to manage nutrition is rapidly advancing, and technologies have not been reviewed specifically in the context of older adults, we selected a scoping review methodology (Peters et al., 2015). This methodology is advised to map the types and nature of technology

(Peters et al., 2015), which is vital for older adults' nutritional needs.

We searched for articles in prominent nutrition science (PubMed and Web of Science) and business databases (Business Source Elite, ABI/INFORM Collection, and Science Direct). The database searches were a combination of three groups of keywords: (1) "older adult", "senior", "elderly", "geriatric", "aging", and "older person"; (2) "nutrition", "diet quality", "diet", "nutritional status", "health", and "undernutrition"; and (3) "technology", "telenutrition", "telehealth", "digital health", "eHealth", and "information systems". To ensure a comprehensive search, we searched for papers in the top nutrition, gerontology, and information systems (IS) journals.

We included papers about older adults that addressed technology to manage nutrition. All papers were written in English and published in 2000 through 2020. This time frame is a key foundational period of internet and computer adoption for in-home use. Papers included mixed methods studies, future research designs, randomized controlled trials, interventions, qualitative and quantitative studies, literature reviews, and commentaries. We excluded papers that did not include older adults or examine technology usage to manage nutrition, as well as conference abstracts, poster sessions, and studies of older adults that addressed only nutrition or technology.

We completed an initial screening by examining the title, online abstract, and keywords to understand how each study framed the search terms. Our abstract review examined how older adults were referenced. If the research included participants by age group and older adults were among them, we included the paper. We completed a full-text review of the retained articles against our inclusion criteria. We discussed and resolved disagreements on study inclusion. In a final review of the remaining full-text articles, we excluded additional articles after further discussion. We extracted the following information for each paper: authorship, study type, study population, technology type, country, study purpose, and nutrition/medical outcomes. Data from each article were sorted into a summary database table and synthesized.

Technology type data in each study were recorded into the following categories: home-based sensors, smart devices (TV, smart scale, adaptive kitchenware), mobile device sensors, fitness devices, assistive robots, tablet computers, computers, smartphones, telephones, webcams (photos, video monitoring), internet access, videoconferencing (personal and health related), and software (applications, web-specific resources) (Table 1). Technology categories were determined a-priori and post-hoc by the second author, an expert in IS, and finalized with the first author. Additional data were

extracted from each article to identify the technology used to manage nutrition, the nutrition focus, the specific end users of interest, and the study setting (community vs. institutional) (Table 2).

Data on each study's nutrition area of focus were recorded and placed into the following categories and subcategories: assessment, monitoring, and/or tracking; weight and body composition; nutrition status; education/counseling; diet intake/diet quality; and activities of daily living (ADL). The first author, a RDN, determined these categories and finalized them with the second author based on standard nutrition and medical terminology. We reviewed each article to understand the end user, with three categories: (1) self-use of technology (SUT, where older adults use technology to manage nutrition and health); (2) provider use of technology to support older adults (PUT, where providers use technology to optimize or enhance the care of older adults); and (3) ability or readiness to use technology (ART, where older adults or providers received technology education or training).

3. Results

3.1. Article Characterization

From the initial search, 254 papers were extracted, and 52 were added as identified through other sources (i.e., references within papers, gathered from database searches or suggested by colleagues); duplicates were removed, and 141 were selected for the first analysis. The full-text analysis included 79 articles and 44 full-text, peer-reviewed papers that met the search criteria and were retained. Some papers fit into multiple study categories, yet only the first category associated with the study was summarized. Most studies described the early stages of digital nutrition, including older adults and providers technology preferences, research protocols, and pilot/feasibility interventions. Mixed method and qualitative studies explored the end users' experiences and the cocreation of digital nutrition interventions. Quantitative studies compared digital technologies with traditional methods of collecting nutrition data. Most studies addressed community-dwelling older adults (n=41). Target end users included: 23 papers on SUT, seven on PUT, 11 on SUT and PUT, and four on ART.

3.2. Technology Characterization

Most studies discussed multiple technologies, particularly a combination of hardware and software (Table 1). Thirty-one papers described applications to assess, track, and monitor health and nutrition outcomes; provide food options, recommendations, reminders, and education; and track and analyze diet. Two applications were designed to help health care professionals improve the quality of care and integrate their applications with electronic health records. Nine studies used applications that required end users to use the internet to connect to resources or providers. Three studies used applications with webcams. Five studies used a fitness device and software. Three studies used a smart device with an application. One paper reported enhanced diet and activity assessments using software and home-based mobile device sensors (Takemoto et al., 2018). One review examined how robots, home-based sensors, and mobile device sensors could help overcome sarcopenia (Scott et al., 2018). Tablets were used to collect and monitor nutrition data and provide nutrition education. Participants used tablets primarily to access software. Three studies used a tablet with a fitness device. Four studies used tablets and webcams. Some studies used different devices to provide nutrition services, including tablets, smartphones, and laptops. Less frequently used technology included sensors and smart devices, robots, desktop/laptops, mobile phones or smartphones, webcams, videoconferencing, and internet access. Nineteen studies examined the use of sensors and smart devices, such as home-based, mobile or fitness sensors.

3.3. Nutrition Focus Characterization

Most studies focused on multiple nutrition areas (Table 2), including nutrition assessment, monitoring, or tracking; nutrition education and counseling; and dietary intake and quality. Many studies focused on nutrition assessment, monitoring, or tracking behaviors.

Studies evaluated self-monitoring where older adults tracked dietary intake and nutrition-related markers (e.g., weight and laboratory values). Some studies evaluated passive monitoring technology that tracks movement and behaviors through wearable devices, robots, and sensors (e.g., Angelini et al., 2016). In four studies, health professionals assessed and monitored via videoconferencing (e.g.,Batsis et al., 2020). Older adults collected data via a tablet application to identify environmental factors to healthy living (Sheats et al., 2017).

Studies that focused on nutrition education included remote nutrition counseling, self-directed education, and publications that described how to improve nutrition via technology. Several studies focused on nutrition education through webinars and counseling with an RDN (e.g., Beasley et al., 2019). Two papers used telephone sessions with an RDN (Dorner & Friedrich, 2018; Scott et al., 2018). One study educated long-term care staff to enhance their knowledge (Ploeg et al., 2019).

Table 1, Forms of Technology Used to Manage Nutrition for Older Adults

ID	Study	End User	Home-based Sensors	Smart Devices	Mobile Device Sensors	Fitness Devices	Robots or Assistive Robots	Tablet Computer	Desktop or Laptop	Mobile or Smartphone	Telephone	Webcam	Internet Access	Video-conferencing	Applications	Various ICT
			Hardware										Software			
S1	Ali et al., 2013	ART							✓						✓	
S2	Angelini et al., 2016	SUT, PUT														✓
S3	Astell et al., 2014	SUT						✓				✓			✓	
S4	Aure et al., 2020	SUT						✓						✓	✓	
S5	Batsis et al., 2019	SUT, PUT	✓			✓										
S6	Batsis et al., 2020	SUT, PUT				✓		✓					✓		✓	
S7	Beasley et al., 2019	SUT				✓								✓		
S8	Cabrita et al., 2019	SUT		✓		✓				✓					✓	
S9	Chiu et al., 2019	SUT						✓					✓		✓	
S10	Dugas et al., 2018	SUT				✓		✓							✓	
S11	Espín et al., 2016	SUT						✓	✓						✓	
S12	Farsjø et al., 2019	SUT, PUT						✓					✓	✓	✓	
S13	Göransson et al., 2020	SUT						✓		✓						
S14	Hendrie et al., 2017	ART													✓	
S15	Hermann et al., 2012	ART		✓											✓	
S16	Kaddachi et al., 2018	PUT	✓	✓	✓											
S17	Kirkpatrick et al., 2017	PUT						✓	✓	✓			✓		✓	
S18	LaMonica et al., 2017	ART							✓	✓			✓		✓	
S19	Lete et al., 2020	PUT	✓		✓											
S20	Lindhardt & Nielsen, 2017	SUT, PUT						✓					✓		✓	
S21	Łukasik et al., 2018	SUT, PUT					✓									
S22	Manea & Wac, 2020	SUT, PUT				✓										
S23	Marshall et al., 2017	PUT												✓		
S24	Marx et al., 2018	SUT, PUT									✓				✓	
S25	McCabe et al., 2001	SUT, PUT												✓		
S26	McCauley et al., 2019	PUT													✓	
S27	Moguel et al., 2019	SUT, PUT	✓		✓			✓		✓		✓	✓			
S28	Ploeg et al., 2019	PUT, SUT						✓							✓	
S29	Pownall et al., 2019	PUT						✓							✓	
S30	Qian & Gui, 2020	SUT													✓	
S31	Recio-Rodríguez et al., 2019	SUT				✓				✓					✓	
S32	Roberts et al., 2020	SUT, PUT						✓							✓	
S33	Scott et al., 2018	SUT	✓	✓	✓		✓						✓		✓	✓
S34	Sheats et al., 2017	SUT						✓							✓	
S35	Singer et al., 2018	SUT, PUT				✓		✓		✓	✓				✓	
S36	Takemoto et al., 2018	ART	✓		✓			✓		✓	✓	✓			✓	✓
S37	Timon et al., 2015	SUT						✓				✓			✓	
S38	van den Helder et al., 2018	SUT						✓							✓	
S39	van Doorn-van Atten et al., 2019	SUT						✓	✓						✓	
S40	van Doorn-van Atten et al., 2018	SUT		✓				✓	✓						✓	✓
S41	van Doorn-van Atten et al., 2019	SUT		✓				✓	✓				✓		✓	
S42	Ventura Marra et al., 2019	SUT									✓			✓		
S43	Ward et al., 2019	SUT						✓	✓				✓		✓	
S44	West et al., 2010	SUT												✓		
Total:			6	6	5	8	2	23	8	8	4	4	10	7	31	4

Table Legend: ART=ability or readiness to use technology; ICT=information and communication technology; PUT=provider use of technology in support; SUT=self-use technology

Table 2, Nutrition Area of Focus and Study Setting to Manage Nutrition for Older Adults

ID	Study	Assessment, Monitoring, and/or Tracking	Weight and Body Composition	Nutrition Status	Education/ Counseling	Diet Intake/ Diet Quality	Activities of Daily Living	Acute/Long-term Care	Community Dwelling
S1	Ali et al., 2013				✓				✓
S2	Angelini et al., 2016	✓	✓				✓ frailty		✓
S3	Astell et al., 2014	✓sarcopenia				✓			✓
S4	Aure et al., 2020			✓	✓				✓
S5	Batsis et al., 2019		✓						✓
S6	Batsis et al., 2020	✓	✓		✓				✓
S7	Beasley et al., 2019		✓		✓	✓			✓
S8	Cabrita et al., 2019	✓							✓
S9	Chiu et al., 2019				✓				✓
S10	Dugas et al., 2018	✓			✓	✓			✓
S11	Espín et al., 2016	✓		✓	✓	✓			✓
S12	Farsjø et al., 2019	✓	✓	✓	✓	✓			✓
S13	Göransson et al., 2020	✓		✓	✓				✓
S14	Hendrie et al., 2017					✓			✓
S15	Hermann et al., 2012				✓		✓		✓
S16	Kaddachi et al., 2018	✓					✓		✓
S17	Kirkpatrick et al., 2017	✓				✓			✓
S18	LaMonica et al., 2017	✓			✓				✓
S19	Lete et al., 2020	✓			✓		✓		✓
S20	Lindhardt & Nielsen, 2017	✓	✓	✓	✓	✓			✓
S21	Łukasik et al., 2018	✓			✓	✓	✓		✓
S22	Manea & Wac, 2020	✓							✓
S23	Marshall et al., 2017				✓	✓			✓
S24	Marx et al., 2018				✓				✓
S25	McCabe et al., 2001	✓			✓				✓
S26	McCauley et al., 2019				✓			✓	
S27	Moguel et al., 2019								✓
S28	Ploeg et al., 2019	✓			✓				✓
S29	Pownall et al., 2019				✓	✓ hydration		✓	
S30	Qian & Gui, 2020					✓			✓
S31	Recio-Rodríguez et al., 2019				✓	✓			✓
S32	Roberts et al., 2020	✓ screening		✓	✓	✓		✓	
S33	Scott et al., 2018	✓	✓ sarcopenia			✓	✓		✓
S34	Sheats et al., 2017	✓environment							✓
S35	Singer et al., 2018		✓ frailty		✓				✓
S36	Takemoto et al., 2018	✓	✓	✓	✓	✓ hydration			✓
S37	Timon et al., 2015	✓				✓			✓
S38	van den Helder et al., 2018		✓		✓	✓			✓
S39	van Doorn-van Atten et al., 2019	✓		✓	✓	✓			✓
S40	van Doorn-van Atten et al., 2018	✓	✓	✓	✓	✓			✓
S41	van Doorn-van Atten et al., 2019	✓	✓	✓	✓	✓			✓
S42	Ventura Marra et al., 2019			✓	✓	✓			✓
S43	Ward et al., 2019	✓							✓
S44	West et al., 2010	✓			✓	✓			✓
	Total:	27	13	13	27	23	6	3	41

Table Legend: Acute=acute care, hospital; ADL=activities of daily living, such as preparing food; LTC=long-term care facilities (e.g., nursing home, assisted living facility).

Studies focused on self-directed nutrition education provided older adults nutrition information, guidance, recipes, or feedback. Older adults set personal nutrition goals, usually through an application (e.g., Ali et al., 2013). Two studies used a blend of education sessions and self-directed learning (Chiu et al., 2019; Ploeg et al., 2019). Some studies examined older adults' preferences to understand how to deliver nutrition information (e,g., Łukasik et al., 2018). One study found that older adults and caregivers thought it helpful if a robot provided nutrition advice. Two studies synthesized the literature and offered the best nutrition and health education practices via technology (McCabe et al., 2001; Takemoto et al., 2018).

About half of the studies focused on assessing, tracking or improving dietary intake. Studies examined how technology can be used to assess intake (e.g., Astell et al., 2014;), or dietary pattern adherence (e.g., Dugas et al., 2018). Three studies provided meal plans to improve nutrition (e.g., Espín et al., 2016). Two papers examined how caregivers could improve older adults' dietary intake (Marshall et al., 2017; Pownall et al., 2019). Others collected older adults' opinions on how technology could improve their intake (Łukasik et al., 2018) or synthesized literature (Scott et al., 2018; Takemoto et al., 2018). One study evaluated online communities and found posts included concerns about vitamins, fats, and protein (Qian & Gui, 2020).

Less frequently considered nutrition topics included status, weight and body composition, and ADL. Several studies used technology to improve nutrition status of malnourished or at nutritional risk (e.g., Aure et al., 2020). Three studies examined how technology can promote weight loss (e.g., Batsis et al., 2019). One study described how caregivers could treat and prevent protein-energy malnutrition. Two studies assessed the previous research on how technology can help prevent and manage malnutrition (Recio-Rodríguez et al., 2019; Takemoto et al., 2018). Several studies highlight how technology can preserve independence by completing food-related ADLs.

The use of hardware and software compromised three domains related to nutrition management: 1) *track, plan, and execute* (track dietary intake, plan changes, and execute actions); (2) *assess* (obtain health data); and (3) *build knowledge* (promote nutrition understanding among providers or older adults).

4. Discussion

This scoping review examined current technologies used to manage and care for the nutrition needs of older adults. The use of technology comprised three domains: (1) *track, plan, and execute*; (2) *assess*; and (3) *build knowledge*. Applications were the most common form of software used, and tablet computers were the most commonly used hardware. Nutrition areas of focus included assessment, monitoring/tracking, education/counseling, and dietary intake and quality. Nutrition assessment, monitoring, and evaluation are essential components of the NCP to detect and treat poor nutritional status and understand intervention effectiveness (Dorner & Friedrich, 2018).

The most prominent area of technology use was software (68% of studies), which was used to *track, plan, and execute*; to *assess*; and *build* knowledge. One type of software to *track, plan, and execute* (45.16%) used a mix of custom development, existing software, and existing software with modifications. No study used commercially available software, such as *Lose It!* Or *Fooducate*. Many of these apps are free; however, there is a cost for tracking important intake goals, such as fluid and protein type. These apps promote weight loss, creating confusion because many older adults need to maintain or gain weight. Software to *track, plan, and execute* a nutrition program is essential to ensure proper food consumption by older adults.

Another type of software described assessed nutrition (35.48%). Nutrition assessment, monitoring, and evaluation are components of the NCP to detect, treat and monitor poor nutritional status among older adults (Dorner & Friedrich, 2018). Existing assessment forms were converted to applications, which may become mandated as electronic data collection requirements increase the sharing of health care data to electronic health records and electronic medical records (US Health Information Technology for Economic and Clinical Health (HITECH) Act, 2009).

The third area of software use was to *build knowledge* (16.13%), which includes 3D animation and other replacements for printed material. These applications recognized the heterogeneity of older adults and the need for personalized recommendations to improve nutrition outcomes. Standardization of application interfaces is needed to enhance usability and tailor content (Scott et al., 2018). Many studies considered older adults' preferences, which is an essential component of user-centered design and promoting technology adoption (Peek et al., 2016). Additionally, this paper captures the different forms of technology used to support nutrition for older adults and enhance nutrition management for health providers. The remaining software (3.23%) included social media use, such as social communities devoted to older adult health, safety, and welfare topics.

Under hardware, the tablet computer was the second most prominent area of technology use (55% of studies), which is not surprising because it is an intuitive and user-friendly device (Gjevjon et al., 2014). Tablets

can support the NCP by connecting older adults with nutrition assessment, counseling, and education providers. Tablets were used to *track, plan, and execute* (20.45%*assess* (20.45%), and *build knowledge* (6.22%). In the track, plan, and execute category, only one study used the tablet's webcam to track and assess food intake by having participants take pictures of their food before and after meals. Food photography was used in one study to record dietary intake among older adults (Naaman et al., 2021). Older adults used the tablet webcam for videoconferencing for nutrition follow-up. However, only one study used tablets to *build knowledge*; interactive, video, and 3D knowledge for providers and older adults present opportunities.

Studies since 2018 (56.82%) show a movement toward researching the internet of things (IoT), such as fitness and sensors, to support older adults. The IoT consists of objects embedded with technology that can sense or capture information, communicate over the internet, and interact with its features or outside influences. This technology allows the continuous collection of health data and reporting outcome (Recio-Rodríguez et al., 2019). These studies did not explicitly discuss internet usage, but internet use is necessary for people to interact digitally. Increasing broadband access among older adults can expand digital nutrition services and reduce social isolation (Batsis et al., 2021).

This study shows that nutrition and technology together can support older adults. The study identified four areas of interest in managing nutrition for older adults through technology: (1) applications lack standardization, (2) the family of IoT is a promising area for research, (3) personal device use is evolving to the tablet computer, and (4) broadband internet access is vital. Software standardization is an essential first step, specifically, in the categories of *track, plan, and execute*; and *assess*. The value of standardization is making software used to access evidence-based programs habitual for older adults. The software must be straightforward and accessible for older adults.

5. Future Research and Limitations

This scoping review drew out current technologies used to manage nutrition and health for and by older adults. Future research could conduct a systematic review to examine the effectiveness of these different types of technologies to enhance and support the NCP and improve health outcomes for older adults. Different research designs should also be accounted for when examining the effectiveness of other technologies in managing nutrition.

As a result of COVID-19, research is needed to understand the movement to technology for medical support and social connections. The studies reviewed were conducted pre-pandemic when videoconferencing was considered an emerging technology. Like tablet hardware, this popular software is becoming increasingly important. Only one study addressed social media use (Qian & Gui, 2020); however, the new generation of aging adults is social media aware. Social media is a promising area to introduce future older adults to videos, 3D experiences, and new learning. More research is needed to understand how technology can be used to provide food and improve diet (Lindhardt & Nielsen, 2017). Future studies may consider increasing the number of participants and tailoring technology interventions to identify older adults' diverse nutrition needs.

Our findings can be incorporated into the Theory of Andragogy (Knowles et al., 2005) which views adult learners as mutual partners in learning, where adults draw on their own experiences to learn new information. When teaching older adults and their health professionals how technology can be used to manage nutrition, an effective learning environment can be created by basing learning objectives on the end-user's needs, skill level, and interests.

6. Conclusion

This scoping review provides valuable evidence of extant literature on technology, nutrition, and gerontology. The literature search included 21 years; however, 86 percent (n=38) of the studies were published after 2015. This time frame shows that technology, nutrition, and gerontology research are new. Critical analysis of the findings shows that software can be used for older adults to *track, plan, and execute*. Additionally, nutrition assessment programs lack standardization. The IoT is a promising research area, and personal device use is evolving to the tablet computer. Finally, broadband internet access is critical for nutrition care. Findings suggest digital nutrition for older adults are not a formable research area; however, efforts to build this knowledge are underway.

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