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Electronic assistive technology for community-dwelling solo-living older adults: A systematic review

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ABSTRACT

The proportion of older adults who live alone in single households is growing continuously. In the care of these solo-living older adults, electronic assistive technology (EAT) can play an important role. The objective of this review is to investigate the effects of EAT on the wellbeing of community-dwelling older adults living alone in single households. A systematic review of English articles was conducted based on PMC, Scopus, Web of Science and the Cochrane database. Additional studies were identified from the references. In total, 16 studies were identified, six of them with follow-up. There is evidence that EAT can improve the physical and mental wellbeing of older adults. There was little evidence that EAT can improve social wellbeing. We conclude that more personalized designs and interventions, and more user engagement could be embedded in the design of EAT for solo-living community-dwelling older adults and that more evidence is needed regarding the effects of those interventions.

1. Introduction

Between 2015 and 2050, the proportion of the global population that is aged 65 years or more will double, from 8.3% to 15.8% [1]. In Europe, the proportion of the population aged over 65 reached 19.2% in 2016 [2]. Meanwhile, the number of older people living in single households is increasing as well; for example, in the EU-28, the average percentage of people aged ≥65 in single households was 13.1% in 2010 and 14.3% in 2017 [3], an increase of 1.2%. Similar trends can be observed in the USA [4], where 21.9% of those aged 65–74, 31.2% of those aged 75–84 and 38.7% of those aged ≥85 live alone [5].

Preventing the institutionalization of older adults is important from personal, social and economic perspectives [6]. However, older people who live alone may encounter various physical, mental and social problems. Physiological changes not only make older adults vulnerable to disorders, but also influence their behaviors, which may in turn influence their physical, mental and social status. For instance, falls and fall-related injuries in frail older adults can have serious health and social consequences, including hospitalization, permanent disability, change of residence, loss of independence, isolation, depression and long-term reduced quality of life (QoL), as well as high healthcare consumption and costs [7].

Mental health is "a state of wellbeing in which an individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively and is able to make a contribution to his or her community" [8]. Mental disorder is the commonest single cause of disability (23%) in the western world, outranking cardiovascular diseases (16%) and cancer (16%) [8]. It is estimated that 20% of people aged ≥55 in the USA experience some types of mental health concern. The most common conditions include anxiety, severe cognitive impairment (e.g. Alzheimer's disease) and mood disorders (e.g. depression) [9].

Loneliness is a common among older people and is closely associated with impaired QoL, cognitive decline [10], poor subjective health [11], disability [12], increased use of health and social services, and increased mortality. Loneliness has been defined as an individual's subjective experience of a lack of satisfying human relationships [13]. Older people are prone to feel lonely, as losses tend to occur in old age. Retirement from work, the death of a spouse, and greater disability may all reduce social integrity [14].

Assistive technology (AT) is technology that is adapted or specially designed to improve the functioning of people with disabilities [15]. The definition of AT varies [16]. WHO describes assistive devices and technologies as those "*whose primary purpose is to maintain or improve an individual's functioning and independence to facilitate participation and to enhance overall well-being*" [17]. In practice, AT is "an umbrella term for any device or system that allows an individual to *perform a task*" [18]. There are many types of ATs, ranging from a simple wheelchair to an

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intelligent robot. Electronic assistive technology (EAT) [19], which is a subset of a wider range of AT products and services [20], is able to empower people with embedded electronic and digital technologies [21–23]. EATs have been widely used to help people in rehabilitation [24], care of dementia [20], etc. Typical EATs include telecare, wearables, and ambient assisted living (AAL) [23]. Some EATs have been developed as product-service systems, such as the personal emergency response system (PERS), where a service can be triggered by an older adult in case of emergency, for example a fall.

The aim of this review is to evaluate: (1) what types of EATs are used for community-dwelling solo-living older adults and (2) the evidence that using EATs can improve the physical, mental and social wellbeing of those older adults.

2. Methods

2.1. Search strategy

This review is in accordance with the PRISMA guidelines [25] for systematic reviews. A comprehensive search was conducted in PMC, Scopus, Web of Science, Cochrane library and clinicaltrials.gov till Jan.31, 2019, using the following search terms: (“elderly” OR “older adult”) AND “Assistive technology” AND (“living alone” OR “single household” OR "solo-living"). We selected English-language articles only and the keyword “independent living” was not included as it does not necessarily mean “living alone” [26].

2.2. Study selection

Inclusion criteria were: (1) academic and peer-reviewed journals; (2) cohort studies with older adults aged ≥60 or ≥65, and > 50% of participants living alone in a community, or living alone as a criterion in the evaluation, or living alone is (one of) the major focus(es) of the research; and (3) EAT involved as a (major) monitoring tool/intervention. Exclusion criteria were: (1) older adults living in social or sheltered housing; (2) mechanical assistive devices in which intelligent functions are not embedded. In total 16 studies were identified that evaluated the use of EAT(s) for solo-living older adults (see Fig. 1).

2.3. Data

Title and abstract, and in the eligibility check the full-text of each candidate paper were screened/studied according to the inclusion and exclusion criteria. The following information was collected if a paper was selected for the review: the type(s) of EAT(s), the type of study, number of older adults living alone, the follow-up time, the evaluation methods and possible ethical issues.

2.4. Quality

Because the 16 studies included in this review are diverse in terms of both approach and intervention, a meta-analysis was not possible. The authors present a qualitative analysis of the 16 selected studies regarding the types of EATs, the use of EATs, the evidence on the effects of EATs on the physical, mental and social wellbeing of solo-living older adults and, where possible, ethical issues in the use of EATs.

3. Results

In the included 16 studies, older adults were rather frail, without or with some degree of cognitive impairment (e.g. lowest MMSE ≥ 20 points in [27]). The majority were female (˜66%, n = 3276 out of 4954 in 14 studies). In two studies [28,29] gender was not reported.

3.1. Types of EAT interventions

The types of EAT interventions varied from a simple personal alarm (or PERS) [30] to an AAL environment [31]. The functions of all EATs were fixed at the moment of the deployment; that is, we did not identify personalized adaptive features. Regarding function, an alarm was the most frequently used EAT in the reviewed cases (7/16), followed by monitoring (3/16), telepresence (2/16), robot (2/16), SmartHome (1/16), AAL (1/16), computer device (1/16), electric bike (1/16), mobile phone (1/16) and video surveillance (1/16). Some studies included more than one EAT. Only six trials [6,27,30–33] evaluated the effects of the intervention with a follow-up; in those that did, the follow-up ranged from 6 months to 33 months. The remaining 10 studies [28,29,34–41] did not include a follow-up period. Most studies were conducted in North America, Europe and Australia, and one in both Australia and India (see Table 1).

3.2. Evidence of improving the physical, mental and social wellbeing

The physical conditions of solo-living older adults are closely connected to their independence. Using an alarm system was effective in preventing older adults lying on the floor for long times after falls, providing that the alarm was triggered [30]. However, in 38 out of 141 fall incidents, the older adults had lain on the floor for over an hour even though an alarm system was available to them.

Regarding the numbers and types of emergencies experienced, there were no significant differences between the purchasers of the alarm system and non-purchasers [33]. Older adults used the alarm system as a strategy to maintain their independence and minimize the unexpected risks [38]. Persons aged 85+ were significantly more likely to report the use of alarms whether living alone or with others, and those aged 75–84 and living alone were significantly more likely to use alarms than those aged 65–75 [37]. For other EAT interventions, in a trial of AAL

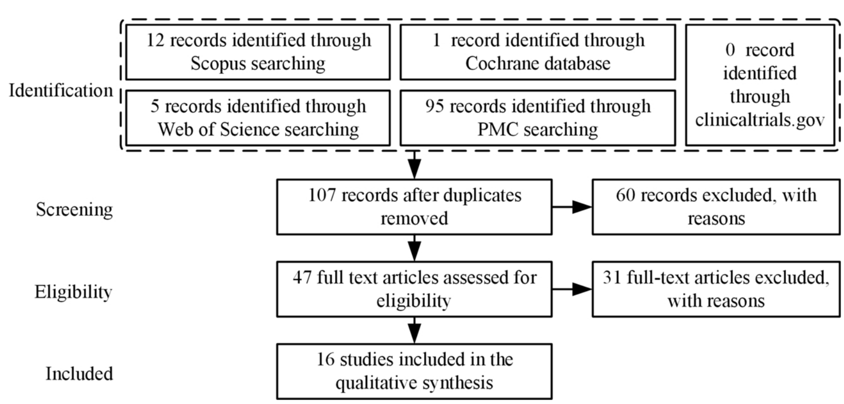

Fig. 1. Flow chart of included studies.

Table 1
List of included studies.

Studies / Country [ref]	Target group	N (alone)	Intervention	Study type	Follow-up	Evaluation methods	Main findings
Tomita et al. 2007, US [6]	Older adults	34 (34)	SmartHome	Trial	24M	FIM motor, SIP movement, ADL/IADL, CHART Mobility, MMSE, FIM cognition	After two years, 65% of participants were utilizing software to control the SmartHome functions. FIM Motor and MMSE scores did not show any significant difference between the two groups, but there was a significant decline in the control group regarding SIP Movement, CHART Mobility and FIM Cognition.
Nygård et al. 2008, SE [34]	Older adults	939 (769)	Stove Timer	Survey		Self-developed Questionnaire	The implementation process of the EAT (a stove timer) was not optimal, no healthcare professional was responsible for the follow-up. More education and collaboration of stakeholders were suggested.
Fleming et al. 2008, UK [30]	Older adults	110 (43)	Alarm	Trial	12M	Fall(s) Calendar	In 80% (113/141) of fall incidents, the older adults did not use their equipped alarm to summon help in community/institutional settings and sheltered accommodation.
Johnston et al. 2010, AU [35]	Older adults	31 (31)	Alarm	Interview		Self-developed Questionnaire	Four groups were identified: Effective users, Potential users (major barrier: costs), ineffective users (major barrier: did not use it properly or inappropriate design of the EATs) and non-alarm users (major barrier: threat to their independence).
Kaye et al. 2011, US [32]	Older adults	233 (121)	Monitoring	Trial	33M	Medical History and Physical Examination, Personal & Family History, Physical/ Neurological Examination, Neurobehavioral Cognitive Status Examination, Neuropsychological Examination, Telephone Interview of Cognitive Status, CIRS, TAQ, BMI, ADL/IADL, MMSE, CDRS, UPDRS, OBASMQ, SDSQ, GD	Demonstrated the feasibility of monitoring older adults' home activity in a relatively large-scale trail. Continuous assessment was enabled and new novel measures regarding the older adults can be developed based on the collected data.
Seelye et al. 2012, US [36]	Older adults	8 (8)	Tele-presence/Robot	Interview		MMSE, CDRS, AUFD, RUQ	Participants' experience of using the robot was positive and enjoyable. For tele-operated remote-control robot designers, functionality as well as the unique physical, cognitive, emotional, and social needs of the older adults should be addressed.
Lexis et al. 2013, NL [27]	Older adults/Formal caregivers/Informal caregivers	19 (19)/12/16	Monitoring	Trial	12M	MMSE, GARS, EQ-5D, RTLS, VAS, CSI, OBM SRB	The usage of the home activity monitoring system did not significantly impact clients' perceived independence, QoL, health status, feelings of loneliness and safety. However, it was effective in reducing the subjective burden of informal caregivers, and enabling formal caregivers to deliver more tailored care.
Nyman & Victor 2014, UK [37]	Older adults	3062 (1240)	Alarm	Survey		Fall numbers, ADL/IADL, C5Q, CES-D, CASP-19	Age 85+ were significantly more likely to report use of personal call alarms. Age 75–84 and living alone were significantly more likely to use personal call alarms compared to 65-75. Living alone and experiencing a fall in the past two years were significantly more likely to self-report personal call alarm use. Older adults with greater difficulty with ADL/IADL were more likely to self-report using a personal call alarm.
McKenna et al. 2015, CA [38]	Older adults	20 (20)/10 (10)	Alarm	Focus group/ Interview	Mean 3.3M	Self-developed Questionnaire	Older adults used the alarm system as a strategy to maintain their independence and minimize the unexpected risks.
Luijkx et al. 2015, NL [39]	Older adults	53 (38)	Computer Device, Electric Bike, Mobile Phone, Alarm	Interview		MMSE $\geq$ 24, SRRS, TFI	Older adults were willing to try technology especially when their children were convinced of its positive effects. Meanwhile, children should be provided such information and the value of using the EAT.

(*continued on next page*)

Table 1 (*continued*)

Studies / Country [ref]	Target group	N (alone)	Intervention	Study type	Follow-up	Evaluation methods	Main findings
De San Miguel et al, 2015, AU [33]	Older adults	157 (119)	Alarm	Trial	12M	MFES, ADL/IADL, LSNS, PWI	There were no significant differences between the purchasers of the alarm system and non-purchasers regarding the numbers and types of emergencies experienced. But significant differences on depression were identified between the two groups. Financial aspects and lack of family support were the major barriers for non-purchasers.
Korchut et al. 2017, PL [41]	Older adults /Caregivers /Medical Staff	83 (83)/81/100	Robot	Survey		MMSE 20-26, Self-developed Questionnaire	People with cognitive impairment were increasingly willing to take the robot into their home. More than 75% of caregivers agreed to leave the potential user alone with a robot. The development of robotic assistants requires both the understanding of the needs of the persons with cognitive impairment and a positive image of assistive robots.
Ray et al., 2017, AU/ IN [40]	Older adults	Phase 1 = 12 (not specified) Phase 2 = 7 (7) Phase 3 = 47 (47)	Tele-presence	Focus group/ Interview		Self-developed Questionnaire	All users were positive about the tablet-based tele-presence system. Family's ongoing involvement and motivation positively affected the older adults. However, older adults preferred to seek help from professionals or web.
Mulvenna et al., 2017, UK [28]	Older adults/ Caregivers	2 (2) /22	Video Surveillance	Interview		Self-developed Questionnaire	A clear description of the meaning of video surveillance in practice would be useful to the person living with dementia and their caregivers. The use of cameras in the home of a person living with dementia for family caregivers was supported as useful, ethical and moral providing the right protocol is in place to gain consent.
Dupuy et al. 2017, FR [31]	Older adults	32 (32)	Ambient Assistive Living Environment	Trial	6M	MMSE ≥ 25, BMI, SF-36, SPPB, TGUGT, MNA, CDS, EPR, GHQ-28, IHVA, MBI, IADL	No significant effect was found regarding the self-reported IADL scale. However, equipped participants were perceived as more autonomous compared to controls from caregiver's perspective.
Zwierenberg et al., 2018 NL [29]	Older adults / Caregivers	63 (63)/50	Monitoring	Interview	300D	Self-developed Questionnaire	The system reduced the stress and the burden of informal caregivers by providing them with support, reassurance and confirmation. Caregivers focused more on the utility of the system and did not directly address any ethical and moral considerations.

*ADL/IADL: Activities of Daily Living and Instrumental Activities of Daily Living; AUFD: Alpha User Feedback Questionnaire; BMI: Body Mass Index; CASP-19: Control, Autonomy, Self-Realization and Pleasure scale; CDRS: Clinical Dementia Rating Scale; CDS: Cognitive Difficulty Scale; CES-D: Center for Epidemiologic Studies Depression Scale; CHART-Mobility: Mobility for Handicap measure in Craig handicap assessment and reporting technique; CIRS: Cumulative Illness Rating Scale; CSI: Caregiver Strain Index; EPR: Echelle de Préférence de Routinisation; EQ-5D: Quality of life; FIM: Functional Independent Measure for ADL; GARS: Groningen Activity Restriction Scale; GDS: Geriatric Depression Scale; GFI: Groningen Frailty Index; GHQ-28: General Health Questionnaire; IHVA: Inventaire des Habiletés pour la Vie en Appartement (Residents' Inventory for Life in the Apartment); LSNS: Lubben Social Network Scale; MBI: Maslach Burnout Inventory; MFES: Modified falls efficacy scale; MMSE: Mini-Mental State Examination; MNA: Mini Nutritional Assessment ; OBASMQ: Oregon Brain Aging Study Memory Questionnaire; OBM: Objective Burden Informal Caregiver; PWI: Personal wellbeing index; RTLS: Rasch-Type Loneliness Scale; RUQ: The Remote User Questionnaire; SDSQ: Sleep Disturbance Symptom Questionnaire; SF-36: 36-Item Short Form Survey; SIP-Mobility: mobility subsection of dysfunction section of sickness impact profile; SPPB : Short Physical Performance Battery; SRA: Self-rated Health (1–5 scale); SRB: Self Rated Burden; SRI: Self-rated Independence (1–5); SRRS : Social Readjustment Rating Scale (Independence); TAQ: Technology Attitudes Questionnaire; TFI: Tilburg Frailty Indicator; TGUGT: Timed Get Up and Go Test; UPDRS: Unified Parkinson's Disease Rating Scale; VAS: Visual Analogue Scale.

platforms, functional benefits were found for both frail older individuals and professional caregivers [31]. For the use of a SmartHome, there were no statistically significant differences between the treatment group (34 participants) and the control group (44 participants) regarding FIM motor and SIP Movement scores after 24 months [6]. However, there were statistically significant differences of IADL scores and CHART mobility between the control group and the treatment group, with the latter performing better.

Using EAT may improve older adults' mental health. A significant difference in the incidence of depression was identified between the purchasers and non-purchasers of an alarm system, with more non-purchasers suffering from depression [33].

Little evidence for improvements in the social wellbeing of older adults was identified. In a study of the use of telepresence robotic technology [36], participants (n = 8) indicated that, in general, they appreciated the potential to enhance their physical health and wellbeing, social connectedness, and ability to live independently at home. However, the usage of a home activity monitoring system did not significantly impact older adults' perceived independence, QoL, health status, feelings of loneliness and safety in a 6-month follow-up [27].

In the remaining eight studies [28,29,32,34,35,39–41], either caregivers were the focus of the study, or little evidence was reported about the impact of using EATs on the wellbeing of older adults,

3.3. *Factors influencing the adoption of EATs*

EATs are designed to enhance older adults' physical health, wellbeing, social connectedness, and ability to live independently at home [32]. An EAT may help older adults to reduce risks. For example, purchasers rated the important reasons for them to buy the alarm system as: (1) the fear of falling and not being able to get up (89%), (2) living alone (83%) and (3) family members' wish (80%). For non-purchasers, the high cost was the major barrier (77%) [33]. In another study, 90% of the participants used EAT to maintain their independence and minimize the risk of the unexpected [38]. Family members also play an important role in the adoption of technology: "*grandchildren [are] a natural coincidental part of older adult interaction*" [39].

However, attitudes towards EAT differ. In one study [39], respondents who did have a personal alarm stressed the feeling of safety; but several non-purchasers mentioned that they would feel really old if they felt the need for a personal alarm [39]. Purchasers of an alarm system (mean = 82.6 years) were significantly older than non-purchasers (mean = 79.3 years) and more functionally dependent, according to their ADL/IADL function scores [33]. Attitudes also varied among different types of EATs. Among older adults using a passive activity monitoring system [27], "*feelings of safety*" did not show significant differences at T0, T1 (3-month) and T2 (6-month).

3.4. *Training and education*

The need for user training was highlighted in several studies. Longer and more detailed initial training with EAT might address concerns about a smooth user experience [36]. As stated before, in 38 out of 141 fall incidents, the older adult was lying on the floor ≥ 1 h despite the installed alarm system [30]. Though the reason was complicated, the comments from older adults suggested that training was needed regarding the way to activate the devices and the signal range of the alarm [30]. Training is associated with the complexity of the EAT, and is also a concern of caregivers. Regarding the use of service robots, even more caregivers (83.95%) than potential users (69.88%) stated that they needed a minimum of three or four training sessions before they would agree to cooperate [41].

3.5. *Limitations and failures of EAT*

Limitations of EAT were reported in many studies. For instance, 25% of participants in a focus group and 10% of participants in interviews agreed that alarm systems can be triggered by accident [38]. Another study reported that, over a period of 36 months, the deployed alarm systems generated on average 1.5 red alerts (first-level alarm) and 7.7 yellow alerts (second-level alarm) per client (n = 19) per month [27]. The majority of the red alerts were caused by technical failures of the system, i.e., unexplained errors in the base station unit (43.9%). Besides the alarm, similar problems were encountered in a SmartHome, where only 52%–68% of the deployed systems (n = 34) were in use after 2 years and the major reason for "no use" was failure [6]. Those failures were not necessarily a malfunction of the system, but rather a combination of unfriendly features of the EAT and participants' unfamiliarity with the system.

3.6. *EAT and cares*

EAT can relieve the burden on informal caregivers by providing historical records and real-time information, and/or real-time alarms. For instance, an informal caregiver indicated that a video surveillance system *"relieves the anxiety of the family who are concerned about the safety of the person with dementia…"* [28]. Formal caregivers (n = 41) also stated that an activity monitoring system enabled them to deliver more tailored care based on historical records [27]. According to an objective measure of the burden on the formal caregivers, a decrease in the time spent on the client was found, from 2.93 days per week at T0 to 2.47 at T1 (3-month). The subjective burden decreased from 5.94 on T0 to 5.06 at T2 (6-month, p = 0.03) as well [27]. This finding is in line with those of another study [42] included in this review.

3.7. *Ethical issues*

Two of the 16 selected studies discussed ethical issues in the use of EAT from the perspective of (informal) caregivers. The video surveillance system for older adults with dementia might be the most ethically sensitive EAT [28]. In that study, a family caregiver indicated that "*Proper consent from [the] person needs to be sought so that they feel comfortable with this method*". Informal caregivers indicated that the impact of EAT on privacy should be compensated by the perceived sense of safety that it brought; however, (informal) caregivers tended to focus more on the functions and did not directly address any ethical and moral concerns [29].

3.8. *Personalized intervention by EAT*

Most EATs are mass-manufactured, and have a fixed form and fixed functions. However, the situations of older adults differ and the needs of older adults may vary, as frailty is personalized. In one study older adults (n = 30, Mean age: 88.7) operationalized frailty as unpredictability and perceived risk [38]. This is accordance with the findings of another included study [34] which concluded that "*When the user group is heterogeneous, the recommendations for individualization and for adaptations to be made to meet individual needs become especially important*".

4. Discussion

The current review on EAT-based interventions for community-dwelling solo-living older adults in single households demonstrates that the use of different EATs has different effects on physical, mental and social wellbeing of older adults. Ten types of EATs, ranging from a simple alarm to robots, were used in the included studies. There is some evidence that EATs can improve the physical [6,30] and mental [33] wellbeing of solo-living older adults but there is little evidence that EAT may improve their social wellbeing. While older adults stated that maintaining their independence and minimizing unexpected risks were the major reasons for adopting EATs, using EATs may also reduce the burden on (informal) caregivers. Technical failures and unfriendly features were the major limitations of using EATs. Better designs as well as training and education were suggested by both older adults and (informal) caregivers.

In a review on the use of EATs for a different target group, i.e., people with Alzheimer's disease and other dementias, only three randomized clinical trials (RCTs) were identified [23]. And for using ATs for memory support in dementia, no evidence was found [43]. In a similar review, the author also concluded that "*There was a significant lack of evidence on the effectiveness of using EATs to support people with dementias in their living environment*" [20].

The EATs used in the included studies are similar to those reported in other reviews [20,23], but the range is limited. Using other types of EAT may further improve the physical, mental and social well-being of solo-living older adults. For instance, for older adults in assisted living communities, Internet usage was associated with lower levels of loneliness [44]. Through careful design, social media can also help older adults overcome loneliness, or could even be used as an emergency alarm [45]. Further research is needed on how engaging solo-living older adults and their caregivers in the design and use of EAT(s) might improve their effectiveness in relation to physical, mental and especially social wellbeing.

Factors that influence the adoption of EATs identified in this review are similar to those described in a model for technology adoption by people with dementias [46]. However, new elements are identified: 1) the cost of EATs for solo-living adults, and 2) the "new generation" of older adults as well as informal caregivers, who are more acquainted with technology. In the UK, the proportion of single-household older adults (65+) using the internet rose from 36% to 59% between 2012 and 2018 [47]. "*Everyone that is older should have one*" is one of the comments of caregivers when they were evaluating a remote-controlled video-communication robot [36]. Such factors may increase the acceptance of future interventions delivered by EAT devices/services.

While the principle of engaging users in the general design and development of EAT is often adopted [40], the option of personalized interventions was suggested by several studies [32,34,38]. Enabled by the development of technology, EAT is able to monitor personal activities in real-time, e.g., continuously measuring in-home older adult activity regarding the numbers of steps, mean speed, etc [32,48]. It can be expected that personalized digital interventions can be delivered through EAT in order to improve the wellbeing of older adult and to increase the satisfaction of their (formal and informal) caregivers [49]. Besides, in the design of EAT, special attention should be paid to older women, as women constitute the majority (˜66% in the included studies) of single households. Ethical issues for older adults, especially persons with dementia, in the use of EAT should be addressed as well [50].

As far as the design and user-friendliness of EAT is concerned [51], limitations and failures have been reported. For example, in the setting up of a stove timer for older adults, there was a lack of specified recommendations for the appropriate time setting in one-fifth of the cases [34]. The failures of EAT can be associated with the method of deployment, the method of use, as well as the complexity and the reliability of the technology. In the design, development, deployment and use of EATs, using different AT assessment methods might minimize those problems [52].

The current review focused on single households of older adults, and just a few studies addressed this topic. This may have limited the evidence resulting from this review. In the selected 16 studies, only six evaluated the effectiveness of the EAT-based intervention with a follow-up, so much information might be gained from better study design, including education and practice, and follow-up.

5. Conclusions and implications for practice and future research

Although the numbers of community-dwelling solo-living older adults are increasing continuously, the effectiveness of the use of EAT in older adults' homecare is only starting to be evaluated. Research in this field is interdisciplinary in nature, as the interventions are diverse. Researchers have tried to improve the physical, mental and social wellbeing of older adults using different types of EATs; however, evidence is scant compared with the variety of EATs, especially on social wellbeing. We conclude that better design of EATs, with embedded personalized interventions and more user engagement, better deployability, usability and reliability, and the better tolerance of errors in use, are needed for older adults. Concrete evidence on how using EATs can improve the physical, mental and social wellbeing of community-dwelling solo-living older adults is needed.

Contributors

Both authors conceived this study, carried out the systematic review. Yu Song wrote the initial draft of the manuscript. Both authors were involved in the critical revisions of the manuscript.

Conflict of interest

The authors declare that they have no conflict of interest.

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