Supplementary

Appendix 1 Search strategy in PubMed, Web of Science and CENTRAL

PubMed = 3823 records

((Aged[Mesh] OR Aging[Mesh] OR Aged[Text Word] OR aging[Text Word] OR elder*[Text Word] OR "old adult*"[Text Word] OR "older adult*"[Text Word] OR "old person*"[Text Word] OR "older person*"[Text Word] OR "old individual*"[Text Word] OR "older individual*"[Text Word] OR "old people"[Text Word] OR geriatr*[Text Word] OR "independent living"[Mesh Terms] OR "independent living"[Text Word] OR "healthy aging"[Mesh] OR "healthy aging"[Text Word] OR healthy[Text Word]) AND (Exercise[Mesh] OR Exercise[Text Word] OR "physical activity"[Text Word] OR "physical exertion"[MeSH] OR "physical exertion"[Text Word] OR "physical fitness"[Mesh] OR "Physical Education and Training"[Mesh] OR "Physical Education and Training"[Text Word] OR "Physical Education"[Text Word] OR "Physical Training"[Text Word] OR "physical fitness"[Mesh] OR "physical fitness"[Text Word]) AND (mhealth[Text Word] OR "m-health"[Text Word] OR "mobile health"[Text Word] OR "wearable technolog*"[Text Word] OR "Smartphone*"[Text Word] OR "mobile app*"[Text Word] OR app*[Text Word] OR webapp*[Text Word] OR ehealth[Text Word] OR "e-health"[Text Word] OR Telemedicine[Text Word]))

Web Of Science, Title = 598

((Aged OR Aging OR aging OR elder* OR "old adult*" OR "older adult*" OR "old person*" OR "older person*" OR "old individual*" OR "older individual*" OR "old people" OR geriatr* OR "independent living" OR "healthy aging" OR healthy) AND (Exercise OR "physical activity" OR "physical exertion" OR "physical fitness" OR "Physical Education and Training" OR "Physical Education" OR "Physical Training" OR "physical fitness") AND (mhealth OR "m-health" OR "mobile health" OR "wearable technolog*" OR "Smartphone*" OR "mobile app*" OR app* OR webapp* OR ehealth OR "e-health" OR Telemedicine))

CENTRAL = 32

Aged [Mesh] OR aging [title/abstract/keyword] OR old age [title/abstract/keyword]) AND (mhealth [title/abstract/keyword] OR mobile app [title/abstract/keyword] OR Telemedicine [Mesh]) AND Exercise [Mesh]

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Table S1 Detailed description of the mHealth interventions for promoting PA in older adults

Author(s), year	Country	Study design	Sample	Age (years)	Technology category	Type of intervention	Outcome measures	Conclusion
Delbaere *et al.* 2021 (56)	Australia	RCT	503 (339 females)	77.0	Website	Technology: standing tall program E: tablet computer with a health promotion education program that focused on health-related information + standing tall program with exercise equipment. The StandingTall program consisted of balance exercises delivered through a tablet computer in the participants' homes with embedded behavioural change techniques, including a weekly calendar for scheduling exercises, goal setting, and educational fact sheets. The exercises focus on standing balance, targeted stepping, and step-up (box) exercises C: tablet computer with a health promotion education program that focused on health related information Duration: 2 years	Fall rate (diary); proportion of individuals wo had a fall; fall injuries; fall risk; standing balance; maximum forward-backwards and controlled leaning balance; timed sit to stand; TUG; SPPB; 10-m walk speed; stepping performance; montreal cognitive assessment; trail-making test; Victoria stroop test; Iconographical falls efficacy scale; PHQ-9; COMPAS-W; EQ-5D-5L; AQOL-6D; PA (self-report); walking, standing (McRoberts)	The fall rates were not statistically different in the two groups after the first 12 months. Additionally, the proportion of people who fell was not statistically different at 12 months. However, the intervention group had a 16% lower rate of falls over 24 months and a 20% lower rate of injurious falls over 24 months compared with the control group. Both groups had a similar proportion of people who fell over 24 months. In the intervention group, 68.1% and 52.0% of participants exercised for a median of 114.0 min/week after 12 months and 120.4 min/week after 24 months, respectively. Groups remained similar in mood and activity levels. The intervention group had an improvement in QoL at six months, and an improvement in standing balance at 6 and 12 months
Pischke *et al.* 2022 (57)	Canada	RCT	484 (161 females)	69.6	Website + wearable device	Technology: web-based intervention Group 1: web-based intervention. It comprises a website and a smartphone app that feature PA tracking, goal setting, and feedback mechanisms Group 2: web-based intervention and PA tracker. A PA tracker (Fitbit Zip) was used to collect objective PA data, which is then synchronized with the web-based platform to enhance tracking and feedback Group 3: print-based intervention. It utilizes printed materials along with a PA diary for self-monitoring purposes Duration: 10 weeks	MMSE 2; MVPA, SB (Actigraph); acceptance (questionnaire)	The proportion of individuals reaching the MVPA recommendations did not change over time, and no significant changes in sedentary behavior was seen. MVPA only increased slightly from baseline to 3 m and then decreased by 9 m. Although the interventions were initially well-received, overall effectiveness in increasing physical activity and reducing sedentary behavior was limited
van den Helder *et al.* 2020 (58)	Netherlands	RCT	245 (174 females)	72.0	Application	Technology: application Group 1: Blended home-based exercise intervention. This included a tablet PC with developed app and personalized coaching. The app allowed participants to draw up a personalized weekly program with progressive functional training exercises (type, level, duration, sets, and complexity) Group 2: Blended home-based exercise intervention and dietary protein counselling. It was focused on increasing protein intakes to a minimum of 1.2 g/kg/day and optimum of 1.5 g/kg/day, timing (breakfast, lunch, dinner, and snacks), and source of protein (high-quality protein sources, such as dairy protein) Group 3: no intervention Duration: 6 months	m-PPT; SPPB; PA (self-report); Handgrip strength; TUG; 6MWT; protein and energy intake (self-report); skeletal muscle mass (DXA); SF-36; GDS; trail-making test; stroop color-word test; letter-fluency test; adherence	The blended home-based exercise and dietary protein interventions did not significantly change physical performance in community-dwelling older adults. However, improvements in gait speed, PA, muscle mass, strength, and dietary protein intake were observed in response to the combined intervention
Thompson *et al.* 2023 (67)	USA	Single-group study	13 (10 females)	82.56	Website	Technology: Vivo The virtual fitness training program was delivered by Vivo, a digital fitness solution company that provides live and interactive small group fitness training classes designed specifically for older adults. Sessions were delivered via Zoom, involving a mix of cardiovascular, strength, balance, and agility exercises Duration: 8 weeks	SPPB balance component; 30-s chair stand test; 8 foot up and go test; 30-s arm curl; 2 min step test	Functional improvements in several aspects of functional fitness were observed following 8 weeks of the virtual fitness training program
Jungreitmayr *et al.* 2022 (59)	Austria	RCT	110 (110 females)	65.3	Application	Technology: Application E: App-based, unsupervised physical exercise program, in which the exercise frequency and duration of sessions were self-selected. The physical exercise program consisted of simple, functional exercises such as arm circles, squats, lateral raises. The participants were provided with an elastic resistance band and an exercise ball allowing them to increase exercise intensity if needed C: no intervention Duration: 14 weeks	30-s chair stand test; uni-pedal stance test; Handgrip strength; isometric strength of shoulder abduction, hip extension, hip abduction, arm flexion; flexibility; adherence	The app-based physical exercise program had positive effects on muscular strength and flexibility in women over 60 years of age. The intervention group showed significant improvements in these areas compared to the control group, which faced a decrease in performance. The program demonstrated that app-based exercise can be an effective method to promote physical fitness in older adults
Daly 2021 (68)	Canada	Single-group study	19 (10 females)	70.1	Application	Technology: Physitrack A home-based, muscle strengthening, weight-bearing impact and challenging balance/mobility program using a commercial exercise prescription app on a tablet computer Duration: 8 weeks	Feasibility: retention, adherence, adverse events; usability (SUS); PA enjoyment (PACES); MVPA (Active Australia survey); SPPB; Perceptions of the app (questionnaire)	The adherence rate was 84%. Across 401 sessions, there were two minor adverse events. Participants increased their weekly walking time by 78 minutes and MVPA by 41 minutes. The SPPB scores improved slightly by 0.3 points over 8 weeks. System usability scored high at 86 out of 100, and participants reported high enjoyment with a median satisfaction score of 4 out of 5. No outcome differences were observed between previous tablet owners and non-owners. The study concludes the program is safe and effective for enhancing musculoskeletal health in older adults
Van Dyck *et al.* 2019 (60)	Belgium	RCT	72 (35 females)	70.9	Website	Technology: MyPlan 2.0 E: MyPlan 2.0 was based on the self-regulatory theory and focused on both pre- and postintentional processes to increase PA C: no intervention Duration: 5 weeks	IPAQ; LPA, MVPA, total PA (Actigraph)	The study observed notable but borderline significant improvements in physical activity among the intervention group compared to the control group, with accelerometer-based MVPA increasing by 5 minutes per day and total physical activity by 20 minutes per day. MyPlan 2.0 also effectively increased self-reported physical activity, particularly in the intermediate term, with increases in leisure-time vigorous and moderate household-related activities, as well as gardening. Conversely, reductions were noted in leisure-time moderate PA and cycling for transport. The results suggest that eHealth interventions grounded in self-regulation theories could be effective for behavior change in older adults, recommending further studies with larger samples and longer follow-ups to validate these findings
Shake *et al.* 2018 (77)	USA	Pre Post	105 (90 females)	73.4	Application	Technology: Bingocize E: Bingo with exercise and health education. It is a game-centered mobile app that can combine bingo with healthy activities such as exercise and health topic education C: Bingo with health education Duration: 10 weeks	SPPB; Arm curls; Examiner cognitive battery; Health knowledge (questionnaire)	The data suggest that using a mobile app to combine exercise and health education in a familiar and friendly context (bingo) appears to be a very effective means to maintaining older adult adherence to a health promotion program. This strong adherence may in turn allow us to design future interventions using Bingocize that lead to more demonstrable improvements in aspects of physical and cognitive performance
Konstantinidis *et al.* 2016 (75)	Greece	Non-RCT	232 (182 females)	69	Website	Technology: FitForAll E: the FitForAll platform consists of specifically designed games aiming at elderly exercise and maintenance/advancement of healthy physical status and wellbeing. It offers elderly-specific exercises within an engaging game environment aiming at promoting physical exercise protocol adherence. C: cognitive training Duration: 8 weeks	Usability (SUMI, SUS); Adherence; Senior fitness test; WHOQoL-BREF	The study reported high usability scores, correlating with an 82% adherence rate in a two-month pilot. Elderly participants using the FitForALL exergaming platform showed significant improvements in strength, flexibility, endurance, and balance, along with notable improvements in quality of life. This is the first intensive evaluation of an elderly-focused exergaming platform with over 100 participants, providing comparable data that contributes to an emerging corpus on elderly exergaming
van Het Reve *et al.* 2014 (76)	Canada	Non-RCT	88 (56 females)	75	Application	Technology: ActiveLifestyle app E: ActiLifestyle app. It offers autonomous-living older adults tablet-based software that supports them doing their physical exercises. The app assists, monitors, and motivates this group of people while doing their exercise program at home. The program consists of a strength and balance training plan. Exercises are shown with videos and explained with written and oral instructions. C: exercises using a training plan on paper Duration: 12 weeks	Adherence; gait analysis; SPPB; Fear of falling	Participants using the tablet-based program showed significant improvements in single and dual task walking, with marked increases in gait velocity and cadence during dual task walking at preferred speed compared to those in the brochure group, who showed no significant changes. Although the brochure group had more inactive participants, this difference was not statistically significant. Active participants performed better than inactive ones in all measured walking tasks and SPPB scores. Overall, the tablet-based program was more effective in enhancing gait and physical performance among autonomously living older adults compared to the brochure-based approach
Tuominen *et al.* 2021 (61)	USA	RCT	231 (192 females)	65	Wearable device	Technology: Activity tracker E: use of Activity tracker (Polar) with daily activity goal. C: no intervention Duration: 12 months	MVPA, LPA, SB (Actigraph)	Among participants with obesity, the intervention led to an increase in LPA and a decrease in SB at six months, although these changes were not sustained at 12 months. There was no significant impact on MVPA. In contrast, the control group showed a decrease in LPA and an increase in SB. No significant differences were found in changes in MVPA, LPA, or SB over time among participants with normal weight or overweight. Wearable activity trackers may help manage the balance between SB and LPA in older adults with obesity, but their effects appear to be short-lived
Brickwood *et al.* 2021 (62)	Canada	RCT	117 (75 females)	72	Wearable device	Technology: Activity tracker Group 1: individualized home-based exercise program with activity tracker Group 2: individualized home-based exercise program with telephone counselling Group 3: individualized home-based exercise program Duration: 12 months	Daily steps (ActivPAL); Active Australia Survey; health risk factors (body weight, BMI, blood pressure, bodyfat, lean mass); 10 times sit to stand; TUG; 6MWT; SF-36	Both activity tracker and telephone counseling groups were similarly effective at successfully maintaining daily step count over the 12-month intervention. The control group maintained daily step count throughout the 9 months; however, a significant reduction in daily steps was observed at 12 months
Rowley *et al.* 2019 (63)	USA	RCT	170 (134 females)	67	Website + wearable device	Technology: Pedometer Group 1: Pedometer (Omron) only with a daily step goal and paper logs Group 2: Pedometer (Omron) with interactive website. The interactive website employed key strategies to increase PA systematically in older adults. These included education and goal setting, self-regulation, and frequent feedback and rewarding Group 3: no intervention Duration: 12 weeks	Daily steps (pedometer)	The pedometer with interactive website significantly increased daily steps more so than both control and pedometer only group
Albergoni *et al.* 2020 (69)	Switzerland	Single-group study	10 (4 females)	75	Application + wearable device	Technology: PACE app It is an application designed to visualize patient's adherence to PA programs. The PACE app ran on a tablet and received walking and exercise minutes from a wrist watch (Philips Health Watch) via Bluetooth Low Energy. The synchronization was automatically initiated when opening the app. The researcher entered the target walking minutes and the target heart rate zone and exercise minutes via a professional dashboard	Body mass; BMI; resting HR; 6MWT; cardiorespiratory fitness; activity pacing questionnaire; exercise self-efficacy; fatigue severity scale; SF-12; SQUASH	No significant changes, except for the exercise self-efficacy which showed a significant main effect of time
Cai *et al*., 2022 (79)	Switzerland	RCT	72 (45 females)	67	Application	Technology: Wechat E: virtual community was built via an app to motivate participation in walking programmes. Participants were encouraged to send their step diaries and the photos of their group walking to this virtual community. Knowledge about the benefits of PA and behaviour change techniques were also provided via the app C: invited to attend lectures covering topics related to benefits of PA 1×/week during the first 2 weeks. They were also provided the printed booklets. During the whole period, they received a phone-call once a month, addressing issues related to daily walking steps, barriers to PA and the copying strategies. Duration: 3 months	Daily steps (pedometer); 5-m walking test; Handgrip strength; 5STS; body fat; lean mass; Visceral fat index; Exercise self-efficacy scale; QoL	A 3 m peer support and mobile application-based walking program could effectively increase PA and handgrip strength. No significant improvement was found for gait speed, 5STS or body composition
Roberts *et al.* 2019 (65)	New Zealand	RCT	40 (24 females)	72	Wearable device	Technology: Activity tracker E: center-based exercise intervention with aerobic and resistance exercises and wearable activity tracker (Fitbit), along with behavioral monitoring and feedback C: center-based exercise intervention with aerobic and resistance exercises Duration: 8 weeks	Daily steps, SB (Actigraph); blood samples; blood pressure; 4-m walk test; Handgrip strength; SPBB	Interventions with a structured exercise and the addition of a wearable activity tracker appeared to positively influence daily activity patterns and changes in blood pressure, potentially improving risk factors for CVD. A fully powered randomized trial is needed
Frei *et al.* 2019 (70)	Switzerland	Single-group study	29 (22 females)	75.4	Wearable device	Technology: Stepcounter app Smartphone provided access to a stepcounter app to monitor steps, to Google calendar where time and meeting places of the group walks were displayed and to Whatsapp to enable communication between particpants and between particpants and the study team Duration: 6 months	Daily steps, MVPA (Actigraph); 1MSTS; EQ-5D-5L; feeling thermometer; HADS; social support; feasibility and acceptability (interviews); sustainability	The intervention was successfully implemented, transferred to participants and has now been self-sustained in the community for almost 1 year. The study showed that it is possible to combine different approaches to promote PA in the community using technology and a dynamic citizen science approach. A significant increase was seen in MVPA, not for other outcomes
Nikitina *et al.* 2018 (71)	Canada	Single-group study	60 (24 females)	67	Website	Technology: Gymcentral Home-based online group training. It is a tablet and web app that allows trainees of different functional abilities to follow online group exercises from home, under supervision of a remote coach. It contains tailored training programs, online group exercises, persuasion strategies, remote monitoring and feedback, communication features Duration: 8 weeks	Usability (SUS); Acceptance (questionnaire); Adherence; SWLS; R-UCLA loneliness scale; PA (PACES); MOS social support; 30-s chair stand test	Online group-exercising tool was rated as highly usable. Participants reported the training feature as very usable, whereas messaging was reported as usable (1 point lower). The intention to use the app in the future was also very high. Overall improvement in SWLS score was seen, and no decrease in loneliness score because of the training
Johnson *et al.* 2021 (72)	Switzerland	Single-group study	13 (10 females)	71	Website	Technology: telehealth Intervention contents were shared with participants on Google Classroom with didactic materials related to practicing healthy lifestyle behaviors (i.e., PA). It included study-specific videos, pre-recorded presentations and demonstrations of PA, and reading that were germane to practicing healthy lifestyles overall and during the COVID-19 pandemic. Interviewers worded individually with participants over the telephone to discuss the intervention and develop a customized strategy for practicing PA that aligned with each participant's abilities and environment. Theory-based goal-setting was used, practicing in light and MVPA was emphasized Duration: 6 weeks	PA (MARCA); SB, LPA, MVPA (Actigraph)	After the 6 weeks, participants reported spending more time in front of a computer and less time in active transport, and a non-significant trend in participants engaging in more minutes in MVPA was observed. It suggests that participants may have replaced engaging in PA through active transport with participating in PA in front of a computer while using this intervention as a guide
Kari *et al.* 2023 (73)	Finland	Single-group study	241 (149 females)	70	Website + wearable device	Technology: activity tracker Mobile PA tracker application to be used in daily lives for tracking PA. The application operated on the Wellmo platform and the central features were built around the tracking of everyday PA: tracking PA and exercises as well as weekly, monthly, and annual reports. Kcal and MET-minutes were calculated and could be used to set a personal weekly goal Duration: 24 months	PA (IPAQ-E)	Assessments were done at baseline, after 12 months and after 24 months. The results indicate that PA tracker application use can promote PA behavior among older adults. There was a significant increase in walking, moderate PA and total PA levels. There was no change in sedentary behavior
Bosco *et al.* 2022 (74)	UK	Single-group study	41 (34 females)	68.4	Website	Technology: make movement your mission platform It is an initiative to promote additional movement minutes into the day over and above any other physical activity or structured exercise people may be doing. Movement 'snacks' and these are then available to 'catch up' on the Facebook page and on an open access YouTube channel. Each movement 'snack' consists of a 15–20 min session, including a welcome 'preamble' chat. The Facebook platform also allows interaction with participants and between group participants to create group cohesion to promote adherence Duration: NR	Survey about socio-demographics, PA, surrounding support; survey about changes in shoulder mobility, flexibility, 30 s chair stand test; SF-36; UCLA loneliness scale; ELSA	They attended an average of 14.3 sessions weekly (3.5 hours). Of these, 73% had participated in MMYM for over a year, 90% reported increased daily movement, and 75% saw improvements in moderate physical activity. Strength, balance, and flexibility activities improved by 48%, 73%, and 75%, respectively. Over 80% met the strength and balance physical activity guidelines. Between 18% and 53% noted improvements in daily activities, 53% reported better quality of life, and 28% used the internet more. Eight interviews revealed that direct instructor support, group expectations, and regularity of sessions enhanced engagement and confidence, particularly through noticeable improvements in balance and posture
Recio-Rodríguez *et al.* 2022 (80)	Spain	RCT	160 (98 females)	70.8	Application + wearable device	Technology: EVIDENT 3 E: advice on nutrition and PA. The app allows daily monitoring of food and physical activity by integrating the information collected by the smartband in the form of steps, calories and heart rate (physical activity) and food and dishes eaten as recorded daily by the participant in selecting from the application menu C: advice on nutrition and PA Duration: 3 months	Daily steps (Actigraph); PA (IPAQ); SB (questionnaire); Mediterranean diet adherence questionnaire; body composition; MMSE; functional activities questionnaire	The EVIDENT 3 smartphone app for three months did not significantly change physical activity levels, eating habits, or most clinical parameters compared to those receiving brief lifestyle advice. However, a slight improvement was noted in cognitive functions

AQOL-6D, assessment of quality of life; BMI, body mass index; C, control group; COMPAS-W, COMPAS-W scale; E, experimental group; ELSA, English longitudinal study of ageing; EQ-5D-5L, euroqol five dimension file level; GDS, geriatric depression scale; HADS, hospital anxiety and depression scale; IPAQ, international physical activity questionnaire; IPAQ-E, international physical activity questionnaire modified for the elderly; IVR, interactive voice response; LPA, light intensity physical activity; m-PPT, modified physical performance test; MARCA, multimedia activity recall for children and adults; Mini-BESTtest, mini balance evaluation system test; MMSE, mini-mental state examination; MOS, medical outcome survey; MVPA, moderate-to-vigorous physical activity; NR, not reported; PA, physical activity; PACES, physical activity enjoyment scale; PHQ-9, patient health questionnaire; R-UCLA, revised-university of California, Los Angles; RCT, randomized controlled trial; SB, sedentary behavior; SF-12, short-form health survey 12 items; SF-36, short-form health survey 36 items; SPPB, short physical performance battery; SQUASH, short questionnaire to assess health-enhancing physical activity; SUMI, software usability measurement inventory; SUS, system usability scale; SWLS, satisfaction with life scale; TUG, timed up and go; UCLA, revised-university of California, Los Angles; WHOQol-BREF, world health organization quality of life questionnaire; 1MSTS, one-minute sit-to-stand test; 5STS, five times sit-to-stand test; 6MWT, six-minute walk test.

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