

Effect of AI intervention programs for older adults on the quality of life: A systematic review and meta-analysis of randomized controlled trials

Kawoun Seo¹ , Taejeong Jang¹  and Jisu Seo² 

Abstract

Background: The extension of life expectancy due to medical advancements has resulted in global aging and increased social costs for elder care. Additionally, stringent health measures related to infectious disease pandemics have adversely affected the quality of life for older adults. This study investigates AI-based interventions to address quality of life issues.

Objective: This study systematically examines AI interventions for the older adults, focusing on randomized experimental studies, and aims to provide guidelines for future intervention programs through meta-analysis.

Method: A comprehensive meta-analysis that examines the impact of various AI interventions on the overall quality of life experienced by older adults has been conducted, encompassing thirteen randomized controlled trials.

Results: The overall effect size of AI intervention programs on the quality of life in the older adults, assessed using the random-effects model, was found to be small (Hedges' $g = 0.30$, 95% CI = 0.10–0.51). Additionally, the effect size of quality of life was examined based on the subfactors of the AI intervention program, revealing a range of 5–11 weeks. Robot intervention exhibited a higher effect size than smart device intervention.

Conclusion: To improve the quality of life of older adults, further investigation is warranted, including a follow-up study to develop a AI-based intervention program tailored to the type of AI program and intervention duration.

Keywords

Older adults, AI program, quality of life, meta-analysis, nursing intervention

Submission date: 16 August 2024; Acceptance date: 11 February 2025

Introduction

According to data from Statistics Korea, the global proportion of older adults was 9.8% in 2022 and is projected to increase to 20.1% by 2070.¹ This demographic shift poses a dual challenge: society must contend with escalating dependency costs, while individuals experience extended life expectancy. However, an extended life is accompanied by physical, psychological, and social obstacles leading to functional impairment, increased reliance on assistance, reduced mobility, depression, isolation, and loneliness.² These challenges have been further exacerbated by the

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recent COVID-19 pandemic, necessitating stringent health measures such as quarantine and social distancing for older adults owing to their heightened susceptibility to the virus.^{3,4} Consequently, older adults reported a decrease in their quality of life, mainly attributed to social isolation and feelings of loneliness.^{4,5} In response to this situation, there has been a growing interest in utilizing AI-driven interventions to mitigate the decline in the quality of life of older adults.

AI-driven solutions, particularly within the healthcare sector, are progressively gaining ground, facilitated by the growing prevalence of ICT-convergent medical devices, making it increasingly feasible to amass substantial medical datasets.⁶ AI manifests its utility in diverse forms, ranging from software such as deep learning, machine learning, image recognition technology, and voice recognition^{7,8} to robotic appendages that enhance the activities of daily living by augmenting physical capabilities^{9,10} and social robots designed for interaction and information exchange.^{11,12} These AI-enabled interventions hold promise for improving the quality of life of older adults who often face physical and psychological challenges accompanying aging, along with social isolation stemming from these issues.

In certain situations, the use of robotic arms, legs, or gait assistants can improve the quality of life for older adults by enhancing their ability to perform daily activities.^{9,10} Robots can directly impact the well-being of older individuals by assisting them with their daily tasks, particularly when access to external help is limited, such as during the COVID-19 pandemic.¹ Additionally, AI interventions utilizing speech recognition technology have shown promise in addressing memory decline in older adults⁶ and in reducing loneliness by providing companionship through conversation.¹³ Consequently, it is crucial to assess the effectiveness of AI-related interventions in older adults to develop programs aimed at improving their quality of life.

Despite numerous studies on AI-related interventions for older adults, there is a lack of comprehensive meta-analyses evaluating the overall effectiveness of these interventions. Analyzing existing meta-analysis studies, Lu et al.¹⁴ examined the impact of AI interventions with robots on dementia patients and revealed that such interventions were effective in reducing depression among dementia patients but did not significantly improve their overall quality of life. Similarly, Pu et al.¹² showed that the effects of social robots on older adults did not significantly improve their quality of life. However, both studies were limited to robot interventions, which restricts the generalizability of their findings to AI interventions such as speech recognition. In this study, we conducted a systematic review of experimental studies evaluating the effectiveness of AI interventions and a meta-analysis to integrate the findings, providing essential information for the development of programs to improve the quality of life of individuals aged 65 years and older.

Methods

Study design

This systematic review and meta-analysis were prospectively registered in the PROSPERO database (PROSPERO Register code: CRD 42023491142, <http://www.crd.york.ac.uk/PROSPERO/>) and are reported in accordance with the relevant extensions of the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) reporting guideline¹⁵ and the Cochrane Handbook for Systematic Review of Interventions.¹⁶

Search strategy

Electronic literature published up to August 10, 2023 was systematically retrieved using five English literature databases (MEDLINE, Embase, Cochrane Library, CINAHL, and ProQuest) and six Korean databases (National Assembly Library, Korea Citation Index [KCI], Research Information Sharing Service, Korean Studies Information Service System [KISS], DBpia, and KoreaScholar). To reduce publication bias, we considered studies published in peer-reviewed journals as well as gray literature, including conference proceedings. Three independent researchers conducted the search to identify studies reporting outcomes related to the impact of AI intervention on the quality of life in older adults. Search terms were applied in conjunction with Medical Subject Heading (MeSH) terms, keywords, and synonyms. The primary search terms used in the databases were “aged,” “Artificial intelligence,” “robotics,” and “quality of life.” Articles extracted from each database were managed using EndNote (version 20) reference management software.

Eligibility criteria

This systematic review and meta-analysis exclusively included randomized controlled trials (RCTs). The studies meeting the following criteria were included in this analysis:

- (1) participants were older adults (≥ 65 years),
- (2) the intervention involved any form of AI to include robots and other systems,
- (3) the article reported outcomes related to quality of life, and
- (4) the article was published in English or Korean.

No restrictions were imposed on the type, duration, or setting of AI intervention in the intervention group. The control group encompassed alternative interventions, usual care, or waitlists. Pre- and post-test data were also included. As this research does not contain any humans or animals subjects, ethical approval and informed consent are not required.

Study selection and data extraction

The articles retrieved from each database were imported into EndNote version 20, and duplicate articles were

systematically removed. Subsequently, three independent researchers reviewed the titles and abstracts of the selected studies. Full texts of potentially eligible studies were then retrieved, and two authors independently reviewed the full texts, identifying studies that met the eligibility criteria for inclusion, and subsequently performed data extraction. Any disagreements were resolved through discussion or consultation with other researchers.

For the included studies, essential study information such as authors and publication year, population details (target population, gender ratio by group, and mean age), intervention characteristics (AI program, AI mode, intensity, and duration), comparisons (active or inactive with usual care, waitlist), and outcome measurements were recorded using Microsoft Excel. Outcome data, including means and standard deviations of raw data, were extracted and summarized to assess the impact of the AI program on the quality of life.

Quality and risk-of-bias assessments

The quality and risk of bias for all included articles were evaluated using Cochrane's Risk of Bias (version 2.0) tool (RoB 2.0).¹⁷ The Cochrane RoB 2.0 contains five domains of bias: bias arising from the randomization process, bias due to deviations from intended interventions, bias due to missing outcome data, bias in outcome measurements, and bias in the selection of the reported result. An algorithm assessed the risk of bias in each domain, resulting in a final determination of "low risk of bias," "some concerns risk of bias," or "high risk of bias."¹⁶ All researchers independently assessed the quality and risk of bias of all articles included in the final review. The outcomes of the assessments by each researcher were then compared. Any disagreements among independent researchers were resolved by mutual agreement or, if necessary, by involving a third expert reviewer to achieve consensus.

Data analysis and synthesis

A comprehensive meta-analysis (version 3; Biostat Inc., Englewood, NJ, USA) was conducted to combine effect sizes and assess heterogeneity and publication bias. For each study, baseline and postintervention mean and standard deviation (SD) values were extracted. Continuous variables were calculated using Hedges's *g* effect sizes with 95% confidence intervals through CMA. Hedges' *g* effect size represents the between-group mean difference for the selected outcome measure, adjusted for small sample sizes.¹⁸ The effect-size direction was determined by the difference between mean values for the experimental and control groups. A random-effects model was employed due to variations in the type and duration of AI intervention programs, enabling the generalization of results to comparable studies.¹⁹ Heterogeneity was assessed by calculating

the *Q* value and I^2 (I-squared) statistics.²⁰ A low *p*-value ($p > .01$) for the *Q* statistic or an I^2 (I-squared) ratio greater than 75% indicated heterogeneity across the studies.²⁰ A subgroup analysis based on intervention delivery mode (robot vs smart device) and intervention duration (4 weeks less than as short-term vs 5–11 weeks as mid-term vs 12 weeks longer as long-term) was conducted. Publication bias was assessed using funnel plots¹⁶ and Egger's regression tests ($p > .05$).²¹ Egger's regression test was used to evaluate the relationship between effect size and standard error to determine the significance of asymmetry.²¹

Results

Study selection and characteristics

The literature search strategy, following the PRISMA 2020 guidelines, is summarized in Figure 1. The initial search yielded 4463 records—4265 from English databases (MEDLINE, Embase, Cochrane Library, CINAHL, and ProQuest) and 198 from Korean databases (National Assembly Library, KCI, RISS, KISS, DBpia, Korea Scholar)—up to August 2023. Duplicate records were removed using EndNote, resulting in 3826 records. Selection was based on titles and abstracts, adhering to the PICOS and inclusion criteria. After initial screening, we reviewed the full texts of 407 articles, excluding studies not involving older adults ($k = 153$), not employing AI intervention ($n = 111$), not following an RCT design ($k = 58$), or having unmatched outcomes ($k = 72$). Thirteen studies met the inclusion criteria and were included in the final analyses.

Table 1 lists the main characteristics of the 13 RCTs. These studies were conducted in Italy ($k = 4$),^{9,10,22,23} the Netherlands ($k = 3$),^{2,8,24} the USA ($k = 2$),^{7,25} Australia ($k = 1$),¹³ Canada ($k = 1$),²⁶ Turkey ($k = 1$),²⁷ and the UK ($k = 1$).²⁸ The participants comprised community-dwelling older adults ($k = 2$),^{2,26} stroke patients ($k = 4$),^{22,23,25,27} patients with cognitive deficiencies, such as dementia, mild cognitive impairment, or Parkinson's disease ($k = 3$),^{7,10,13} patients with functional limitations, such as hearing loss or upper limb impairments ($k = 3$),^{8,24,28} and patients with multiple sclerosis ($k = 1$).⁹ The 13 included RCTs involved 1498 participants, with 18–770 participants in each trial, and a mean age ranging from 46 to 85 years. The interventions were delivered through a robot ($k = 8$),^{9,10,13,22,26–28} smart device ($k = 4$),^{7,8,24,26} or the Internet ($k = 1$).² Short-term interventions ($k = 3$)^{7,9,10} were defined as lasting less than 4 weeks, with a range of 3–5 sessions and 40–45 min per week. Mid-term interventions ($k = 5$)^{13,22–24,27} were conducted over 5–11 weeks, with 2–3 sessions and 30–90 min per week. The remaining 5 studies applied long-term interventions (over 12 weeks), with sessions occurring three times per week and lasting 30 min or daily. Two studies did not provide a clear

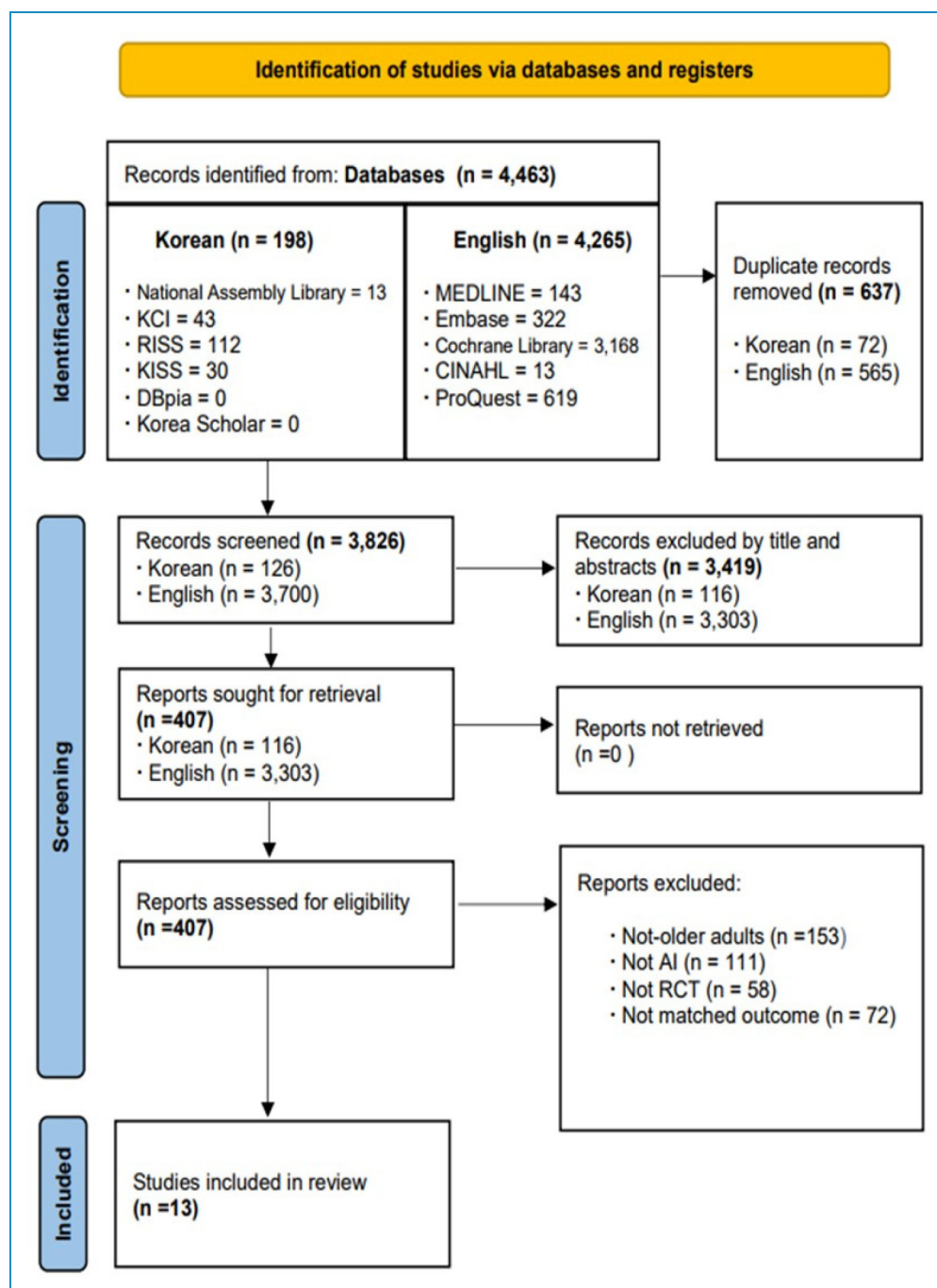


Figure 1. Flow diagram of the study selection process.

indication of intervention intensity. Settings included home ($k = 3$)^{2,7,24} or clinical settings ($k = 8$)^{9,10,22,25,27,28} such as hospitals, rehabilitation centers, and primary care centers. Comparison groups received usual care ($k = 2$)^{8,28} were on a waitlist ($k = 1$)² or received active control ($k = 10$)^{7,9,10,13,22,27} (rehabilitation training or therapy, reading activity, or rehabilitation training without a robot). All 13 studies measured quality of life as an outcome variable. The tools used to measure the quality of life included

in the SSQOL ($k = 2$), QOL-AD ($k = 2$), RAND36 ($k = 1$), SF12 ($k = 1$), Physical SF36 ($k = 1$), EQ-5D-5L ($k = 1$), etc.

Quality of studies and risk of bias

The quality and risk of bias were assessed using Cochrane RoB 2.0¹⁷ to evaluate bias in each domain through an algorithm. The quality assessment of the 13 studies indicated that 8 studies had a low risk of bias (61.5%)^{2,7,9,10,22,25,27,28} and 5

Table 1. Characteristics of the included studies.

Study (year)	Participants			Intervention							Outcome		
	Country	Study design		E (M:F)	C (M:F)	Mean age [†] (years)	AI program	Delivery type	Intensity (per week)	Duration (wk/m/yr)		Setting	
Ambrosini (2021) ²²	Italy	Single-blinded multicenter RCT	Stroke survivors	36 (25:11)	36 (25:11)	60.9 ± 13.7 (25:11)	Functional electrical stimulation	Robot	90 min/3 times	9 wks	Clinical center	Advanced conventional therapy (ACT)	SSQOL
Broekhuizen et al. ²	Netherlands	RCT	Aged 60–70 years	119 (72:47)	116 (67:49)	64.7 ± 3.0	E-coaching	Wearable device	everyday	12 wks	Home	Waitlist	RAND36
De Luca (2020) ²³	Italy	Parallel-group RCT	Chronic ischemic stroke	15 (11:4)	15 (11:4)	54.4 ± 11.9 (11:4)	Robotic device with a Smart-Assist software	Robot	60 min/3 times	8 wks	Hospital	Physiotherapist-aided training	SF12
Gray (2021) ²⁶	Canada	Cluster RCT	Complex care needs	23 (8:15)	21 (14:7)	68.65 ± 7.10	Electronic patient-reported outcome tool (ePRO)	Smart device (system)	everyday	6 m	Primary care center	Technology training	AQOL-4D
Hornby (2008) ²⁵	USA	RCT	Chronic stroke with hemiparesis	24 (15:9)	24 (15:9)	57 ± 10	Robotic device with a locomotion assist software	Robot	30 min/	2 yr	Rehabilitation institute	Therapist-assisted locomotor training	Physical SF36
Kramer (2005) ²⁴	Netherlands	RCT	Hearing impairment	24 (16:8)	24 (12:12)	69 ± 7.7	Tailored hearing aid program	Smart device (videotape/DVD)	.	11 wks	Home	Hearing aid fitting	IOIHA-QOL
Meijerink et al. ⁸	Netherlands	Cluster RCT	Hearing loss	72 (50:22)	74 (28:46)	61.9 ± 10.0	Hearing aid dispenser	Smart device (Booklet, videos)	.	6 m	Hearing aid dispenser	Usual care	IOI-HA items
Moyle et al. ¹³	Australia	Pilot RCT	Dementia	9	9	85.3 ± 8.4	AI software with robot's behavior based on a host of sensory system	Robot	45 min/3 times	5 wks	Residential care facility	Reading activity	QOL-AD
Mustafaoglu, (2020) ²⁷	Turkey	Single-blinded RCT	Older adults with stroke	E1 17 (11:6) E2 17 (10:7)	17 (12:5)	53.8 ± 10.7	Robotic device with a Smart-Assist software	Robot	45 min/2 times	6 wks	Rehabilitation center	Conventional training (CT)	SSQOL

(continued)

Table 1. Continued.

Study (year)	Participants			Intervention								
	Country	Study design	E (M:F)	C (M:F)	Mean age [†] (years)	AI program	Delivery type	Intensity (per wk/m/ week)	Duration (yr)	Setting	Comparisons	Outcome
Rodgers (2020) ²⁸	UK	Three-group RCT	E1 257 (156:101) E2 259 (159:100)	254 (153:101)	59.9 ± 13.5 (153:101)	Robotic device with a Smart-Assist software	Robot	60 min/ 3 times	12 wks	Robotic gym in clinical rehabilitation application	Usual care	SIS EQ-5D-5L QALYs
Schmitter-Edgecombe et al. ⁷	USA	Pilot RCT	17 (10:7)	15 (5:10)	70.6 ± 6.3	Electronic memory and management aid (EMMA) application	Smart device (application, smart home)	5 times	4 wks	Home	Partnered with smart home prompting	QOL-AD
Spina et al. ¹⁰	Italy	Pilot RCT	11 (6:5)	11 (7:4)	68 ± 6.9	Robotic device with a Smart-Assist software	Robot	45 min/ 5 times	4 wks	Hospital	Conventional balance training	PDQ-39
Tramontano et al. ⁹	Italy	Single-blind RCT	14 (6:8)	16 (6:10)	46.7 ± 10.4	Upper limb Sensory-motor training with robotic support	Robot	40 min/ 3 times	4 wks	Rehabilitation center	Upper limb sensory-motor training without robotic support	MSQOL-24

[†]Data are mean ± standard deviation or range values.

Abbreviations: M, male; F, female; SSQOL, stroke specific quality of life scale; SF12, short form 12 quality of life test; AQOL-4D; assessment of quality of life-4 dimensions, SF36; short form 36 quality of life scale; QOL18; 18-item quality-of-life questionnaire, IOI-HA; international outcome inventory for hearing aids, QOL-AD; quality of life in Alzheimer's disease, WHOQOL26; World Health Organization Quality of Life Questionnaire 26, SIS; stroke impact scale, EQ-5D-5L; euroqol-5 dimensions, QALYs; quality-adjusted life-years, PDQ-39; Parkinson's disease questionnaire, MSQOL-54; multiple sclerosis quality of life-54.

studies had some concerns about bias (38.5%) (Figure 2).^{8,13,23,24,26} None of the studies showed a high risk of bias. Upon analysis by domain, 3 studies (23.1%)^{23,24,26} showed concerns about bias in the “randomization process.” While a randomization process was described in 10 studies, two provided no information about the details of the randomization process, and one study lacked information on allocation concealment. Regarding “deviations from intended interventions,” eleven studies (84.6%) showed a low risk of bias, and 2 studies (15.4%)^{13,24} had some concerns about the risk of bias. Most studies involving AI intervention did not implement blinding for participants and staff due to the nature of the interventions. However, no deviation from the intended intervention was observed in the experimental context. Most studies used the intent-to-treat population (ITT) or the modified intent-to-treat (mITT) population. However, two studies (15.4%)^{13,24} lacked sufficient information about the analysis and employed inappropriate statistical

methods. Concerning the domains of “missing outcome data” and “measurement of the outcome,” only one study (7.7%)⁸ showed the risk of bias. In most of the remaining studies, a low risk of bias was observed. Some of the study outcome measurements were conducted with blinding ($k = 9$, 69.2%),^{2,7-10,13,22,23,27} while others were performed without blinding ($k = 4$, 30.8%).^{24,26,28} However, mostly objective, or self-reported measures were used as study outcomes. Regarding the “selection of the reported result,” all the studies demonstrated a low risk of bias.

Effect of AI intervention on quality of life

The meta-analysis of 13 studies, employing a random-effects model, revealed a modest effect size for AI intervention in improving the quality of life (Hedges’s $g = 0.30$, 95% CI = 0.10 to 0.51) (Figure 3(a)). Potential heterogeneity was identified through the Q value and I^2 ($Q = 24.60$, $p = 0.017$, $I^2 = 51.22$). Funnel plots and



Figure 2. Assessment of risk of bias in the included studies.

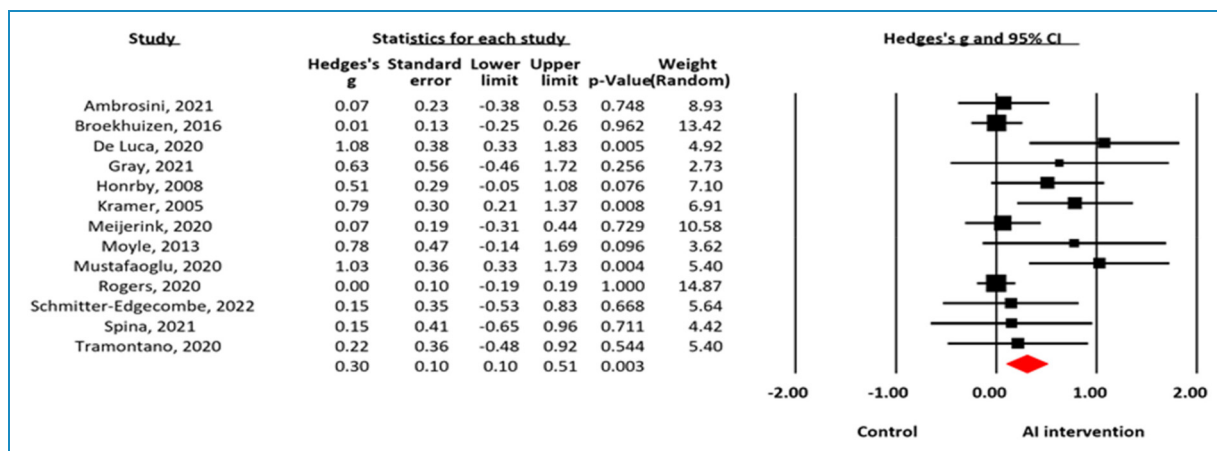


Figure 3. (a) Forest plots showing the total effect of AI intervention on quality of life. (b) Forest plots showing the subgroup analysis of AI intervention on quality of life based on AI intervention delivery mode. (c) Forest plots showing the subgroup analysis of AI intervention on quality of life based on AI intervention duration. (continued)

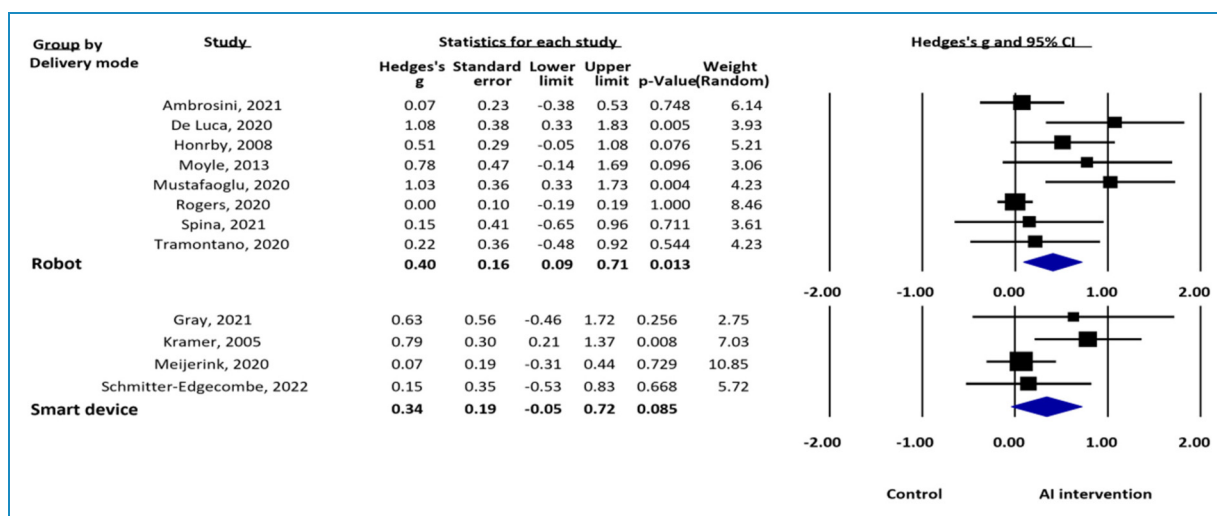


Figure 3. Continued.

Egger's regression test indicated a potential risk of publication bias ($p=0.002$) (Figure 4).

Subgroup analysis

A subgroup analysis was conducted using the AI intervention delivery mode, comparing robots ($k=8$)^{9,10,13,22,26–28} and smart devices ($k=4$)^{7,8,24,26}. The effect sizes of AI intervention based on delivery mode were quantified by Hedges' g values for robots (Hedges' $g=0.40$, 95% CI=0.09 to 0.72) and smart devices (Hedges' $g=0.34$, 95% CI=-0.05 to 0.72) (Figure 3(b)). Funnel plots and Egger's regression test ($p=0.020$, $p=0.445$) indicated a potential risk of publication bias in the AI intervention delivery mode for robots. In the AI intervention subgroup analysis, potential heterogeneity of robots and smart devices was identified through the Q value and I^2

($Q=17.69$, $p=0.013$, $I^2=60.43$; $Q=4.73$, $p=0.193$, $I^2=36.58$).

Another subgroup analysis was conducted based on AI intervention duration, comparing short-term ($k=3$)^{7,9,10} mid-term ($k=5$)^{13,22–24,27} and long-term ($k=5$) durations (Figure 3(c)). The effect sizes of AI intervention duration were expressed through Hedges' g values for short-term (Hedges' $g=0.17$, 95% CI=-0.24 to 0.59), mid-term (Hedges' $g=0.69$, 95% CI=0.26 to 1.12), and long-term (Hedges' $g=0.05$, 95% CI=-0.09 to 0.19) durations. Funnel plots and Egger's regression test ($p=0.853$, $p=0.106$, and $p=0.040$) suggested a potential risk of publication bias in AI intervention for the long-term duration. In the AI intervention subgroup analysis, the potential heterogeneity of robots and smart devices was identified through the Q value and I^2 ($Q=0.02$, $p=0.989$, $I^2=0$; $Q=8.61$, $p=0.071$, $I^2=53.58$; $Q=4.03$, $p=0.401$, $I^2=0.882$).

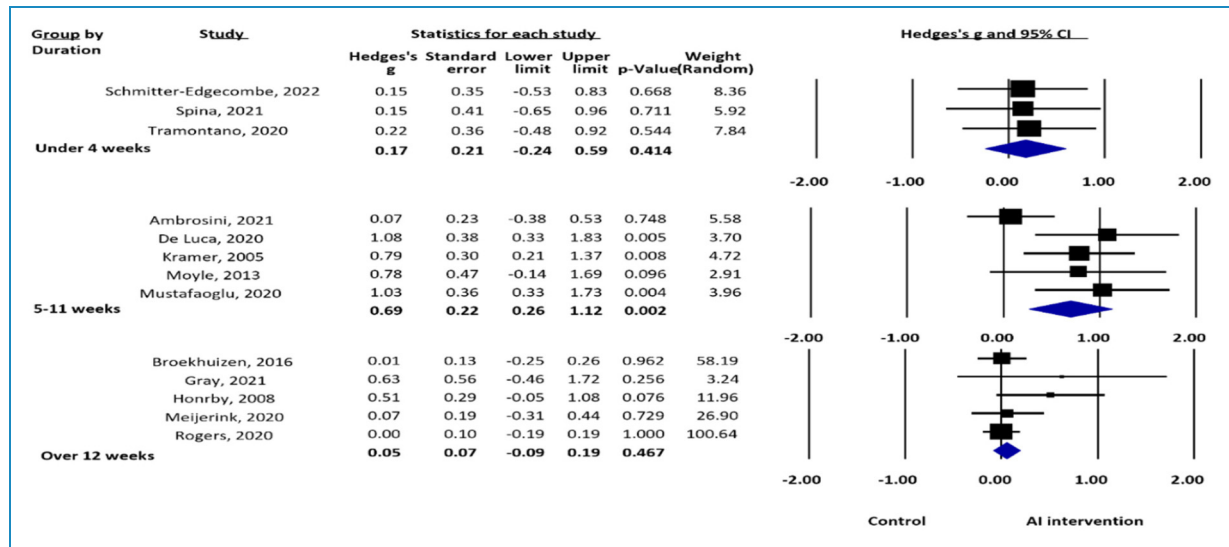


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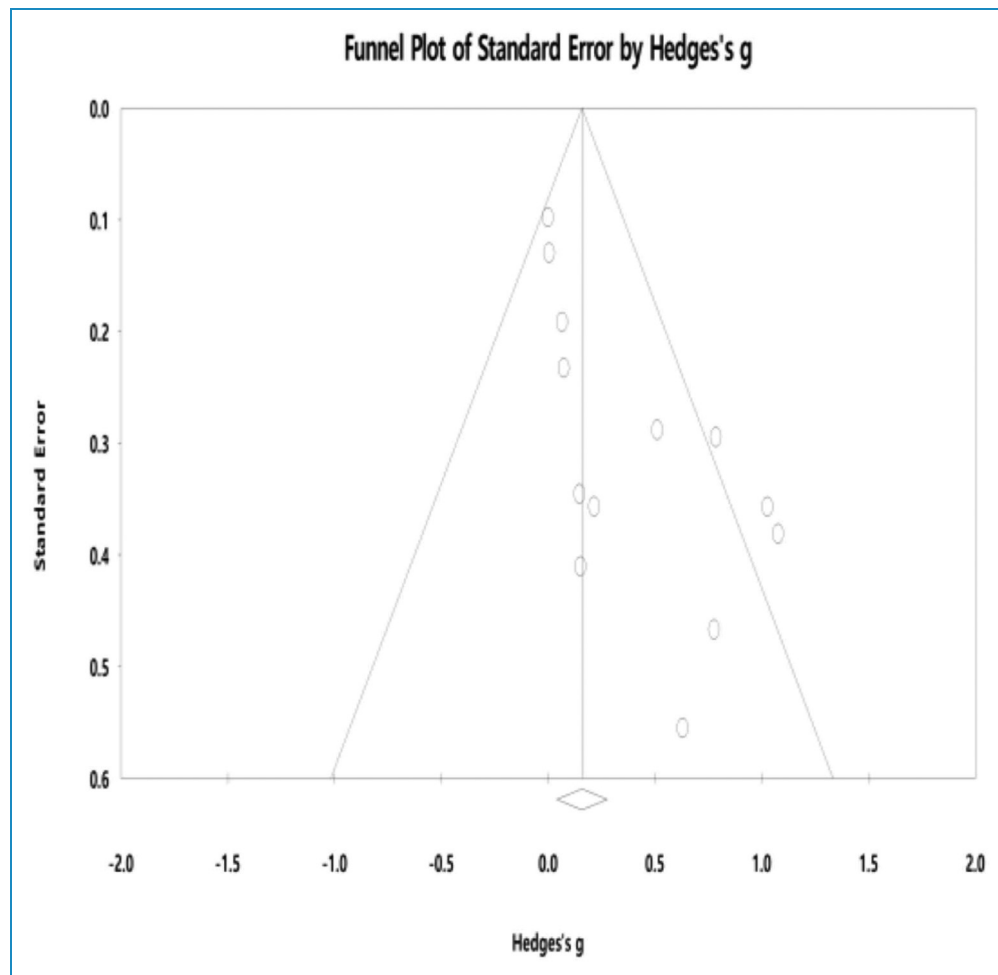


Figure 4. Funnel plots showing the effects of AI intervention on quality of life.

Discussion

The use of AI programs has expanded rapidly due to the COVID-19 pandemic,^{4,5} increasing the accessibility of AI devices such that 75% of older adults aged 64–75 years have used the internet and smart devices within the last month. AI-based intervention refers to using smart applications or social chat-bots with artificial intelligence to analyze situations or provide decision support to encourage participation in program and to offer reasonable solutions. The Previous Studies on AI-Related Intervention for the older adults have explored the effectiveness of AI intervention in the older adults; however, they exclusively focused on interventions using robots, and most of the studies analyzed only patients with dementia. The number of older adults is increasing owing to extended life expectancy,¹ and to assist this population, AI programs continue to develop and diversify. The application of effective AI intervention programs can contribute to improving the quality of life and psychosocial effects in old age. In recent years, various types of robotic devices, such as robotic pets or robot-assisted training, have been increasingly used to improve physical and cognitive function in residential care settings. AI intervention methods can provide vital data for the development and application of nursing intervention programs aiming to improve the quality of life of the older adults.

Effects of AI intervention on quality of life

AI-based intervention had a significant effect on improving the quality of life of the older adults. (Effect size, $ES = 2.95$, $p = .003$). No previous study has individually analyzed AI-based interventions—smart devices-based and robot-assisted interventions—for the older adults. In this study, seven studies that applied robot intervention showed a significant effect on the quality of life of the older adults, and these findings differed from the results of previous studies (Pu et al.¹²) that suggested that robots did not show a significant effect on the quality of life of participants. This may be because except for one robot intervention study, all the studies we analyzed enrolled subjects with stroke as participants, while previous studies focused on patients with dementia; therefore, there was likely a difference in cognitive function in the participants. Therefore, in future studies, it is imperative to assess whether robot intervention affects the quality of life of the older adults relative to the level of cognitive function.

Of all AI-based intervention studies, robotic intervention studies were the most abundant, with 8 studies, in this meta-analysis and had the largest effect size ($ES = 2.50$, $p = .013$). Of the five other studies, two focused on the older adults living in the community, two focused on participants with hearing impairment, and one focused on a complex disease. The findings of these are similar to

those of a previous study²⁹ that showed that the quality-of-life score of the older adults with advanced dementia improved as a result of robot intervention. However, in another meta-analysis of the older adults with dementia, the effect of pet robots on the quality of life was not significant.⁹ These findings show that older adults individuals with high cognitive ability participated in the program more actively than those with low cognitive ability,^{13,16} and it is presumed that the effect of robotic intervention was less in the dementia group with decreased cognitive function. Therefore, it is necessary to verify the significance of robot intervention through repeated studies that specifically investigate effects on the quality of life across various levels of cognitive function.

AI programs such as smart devices and web-based interventions using voice support have been shown to be more effective in improving the cognitive ability of the older adults and reducing loneliness in old age than AI interventions using robots.⁷ However, in this study, the effect was not found to be significant as a result of systematic considerations. Lu et al.¹⁴ showed that the effect on improving the quality of life of the older adults with cognitive decline was insufficient; however, as the significance of the effect varies according to the study intervention duration, a subgroup analysis was conducted. As a result of subgroup analysis, the effect size according to the duration of the AI intervention program showed the greatest effect that was also significant ($ES = 3.12$, $p = .002$) when the intervention duration was more than 5 weeks and less than 12 weeks. Although a direct comparison is difficult because no study has analyzed the effect of the intervention duration, a significant effect size was found when a training program was provided three times a week for more than 60 min per session in a randomized intervention study of AI programs in the older adults.⁹ As a result of meta-analysis subgroup analysis in this study, the effect of the intervention program was not significant when the intervention was less than 4 weeks or more than 12 weeks, but there was a significant effect in previous studies. Therefore, a follow-up study is needed to verify the significance of the effect of applying the AI-based intervention program depending on the intervention period.^{30,31} As the quality of life affects clinical conditions, such as physical and psychosocial factors and health conditions, it is also necessary to consider the quality of life and related variables when classifying the older adults experiencing cognitive decline as well as physical function limitations owing to age-associated diseases.

In this study, a randomized experimental study and a meta-analysis were conducted to understand the effect of AI programs on the quality of life of older adults. The review revealed variations in effect size and significance depending on the method and intervention duration of the AI intervention program. Therefore, a follow-up study is required to confirm the applicability of step-by-step AI

interventions based on the level of cognitive function. The results of this study can be used as preliminary data to develop AI programs to improve the quality of life of older adults. However, some studies may have a publication bias and the heterogeneity of the literature is moderate; therefore, data should be interpreted with caution. In addition, follow-up studies are needed to confirm the effectiveness of the development and intervention of standardized AI programs to improve the quality of life of older adults.

Conclusion

This study was conducted to determine the effect of AI intervention programs on the quality of life of older adults in the community. In total, 13 studies were selected, and the effect of AI intervention programs on the quality of life of the older adults was analyzed using a random-effects model. AI intervention program showed a significant positive effect on the quality of life of the older adults and was particularly effective when the robotic intervention period was more than 5 weeks and less than 12 weeks. The results of this study are significant in delineating the effects based on the type of AI intervention and can serve as a foundational database for the development of intervention programs to improve the quality of life for older adults in the future. However, intervention programs using robots are limited in that it is challenging to assess the true effect of the AI program because of the influence of varying cognitive functions of participants. Moreover, considering the recent trend in robot commercialization, it is necessary to determine whether robot interventions improve the cognitive function of the older adults. Based on the findings of this study, we propose the following recommendations.

A follow-up study is necessary to understand the effect of robot intervention relative to cognitive function levels of the older adults. Furthermore, it is necessary to develop a standardized intervention program to improve the quality of life in older adults.

Acknowledgements: None.

Authorships: Conceptualization, T.J.; methodology, J.S. and K.S.; software, J.S.; formal analysis, K.S.; investigation, K.S. data curation, J.S., T.J. and K.S.; writing—original draft preparation, K.S., J.S. and T.J.; writing—review and editing, K.S. and T.J. All authors have read and agreed to the published version of the manuscript.

Declaration of conflicting interests: The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical approval: This article is a systematic review in which human is not involved in, there is no need for ethical approval.

Funding: This study was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF-2022R1G1A1012133)

National Research Foundation of Korea, (grant number NRF-2022R1G1A1012133).

Informed consent: It is not applicable because this research does not contain any humans or animals subjects.

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Supplemental material: Supplemental material for this article is available online.

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