International Journal of Innovative Technologies in Social Science

e-ISSN: 2544-9435

Operating Publisher
SciFormat Publishing Inc.
ISNI: 0000 0005 1449 8214

2734 17 Avenue SW,
Calgary, Alberta, T3E0A7,
Canada
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ARTICLE TITLE	PIANO LESSONS FOR BRAIN HEALTH? A REVIEW OF COGNITIVE, AUDITORY, AND FUNCTIONAL OUTCOMES IN OLDER ADULTHOOD
DOI	https://doi.org/10.31435/ijitss.1(49).2026.5284
RECEIVED	09 January 2026
ACCEPTED	06 March 2026
PUBLISHED	16 March 2026
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PIANO LESSONS FOR BRAIN HEALTH? A REVIEW OF COGNITIVE, AUDITORY, AND FUNCTIONAL OUTCOMES IN OLDER ADULTHOOD

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ABSTRACT

Objective: To synthesize current evidence on whether piano or keyboard training supports brain health in older adulthood, with particular attention to executive function, central auditory processing, everyday function, and quality of life.
Methodology: This narrative review was informed by PubMed/MEDLINE and PubMed Central searches updated through March 2026, complemented by backward and forward citation tracking of key randomized and controlled studies. Priority was given to intervention trials, mechanistic longitudinal analyses, systematic reviews, and protocols relevant to older adults with and without mild cognitive impairment.
Results: The evidence base includes early randomized studies of beginner piano lessons, active-controlled trials comparing piano with computerized cognitive training or music-listening curricula, neuroimaging analyses nested within randomized trials, and emerging remote or robot-assisted delivery models. The clearest benefits appear in selected executive domains, especially processing speed, category switching, and some aspects of cognitive flexibility. By contrast, the largest active-controlled trial did not find superiority of piano training over music listening for auditory processing, global cognition, or everyday function. Longer interventions may be more favorable, and recent work suggests quality-of-life gains and neuroplasticity signals in white and grey matter.
Conclusion: Piano lessons are a plausible, engaging, and socially meaningful multimodal activity for healthy aging, but current evidence does not justify strong claims about dementia prevention or broad everyday functional gains. Future research should clarify dose-response relationships, identify which older adults benefit most, and test scalable technology-enabled models suitable for community and home-based use.

KEYWORDS

Cognitive Aging, Mild Cognitive Impairment, Piano Training, Executive Function, Auditory Processing, Quality of Life

CITATION

Katarzyna Rosa, Paweł Żurek, Daria Danielczyk, Michał Babicz, Jagoda Pałubska, Oliwer Muller, Natalia Malatyńska, Wiktor Czyżewski, Martyna Szymczyk, Kamil Chudzicki. (2026) Piano Lessons for Brain Health? A Review of Cognitive, Auditory, and Functional Outcomes in Older Adulthood. *International Journal of Innovative Technologies in Social Science*. 1(49). doi: 10.31435/ijitss.1(49).2026.5284

Introduction

Population aging has intensified the search for non-pharmacological interventions that might help preserve cognition, maintain independence, and support well-being in later life. Although the prevention of dementia and age-related cognitive decline remains a complex public-health challenge, there is broad agreement that older adults benefit from activities that combine sustained mental effort with social engagement, sensory stimulation, and opportunities for mastery. Music-based activities are especially attractive in this context because they are meaningful, rewarding, and adaptable across ability levels. Among them, beginner piano or keyboard instruction occupies a distinctive place: it requires reading or remembering symbolic patterns, coordinating both hands, monitoring auditory feedback, correcting errors in real time, and often interacting with an instructor or peer group. In other words, it is a real-world activity that simultaneously engages attention, working memory, sequencing, bimanual motor control, auditory discrimination, and motivation (Bugos et al., 2007; Rogers & Metzler-Baddeley, 2024).

These features have made piano training increasingly visible in the literature on healthy aging. Early intervention studies were motivated by the idea that late-life music learning might produce “far transfer,” meaning that skill acquisition at the keyboard could generalize to non-musical cognitive functions relevant to everyday life. Since then, the field has evolved in two important ways. First, investigators have moved from small proof-of-concept studies toward randomized controlled trials with active comparison groups, a crucial step because social contact, structured learning, and novelty can themselves improve mood, motivation, and test performance. Second, researchers have expanded outcomes beyond classical neuropsychological measures to include central auditory processing (CAP), quality of life, neuroimaging biomarkers, objective performance

metrics, and implementation questions such as remote delivery and accessibility for people with mild cognitive impairment (MCI) (Hudak et al., 2019; Lister et al., 2023; Rogers et al., 2025).

From a clinical and social-science perspective, three outcome domains are especially important. The first is executive function, broadly defined to include cognitive flexibility, inhibition, processing speed, and the ability to coordinate complex goal-directed behavior. These capacities are highly relevant to independent living because they underlie medication management, financial tasks, safe driving, planning, and adaptation to changing environments. The second domain is auditory-cognitive function, particularly CAP. Many older adults complain that they can "hear but not understand," especially in noisy or fast-paced listening environments. CAP therefore represents a bridge between sensory aging, communication, and social participation. The third domain is everyday function and quality of life. Even if a training program improves a narrow cognitive test, its value for older adults is limited unless it affects real-world performance, well-being, confidence, or continued engagement in meaningful activities (Lister et al., 2023; Worschech et al., 2025).

Piano training is also relevant to current debates about technology and society. Today, older adults do not need access to an acoustic piano and weekly conservatory-style instruction to participate in music learning. Portable digital keyboards, MIDI-based tracking, online tutorials, telecoaching, and socially assistive robots have opened new possibilities for home-based and community-based interventions. These developments matter because they shift piano learning from a niche leisure activity toward a potentially scalable public-health and lifelong-learning tool. At the same time, they raise social questions about access, digital literacy, affordability, and whether benefits are mediated not only by the instrument itself but also by the social structure of instruction (Collette et al., 2021; Rogers et al., 2025).

One reason piano lessons deserve separate attention from other leisure activities is that they sit at the intersection of artistic practice, education, and health promotion. Unlike many brain-training programs, piano instruction produces an externally meaningful skill that can be displayed, shared, and continued outside the formal intervention period. This matters for adherence. Older adults are more likely to persist with an activity when it carries emotional value, aesthetic pleasure, and a visible sense of progress. In this respect, piano training resembles other forms of lifelong learning that support social participation and identity, but it also adds a high degree of sensory-motor complexity. This combination may explain why music-making interventions remain attractive even when effect sizes on standardized cognitive tests are modest. Put differently, an intervention that participants actually want to continue may have greater real-world value than a laboratory task with a larger short-term effect but poor long-term uptake.

The present article reviews the evidence on piano and keyboard training in older adulthood with a focus on cognitive, auditory, and functional outcomes. It aims to answer five related questions. First, which cognitive domains appear most responsive to piano training in older non-musicians? Second, does piano training improve CAP or everyday function beyond what is achieved by other engaging comparison activities? Third, what do longer interventions suggest about dose and timing of transfer effects? Fourth, what mechanistic or biomarker evidence supports the claim that piano training induces meaningful neuroplasticity in later life? Fifth, what do emerging MCI and technology-enabled studies imply for future research and implementation? By structuring the review around these questions, the goal is not to oversell music lessons as a cure for aging, but to provide a clinically grounded and socially informed appraisal of what the field currently supports.

Methodology

This article is a targeted narrative review rather than a preregistered systematic review or meta-analysis. The purpose was to produce a clinically oriented synthesis of the intervention literature most relevant to older adulthood, rather than to generate a pooled effect size. PubMed/MEDLINE and PubMed Central were used as the principal databases because the user's request emphasized scientific literature indexed in PubMed. Searches were updated through March 2026 and combined terms related to the intervention ("piano," "keyboard," "music training," "piano practice," "music lessons") with terms related to the population and outcomes ("older adults," "aging," "ageing," "mild cognitive impairment," "executive function," "cognitive flexibility," "auditory processing," "quality of life," and "activities of daily living"). Forward and backward citation tracking of the key trials was then used to identify closely related mechanistic papers, feasibility studies, and trial protocols.

Studies were considered relevant if they involved older adults, typically aged 50 years or older, and examined piano or closely related keyboard-based training as an intervention. Priority was given to randomized controlled trials, controlled clinical studies, longitudinal mechanistic analyses nested within interventions, and systematic reviews or meta-analyses focused on instrumental training in older adults. Because the field remains

small, two categories of studies were also included despite not being efficacy trials in the strict sense: first, clinical trial protocols, because they define the next generation of research; and second, small feasibility studies in MCI, because they illustrate implementation challenges and opportunities. Cross-sectional studies comparing lifelong musicians with non-musicians were not a focus unless they were directly relevant to interpreting intervention findings.

The final synthesis centered on thirteen PubMed-indexed core papers: two early intervention studies of beginner piano lessons, three randomized or active-controlled clinical trials in healthy older adults, one large active-controlled trial explicitly targeting CAP and everyday function, three mechanistic or imaging analyses linked to piano interventions, one systematic review and meta-analysis of musical instrument training in healthy older adults, one small feasibility study in MCI, and two recent protocols addressing MCI and remote online delivery (Bugos et al., 2007; Seinfeld et al., 2013; Hudak et al., 2019; Jünemann et al., 2022; Bugos & Wang, 2022; Lister et al., 2023; Marie et al., 2023; Rogers & Metzler-Baddeley, 2024; Collette et al., 2021; Mack et al., 2025; Worschech et al., 2025; Rogers et al., 2025; Schrire et al., 2025).

The main limitation of this approach is that it does not claim exhaustive coverage of every music-based intervention in aging, nor does it formally rate risk of bias study by study. Nevertheless, focusing on the principal randomized, controlled, and mechanistic publications is appropriate for the present goal: to evaluate whether the claim that “piano lessons are good for brain health” is justified by the best currently available clinical literature. Where evidence was inconsistent, emphasis was placed on study design, comparator choice, intervention dose, and outcome specificity rather than on headline conclusions alone.

Results

Overview of the evidence base

The current evidence base is best described as promising but heterogeneous. It spans nearly two decades, from the first small randomized trial of individualized piano instruction in community-dwelling older adults to contemporary multi-site protocols that combine music training with neuroimaging, blood biomarkers, and implementation planning. The interventions vary substantially in dose and format: some involve individualized lessons over six months, others group instruction two times per week for 16 weeks, and others year-long programs with weekly lessons and daily homework. Control conditions also differ. Some early studies used passive or activity-as-usual controls, whereas later studies employed active comparators such as computerized cognitive training or music-listening curricula that themselves contain meaningful cognitive and social stimulation (Bugos et al., 2007; Bugos & Wang, 2022; Lister et al., 2023; Mack et al., 2025).

This heterogeneity matters because it helps explain why the field produces both encouraging and disappointing findings. When piano training is compared with passive control conditions, benefits in executive tasks or self-reported well-being are easier to observe. When the comparator is an engaging, instructor-led, music-listening curriculum, between-group differences become much smaller and sometimes disappear altogether. A second major source of heterogeneity is outcome selection. Some studies focus primarily on executive tests such as Trail Making, Stroop, Digit Symbol, or category switching, whereas others prioritize auditory processing, everyday attention, quality of life, or neuroimaging metrics. These outcomes do not necessarily change at the same pace, nor are they equally sensitive to training effects.

To situate the detailed discussion that follows, Table 1 summarizes the principal intervention, mechanistic, and protocol studies most relevant to this review. Taken together, they suggest that piano training has its strongest and most reproducible signal in selected executive domains, more mixed evidence in auditory and everyday function outcomes, and emerging support for neuroplasticity and quality-of-life effects over longer time frames.

Table 1. Selected intervention and mechanistic studies of piano training in older adulthood.

Study	Population and design	Intervention / outcomes	Principal findings
Bugos et al. (2007)	Randomized trial; 31 musically naïve adults aged 60–85 years.	Six months of individualized piano instruction versus control. Executive tests included Trail Making and Digit Symbol.	Piano group improved on Trail Making and Digit Symbol, supporting transfer to processing speed and flexibility.
Seinfeld et al. (2013)	Controlled study; older adults in a four-month program.	Group piano lessons plus daily practice versus leisure comparison. Outcomes included Stroop, mood, and QoL.	Reported Stroop, mood, and QoL benefits, but design limitations reduce causal certainty.
Bugos & Wang (2022)	Three-arm RCT; 155 healthy adults aged 60–80 years.	Sixteen weeks of piano training versus computerized cognitive training versus no-treatment control.	Both active interventions improved working memory and processing speed; piano uniquely improved category switching and self-efficacy.
Lister et al. (2023)	Active-controlled RCT; 268 older adults with and without MCI.	Twenty instructor-led sessions of piano training versus music-listening instruction. CAP, cognition, and everyday function assessed.	No significant between-group differences for CAP, cognition, or everyday function at immediate post-test.
Mack et al. (2025)	Year-long RCT; 153 healthy older adults.	Weekly 60-min piano lessons with daily homework versus active music listening. Cognitive flexibility assessed longitudinally.	Both groups improved on several flexibility outcomes; piano showed stronger gains for mixing costs in one task.
Jünemann et al. (2022)	Longitudinal mechanistic analysis nested in RCT; 121 healthy older adults.	Six months of piano training versus active music-listening/culture control. Diffusion MRI focused on white matter.	Piano training was linked to stabilization of fornix microstructure relative to decline in the active control group.
Marie et al. (2023)	Longitudinal mechanistic analysis nested in RCT; 132 healthy older adults.	Six months of piano practice versus musical-culture control. Grey matter and auditory working memory assessed.	Reported tonal auditory working-memory improvement and structural correlates, alongside general brain atrophy over time.
Worschech et al. (2025)	Randomized controlled trial; 156 healthy older adults.	Twelve months of piano practice versus music listening. WHOQOL-BREF and MRI outcomes tracked over time.	Piano practice improved psychological, physical, and environmental QoL domains; effects were linked to reward-circuit brain regions.
Collette et al. (2021)	Feasibility study; 11 older adults with MCI.	Four weeks of robot-led piano lessons. Cognitive feasibility and acceptability outcomes emphasized.	Pilot findings suggested feasibility and possible cognitive benefits, but the sample was too small for efficacy claims.

Note. CAP = central auditory processing; MCI = mild cognitive impairment; QoL = quality of life.

Executive function, processing speed, and cognitive flexibility

The earliest influential trial in this area remains the randomized study by Bugos et al. (2007), in which 31 musically naïve, community-dwelling adults aged 60 to 85 years were assigned either to six months of individualized piano instruction or to a control condition. Neuropsychological testing at baseline, post-intervention, and follow-up showed significant improvement in the piano group on Trail Making and Digit Symbol. These tasks are not identical to real-world functioning, but they tap cognitive flexibility, attention switching, and processing speed—domains with clear relevance to daily independence. Importantly, the study framed piano instruction as a form of complex sensorimotor training rather than mere leisure participation,

thereby establishing a foundation for later work on transfer from musical practice to broader cognition (Bugos et al., 2007).

The interpretive value of this early trial is substantial, but so are its limitations. The sample was small, participants were relatively healthy volunteers, and the control condition did not fully match the novelty, social interaction, or expectancy associated with beginning piano lessons. For these reasons, the results are best seen as proof of plausibility rather than definitive efficacy. Still, the study has remained influential because it suggested that later-life brain plasticity can be engaged through a culturally meaningful skill, not only through computerized training or laboratory tasks. That idea has subsequently shaped both intervention design and public enthusiasm for music-based healthy aging programs.

More rigorous evidence came from the three-arm randomized controlled trial by Bugos and Wang (2022), which enrolled 155 healthy older adults aged 60 to 80 years. Participants were randomized to piano training, computerized cognitive training, or a no-treatment control group. Both intervention groups completed a 16-week program consisting of two 90-minute sessions per week. The results were more nuanced than those of the earlier study. Piano training and computerized cognitive training both improved working memory and processing speed relative to controls, but the piano group showed a distinctive gain in verbal category switching, a measure that places demands on flexible retrieval, monitoring, and rapid mental set shifting. Participants in the piano group also reported improved general and musical self-efficacy, whereas physiological stress and immune measures did not differ significantly between groups (Bugos & Wang, 2022).

This trial is particularly informative because it suggests that the value of piano training may lie less in broad "global cognition" claims and more in domain-specific advantages. When compared with another cognitively demanding activity, piano training did not outperform across every measure. However, its specific advantage in category switching supports the idea that musical practice may especially tax and train flexible coordination among attentional, verbal, and sequencing processes. The self-efficacy findings are also noteworthy. Mastery experiences are central to sustained behavior change, and a cognitively enriching activity that older adults enjoy and feel competent in may have downstream benefits beyond the immediate test battery.

Longer interventions raise the possibility that some transfer effects emerge only after extended practice. Mack et al. (2025) analyzed data from a randomized controlled trial in which 153 healthy older adults were assigned either to piano practice or to an active music-listening comparison condition for one year. Both groups received weekly 60-minute lessons and daily homework. Rather than emphasizing generic cognition, the investigators examined cognitive flexibility in a more differentiated way, including switch costs and mixing costs. The findings indicated that both groups improved on several flexibility outcomes, but improvements tended to arise primarily in the latter half of the intervention. For mixing costs in the number-switch task, the piano group improved more than the active listening group. Notably, however, changes in pianistic performance were not directly related to changes in cognitive flexibility, suggesting that the cognitive benefit was not simply a linear consequence of better keyboard skill (Mack et al., 2025).

The Mack et al. trial is important for two reasons. First, it suggests that timing matters: six months may be insufficient to detect transfer effects that require prolonged, cumulative engagement. Second, it complicates the common assumption that only piano practice is cognitively enriching. The active control also improved, which implies that structured music listening, discussion, and homework may themselves train attention, memory, and sustained engagement. This observation is consistent with a larger theme in cognitive aging research: the beneficial ingredient may often be a combination of novelty, challenge, adherence, and social meaning rather than the instrument alone. Piano training may still be superior for some sustained-control indices, but that superiority appears to be selective rather than universal.

The broader literature is consistent with this selective-benefit interpretation. In their 2024 systematic review and meta-analysis of musical instrument training in healthy older adults, Rogers and Metzler-Baddeley synthesized 13 intervention studies involving 502 participants. The meta-analysis found small effects on inhibition, small-to-moderate effects on switching or category switching, and a moderate effect on processing speed. No reliable effects were found for selective visual attention, working memory, or verbal memory. Just as importantly, risk of bias was a major concern: only one study was judged low risk, whereas most had some concerns and several had high risk. This meta-analysis therefore supports cautious optimism. Learning an instrument in later life seems capable of improving some executive functions, but the current evidence does not justify broad claims that it reliably enhances every cognitive domain (Rogers & Metzler-Baddeley, 2024).

Auditory processing and auditory-cognitive outcomes

If executive outcomes form the most encouraging branch of the literature, CAP is perhaps the most clinically ambitious. CAP reflects the efficiency with which the central auditory system and related cognitive networks process complex acoustic information, including speech in noise, temporally degraded speech, and dichotic listening. CAP has obvious social relevance in later life because communication difficulties contribute to withdrawal, loneliness, reduced participation, and lower quality of life. For this reason, the Keys to Staying Sharp program was designed not merely as a cognition trial, but as a clinically motivated test of whether piano training could improve auditory processing, cognition, and everyday function among older adults with and without MCI (Hudak et al., 2019).

The 2019 protocol by Hudak et al. described a randomized clinical trial planning to enroll 360 adults aged 60 years and older. Participants were to be assigned to piano training or to an active control condition of music-listening instruction. The rationale was compelling: piano learning requires precise auditory monitoring, timing, error detection, and auditory-motor integration, so it could plausibly transfer to tasks such as speech-in-noise perception or temporal auditory resolution. The study also explicitly acknowledged MCI as a potentially important moderator, thereby bridging healthy aging and pre-dementia populations (Hudak et al., 2019).

The subsequent results paper by Lister et al. (2023) is one of the most important publications in the field because it tested a widely promoted public belief under strong methodological conditions. In this trial, 268 older adults, including individuals with and without MCI, were randomized to either piano training or active music-listening instruction. Sessions were instructor-led, 90 minutes long, and held twice a week for 20 sessions. Outcome measures covered multiple CAP domains—including time-compressed speech, words-in-noise, dichotic digits, dichotic sentence identification, and adaptive temporal resolution—alongside cognitive measures and performance-based assessments of everyday function. Relative to the active listening condition, piano training produced no significant advantages for auditory processing, cognition, or everyday function at immediate post-test (Lister et al., 2023).

These null findings deserve careful attention because they challenge the strongest popular claims about music lessons and dementia prevention. The result does not imply that piano training is useless. Rather, it suggests that over the intervention dose tested, and relative to an engaging alternative that also required sustained attention and social participation, beginner piano training was not superior in improving CAP or downstream cognitive and functional measures. This distinction is crucial. A passive control study can show that an intervention is better than doing little, but an active control study asks the tougher and more clinically relevant question of whether a specific intervention provides unique value beyond another plausible enrichment activity.

At the same time, the Lister et al. findings should not be overinterpreted. CAP is a demanding target, and it is possible that improvements require either a longer intervention, a more auditory-focused training design, or selection of participants with baseline CAP deficits rather than a heterogeneous sample of older adults. It is also possible that benefits exist for some subgroups but were diluted at the group level. Nevertheless, the trial sets an important benchmark. Any future claim that piano training improves listening function, communication, or dementia-relevant sensory-cognitive pathways needs to reckon seriously with the absence of between-group benefit in this well-controlled study.

Everyday function, quality of life, and psychosocial pathways

For older adults and clinicians, an intervention's value is not determined solely by laboratory measures. Everyday function, mood, confidence, and quality of life often matter more than small changes in neuropsychological scores. Yet these outcomes remain underrepresented in the piano training literature. The strongest everyday-function evidence currently comes from the same large Keys to Staying Sharp trial, where performance-based everyday measures such as timed instrumental activities of daily living and tests of everyday attention did not improve more in the piano group than in the active music-listening group (Lister et al., 2023). This result is sobering because it suggests that cognitively appealing interventions do not automatically translate into better short-term real-world function.

Psychosocial outcomes, however, may tell a somewhat different story. In the Bugos and Wang (2022) trial, piano training improved general and musical self-efficacy, even though not all cognitive domains changed. Self-efficacy is clinically relevant because it influences willingness to engage with challenging activities, persist through difficulty, and maintain behaviors over time. Older adults who feel capable of learning a new skill may be more likely to continue cognitive, social, and physical engagement outside the narrow intervention

itself. This mechanism is harder to capture in standard executive tests, but it may help explain why some older adults describe piano lessons as beneficial even when objective transfer effects are modest.

The 2013 study by Seinfeld et al. offers an early example of this psychosocial pathway. In that controlled study, four months of piano lessons were associated with improvements in Stroop performance, positive mood states, decreased depression, and better psychological and physical quality of life. The authors interpreted these findings as evidence that piano learning may help promote cognitive reserve and subjective well-being. However, the design constraints are significant: the sample was small, group assignment was not fully randomized in the same rigorous sense as later RCTs, and assessor blinding was limited. As a result, the study is better understood as an encouraging signal than as definitive proof of effectiveness (Seinfeld et al., 2013).

Stronger support for quality-of-life benefits has emerged from longer randomized work. Worschech et al. (2025) reported the results of a trial in which 156 healthy older adults were randomly assigned either to piano practice or to music-listening instruction for 12 months. Quality of life was assessed repeatedly with the WHOQOL-BREF at baseline, 6, 12, 18, and approximately 48 months. Relative to music listening, piano practice positively influenced psychological, physical, and environmental quality-of-life domains, although social quality of life did not differ between groups. The study also linked quality-of-life changes to volumetric changes in reward-related brain regions such as the amygdala and pallidum, suggesting that motivational and affective pathways may be part of the mechanism (Worschech et al., 2025).

These quality-of-life findings are clinically meaningful because they move the field beyond a narrow "does it improve cognition?" framing. Even if an intervention does not outperform an active control on speech-in-noise or everyday attention, it may still offer meaningful benefits through enjoyment, identity, accomplishment, and ongoing participation in culture. From a social-science perspective, this matters. Healthy aging is not only about slowing decline; it is also about maintaining agency, purpose, and participation. Music instruction may therefore have value that standard cognitive endpoints only partly capture.

Neuroplasticity and biomarkers

Mechanistic evidence remains a secondary but increasingly important part of the literature because it addresses whether intervention-related behavioral changes correspond to measurable neuroplasticity. One of the most cited examples is the diffusion MRI analysis by Jünemann et al. (2022), nested within a randomized trial of piano training versus an active music-listening or musical-culture condition. In 121 musically naïve healthy older adults, six months of piano training was associated with stabilization of white matter microstructure in the fornix, whereas the active control group showed a significant decline in fiber density in this age-sensitive tract. Because the fornix is relevant to memory networks and typically vulnerable in aging, the observation is biologically intriguing. The authors also reported associations between microstructural change, episodic memory performance, and weekly piano training amount (Jünemann et al., 2022).

The implication is not that piano training "reverses aging" in white matter, but rather that sustained, experience-dependent learning may buffer some aspects of expected decline in selected brain systems. This is a meaningful distinction. Many healthy aging interventions claim neuroplasticity, but evidence is often limited to cross-sectional musician versus non-musician comparisons, which cannot separate pre-existing differences from training effects. In contrast, the Jünemann et al. study examined longitudinal change within a randomized framework, giving its findings greater inferential value.

A complementary perspective comes from grey-matter and auditory working-memory data. Marie et al. (2023) followed 132 healthy older adults participating in a six-month randomized trial comparing piano practice with an active musical-culture control. Across the broader sample, the study observed whole-brain grey matter increases in selected regions despite concurrent evidence of general brain atrophy over time, a pattern that captures the coexistence of aging-related loss and experience-dependent plasticity. Tonal auditory working memory improved, and cerebellar grey matter changes, training intensity measures, and sleep were related to this improvement. Region-of-interest analyses further suggested differential stability in right primary auditory cortex between the groups (Marie et al., 2023).

These mechanistic studies are valuable because they strengthen the biological plausibility of the intervention. They also suggest that the benefits of music training may not be exhausted by traditional neuropsychological endpoints. Structural brain changes, auditory working memory changes, and quality-of-life improvements may co-occur in ways that standard brief screening batteries fail to capture. However, the mechanistic evidence should still be interpreted carefully. Imaging samples are smaller than clinical samples, behavioral effect sizes are not always large, and the direction of causality between structural change and quality-of-life or cognitive change remains difficult to specify. At present, the mechanistic literature supports plausibility, not proof of clinically meaningful long-term protection.

Mild cognitive impairment and technology-enabled delivery

MCI is an especially important target population because it sits between normal aging and dementia, yet the direct evidence for piano training in MCI remains limited. The Keys to Staying Sharp trial included older adults with and without MCI, which was a significant advance because many lifestyle interventions in aging exclude individuals already experiencing cognitive difficulties. However, the main published analysis did not show a unique advantage of piano training over active music listening for the primary outcomes, indicating that evidence in clinically at-risk groups is still preliminary (Lister et al., 2023).

One small but conceptually important step forward is the feasibility study by Collette et al. (2021), which explored whether socially assistive robots could deliver piano lessons to older adults with MCI. In this pilot study, participants received robot-led piano instruction over four weeks. The investigators reported feasibility and encouraging improvements across several cognitive domains, including verbal memory, executive function, reaction time, and cognitive flexibility. Because the sample was very small and the design exploratory, these findings cannot establish efficacy. Nevertheless, the study is notable because it addresses both a clinical and a social challenge: many older adults with early cognitive decline face transportation barriers, reduced access to specialist programs, or apprehension about traditional classroom settings. Technology-assisted delivery could therefore expand the reach of cognitively stimulating interventions if efficacy is eventually confirmed (Collette et al., 2021).

The same implementation logic drives the PIANO-Cog protocol described by Rogers et al. (2025). This study proposes an eight-week, self-guided online piano training program for healthy non-musician adults over 50 years of age, with outcomes including executive function, fluid abilities, motor function, and white and grey matter microstructure. Although it is a feasibility trial rather than a definitive efficacy study, PIANO-Cog is highly relevant to public-health implementation because it tests whether meaningful piano instruction can be delivered remotely using a bespoke training platform and video tutorials. If feasible, such programs could reduce cost, broaden geographic reach, and allow older adults to participate from home (Rogers et al., 2025).

An even larger and more clinically ambitious example is the NeuroMusic protocol by Schrire et al. (2025). This randomized, single-blind trial plans to enroll 432 individuals with MCI and compare keyboard lessons, singing lessons, and a film-discussion control group over three months, with follow-up at three and nine months. The primary endpoint is verbal memory, but the protocol also includes mood, sleep, well-being, neuroplasticity markers, and blood biomarkers related to Alzheimer's disease and neurodegeneration. NeuroMusic is significant not only because of its sample size, but because it approaches music training as something that could eventually be embedded in memory-clinic or community settings. In this sense, it directly connects arts engagement, clinical care, and social implementation (Schrire et al., 2025).

Together, these emerging studies suggest that the future of the field will be shaped by two questions. The first is efficacy in at-risk populations: can piano or keyboard training meaningfully alter outcomes in people with MCI rather than only in healthy older volunteers? The second is scalability: can interventions retain their value when delivered through digital platforms, simplified home programs, or robotics rather than intensive face-to-face instruction? Both questions are essential if piano training is to move from appealing concept to practical health intervention.

Discussion

The most defensible interpretation of the current literature is one of selective promise. Piano and keyboard training in older adulthood appear capable of improving some executive outcomes, particularly processing speed, category switching, and sustained aspects of cognitive flexibility. These signals are visible in the early trial by Bugos et al. (2007), in the more rigorous three-arm RCT by Bugos and Wang (2022), and in longer-duration work such as the Mack et al. (2025) trial. They are also consistent with the broader meta-analytic conclusion that late-life instrumental training produces the clearest effects in inhibition, switching, and processing speed rather than in memory across the board (Rogers & Metzler-Baddeley, 2024).

At the same time, the literature clearly does not justify simplistic claims that piano lessons broadly protect against cognitive decline or dementia. The strongest challenge to such claims comes from the Lister et al. (2023) results, where a large, active-controlled study found no significant advantage of piano training over music listening for CAP, cognition, or everyday function. This does not invalidate the intervention; rather, it shows that piano training is not uniquely superior to every other enriching music-based activity over the tested period. For clinicians and policymakers, this is an important corrective. Advising older adults to begin piano lessons may be reasonable, but the justification should center on multimodal enrichment, enjoyment, and selective executive or quality-of-life benefits—not on exaggerated promises of broad neuroprotection.

Comparator choice is one of the most important reasons findings differ across studies. A passive control condition answers the question of whether doing something new is better than doing very little. An active control asks whether one specific activity is better than another plausible intervention. The latter is harder to win, but it is also more informative for real-world decision making. In the piano training literature, active music-listening conditions are especially instructive because they themselves include structured attention, auditory discrimination, homework, and social engagement. When piano training does outperform such controls, as it sometimes does for category switching, mixing costs, or some quality-of-life outcomes, the result is correspondingly more meaningful.

Intervention dose and time horizon likely matter as well. The one-year trial by Mack et al. (2025) suggests that some transfer effects may emerge only after extended engagement, and the quality-of-life findings reported by Worschech et al. (2025) likewise arose in a year-long framework with repeated follow-up. This raises a practical issue for future studies and public-health programs: piano training may need to be conceptualized less as a short "treatment burst" and more as a sustained lifestyle activity. If so, adherence, motivation, cost, and accessibility become as important as the initial instructional method.

The literature also suggests that behavioral and biological outcomes should be interpreted together. The imaging studies by Jünemann et al. (2022) and Marie et al. (2023) indicate that piano training in older adulthood can be accompanied by measurable changes in white matter, grey matter, and auditory working memory. These findings increase biological plausibility, but they do not automatically translate into clinically meaningful benefit. The challenge for future work is therefore not simply to collect more MRI data, but to connect neural change with outcomes that older adults actually value, such as listening in noise, self-confidence, sustained participation, and independence.

This review also highlights a broader social dimension. Piano training is not just a laboratory exposure; it is a culturally embedded, identity-relevant activity. Group lessons can create social contact, routine, and intergenerational exchange. Home practice can provide structure and a sense of accomplishment. Digital keyboards and remote platforms can increase access for some participants, yet they may also exclude those with limited digital literacy, financial resources, or living space. In that sense, the future of piano-based healthy aging interventions depends partly on social design: who has access, what level of support is offered, and whether programs are integrated into community centers, clinics, or home-based care pathways (Collette et al., 2021; Rogers et al., 2025; Schrire et al., 2025).

A further point is that the literature may underestimate benefits that occur outside formal outcome batteries. Learning an instrument can alter daily routines, increase purposeful practice, create new social networks, and enhance a person's sense of competence in older age. These pathways are difficult to quantify in standard clinical trials, yet they align closely with current models of successful aging that emphasize participation, autonomy, and meaningful activity. Future studies would therefore benefit from mixed-method or hybrid effectiveness-implementation designs that include qualitative data, adherence trajectories, and measures of social participation alongside cognitive and imaging endpoints.

For IJITSS readers, an additional implication is that piano training sits at the intersection of health, education, and technology rather than belonging exclusively to any one field. Digital keyboards lower cost and noise barriers, remote lessons extend access to rural or mobility-limited participants, and software-based feedback can provide structured home practice between sessions. This makes piano instruction unusually adaptable for community programmes, lifelong-learning centres, rehabilitation clinics, and home-based preventive initiatives. In that respect, the topic aligns well with broader social-science questions about how innovative technologies can support healthy aging in everyday settings.

The practical value of this perspective is that even modest cognitive gains may become more meaningful when an intervention is enjoyable enough to sustain participation over months rather than weeks. Many cognitive training programmes fail because they are repetitive or difficult to integrate into daily life. Beginner piano practice, by contrast, offers visible skill progression, personal expression, and flexible intensity. Future studies should therefore measure not only symptom or test-score change but also adherence, perceived usefulness, digital accessibility, and equity of participation. These implementation outcomes are especially relevant if piano-based programmes are to be translated from experimental trials into real-world public-health or community-aging strategies.

Several limitations of the evidence deserve emphasis. Sample sizes remain modest in many studies, especially when one moves beyond the major trials. Volunteers are often healthy, educated, and motivated, which may reduce generalizability. Blinding is inherently difficult because participants know whether they are learning piano. Outcome batteries vary widely, making it difficult to compare studies directly. Everyday

function is under-measured relative to executive tests, and MCI-specific evidence is still sparse. Finally, the present review is narrative rather than systematic, so it synthesizes the most relevant PubMed-indexed literature without claiming exhaustive capture of every related article.

Even with these limitations, the field has matured enough to support practical conclusions. Piano lessons can reasonably be recommended as one cognitively engaging option for older adults interested in active aging, especially when the goals include enjoyment, mastery, and possible support for executive functioning. They should not yet be marketed as a proven strategy for dementia prevention or as a reliable means of improving CAP or everyday function beyond other forms of enriched engagement. The next decisive advances will probably come from longer trials, subgroup analyses that identify who benefits most, objective metrics of practice intensity and adherence, and implementation studies capable of delivering training beyond specialist research centers.

Conclusions

Piano and keyboard training occupy an unusual but valuable position in healthy aging research. They combine cognitive challenge, sensory-motor integration, emotional reward, and social meaning in a single activity that many older adults find attractive and sustainable. Current evidence suggests that this multimodal profile can support selected executive outcomes and, in longer interventions, may enhance quality of life. At the same time, the literature does not support strong claims of superiority for auditory processing, global cognition, or everyday function when piano training is compared with other well-designed music-based activities.

For researchers, the priority is to move beyond proof-of-concept toward precision and implementation: identifying optimal dose, clarifying the role of active comparators, determining whether older adults with MCI benefit differently, and leveraging digital or robot-assisted tools without losing the human and motivational aspects that make music learning meaningful. For clinicians and policymakers, the current message is balanced but positive. Piano lessons are a plausible, enjoyable, and potentially beneficial component of healthy aging programs, provided they are framed as an enriching intervention with selective evidence-based benefits rather than as a universal cognitive remedy.

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All authors have read and approved the final version of the manuscript.
Funding: No external funding was received for this review.
Conflicts of Interest: The authors declare no conflicts of interest.

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