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PRACA POGLĄDOWA
REVIEW

Musical instrument playing and its association with reduced risk of dementia and cognitive impairment: A literature review

Gra na instrumencie muzycznym a zmniejszone ryzyko demencji i zaburzeń funkcji poznawczych – przegląd literatury

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ABSTRACT

INTRODUCTION: Dementia is a chronic and progressive decline in cognition without impairment of consciousness. The condition intrudes on the ability to live independently. The occurrence of dementia increases with age. Nowadays, there is no cure for dementia. There are some modifiable risk and protective factors that can be used to prevent the occurrence of the disease and delay its onset. Studies show that one of the factors that can reduce the risk of developing dementia is participation in leisure activities. This protective effect has also been observed in individuals who play a musical instrument. The aim of this study is to review the literature on the impact of playing a musical instrument on the development of dementia and cognitive impairment.

MATERIAL AND METHODS: A review of available studies examining the relationship between playing a musical instrument and the risk of dementia and cognitive aging was conducted. To identify relevant literature, the PubMed and Google Scholar databases were used.

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RESULTS: Several studies investigating the benefits of playing a musical instrument on cognitive function and dementia have shown that playing a musical instrument has a positive impact on tasks involving working memory, executive functions, crystallized intelligence, processing speed, letter fluency, digit span forward and backward, learning, and visuospatial functions.
CONCLUSIONS: Playing a musical instrument is a protective factor against dementia and cognitive impairment.

KEYWORDS

playing a musical instrument, dementia, cognitive function

STRESZCZENIE

WSTĘP: Demencja to przewlekły i postępujący spadek funkcji poznawczych, który nie jest związany z upośledzeniem świadomości. Schorzenie ogranicza zdolność do samodzielnego życia. Częstość występowania demencji wzrasta z wiekiem. Obecnie nie ma lekarstwa na demencję. Istnieją pewne modyfikowalne czynniki ryzyka i czynniki ochronne, które można wykorzystać, aby zapobiec chorobie i opóźnić jej wystąpienie. Badania wskazują, że jednym z czynników zmniejszających ryzyko rozwoju demencji jest uczestnictwo w zajęciach rekreacyjnych. Ten efekt ochronny zaobserwowano również u osób grających na instrumencie muzycznym. Celem niniejszego badania jest przegląd literatury dotyczącej wpływu gry na instrumencie muzycznym na ryzyko rozwoju demencji i zaburzeń funkcji poznawczych.
MATERIAŁ I METODY: Przeprowadzono przegląd dostępnych badań na temat związku między grą na instrumencie muzycznym a ryzykiem demencji i starzenia się funkcji poznawczych. Do wyszukania odpowiedniej literatury wykorzystano bazy danych PubMed i Google Scholar.
WYNIKI: W kilku doniesieniach badających korzyści płynące z gry na instrumencie muzycznym dla funkcji poznawczych i demencji wykazano, że gra na instrumencie muzycznym ma pozytywny wpływ na zadania związane z pamięcią roboczą, funkcjami wykonawczymi, inteligencją skrystalizowaną, szybkością przetwarzania, płynnością słowną, powtarzaniem cyfr w przód i w tył, uczeniem się oraz funkcjami wzrokowo-przestrzennymi.
WNIOSKI: Gra na instrumencie muzycznym może stanowić istotny czynnik ochronny przed rozwojem demencji i pogorszeniem funkcji poznawczych.

SŁOWA KLUCZOWE

gra na instrumencie muzycznym, demencja, funkcje poznawcze

Introduction

Dementia is a chronic and progressive decline in cognition without impairment of consciousness. The condition intrudes into the ability to live independently. Many medical conditions can lead to dementia. The most common type, reaching 50–60% of all cases, is Alzheimer's disease. It is followed by vascular dementia. The rest are mainly frontotemporal lobar dementia, dementia with Lewy bodies, and Parkinson's disease dementia [1,2,3].
Worldwide, 57 million people had dementia in 2021. There are nearly 10 million new cases of dementia every year [4]. The occurrence of dementia increases with age. Alzheimer's disease may affect 11% of people over the age of 65 and almost 32% over the age of 85 in the United States [5]. It has been shown that the frequency of dementia differs across racial and ethnic groups. Black and Hispanic individuals have higher rates of occurrence than White individuals [6,7]. The neuropathological and etiological complexity of dementia is not fully understood yet. Aggregation and accumulation of misfolded proteins and association with cerebrovascular diseases are thought to be related to the pathophysiology of dementia [8]. Diagnosis is made clinically with the help of other tests, including neuroimaging techniques that can examine the structure, biochemistry, and metabolic state of the brain. Neurodegenerative disorders often exhibit relatively specific imaging biomarkers. For formulating a definitive diagnosis of dementia in the prodromal stages and to help with differential diagnosis, positron emission tomography (PET) with 18-fluorine fluorodeoxyglucose and magnetic resonance imaging are commonly used. Methods such as amyloid PET and tau PET are also useful [3,9].
Nowadays, there is no cure for dementia. There are some modifiable risk and protective factors that can be used to prevent the occurrence of the disease and delay its onset. Some of them are lifestyle factors such as physical activity, smoking, alcohol consumption, body weight, and diet. Other risk factors include abnormal blood pressure, cholesterol, and blood sugar levels. Additionally, depression, social isolation, low levels of education, cognitive inactivity, and exposure to air pollution are noticed to be associated with the development of dementia [4,10]. Studies show that an additional factor that can reduce the risk of developing dementia is participation in leisure activities [11]. This protective effect has also been observed in individuals who play or used to play a musical instrument.

Playing a musical instrument is a complex challenge for the brain. Long time of music training provides sensorimotor skills that can lead to neuroplastic changes in the developing and adult brain. It can have an effect on white matter, gray matter, cortical, and subcortical structures. Musicians learn to associate motor actions with specific sound and visual patterns while receiving multisensory feedback. This can make connections between auditory and motor regions stronger. It has been observed that because of extended neuronal communication between the left and right hemispheres of the brain, playing a musical instrument increases cognitive ability. It has positive effects on learning, memory, fine motor skills, verbal reasoning, and non-verbal reasoning [12,13,14].

Clinical evidence

The effect of playing a musical instrument on the development of dementia and cognitive aging has been assessed in several studies. In a post hoc observational study of the Zurich Disability Prevention Trial by Mansky et al. [15], the impact of playing a musical instrument on Mini-Mental State Examination (MMSE) scores was evaluated. The study included 200 participants. Seventy participants (35%) had previously played a musical instrument, and 27 (13.5%) were actively playing at that time. The largest number of participants played the piano and other keyboard instruments, followed by woodwinds and the violin. Among the 97 participants who had ever played, 62.9% (61) had played one instrument and 25.8% (25) had played two. The median age at which participants began playing their main instrument was 8 years. The median playing duration was 12.5 years among past players and 65 years for current players.

At baseline, current players had higher adjusted MMSE scores than those who had never played (28.9 vs 28.5, $p = 0.059$). After 12 months, participants who had ever played an instrument demonstrated better improvement in adjusted MMSE from baseline compared to those who had never played (0.29 vs -0.12, $p = 0.007$). This association remained significant even after excluding participants with higher education ($p = 0.03$). The study results indicate that older adults who had ever played a musical instrument showed a significant improvement in cognitive function from baseline to the 12-month follow-up compared to those who had never played.

Another study from 2011 by Hanna-Pladdy and MacKay [16] involved 70 adults. They were between 60–83 years old. Participants were divided into three groups, depending on the level of their musical activity throughout their lives. The first group included 21 non--musicians – people who could neither play an instrument nor read sheet music and had never received musical lessons. The second included 27 participants with low musical activity – they played a musical instrument for 1 to 9 years and had some musical training. The third group included 22 individuals who played a musical instrument regularly for at least 10 years and had musical training. They were classified as high-activity musicians. Participants most often played the piano, followed by woodwinds. Other less frequently mentioned instruments included string, percussion, and horn instruments. A comprehensive neuropsychological assessment was performed on the study participants. To determine differences between groups based on their musical activity throughout their lives, analyses of variance (ANOVAs) were conducted on the neuropsychological measures.

The results showed a significant difference between the groups in aspects such as cognitive flexibility, nonverbal memory recall, naming, visuomotor sequencing, and visuomotor speed. The results indicated a linear relationship between years of playing a musical instrument and cognitive aging. However, the authors said that because of the correlational nature of their study, there could be another factor, such as higher intelligence, that could determine who played musical instruments for a longer period of time.

In another study by Arafa et al. [17], data from the Japan Gerontological Evaluation Study were analyzed. The study involved 52601 participants over the age of 65. The 52601 participants were divided into groups depending on their musical activity. Among them, 44562 did not participate in any musical activity, and 7303 participated in one musical activity. Among those who were musically active, 1109 were playing a musical instrument, 5258 were practising karaoke, and 936 were involved in choir or folk singing. Additionally, 736 participants engaged in more than one musical activity. A standardized dementia scale (0–IV) of the long-term care insurance system was used to assess dementia. The diagnosis of dementia was based on the development of symptoms that interfered with daily activities, and their level was ≥ II on the long-term care insurance dementia scale. Compared with adults who did not participate in any musical activity, those who engaged in at least one musical activity were younger, were mostly women rather than men, had better education, had higher annual incomes, walked more often, and had lower smoking rates. Participants in the study were observed for an average of 5.8 years. In that time, 5786 (11%) of them developed dementia.

The results of the study showed that playing a musical instrument had an impact on the risk of dementia, hazard ratio (HR) 0.74 (95% CI 0.59–0.93). However, when the results were divided into men and women, the relationship was still significant only for women, HR 0.75 (95% CI 0.58–0.98).

The 2024 study of Vetere et al. [18] aimed to explore the relationship between musicality and cognitive

function in a large aging cohort from the UK. The study is an analysis of cognitive and musical activity data provided via the PROTECT-UK online cohort study. Participants completed a questionnaire (ELMEQ) about their musical knowledge. The questionnaire included questions about playing a musical instrument, singing, and listening to music. The musical instrument playing section included questions about learning to play a musical instrument, the number of instruments on which the participant could perform a short musical piece, years of learning to play a musical instrument, years of regularly practising a musical instrument, the average number of hours per week the individual practised, and the highest level of musical performance. To measure cognitive performance, a computerized cognitive system was used. A total of 1107 participants were included in the study analysis. The population was 83% women and 17% men. The average age was 68 years. Analysis of the ELMEQ data showed that 89% of participants were involved in playing a musical instrument, and 44% were still playing at the time of analysis. The most common instrument was a keyboard or woodwind instrument. Most participants played one (28%) or two (23%) instruments. Four percent had experience playing five or more. Seventy-eight percent of participants had received musical training, most often for two to five years. Participants most often played for a certain period in their lives, usually five years or less. When they played a musical instrument regularly, the playing time was two to three hours per week (37%) or less (27%).

Analysis of the results showed that participants who played a musical instrument performed significantly better on tasks involving working memory and executive functions. The effect on working memory was particularly evident in those who reported playing the keyboard (alone or in combination with other instruments). Working memory was also significantly better in those who played a wind instrument. Participants playing a woodwind instrument performed significantly better on the executive function task. A significant relationship was also found between singing and executive functions. There were no statistically significant associations between listening to music and cognitive performance. Comparing participants who currently played a musical instrument with those who had previously played showed significantly better scores for working memory in those who were currently involved in music. The effect sizes for the associations reported in this study were statistically significant and ranged from 0.15 to 0.24. While these effect sizes are small when considered in the context of a pharmacological intervention, they are large when applied from a population health perspective. The study found that this benefit, although to a lesser extent, can also be observed for singing.

The next study by Mansens et al. [19] used data from the Longitudinal Aging Study Amsterdam. The study participants were adults aged 55–85 years living in the Netherlands. In 2011–2012, 1522 people took part in the main interview. A total of 1101 participants (578 female, 523 male) answered questions about musical activity. Among them 137 people (11.5%) reported only singing, 62 (5.2%) reported only playing a musical instrument, and 59 people (5.0%) reported both singing and playing a musical instrument, 824 people did not engage in any musical activity, 19 people (1.7%) did not indicate the type of musical activity. To measure the level of musical activity, the LASA Physical Activity Questionnaire was used. The questions were about making music, the instrument that the participants played, singing as a hobby, the frequency of singing or playing a musical instrument per two weeks, and the average time of musical activity in minutes. The results of these questionnaires were used to divide the participants into two groups. The first group included individuals who sang or played a musical instrument. The second group consisted of participants who did not sing and did not play an instrument. The first group was divided into participants who played a musical instrument and did not sing, sang, and did not play musical instruments, and participants who both sang and played an instrument. Cognitive functioning was measured using several tests covering different cognitive areas. General cognitive functioning was measured using the MMSE, processing speed by the Alphabet Coding Task-15, executive functioning by the digit span and fluency tasks, and memory by the Auditory Verbal Learning Test (AVLT).

The results of the study revealed that people who played an instrument or sang had statistically significantly higher results on crystallized intelligence, processing speed, letter fluency, digit span forward and backward, and learning. People who played an instrument had significantly higher results than people who did not play an instrument or did not sing ($p = 0.009$) and people who sang ($p = 0.014$) for processing speed, for the digit span backward ($p = 0.023$) and learning ($p = 0.002$). The minimum time of musical activity was five minutes, and the maximum was 40 hours per two weeks. The mean time of musical activity was about 280 minutes per two weeks.

Another study by Balbag et al. [20] analyzed data from the Study of Dementia in Swedish Twins, known as HARMONY. Individuals in the study were from the population-based Swedish Twin Registry and were aged 65 years and older. To assess dementia in participants, neurological assessment of memory, language, and perceptual motor domains, physical and neurological examination, a complete medical history,

informant interviews, and neuroimaging were used. The assessment of musical activity was conducted using a questionnaire. Questions included instrument playing, frequency of playing, and whether the participant was still playing at the time of assessment or had stopped playing at a certain age. There were no professional musicians in the study. The study consisted of 157 pairs of twins. Controlled variables included gender, education, and physical activity. Thirty-one participants in the study played an instrument as an older adult.

The results showed that individuals who played a musical instrument were less likely to develop dementia (OR = 0.35, 95% CI: 0.14–0.90). When gender, education, and physical activity were controlled, the results were still significant (OR = 0.36, 95% CI: 0.13–0.99). Compared to their twin, musicians who played an instrument in old age were 64% less likely to develop dementia or cognitive impairment.

The next study by Okely et al. [21] analyzed participants from the Lothian Birth Cohort born in 1936. The study involved 420 participants who were between the ages of 70 and 82. Thirteen tests were used to assess their cognitive functions. These tests were performed every three years and included verbal ability, verbal memory, processing speed, and visuospatial ability. Participants completed a questionnaire about their musical experience. The questionnaire asked about playing musical instruments, singing, reading music, and listening to music. Forty percent played a musical instrument, mainly as children and teenagers.

The study results showed that participants who had experience playing a musical instrument performed better in every cognitive domain at age 70 and follow--up assessments up to age 82. When variables such as childhood cognitive ability, years of education, socioeconomic status, and health variables were controlled, statistically significant associations were with processing speed ($\beta = 0.131$, $p = 0.044$) and also visuospatial functions ($\beta = 0.154$, $p = 0.008$).

Conclusions

Several studies investigating the benefits of playing a musical instrument on cognitive function and dementia indicate that playing a musical instrument is a protective factor against dementia and cognitive impairment. In the study by Mansky et al. [15] adults who had ever played a musical instrument showed significant improvements in cognitive function from baseline to the 12-month follow-up. The study by Hanna-Pladdy and MacKay [16] reveals a linear relationship between years of playing a musical instrument and cognitive aging. Analysis of the results of the Vetere et al. [18] showed that participants who played a musical instrument performed significantly better on tasks involving working memory and executive functions. The study by Mansens et al. [19] revealed that people who played an instrument or sang had statistically significantly higher results on crystallized intelligence, processing speed, letter fluency, digit span forward and backward, and learning. In the study by Okely et al. [21] participants who had experience playing a musical instrument performed better in processing speed and visuospatial functions. The results of the study by Arafa et al. [17] indicate that playing a musical instrument had an impact on the risk of dementia. The study by Balbag et al. [20] showed that individuals who had played a musical instrument were less likely to develop dementia, and compared to their twin, musicians who played an instrument in old age were 64% less likely to develop dementia or cognitive impairment. The twin study offers stronger evidence because it controls for genetic and many environmental factors that reduce the likelihood that the results are due to biological differences rather than music training.

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Informed consent statement

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Conflict of interest

The authors declare that there is no conflict of interest.

Authors' contribution

Study design – S. Bryksy, B. Boba, J. Wątor, A. Ożga, B. Chojnacka, P. Kolano
Data collection – A. Ożga, A. Podolska, J. Wątor, A. Przybyłowska, J. Krzeszowiak
Manuscript preparation – S. Bryksy, A. Przybyłowska, B. Chojnacka
Literature research – P. Kolano, J. Krzeszowiak, B. Boba, A. Podolska
Final approval of the version to be published – S. Bryksy

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