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Impact of music on the cognitive function of the elderly living with dementia

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ABSTRACT

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Today’s aging population is experiencing an increasing occurrence of dementia, which is adversely affecting the quality of life of the elderly. About 150,000 people are living with dementia in Finland, with 23,000 people falling ill every year. People living with dementia enjoy music and preserve their ability to respond to musical cues even in their severe or late stages of dementia, in which their verbal communication has ended. This suggests that music can be incorporated as a non-pharmacological tool for managing dementia. The purpose of this thesis was to provide scientific-based information in poster form about the impact of music on cognitive function in the elderly living with dementia that could be used by caregivers in the care of the elderly. Thus, the thesis discussed how music impacted the cognitive functioning of the elderly with dementia. The information search results revealed that music enhances the cognitive function of the elderly living with dementia by acting as a verbal memory aid, eliciting autobiographical memories, improving perceptual processing and attention, improving visuospatial abilities, improving learning, enhancing fine motor coordination, and enhancing auditory processing. This thesis recommended conducting further research on the impact of personally significant music on the elderly living with dementia, particularly music preferred by the elderly.

Keywords: Music, elderly, dementia, cognitive function, cognitive impairment.

Contents

1 INTRODUCTION

Today's aging population is experiencing an increasing occurrence of dementia, which is adversely affecting the quality of life of the elderly. There are numerous cases of impaired memory discovered in the elderly, accompanied by cognitive deficits such as impaired language, which are causing significant impairment in occupational or social functioning. Other deficits associated with dementia in the elderly are emotional and sensorimotor deficits, which are linked with loss of functioning, social isolation, and reduced independence. (Baird and Samson 2015, 207.)

According to the Finnish Institute for Health and Welfare (THL), there are about 150,000 people living with dementia in Finland, with 23,000 people falling ill every year. However, some people are undiagnosed hence the total number is estimated to be higher. It is estimated that the number of people living with memory disorders will have risen to 247,000 in 2040 (Finnish Institute for Health and Welfare 2023.)

There is a need to supplement pharmacological interventions with non-pharmacological measures to improve the care outcome of managing the symptoms of dementia. Accumulating evidence reveals that people living with dementia enjoy music and preserve their ability to respond to musical cues even in their severe or late stages of dementia, in which their verbal communication has ended. This suggests that music can be incorporated as a non-pharmacological tool for the management of dementia. (Samson et al 2015, 249.)

Music has soothing and quite therapeutic elements that comfort human beings from diverse perspectives. Musical abilities are quite evident and intact in people, regardless of situation an individual is entailed in. Music interventions focus on cognitive, physical, emotional, and social areas. It is argued that music activates all higher functions, with the activation leading to long-term effects in dementia patients. (Popa et al. 2021, 2.) This study delves into the impacts of music on cognitive function among the elderly living with dementia

2 THEORETICAL STARTING POINTS

2.1. Dementia

Dementia is a progressive disorder that causes changes in behaviour and cognitive impairment increasing dependency and trouble coping with daily activities. (Hämäläinen et al 2021, 405). Dementia majorly affects the cognitive function, such as memory, emotional abilities, and thinking. However, people with dementia are still capable of remembering the lyrics of songs they listened to even in their childhood years, suggesting that long-term music memory is not easily altered by other typical metabolic conditions and is better reserved than short-term memory or language. This presents an opportunity for improving the cognitive function, with the aim of improving the quality of life and slowing down the progression of dementia. (Dahms et al. 2021, 14.)

Regular musical activities also have a substantive role in enhancing mood, maintaining cognitive ability, and enhancing the well-being of specific family members in both moderate and mild dementia. From the music perspective, listening and singing are beneficial leisure activities for both caregivers and people with dementia and can provide or improve relaxation for both groups. (Soufineyestani et al. 2021, 2.)

i. Risk factors for dementia

The risk factors for developing dementia include age (especially old age of 65 years or more), diabetes (high blood sugar), hypertension (high blood pressure), excessive consumption of alcohol, smoking, obesity or being overweight, social isolation, and depression (World Health Organization 2023).

ii. Common forms of dementia

The common forms of dementia include Alzheimer's disease (which contributes to 60-70% of dementia cases), vascular dementia, diseases that contribute to the degeneration of the brain’s frontal lobe (frontotemporal dementia), and dementia

with Lewy bodies (the abnormal protein deposits inside the nerve cells) (World Health Organization 2023).

iii. Signs and symptoms of dementia

The early signs and symptoms of dementia include; losing or misplacing things, forgetting things or recent events, confusion even in familiar places, getting lost when driving or walking, losing track of time, difficulty performing familiar tasks, difficulty making decisions or solving problems, misjudging distances to objects visually, and trouble finding words or problems following conversations. The common behavioural and mood changes caused by dementia include anxiety, anger, or sadness about memory loss; inappropriate behaviour; personality changes; loss of interest in other people's emotions; personality changes; and withdrawal from social or work activities. (World Health Organization 2023.)

2.2. The elderly

The elderly group commonly exhibit geriatric syndromes such as dementia and frailty (Dehaye, Leemans, and Loas 2018, 15). Geriatric syndromes in the elderly are often under-recognized, thus posing deleterious effects on their quality of life and potentially leading to disability and mortality (Sanford et al. 2020, 2). The failure to appropriately notice geriatric syndromes in the elderly is attributed to the limited time that nurses have to provide care to each patient. The complex care needs of geriatric patients usually require comprehensive evaluation, which may not be properly achieved within a limited time by the care nurses.

Some elderly persons experience mild cognitive impairment (MCI), which is characterized by deterioration of cognitive function, attention, and memory beyond the expected abilities. However, these individuals are still able to engage in their regular activities to some degree since MCI does not significantly affect an individual's daily activities. Different populations of the elderly may experience varying rates of memory impairment based on various factors including sex differences, age, and educational level. Cognitive impairment in the elderly is

mainly attributed to vascular, dysthymia/dysphoria, and neurodegenerative problems. (Eshkoor et al. 2015, 687.)

2.3. Effects of music on the brain

Music serves as a non-medical intervention that can help in elderly care, with positive evidence supporting the use of music as a tool. (Samson et al. 2015, 249.) Music has a positive impact on cognitive function, with its non-verbal and rhythmic nature, as well as its engaging ability being capable of influencing emotions. Music can encourage creativity, engage feelings, and motivate in daily activities. (Eyre 2016, 170.) Music can be used to evoke emotions and memory and stimulate both short-term and long-term memory, particularly through listening to discussions and storytelling about past experiences. Additionally, music can improve problem-solving and thinking abilities. (Moreno-Morales et al. 2020, 160.)

3 PURPOSE, OBJECTIVE AND TASKS OF THE THESIS

The purpose of this research is to create a poster that will guide caregivers on how music impacts the cognitive function of elderly with dementia.

The objective of this thesis is to provide scientific-based material in poster form about the impact of music on the cognitive function of the elderly living with dementia that can be used by caregivers in the care of the elderly. The caregivers would benefit from this educational poster by gaining insight into the positive impact of music on various cognitive functions, including verbal memory, autobiographical memory, perceptual processing and attention, fine motor coordination, and learning.

The research question for this study is: How does the use of music impact the cognitive functioning of the elderly living with dementia?

4 METHODOLOGICAL STARTING POINTS

This research is a functional thesis. A functional thesis is meant to connect theoretical knowledge and put it into a practical environment. The starting point of a functional thesis is a task or issue from working life that is responded to by making an output which can be a video, picture, leaflet, and many more products. (TAMK Student's Handbook.) We have opted for a poster as our ideal output.

Firstly, we have conducted a literature review of certain articles that fit our topic from evidence-based databases including CINAHL and PubMed. The articles that we have selected contain content on our main subjects; music, elderly, dementia, and cognitive abilities. The articles contain evidence-based information, in English language, and fall within 10 years range.

After collecting the necessary data, we implemented the information by creating a poster. A poster is easy to create, affordable, and can reach a large audience within a short period of time. A poster can stay in a particular place for a long time hence is effective in the retention of information and changing of attitude. (Hasanica et al. 2020, 135.)

4.1. PICO Analysis

PICO analysis proved to be an important framework in our research. PICO stands for Population, Intervention, Comparator, and Outcome. This framework is an important part of evidence-based practice (EBP) teaching in nursing. PICO analysis is widely used in nursing and the health science academia, particularly in the formation of questions and ensuring efficiency of searches (Schiavenato and Chu 2021, 1). The aim of PICO is to facilitate search strategies, reduce noise, and improve the accuracy of information retrieval. This framework helps the clinician questioner to pay attention to patients and their relevant issues and outcomes. PICO also influences the selection of key terms, which are useful in the search for research articles, particularly in bibliographic databases such as PubMed or CINAHL.

We categorized our research topic “Impact of music on the cognitive function of the elderly living with dementia” into three major groups of search key terms:

i. Population (P): The elderly living with dementia
ii. Intervention (I): Music as a tool
iii. Outcome (O): The positive impact on cognitive function

4.2. Inclusion and exclusion criteria

Inclusion and exclusion criteria are crucial for designing high-quality research protocols and hence need to be appropriately established (Keung et al. 2020, 47). Inclusion criteria refers to the key features that identify a target population which helps the investigator find answers to their research question. These key features typically include clinical, geographic, and demographic characteristics. (Patino and Ferreira 2018, 84.) We established the inclusion criteria for the study of “Impact of music on the cognitive function of the elderly living with dementia” by considering research materials covering demographic information on the older population aged 65 years and above. We also included research materials covering clinical information on dementia. The research materials were not limited to a particular geographical location hence we included research materials featuring studies conducted worldwide.

On the other hand, exclusion criteria entail the features of the potential sources of information for a study, which meet the inclusion criteria but possess additional features that have the potential to increase the risk of achieving an unfavourable outcome or adversely affect the success of the study. Some of the features considered in exclusion criteria are the characteristics of eligible research materials that make it highly likely for them to provide inaccurate data or bias the results of the study. (Patino and Ferreira 2018, 84.) We established the exclusion criteria for our study by considering research materials that did not cover information on the older population with regard to demographic information. We excluded materials that did not focus on dementia, such as materials that focused on other geriatric syndromes instead of dementia. We also excluded research materials that did not include the impact of music on cognitive function.

Additionally, we excluded research materials published earlier than ten years ago to ensure that the information we gathered from our search was up to date.

5 IMPLEMENTATION

5.1. Poster design

A poster was the product of this functional thesis, aimed at helping disseminate scientific and clinical knowledge in a visually appealing manner. The poster adhered to the specifics including the use of headings, selection of font, arrangement of components, choice of colour, and use of graphics. The use of headings in a poster help align the content with the final poster product (Berg and Hicks 2017, 3). The headings used for this poster included the research topic, which was the "*Impact of music on the cognitive function of the elderly living with dementia*".

The font also plays an important role in the readability of a poster hence should be carefully selected when planning the design of a poster (Berg and Hicks 2017, 3). The font styles and sizes for this poster were carefully selected based on the type of information that was to be communicated, and the extent of its readability. The font types used in the poster included Sans Serif and Garamond. The heading texts used a combination of upper and lower case, whereby the first letter of each word was capitalized.

The poster was primarily designed using Adobe Illustrator, which is a vector graphics design and editor software. The vector graphics enabled infinity scaling of the designs, which proved beneficial whenever the size of the designs needed to be increased without losing quality. Additionally, Adobe Illustrator offered precise control over the designs, especially when moving, upscaling, or downscaling the designs.

5.2. Results

i. Music's impact on the cognitive function in elderly living with dementia

The impact of music on the cognitive function of the elderly living with dementia includes aiding verbal memory, eliciting autobiographical memories, improving perceptual processing and attention, improving visuospatial abilities, improving learning, enhancing fine motor coordination, and enhancing auditory processing.

ii. Verbal memory aid

Music helps improve verbal fluency in elderly persons with dementia through music activities. Verbal production is usually mediated by the language output system that differs neurologically from the melodic output system. Thus, elderly persons exposed to music with lyrics tend to experience a simultaneous development of integrated melodies and lyrics memories. The lyrics in such musical pieces play a crucial role in the activation of memory formation, which boosts verbal fluency in elderly persons living with dementia (Lam et al. 2020, 7).

Music is also effective in retrieving musical and verbal memories in the elderly living with dementia. Music as a tool can effectively activate the musical language memory and activate the process of classification of the presented melodies (Bleibel et al. 2023, 8). Music memory is partly independent of the other memory systems since the vast lesions that constitute the left temporal lobe, right medial temporal lobe, and sections of the insular and left frontal cortex are often preserved in patients who suffer bilateral temporal lobe damage (Jacobsen et al. 2015, 2439).

Furthermore, the early stages of dementia are typically characterized by the development of structural impairment along the hippocampal channel that comprises the posterior cingulate cortex, entorhinal cortex, and hippocampus. The parietal and temporal lobes, the precuneus, and the orbitofrontal cortex usually exhibit early degeneration contrary to the primary sensory, visual, motor,

and anterior cingulate cortices, which are considerably spared. (Jacobsen et al. 2015, 2440.) This suggests that individuals with dementia usually have well-preserved music memory regions, thus making it easy for music to retrieve musical and verbal memories in the elderly living with dementia.

iii.Eliciting autobiographical memories

Music serves as a powerful tool for eliciting autobiographical memories in elderly individuals living with dementia. Autobiographical memories are the memory systems comprising personally meaningful events or episodes that are recollected from a person's life (Baird et al. 2018, 693). These memory systems are typically based on both the semantic memory and the episodic memory. Semantic memory entails general knowledge and facts whereas episodic memory entails personal experiences and particular events, people, and objects (Mehl et al. 2024, 2). The mechanism of episodic memory through which music potentially evokes emotional responses allows an individual to recall their personal experiences and remember particular people, things, or events they encountered in the past (Mehl et al. 2024, 1). The episodic memory can cause an emotional response when an elderly person living with dementia is exposed to a musical selection that evokes autobiographical memories—memories of an event in their life.

Autobiographical memories of the elderly typically constitute their internal life story and allow them to recall the specific details of what transpired at a particular moment in time, what they did, and what they felt, thus capable of triggering strong emotions (Salakka et al. 2021, 3). These memories can be recalled either in an involuntary manner, whereby they appear spontaneously in the mind of an elderly person without the intention of being retrieved, or in a voluntary manner, whereby they are made to appear in the mind of an elderly person through some retrieval effort or search (Belfi et al. 2022, 1). Involuntary autobiographical memories can be evoked in an elderly person living with dementia as a reaction to the external cues in their environment, such as sensory stimuli, people, locations, and activities, or be elicited by internal factors including feelings and thoughts. Music is an important sensory cue for autobiographical memories

(Salakka et al. 2021, 1). When an elderly person living with dementia hears a strain of their favorite song from their youthful years, they are likely to visualize the past events and activities that accompany the song.

Notably, music evokes autobiographical memories that are more episodically detailed compared to other memory cues, such as pictures of famous persons. This can be attributed to the more involuntary manner in which music evokes autobiographical memories than other cues (Belfi et al. 2022, 1). An examination of the episodic richness of the autobiographical memories elicited by music and faces reveals that the memories evoked by music have a considerably larger ratio of the internal-to-total details, suggesting that music has a greater episodic richness compared to the memories elicited by faces of famous people (Belfi et al. 2022, 10). This high episodic richness in music-evoked memories is attributed to music being a better contextual cue compared to faces. In the case of a face acting as a cue, an elderly person living with dementia may not vividly recall a specific instance as they may find the face of a famous person not identical to the face, they previously saw due to different contexts that may seemingly alter the facial appearance. In contrast, the music that an elderly person living with dementia listened to at the time of episodic memory encoding may be easily recalled at the time of episodic memory retrieval due to the high possibility of the context remaining unchanged.

iv.Improving perceptual processing and attention

Music plays a pivotal role in improving perception and attention in the elderly living with dementia. Perception as a cognitive process, is the ability to become aware of things through the senses. On the other hand, attention is the concentration of awareness or focus on a specific phenomenon without the distraction of other stimuli. Both perception and attention in humans are substantially influenced by emotion, with emotion motivating both behaviour and action and regulating the perception and attention selectivity (Tyng et al. 2017, 1). Furthermore, emotion efficiently facilitates the encoding and retrieval of information, with emotional stimuli seemingly consuming more attentional resources compared to non-emotional stimuli. Music as a tool, acts as an

emotional stimulus, whose emotional significance enhances the development of long-term memory traces that help improve performance in explicit memory tasks, and in tasks that indirectly tap memory, such as the perceptual identification tasks.

The selective attention evoked by emotionally important stimuli, such as music, usually results in emotionally enhanced memory functions (Tyng et al. 2017, 3). Selective attention is the processes that enable an individual to choose and concentrate on something within their environment for further processing while simultaneously ignoring, or suppressing the information that is irrelevant or distracting (Kuppuswamy 2023, 1454). The emotional response of an elderly person living with dementia can indirectly influence their perception and attention, which can regulate their behavioural determination and selective sensory processing. The biased nature of attention in the initial perceptual stage, specifically toward the emotionally salient information responsible for supporting recognition by the salient input, increases the possibility of emotional information becoming encoded in the LTM (long-term memory) storage that is linked with a top-down control in the sensory pathways regulated by parietal and frontal cortices (Tyng et al. 2017, 3). Thus, music can help elderly persons living with dementia to improve their ability to regulate how they regularly and sequentially perform their learned sequence of behaviours and how they concentrate on particular stimuli as they filter out irrelevant information. Selective sensory processing enhanced by music enables the elderly living with dementia to only pay attention to the sensory inputs that their brain perceives as most relevant, thus helping them to understand and navigate their surroundings (Bleibel et al. 2023, 8).

v.Visuospatial abilities

Older persons living with dementia tend to experience a decline in their visuospatial skills as they age. Visuospatial skills are the abilities that enable an individual to cognitively recognize, form a mental image of, and manipulate two-dimensional and three-dimensional objects around them (Abd-Alrazaq et al. 2022, 113). Visuospatial cognition covers various skills including looking for and

finding objects, holding items in one's visual memory, shifting spatial attention, detecting patterns, and performing mental rotations (Brown, Buening, and Brown 2018, 79).

Listening to music, especially when engaging in physical exercises, significantly improves visuospatial function (Satoh et al. 2014, 7). Appropriate musical accompaniment can have a positive impact on movement, such as physical exercises. Music can facilitate the success of physical exercises performed by the elderly living with dementia including figure skating, marching, ballet, and rhythmic sportive gymnastics. The complex arrangement and interaction of multiple elements in music influences the physiological arousal levels and the subjective experience of older adults during exercise (Satoh et al. 2015, 306).

The musical elements that promote physiological arousal during physical exercise include predictable rhythm that features the playing of musical instruments by striking or shaking (such as bells, drums, rattles, and xylophones); time with consistent meter; and fast tempo of more than 120 beats per minute. On the other hand, the music elements that promote subjective experience during physical exercise include emotive symbolism in the listener; consonant harmony; melodic lines with large leaps; and tonality in a vital key that possesses a diatonic scale. (Clark, Baker, and Taylor 2016, 3.)

The physiological arousal caused by the rhythmic patterns in music improves balance, coordination, and motor movement symmetry (Clark, Baker, and Taylor 2016, 3). When elderly persons living with dementia listen to music and perceive its rhythm and tempo during physical exercise, they can control their body movements accordingly to make them synchronous with the music. The physiological arousal resulting from this synchronization of music with body movements serves as cognitive training for the elderly living with dementia (Satoh et al. 2014, 7). This cognitive training is attributed to the parietal lobes that contribute to visuospatial and somatosensory function (Salimi et al. 2019, 10). Thus, music and somatosensory inputs can improve visuospatial function in the elderly living with dementia by stimulating the parietal lobes.

vi.Improving learning

Music contributes to improved learning abilities in the elderly living with dementia by influencing emotion, which modulates learning as an aspect of cognition. Emotions influence memory recall and retention in learning, and typically constitute complex interactions of subjective feelings and behavioural and physiological responses, which are usually triggered by external stimuli, such as music (Tyng et al. 2017, 3). The emotions triggered by music facilitate learning by storing the material to be learned along with the memories that are experienced during a particular learning situation. The activation of emotions improves the activation of material linked with long-term memory that facilitates retrieval. Thus, an elderly person living with dementia is more likely to remember the material they have learned about if they experience the same emotion (that they experienced at the storage phase) during retrieval.

The emotional significance of music improves the ability to perform explicit memory tasks and perceptual identification tasks (Tyng et al. 2017, 1). When an elderly person living with dementia listens to music that evokes a sad mood in them, they are likely to learn about a sad story or event. However, learning about the same sad story or sad event may be hindered by listening to music that rather evokes a joyful mood in them, and vice versa. Furthermore, emotions can influence the formation of expectancies that define an individual's state of hoping for things that will happen, which can in turn impact their motivation to learn. When an elderly person living with dementia listens to music while in a positive mood, they are likely to develop positive expectancies, whereby they think or hope that good things will happen. Such positive expectancies may facilitate the development of their positive motivation to learn.

In addition, the motivational and attentional components of emotions are associated with improved learning (Seli et al. 2016, 1280). Motivational

components arouse curiosity, whereby an elderly person develops a psychological interest in learning activities such as learning to play a musical instrument. The curiosity state in the elderly further encourages them to explore more and prepares their brain to learn and remember things. On the other hand, attentional components improve learning by enhancing perceptual processing that helps in the selection and organization of important information.

vii. Fine motor coordination

Music is an effective tool for rehabilitating motor deficits in the elderly living with dementia. Motor deficits in dementia usually aggravate in the disease state and in the developing years preceding any cognitive impairment (Schonfeld et al. 2021, 1034). Engaging the elderly living with dementia in musical activities and training, such as playing drums and piano, can significantly improve their fine motor control. Playing in synchrony while in the company of another person or people, whereby an elderly person makes small, precise movements with their fingers, hands, feet, or toes at the same time as the musical rhythm and tempo, can improve their social engagement, which helps improve their motor outcome.

Learning through observation while engaging in musical activities in the company of other people also helps the elderly living with dementia improve their motor control. The neuronal mechanism of the influence of observing other people performing a musical action depends on the mirror neuronal system. Both periods of execution of an action and observation of the same action being performed by another person result in the activation of mirror neurons, which prepare a particular motor command and optimize the execution of movement. (Bozzacchi et al. 2015, 783.) Thus, the activation of mirror neurons in an older adult living with dementia, who is allowed to observe a musical action while it is being executed may realize improved fine motor coordination, such as grasping action.

viii. Enhancing auditory processing

Auditory processing, also referred to as hearing, is the awareness of sounds and the assigning of meaning to them. Speech perception depends on the auditory

system's ability to process the speech envelope (Gransier and Wouters 2021, 108374). The ability of the brain to synchronize its activity to speech rhythms that feature amplitude modulations' gradients and frequencies in the speech envelope serves as the basis of cortical mechanism for speech perception. The speech envelope, specifically the timescales corresponding to the speech segments, plays a pivotal role in helping perceive speech intelligibly since it comprises low-frequency amplitude fluctuations that correspond to the timescales of words, sentences, phonemes, and syllables.

The elderly living with dementia usually have defective temporal processing that is linked with central and sensory-neural processing deficits associated with reduced speech perception (Sardone et al. 2020, 2). Age-related central auditory processing disorder is a strange deficit typically experienced during the processing of auditory signals, particularly along the central auditory nervous system. This peculiar deficit usually manifests in the elderly living with dementia as the inability to perceive speech against a competing speech or in a noisy environment. (Bellis and Bellis 2015, 537.)

Music training can help stimulate the auditory nerve fibres in the elderly living with dementia. Learning to play a musical instrument typically involves the interaction of higher-order cognitive functions and many modalities, which results in structural, functional, and behavioural changes in the brain (Tian, Cheng, and Luo 2024, 3). Musical training induces brain plasticity—the ability of the brain to adapt and change due to experience (Neves et al. 2022, 2). This capacity of the brain to reorganize its function and structure as a result of the effect of musical training can help the elderly living with dementia improve their auditory processing.

Furthermore, the coding and processing of pitch occur in the brainstem, with the brainstem neurons following the repeating trends of the acoustic stimulus (Plack, Barker, and Hall 2014, 2). Music experience causes functional and structural changes at various auditory pathway stages, such as the brainstem, whereby short-term exposure to particular structured sounds elicit changes in auditory cortical responses since the precision of the temporal pitch information depends

on musical and linguistic experience (Neves et al. 2022, 15). The changes in the auditory cortical responses enhance the auditory processing abilities in the elderly living with dementia by improving their sound detection and their ability to compare and distinguish the separate and distinct sounds in words.

6 DISCUSSION

6.1 Ethics and Reliability

According to the European Code of Conduct for good research integrity, the main pillars of research integrity are honesty, respect, accountability, and reliability. These are important in that they enhance the quality of research, the methodology, the analysis, and the resources used (European Code of Conduct 2023.) This thesis ensures honesty in the whole research process by maintaining trustworthiness in the analysis and presentation of the report. The thesis process was characterized by respect for each author during the collective work, which ensured a smooth process. Furthermore, the thesis respected the work of the other authors by using the correct referencing, publication, and giving credit to authors, with the referencing ensuring accountability of the research in every aspect.

The European Code of Conduct for good research integrity also recommends good research practices that need to be implemented by the institution. These include the rules that the institution oversees, such as training, supervision and mentoring, research procedures, agreements, collaborative working, and data practices and management (European Code of Conduct 2023). This thesis process was guided by these rules, which had been communicated during the school seminars and trainings.

6.2 Reflection

While conducting an information search on the "*Impact of music on the cognitive function of the elderly living with dementia*", we discovered that emotions play a significant role in influencing cognitive function. Both positive and negative emotions have the potential to influence cognitive function. We learned that music can be used as a tool to influence emotions in the elderly, which can subsequently be used to promote learning. The elderly can be made to listen to a sad song that evokes a sad mood in them if the musical intervention seeks to promote learning through interaction with sad stories, and vice versa. We found this information

crucial in determining the type of music that is appropriate for a particular learning activity.

6.3 Limitations

One of the limitations encountered during this thesis process was the language barrier. We were only limited to English research materials and as we are in Finland and the main language used is Finnish, our product would better serve only the audiences with knowledge of the English language. This potentially left out a large number of the Finnish audience. Translating most research materials from Finnish to English was a challenge and would change the context of the content.

Another limitation was that our main tool was music for the elderly. Some of the elderly living with dementia may have a hearing impairment and hence would not be able to hear the music.

In addition, everyone has different music preferences. As we targeted clients with dementia and as some of them would not be able to talk or remember what music they preferred to listen to, it was difficult to determine what music to choose for them and whether it would be beneficial.

Time also had a major impact during our research process, especially while trying to integrate our busy schedules. Finding a suitable time for us to meet as a group was a challenge owing to our inflexible timetable.

6.4 Development proposal

The study on the impact of music on the cognitive function of the elderly living with dementia presents a new research gap in the influence of personalized music on cognitive function. There is a need to conduct further research on the impact of personally significant music on the elderly living with dementia. Exploring how music preferred by the elderly can affect their cognitive function can help determine whether music affects cognitive function in varying degrees.

7 CONCLUSION

The potential to cause changes in behaviour and cognitive impairment makes dementia a harmful condition that poses a significant threat to the quality of life of the elderly. Dementia increases the dependency of the elderly and interferes with their everyday activities. This condition majorly affects cognitive function, including verbal memory, autobiographical memories, attention, perception, visuospatial abilities, learning, fine motor coordination, and auditory processing.

Music comprises soothing and therapeutic elements that have the potential to influence human emotions. Emotions evoked by music influence cognitive functions such as perception and attention, which help the elderly regulate how they regularly perform their learned sequence of behaviours and how they concentrate on specific things as they filter out irrelevant information. Music activities that involve listening to music with lyrics contribute to the activation of memory formation by helping in the development of integrated melodies and lyrics memories that boost verbal fluency.

The elderly living with dementia can benefit from musical interventions by improving their autobiographical memories. This can be achieved in an involuntary manner, whereby listening to music allows the elderly to visualize the past events and activities that accompanied a particular song. Music is a better memory cue compared to pictures due to its greater episodic richness. The context of music tends to remain unchanged, such as from the time in which an individual first listens to a song, to the time in which that particular song is played to them again, which is helpful in eliciting the autobiographical memory of the elderly living with dementia.

Nurses can help the elderly living with dementia to achieve improved auditory processing through musical training. Music can stimulate the auditory nerve fibres during musical training, which can improve sound detection and enable the elderly living with dementia to better compare and distinguish the separate and distinct sounds in words.

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9 APPENDIX 1: Poster presentation on Music's impact on cognitive function in elderly dementia patients