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Comparition of immediate effect of self-selected favourite versus least favourite music on hand grip strength among elderly individuals

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Abstract
Background: In geriatric population evidence is provided that shows grip strength is largely consistent as an explanator of concurrent overall strength, upper limb function, bone mineral density, fractures, falls, malnutrition, cognitive impairment, depression, sleep problems, diabetes, multimorbidity, and quality of life. Aim of the study was to compare the immediate effects of self-selected favorite versus un favorite music on hand grip strength among elderly individuals.
Method: Based on the inclusion and exclusion criteria, 58 participants aged between 60-75 were selected for the study, They were randomly divided into 2 groups (29 in each) - self-selected favorite music and least favorite music group. Hand grip assessment was done before listening the music and immediately after the listening of 30 mins of music. The data was analyzed using jamovi software and non-parametric mann whitney U test was applied for between group comparison (α=0.05).
Results: There was a significant difference in mean hand grip strength between groups. Self-selected favorite music group subject's mean hand grip strength was improved more than the least favorite music.
Conclusion: According to the results obtained it can be stated that self-selected favorite music does have a significant effect on hand grip strength in elderly compared to least favorite music.

Keywords: Hand grip strength, elderly, favorite music, cognitive impairment, upper limb function

Introduction

India is the second most populated country, and the number of older adults is estimated to be 173 million in 2026. [1] The number of falls among older adults is increasing with the transition in demographics over time. [2, 3] Falls have a negative long-term impact on the physical and psychological health and socioeconomic condition of the individual. [4] One of the causes of fall incidents is peripheral muscle dysfunction, which increases in prevalence by age. [5] In geriatric practice, frailty and muscle power are often measured using handgrip strength, which is a valid measure for peripheral muscle function [6].

Handgrip strength is a simple and cheap evaluation way that could be used to measure muscle strength. Thirty-five muscles are involved in the movement of the forearm and hand. A lot of these muscles play a crucial role in gripping. During gripping, flexor muscles create grip strength and the extensor muscles of the forearm stabilize the wrist. [7]. The superficial layer of flexor musculature includes the pronator teres, flexor carpi radialis, flexor carpi ulnaris, flexor digitorum superficialis and palmaris longus. Deeper layer of fascia includes the flexor digitorum profundus, flexor pollicis longus and pronator quadratus, flexor pollicis brevis and abductor pollicis brevis. [8]

The gripping and wrist actions share several muscles; flexor digitorum profundus (FDP) and flexor pollicis longus (FPL) contribute to wrist flexion and grip force production, while extensor digitorum communis (EDC) contributes to wrist extension and grip relaxation. Additionally, there are dedicated muscles for wrist flexion/extension that do not directly affect grip force, whereas the intrinsic muscles of the hand have no direct effect on wrist action but can contribute to grip force via the extensor mechanism [9] The presence of the multiple muscle groups with different actions on the wrist-grip system potentially allows for various muscle activation patterns compatible with any task. [10] Evidence is provided that shows grip strength is largely consistent as an explanator of concurrent overall strength, upper limb function, bone mineral density, fractures, falls, malnutrition, cognitive impairment, depression, sleep problems, diabetes, multimorbidity, and quality of life. [11] Hence grip strength is used as one of the outcome measures in this study.

Grip strength can be tested relatively easily using a hand-held dynamometer. The Jamar dynamometer is the most widely reported device used to measure grip strength. Eighty percent of occupational therapy schools and clinics in the United States use the Jamar dynamometer as their usual instrument to assess grip strength. The Jamar has many useful features for routine screening as well as in the evaluation of hand trauma and disease. The Jamar displays grip force in both pounds and kilograms, with a maximum of 200 lb. (90 kg). It has a peak-hold needle that automatically retains the highest reading until reset. The Jamar test is isometric, with no perceptible motion of the handle, regardless of the grip strength applied. The handle can be adjusted for different size in order to fit for individual use. The Jamar dynamometer presents good inter-rater reliability and test-retest reliability. The American Society of Hand Therapists (ASHT) has recommended the Jamar dynamometer as the gold standard, leading to its widespread use in clinical practice and research. [12] Teraoka and Hillman *et al*. who found that a maximal grip strength is highest in sitting rather than in supine positions. By preventing wrist flexion, the synergists are able to maintain the joint in a position that allows the finger flexors to

develop greater torque, a combination of optimizing sarcomere length and moment arm. The American Society of Hand Therapists (ASHT) recommended testing protocol in which the subject is seated upright against the back of a chair with feet flat on the floor. The shoulder adducted and neutrally rotated, the elbow flexed at 90º and the forearm in neutral and wrist between 0° and 30° of extension [13].

In the recent years music has become one of the favorite likings of people. The general mechanism for music that was heard travelling to the brain is as follows; music enters the ear and is received by the cochlea. It is then transferred to the thalamus, and then to the auditory cortex for processing. Although most reward stimuli do not activate the hippocampal region, music does. The hippocampus's main roles are the conversion of short-term memory into long term memory and spatial relations. It is also responsible for encoding information from the amygdala, which controls emotion, with the long-term memories. In other words, emotional memory becomes combined and remembered with long-term memory through the hippocampus. This supports a growing theory that the hippocampus plays a role in emotional recollection that occurs when listening to music. Because music affects emotions in a way unlike money, food or other reward stimuli, it couples emotion and the memory of a specific piece of music. This activates the hippocampus, leading to feelings of peacefulness, tenderness, joy, or even sadness when the piece is later recalled.

Music is also processed in different areas depending on whether the music is perceived as pleasant. Music that has dissonance and disharmony is more likely to be processed in the temporal lobe, while music that is pleasant and has harmony will be processed in the frontal lobe. Pleasant music is processed in the same way that primary and secondary pleasure stimuli are generally handled. Music activates the nucleus accumbens, ventral tegmentum area, hypothalamus, orbitofrontal cortex, and the insula-frontal cortex. The nucleus accumbens is the center which processes pleasant stimuli, and then releases dopamine into the ventral tegmentum area. Pleasant music, such as music which gives the listener chills, or goosebumps, causes the release of dopamine both in the ventral tegmentum and in the ventral striatum. The anticipation of chills, itself, releases dopamine, as well. Expected chills activate dopamine in the ventral striatum. When the music causes the chills to actually happen, the dorsal striatum becomes activated with dopamine. The hypothalamus, too, gets activated, which lowers the heart rate and breathing rate, leading people to feel calmed and relaxed by music.

Listening to music, especially to subjectively preferred songs, engages brain pleasure pathways. A study using positron emission tomography (PET) measured regional cerebral blood flow changes in response to the subject's chosen highly pleasurable music, which would evoke the experience of "chills" or "musical frisson". With increasing intensity of music-evoked pleasure, cerebral blood flow changes were registered in brain regions associated with reward, motivation, arousal, and emotions, namely ventral striatum, midbrain, amygdala, orbitofrontal, and ventral medial prefrontal cortices. [14]

While music therapy is a specific discipline conducted by trained professionals, music interventions can be implemented by nonprofessionals, healthcare providers, volunteers, or other relevant professionals. Music interventions can include music therapy but also encompass other forms of music-based interventions such as music activities, music appreciation, and music training. Therefore, music therapy is a subset of music interventions, with the former involving specialized training and a therapeutic focus, while the latter encompasses a broader scope of music-related interventions. Music intervention has been shown to have beneficial effects on the cognitive, physiological (such as heart rate, blood pressure, respiratory rate, cortisol levels, immune function markers, and other relevant biomarkers), and psychological problems of older adults. [15]

They listen to music while travelling, workouts in the gyms, traditional gatherings, etc. Listening to music has been repeatedly shown to have ergogenic benefits during various modes of exercise, including endurance [16, 17], sprint [18, 19], and resistance based activities [20, 21, 22]. The ergogenic and performance-enhancing effects of music may be achieved through several different alterations to the exercise response. Music has been shown to potently reduce the perception of fatigue and exertion through dissociation and distraction during exercise [23, 24]. Increases in arousal and neural activity while listening to music have been shown to accompany improved exercise performance. [25, 26]

Among older adults, musical experiences contribute to their well-being, and are also associated with sustained brain volume and activation of networks involved in executive functions, memory, language processing and emotions. These positive effects on well-being highlight the crucial role of music in promoting mental health across the lifespan. [14]

It has been proven that listening to music during a warm up increases catecholamines, which may in turn affect muscular activation and metabolic reactions during subsequent exercise. [27] According to research, listening to one's preferred music enhances functional connectivity in the brain's default network which is involved in memory encoding and self- referential reasoning, and modifies the connection between the hippocampus and auditory brain regions. [28]

In recent years, music has become one of people's favorite likings. They listen to music during travel, training in the sports halls, traditional meetings, etc. Few of the research has shown that listening to a person's favorite type of music improves functional connectivity in the default mode network of the brain and alters connectivity between auditory brain regions and the hippocampus, which are involved in self- referential thinking and memory encoding. Also, dopamine a neurotransmitter has a role in elevating the mood of the geriatrics which is released while listening to music. The hand-held Jamar Dynamometer is a reliable assessment tool for elderly people since it measures grip strength, which is thought to be a reliable indicator of an individual's overall functional capacity.

Various studies are conducted to see the effect of self-selected music on hand grip strength in younger groups, but as there is dearth in Indian literature specifically addressing the geriatric population, hence this study is undertaken.

Aim

To compare the effects of self-selected favourite versus least favourite music on hand grip strength among elderly individuals.

Objectives

1. To find the effect of self-selected favourite on hand grip strength among elderly individuals.
2. To find the effect of least favourite music on hand grip strength among elderly individuals.
3. To compare the effects of self-selected favourite versus least favourite music on hand grip strength among elderly individuals.

Methodology

Study Design: pre-post two group experimental study
Study Population: Elderly
Study Sample: Elderly male and female aged between 65-75 years
Sampling Technique: Convenience sampling.
Sample Size: 58 subjects
Study Setting: community dwelling elderly individuals were asked to participate in present study.
Inclusion Criteria

- Elderly aged 60-75 years
- Male and female both
- People willing to participate

Exclusion Criteria

- Hearing deficits
- Inability to complete hand grip strength measurement

Outcome Measures
Hand grip strength measurement was taken using Jamar hand dynamometer with reliability (ICC=0.98) and validity (ICC=0.99).
The test position for checking grip strength: Subject sitting on a chair with back and arm rest. Feet touching the ground. Shoulder neutral, elbow flexed, forearm midprone, wrist should be over the end of the chair's arm, and angle varying between 0-30 degrees of extension, thumb facing upwards.

Procedure

- An approval from the ethics committee was taken before the commencement of the study.
- Subjects were selected on the basis of the inclusion and exclusion criteria.
- All the participants were explained about the study in a language best understood by the.
- A written consent form was taken from them.
- Descriptive data including name, age, gender, dominance, of the participant was taken.
- Then they were randomly divided into 2 groups

Group A: self-selected favorite music (n=29)
Group B: self-selected least favorite music (n=29)

- Each participant was asked to perform grip strength using Jamar hand dynamometer three times before listening the music. Music was played for 30 minutes. Post measurements were taken immediately after listening the music.
- The values of pre and post grip strength were noted. Mean grip strength post music compared to pre music mean grip strength.

Statistical Analysis

- The data was analysed using the JAMOVI software version 2.4.11
- The Shapiro Wilk test was done and the data did not pass normality hence, non-parametric Wilcoxen signed rank test and mann whitney U test was used for within and between group comparison.
- For all statistical tests $p<0.05$ was considered statistically significant.

Results

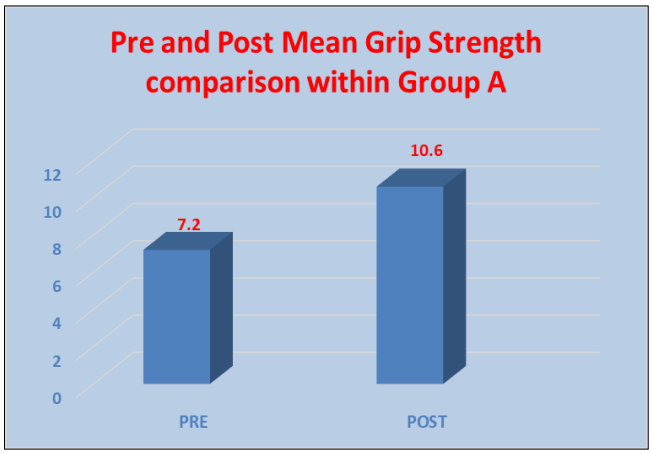
- Among 58 participants 32 [55.17%] were males and the remaining 26 [44.83%] were females.
- Mean age of participants was 68.42 and SD was 3.21

Mean hand grip strength of favorite music and least favorite groups were 8.2±5.24 and 6.5± 4.72 respectively before intervention and 10.6±3.35 and 7.5±2.41 respectively after 30 mins of music intervention.

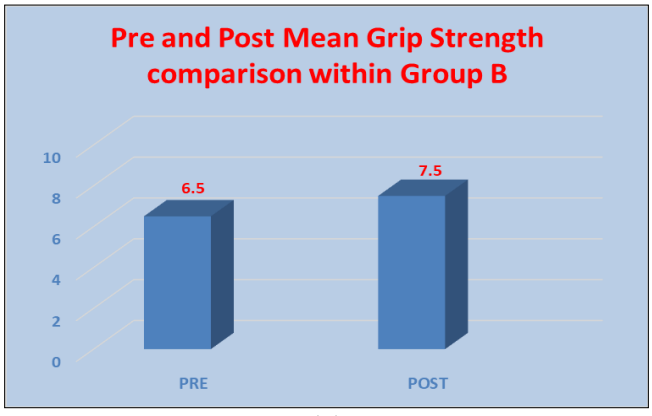
Table 1: Pre and Post Mean Grip Strength comparison within group by paired t test

Grip strength with	Pre	Post	P value
Group a (favorite music)	7.2±5.24	10.6±3.35	0.0047
Group b (least favorite music)	6.5± 4.72	7.5±2.41	0.3139

Graph 1: Pre and Post Mean Grip Strength comparison within group (A) Group A (B) Group B



(A)

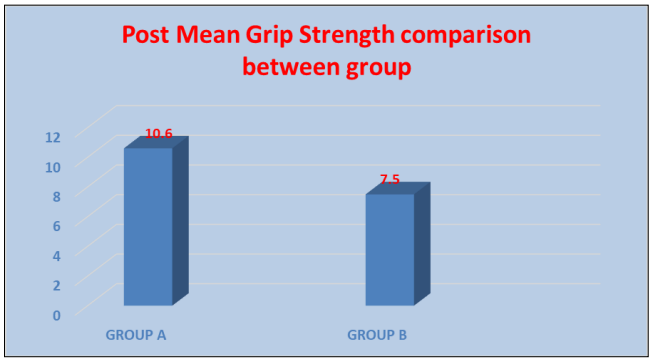


(B)

Table 2: Post Mean Grip Strength comparison between group by un-paired t test

Grip strength	Post	P Value
Group A (Favorite music)	10.6±3.35	0.0002
Group B (Least favorite music)	7.5±2.41	

Graph 2: Post Mean Grip Strength comparison between group



Discussion

The study aimed to find the immediate effect of self-selected favourite versus least favourite music on hand grip strength among elderly individuals. In our study we found a significant difference in hand grip strength when measured after self-selected favorite music as compared to grip strength measured after least favorite and no music at all.

Evidence is provided that in geriatrics, grip strength is largely consistent as an explanator of concurrent overall strength, upper limb function, bone mineral density, fractures, falls, malnutrition, cognitive impairment, depression, sleep problems, diabetes, multimorbidity, and quality of life. [11]

A previous study by Karageorghis *et al*. investigated different types of predetermined music on grip strength. They used stimulative and sedative music in which stimulative music was characterized by 134 b·min^{-1}, whereas sedative music measured 90 b·min^{-1} and found stimulative music to have a positive effect on strength.

Another study extended a line of work into pretask music by examining the interactive effects of music tempo and intensity (volume) on the performance of a simple motor skill and subjective affect in 52 male athletes (age = 26.1 + 4. 8 years) who were exposed to five conditions: fast /loud (126 bpm/80 dB A), fast /quiet (126 bpm /70 dB A), slow/loud (87 bpm/80 dB), slow /quiet (87 bpm/70 dB A) music, and a no -music control. Fast -tempo music played at a high intensity yielded the highest grip strength, while fast -tempo music played at a low intensity resulted in much lower grip strength performing hand grip strength testing. For affective arousal, there was no difference between tempi although there was between intensities, with the high -intensity condition yielding higher scores. [26] Our study showed that the perception of the elderly while performing hand grip strength assessment after listening to their favourite music was better as compared to least favourite music.

There is a significant amount of research that supports the use of music as an ergogenic aid. An ergogenic aid can be defined as an external influence with the ability to increase capacity for bodily or mental labor especially by eliminating fatigue symptoms and can range from articles of clothing to imagery, caffeine, steroids, or music. It has been previously reported that music might allow an individual to dissociate from exercise. The most common positive outcomes when combining music and exercise appear to be decreased ratings of perceived exertion (RPEs), increased performance measures, improved mood, and increased arousal.

Based on these results, it appears that motivating and or self selected music may be beneficial during acute explosive, high-intensity exercise. [26] Music is in charge of our fluctuating emotions and stress levels. When one presses the play button on their device to start up their playlist, this action triggers increased blood flow to areas of the brain that generate and control our emotions. The emotions that we feel when we listen to music are the result of dopamine, which triggers sensations of pleasure and well- being. Dopamine is a signaling molecule that acts as a messenger in our nervous systems and as a hormone that affects tissues in the body. It performs many roles in the body but is best known for its ability to make us feel pleasure and happiness. When our dopamine levels rise, we feel better, and our mood improves. Dopamine is also involved in the brain's reward system, which explains why we often feel a sense of satisfaction and reward when listening to music. This neurotransmitter plays a crucial role in reinforcing pleasurable behaviors, such as listening to music, by creating a positive association in our brains, which not only boosts our mood but also relieves us from anxiety. When we start to get familiar with a certain song, our brains automatically trigger the release of dopamine upon the first few notes of the song. This release of dopamine in response to pleasurable and favorite music can create a sense of euphoria and contribute to the emotional and physiological effects of music on individuals.

Additionally, the researchers found that the anticipation of pleasurable music also triggers the release of dopamine, further enhancing the overall experience. [29] Ferguson *et al*. examined the effects of positive and negative music on performance of a karate drill. They had subjects perform a kata after a 1-minute exposure to positive music, negative music, or white noise. Their results revealed a greater performance on exposure to music with there being no differences between positive or negative music conditions. Post experimental evaluation of the subject's self-perceived performance indicated that 11 subjects felt more comfortable and 10 subjects felt more relaxed after listening to music. [30]

Results contribute to the growing literature on the effect of listening to music on older adults' emotional states and cognitive abilities. Compared to other participants, young old geriatrics who heard happy-sounding music exhibited larger positive changes in arousal, mood, and working memory, a finding predicted by the arousal and mood hypothesis. Nevertheless, the independence between measures of emotion and cognition appears to stem from large inter- and intra-individual variability that characterizes the aging process. Thus, for at least some older people, music listening could represent a cost-free and effective means to induce positive emotional states and to enhance and sustain cognitive performance. [31]

Previous studies have showed that listening to music had an increased tolerance to high intensity exercise followed by greater endurance time in elderly with COPD. It also revealed that the dyspnea was less while listening to music. [32]

Research has shown that listening to and playing music can change brain functions, improving cognitive functions such as memory and attention, as well as behavioral symptoms of older adults. Long-term music training and learning of related skills can even stimulate the brain development of older adults. Music intervention has also been shown to

alleviate negative emotions such as anxiety and depression, and activate the subcortical circuit, limbic system, and emotional reward system, thereby stimulating well-being and improving the quality of life. [33]

Hence music has shown positive results in mood, affect as mentioned in various studies and also significant improvement in hand grip strength in young and elderly population. Thus, it can be used as an adjunct tool for rehabilitation.

Conclusion

According to the results obtained it can be stated that self-selected favorite music does have a significant effect on hand grip strength in elderly compared to least favorite music.

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