

# Pilot study of the effects of rhythmic auditory stimulation on fall risk in older adults

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## Introduction

Falls are a leading cause of injury and mortality among geriatric patients, with a prevalence of up to 30% of short-stays in geriatric unit. Mobility impairments, older age, and previous fall history, are strong factors associated with fall risk (Chabot et al., 2019). The American Physical Therapy Association recommends that physical therapists perform fall risk tests on all older adults (APTA, 2024). The Timed Up and Go (TUG) test is a commonly used clinical tool to assess fall risk. Higher TUG times can be indicators of increased fall risks and lead to assistive walking devices being prescribed. The Timed Up and Go test is clinically applicable and reliable across multiple populations (Christopher et al., 2019).

Music therapy has emerged as a promising, low-cost option for improving mobility and performance in rehabilitation. Prior studies suggest rhythmic auditory stimulation (RAS) can improve walking speed, gait, and balance, as well as lowering fall risk. The rhythmic component of music has been used to regularize gait (Wu et al., 2022).

The purpose of this study was to investigate how Timed Up and Go test times differed between various music tempos. This study focused on developing procedures for implementing RAS in mobility testing. Songs were selected for having 4/4 timing, beat salience, and familiarity (Weineck et al., 2022). Due to this the chosen tempos were between 60–140 beats per minute (bpm). The applications of this study could allow physical therapists to begin to play tempo-specific playlists during mobility training, allowing for older adults to decrease fall risk at negligible cost. Music therapy has been shown to lessen depression symptoms, which older adults are especially susceptible to. Music during appointments also has the possibility to improve patients' enjoyment of physical therapy and increase physical therapy retention.

## Methods and Materials

Seven older adults recruited from McLaughlin Physical Therapy participated in this study, with ages ranging between 66 and 84 years old. Inclusion criteria were: (1) at least 65 years of age and (2) providing informed consent. Participants' age, gender, condition, and hearing impairments were collected. Wireless headphones, an armed chair, a cone, measuring tape, and stopwatch were used.

| Category | BPM | Song Title              | Artist            |
|----------|-----|-------------------------|-------------------|
| Slow     | 60  | My Girl                 | Otis Redding      |
| Moderate | 100 | Crazy in Love ft. Jay-Z | Beyoncé and Jay-Z |
| Fast     | 140 | Beat It                 | Michael Jackson   |

Table 1 (left): Table listing the songs assigned to the slow, moderate, and fast tempo groups.

## Methods and Materials (continued)

Participants were randomly assigned to one of four groups: slow tempo (60 bpm), moderate tempo (100 bpm), fast tempo (140 bpm) or control (no music).

All participants completed baseline TUG testing. Participants in the music groups completed sessions while listening to music through headphones. After 10 sessions, all participants completed a final TUG assessment. Improvement was calculated as the difference between initial and final TUG times.

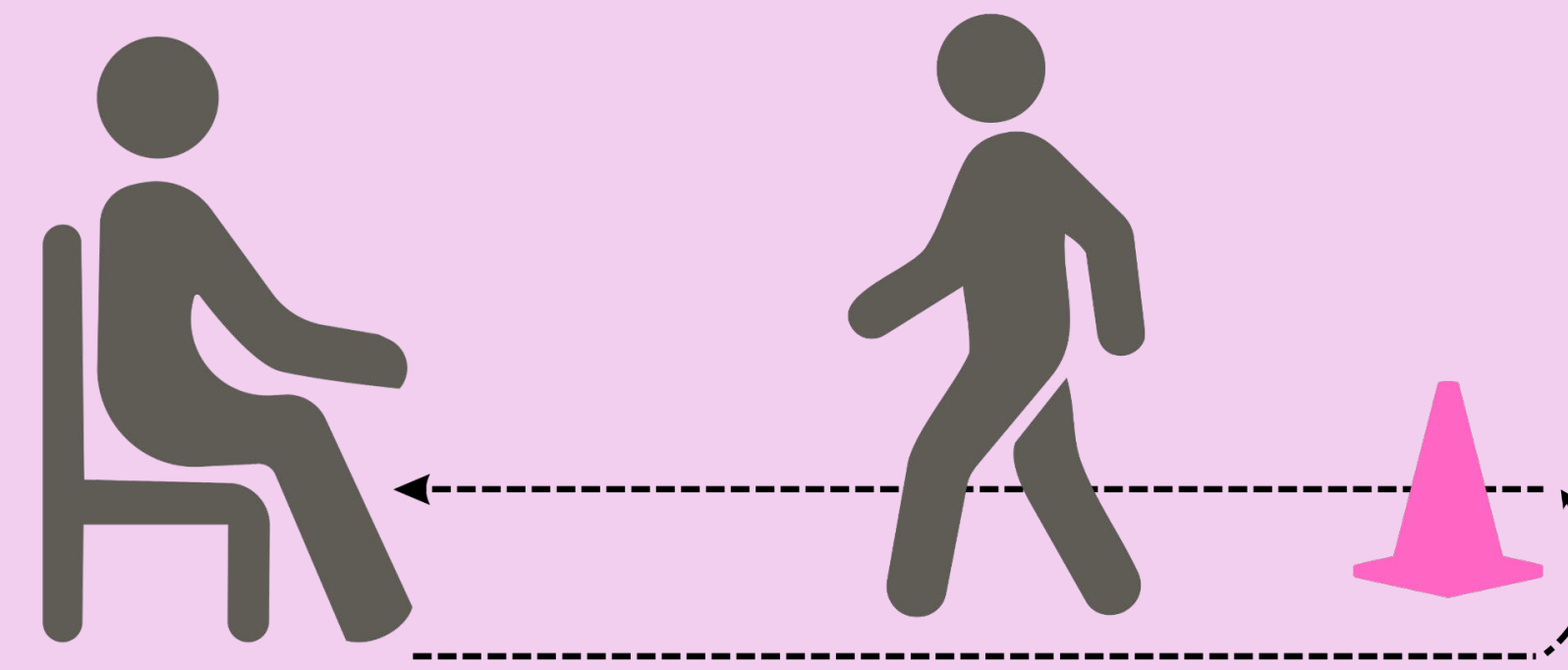
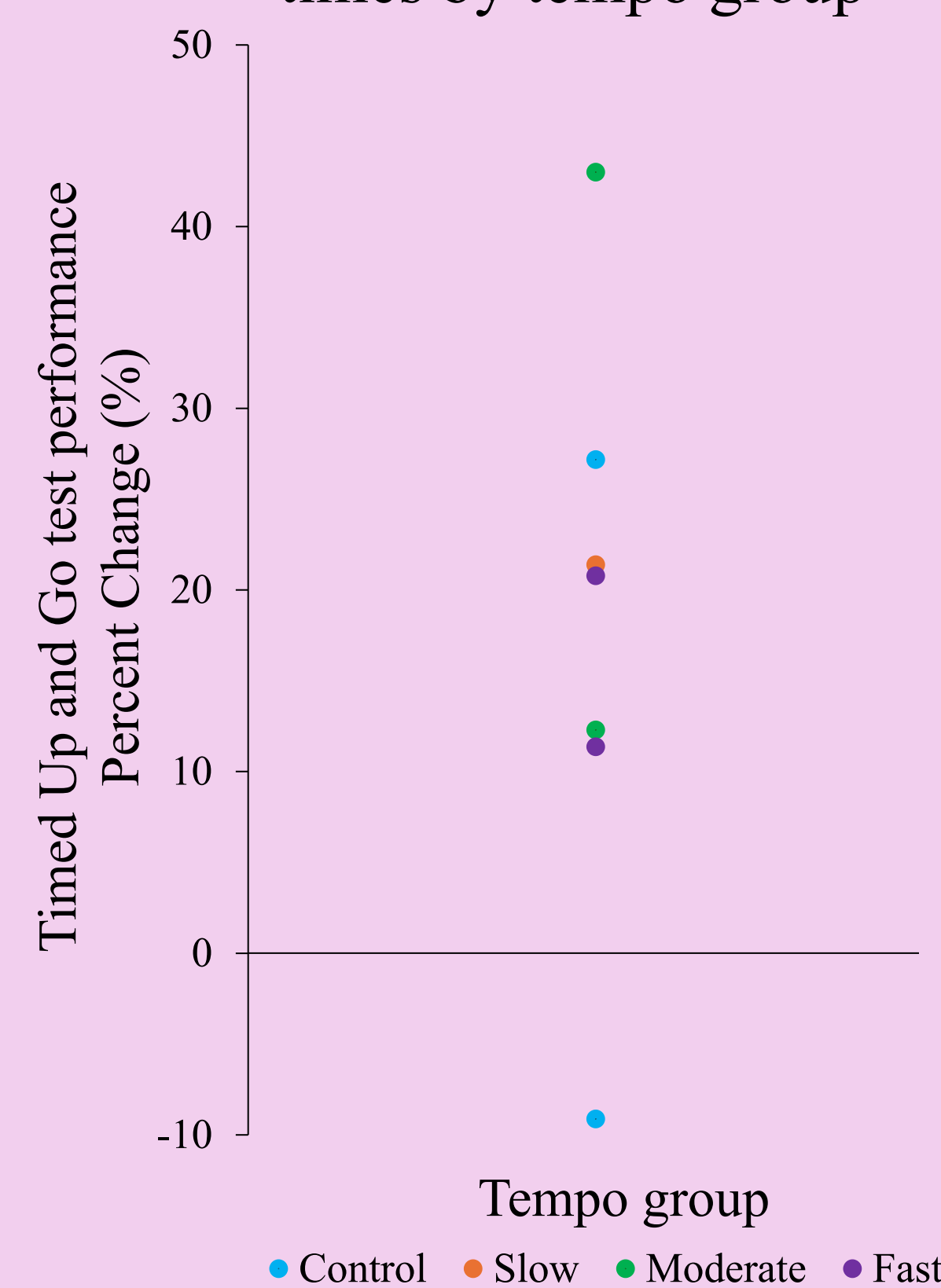


Figure 1 (left): Diagram displaying the execution of a TUG test. The TUG test involved standing from a seat position, walking 10 feet, turning, walking 10 feet back to the chair and sitting down.

## Results

Percent change (%) in TUG test times was examined across tempo groups. The control group ( $n = 2$ ;  $M = 9.0\%$ ), slow music group ( $n = 1$ ;  $21.4\%$ ), moderate music group ( $n = 2$ ;  $M = 27.6\%$ ), and fast music group ( $n = 2$ ;  $M = 16.1\%$ ) percent changes all did not appear to differ substantially from each other.

Graph 1 (left): Graph showing the TUG percent change (%) between music tempo groups. Each point represents a single participant's percent change from session 1 to session 10, with positive percent change reflecting increased mobility.



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| Category                                     | Value |
|--|-------|
| Average participant age (years)              | 74.3  |
| Average Timed Up and Go test time change (s) | 7.0   |
| # of patients with assistive walking device  | 3     |
| # of participants with mobility conditions   | 5     |

Table 2 (above): Table presenting a summary of demographic and mobility related characteristics of the study sample. This provides context for the participants' the range of mobility within the sample.

## Discussion

The purpose of this study was to develop and evaluate methods for investigating effects of rhythmic auditory stimulation on mobility in older adults. Trends suggested that participants in the moderate tempo group showed greatest performance, and all participants, except one, improved in mobility between session 1 and session 10.

One major limitation of this study was the small sample size, which limits the ability to determine significant differences amongst groups. Due to limited number of participants, variability in individual mobility levels may have had a disproportionate impact on the results, so these findings cannot be generalized to the broader population of older adults.

Another limitation was that the music was only played during TUG test as opposed to the entirety of physical therapy sessions, which may have reduced the potential impact of rhythmic auditory stimulation.

This pilot study supports the feasibility of the methods used for future research on RAS in mobility in older adults. Future research should be conducted in senior living or rehabilitation facilities, where participants can be observed over longer periods of time and more consistently. Studies show that music during therapy is effective in neurological disorders (Leale et al., 2025), so future research should be conducted on the differing effects of RAS for people with neurological disorders.

## References

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