Auditory and Visual Cueing for Gait Improvement in Parkinson's Disease

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Background

Parkinson's Disease (PD) is the second most common neurodegenerative disorder, with the number of people diagnosed expected to reach 12 million by 2040[1, 2]. PD is characterized by the degeneration of dopaminergic (DA) neurons, leading to motor impairments which include bradykinesia, movement rigidity, resting tremors, and postural instability. PD may include deviations from normal walking, otherwise known as gait disturbances. Typical treatments for PD includes medication, which requires increased dosages with continued use with disease progression[3].Therefore, cueing interventions are being explored as a potential approach to improving gait disturbances. These interventions encompass a variety of techniques, including auditory, visual, and audiovisual methods.. Auditory cueing can involve devices like a metronome, while visual cueing may use floor markings. Audiovisual cueing combines these modalities. Recent studies have demonstrated that auditory cueing enhances gait[4, 5] but its efficacy outside laboratory settings is limited. New research explores devices better suited for real-world use [6]. To account for new research, this meta-analysis examines the effects of visual, auditory, and audiovisual cueing on gait by analyzing biometric measures such as stride length, cadence, and velocity, while considering recent technological advancements, such as gait aids.

References

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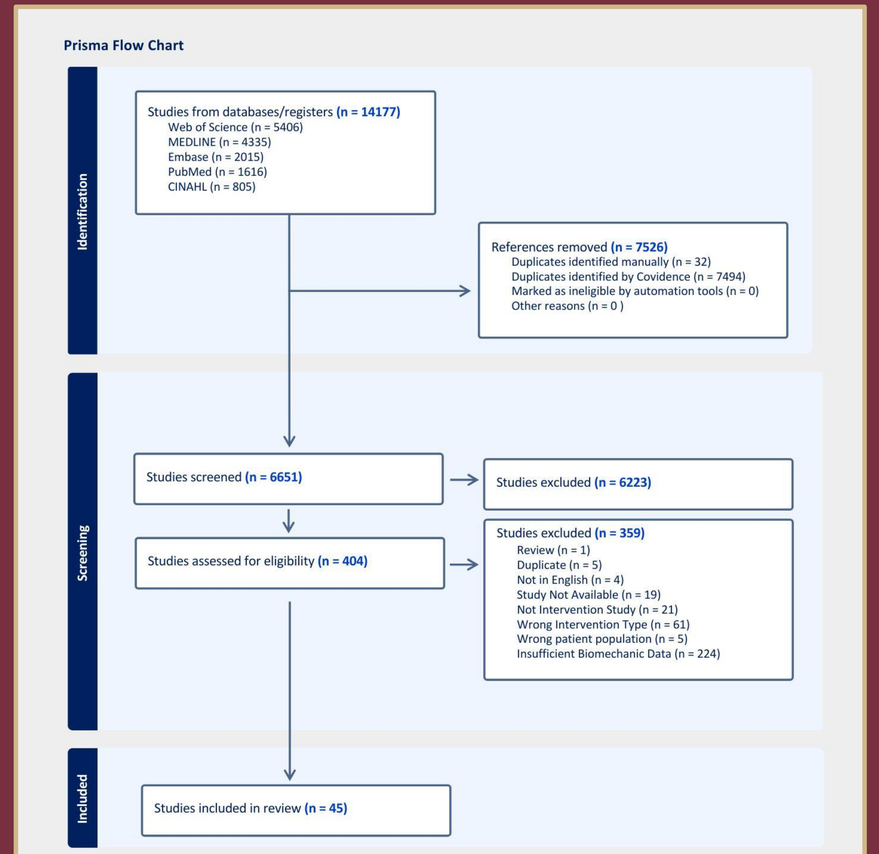
Methods

A search of existing literature was conducted on using the following databases: Embase, Web of Science, Medline, CINAHL, and PubMed. The search was completed with following criteria: ("Parkinson"* OR "PD") AND (("gait" OR "cadence" OR "stride length" OR "step" OR "pace" OR "walk"*) AND ("cue"* OR "prompt")) The literature search concluded on September 10th, 2023. Inclusion was contingent on the evaluation of a visual, auditory, or audiovisual cueing intervention for gait in PD with the use of cadence, stride length, and velocity as biometric measures. Several moderators were coded, including demographic data, intervention length and type, follow-up duration, and biometric values.



Results

A total of 772 PD patients were included for analysis. Hedges' g was used to compute standardized mean differences. Results were synthesized using a multivariate random-effects model, and dependent effect sizes were managed through robust variance estimation. Results indicated that cadence showed no effect ($g = 0.00$, $p < 0.01$), velocity demonstrated a small effect ($g = 0.26$, $p < 0.01$), and stride length showed a small effect ($g = 0.43$, $p < 0.01$) as compared to baseline or non-cued gait. These results are preliminary and further analysis will be done to look at visual and auditory cueing separately.

Discussion

This study analyzed the impact of visual, auditory and audiovisual cueing interventions on gait parameters in individuals afflicted with Parkinson's Disease (PD). The results were obtained by analyzing auditory and visual cueing simultaneously. The results of the meta-analysis demonstrated that both velocity and stride length had small improvements with cueing interventions while cadence remained unaffected. Cadence remaining unaltered may be explained by patients with PD prioritizing step rhythm while modifying stride length and velocity in response to cueing [7]. In the later stages of PD, motor control is progressively diminished and cadence may be less responsive to external prompts which could also explain why it remained unaffected[8]. While the data only illustrated a modest positive impact of cueing interventions on velocity and stride length, these findings are nevertheless significant. Improvements in gait can lead to considerable improvements in the quality of life and mobility of patients with PD. With the small effect sizes, it is clear that further research is needed to understand the best ways to combat gait disturbances with cueing interventions. Further research should focus on evaluating different cueing methods individually by separating analysis of auditory and visual cueing conditions, analyzing variations in cueing durations and understanding the role of PD severity on gait outcomes.