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Review Article

Effect of Treatment of Hypokinetic Dysarthria in Parkinson's Disease with Speech and Language Therapy: A Meta-Analysis

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Abstract

Background: A meta-analysis study was conducted to measure how to forecast the effect of treatment of hypokinetic dysarthria in Parkinson's-disease with speech and language therapy.

Methods: Until October 2024, a comprehensive literature research was conducted, and 1665 related studies were reviewed. The 14 selected studies encompassed 948 participants with hypokinetic dysarthria in Parkinson's disease. The odds ratio (OR) mean difference (MD) and 95% confidence intervals (CIs) were used to look at the outcome of treatment of hypokinetic dysarthria in Parkinson's disease with speech and language therapy using dichotomous or continuous methods with a fixed- or random-effects model.

Results: In individuals with hypokinetic dysarthria in Parkinson-disease, speech and language therapy had significantly higher sound pressure level, phonation (MD, 7. 51; 95% CI, 3. 81-11. 20, p<0. 001), reading (MD, 8. 83; 95% CI, 4. 96-12. 69, p<0. 001), monologue (MD, 4. 28; 95% CI, 2. 47-6. 10, p<0. 001), and picture description (MD, 3. 64; 95% CI, 1. 78-5. 50, p<0. 001), and lower Voice Handicap Index (MD, -5. 61; 95% CI, -9. 05--2. 17, p=0. 001) compared to control treatment.

Conclusion: In individuals with hypokinetic dysarthria in Parkinson's disease, speech and language therapy had significantly higher sound pressure level, phonation, reading, monologue, and picture description, and lower Voice Handicap Index compared to control treatment. To validate these finding more studies are required, caution is needed when interpreting these results, since many comparisons had a limited number of selected studies.

Keywords: Hypokinetic dysarthria; Parkinson's disease; Phonation; Reading; Monologue; Sound pressure level; Speech and language therapy

Introduction

Parkinson's disease is the second most prevalent age-related neurodegenerative disorder following Alzheimer's disease, affecting about 1% of the global population aged 65 and older, and 5% of those up to 85 years of age (1). Parkinson's disease results from diminished dopamine production, causing alternations in the central nervous system that disrupt neuronal networks, including the basal ganglia and supplementary motor regions (2). It is marked by a progressive deterioration in both motor and non-motor functioning, including cognitive and emotional impairments (3). In addition to the established motor symptoms of Parkinson's disease, such as resting tremor, muscular rigidity, bradykinesia, gait impairment, freezing, and postural instability, speech and communication abilities are frequently compromised, and cognitive deficits, depression, and anxiety are common among individuals with Parkinson's disease. Thus, these symptoms may significantly affect the quality of life and well-being of individuals with Parkinson's disease (4). The prevailing treatment modalities for Parkinson's disease consist of polypharmacy and deep brain stimulation. They offer considerable alleviation; nevertheless, they entail severe side effects and high costs (5). Furthermore, prolonged medicinal intervention may correlate with treatment-resistant symptoms and motor consequences such as dyskinesia, fluctuations, and choreoathetosis (6). Consequently, therapeutic approaches that minimize side effects, lower costs, and address multiple symptoms of Parkinson's disease are garnering heightened interest in nonpharmacological therapies for the condition (7).

Throughout their illness, over 89% of people with Parkinson's disease had difficulties speaking and swallowing (8). The most common of these abnormalities is hypokinetic dysarthria, a unique perceptual motor speech condition linked to dysfunction of the basal ganglia control circuit (9). Although it can occur at any level of speech, respiratory, phonatory, resonatory, articulatory, and prosody, its traits are most noticeable in voice, articulation, and prosody (10). Vowel centralization, diminished loudness, inaccurate consonants, pace alterations, and involuntary facial movements are the hallmarks of this particular speech disorder (11). Social isolation caused by hypokinetic dysarthria's detrimental impact on a patient's speech and social engagement can lower their quality of life (12).

Speech and language therapies have been employed for many years as an alternative therapeutic modality for individuals with hypokinetic dysarthria associated with Parkinson's disease (4). Speech and language therapies may activate and influence extensive areas of the brain associated with the perception and regulation of behavior, movement, mood, and cognitive functions, hence demonstrating its utility in neurological rehabilitation (13). Language activities can be conducted actively, such as through singing or speaking, or passively, such as through listening (13).

Various approaches have effectively used speech and language to mitigate both motor and non-motor symptoms of hypokinetic dysarthria in Parkinson's disease. Numerous studies have demonstrated that auditory stimuli can enhance gait-related movements, functional mobility, balance, and reduce freezing of gait and falls in individuals with hypokinetic dysarthria associated with Parkinson's disease (14). Calabrò et al. assert that speech and language therapy can mitigate the deficit in automatic and rhythmic motions (15). Speech and language therapy is a recognized method that seeks to enhance gait patterns using rhythmic auditory signals, utilizing metronome beats or pronounced beats integrated within words. Calabrò et al. propose that rhythmic auditory cueing during gait training enhances the reestablishment of internal synchronization mechanisms responsible for generating and regulating motor rhythmicity, thus improving gait performance (15). Conversely, recent research in the non-motor domain has begun to examine the impact of speech and language therapies on several outcomes, including cognitive functioning (16), speech and communication abilities (17), and emotional and psychosocial symptoms (18). Spina et al. performed a pilot study to examine the impact of language activities on cognitive function in patients with hypokinetic dysarthria associated with Parkinson's disease (18). The findings indicated an enhancement in executive functions, including cognitive flexibility, processing speed, attention, and working memory, implying that speech and language therapies may enhance frontal function by providing a training platform for these cognitive abilities. Tamplin et al. posited that singing engages numerous brain networks and anatomical mechanisms utilized in speech, hence offering potential therapeutic implications for speech and communication disorders (19). Language activities, including auditory engagement, vocalization, and linguistic improvisation, can influence the limbic system and neurochemical pathways (the reward system), yielding beneficial effects on emotional and psychosocial symptoms in patients with hypokinetic dysarthria associated with Parkinson's disease (20). The impact of speech and language interventions on hypokinetic dysarthria in Parkinson's disease, indicating that these interventions may be advantageous in ameliorating both motor and non-motor symptoms in individuals with hypokinetic dysarthria associated with Parkinson's disease (5). The application of rhythmic timing to speech and language therapy and language-based movement therapy has expanded, with results robustly endorsing the efficacy of speech and language interventions on motor functions in hypokinetic dysarthria associated with Parkinson's disease.

Several review studies have examined non-motor symptoms, such as cognitive functioning, depression, and quality of life, and the findings across these research have been contentious concerning the efficacy of linguistic therapies on non-motor symptoms. A recent comprehensive evaluation examined the efficacy of active group-based performing arts therapies on motor and non-motor symptoms in individuals with hypokinetic dysarthria associated with Parkinson's disease (20, 21). Fifty-six studies were examined, encompassing four active arts modalities: dance, singing, language therapy, and theater. The outcomes encompassed motor, communication, and speech capabilities, cognitive status, and quality of life in hypokinetic dysarthria associated with Parkinson's disease. Evidence suggests that active speech and language interventions within the performing arts may serve as an effective therapeutic medium for individuals with hypokinetic dysarthria associated with Parkinson's disease. Previous documentation exists regarding the application of speech and language therapies for managing both motor and non-motor symptoms in individuals with hypokinetic dysarthria associated with Parkinson's disease. Nonetheless, prior systematic reviews and meta-analyses focused solely on either motor symptoms or non-motor symptoms or incorporated a specific sort of linguistic engagement as the intervention. To my knowledge, there have been no systematic reviews and meta-analyses addressing both motor and non-motor symptoms in individuals with hypokinetic dysarthria due to Parkinson's disease, utilizing active and passive language activities as therapies.

The goal of speech and language therapy for hypokinetic dysarthria is to increase speech intelligibility with instrumental assistance and behavioral treatment methods (12). With the potential use of specific devices and/or feedback tools, behavioral approaches, and instrumental aids aim to change behavior by altering one or more speech-motor processes, as well as linguistic or communicative behavior (22). Speech and language therapy is a crucial component of Parkinson's disease treatment (21). There was not enough data to definitively confirm or refute the effectiveness of speech and language therapy in treating hypokinetic dysarthria. The small number of participants analyzed, methodological limitations, and the potential for publication bias were the primary reasons of the lack of evidence. As a result, the study does not examine programs created especially for hypokinetic dysarthria. There are few published studies on the effectiveness, components, and length of speech and language therapy, even though the effect should apply to daily life and result in long-term development. Previous studies, focused on the differential diagnosis of dysarthria, have investigated the importance of assessing orofacial muscle tone (23, 24). Assessing facial muscle tone in Parkinson's disease patients with hypokinetic dysarthria emphasizes the clinical use of normative data and standardized procedures (23, 24). An analysis of the speech and language therapy interventions indicated that the existing programs generally do not include this feature as a metric or component. These limitations yield contradictory results about the tone and activity of face muscles during speech and language treatment (25, 26). Therefore, this study's primary goal was to thoroughly examine the outcomes of specific speech and language therapy regimens for hypokinetic dysarthria. Furthermore, a meta-analysis was conducted to examine the outcomes of the various programs. The study hypothesized that speech and language therapy significantly impacts individuals with hypokinetic dysarthria in Parkinson disease, as evidenced by the significant enhancement in sound pressure level, phonation, reading, monologue, picture description, and Voice Handicap Index.

This study aimed to critically evaluate the efficacy of different speech and language therapies on motor and non-motor symptoms in individuals with hypokinetic dysarthria associated with Parkinson's disease.

Methods

Eligibility criteria

To identify the studies that evaluated the effect of treatment of hypokinetic dysarthria in Parkinson's disease with speech and language therapy (27).

Information sources

The full investigation is depicted in Fig. 1. The literature was included in the study if the following inclusion criteria were met: (28, 29)

1. The research was observational, prospective, retrospective, or randomized controlled trial (RCT).
2. The participants selected for study had hypokinetic dysarthria in Parkinson's disease.
3. Speech and language therapy was included in the study.
4. The study evaluated the effect of treatment of hypokinetic dysarthria in Parkinson's disease with speech and language therapy.

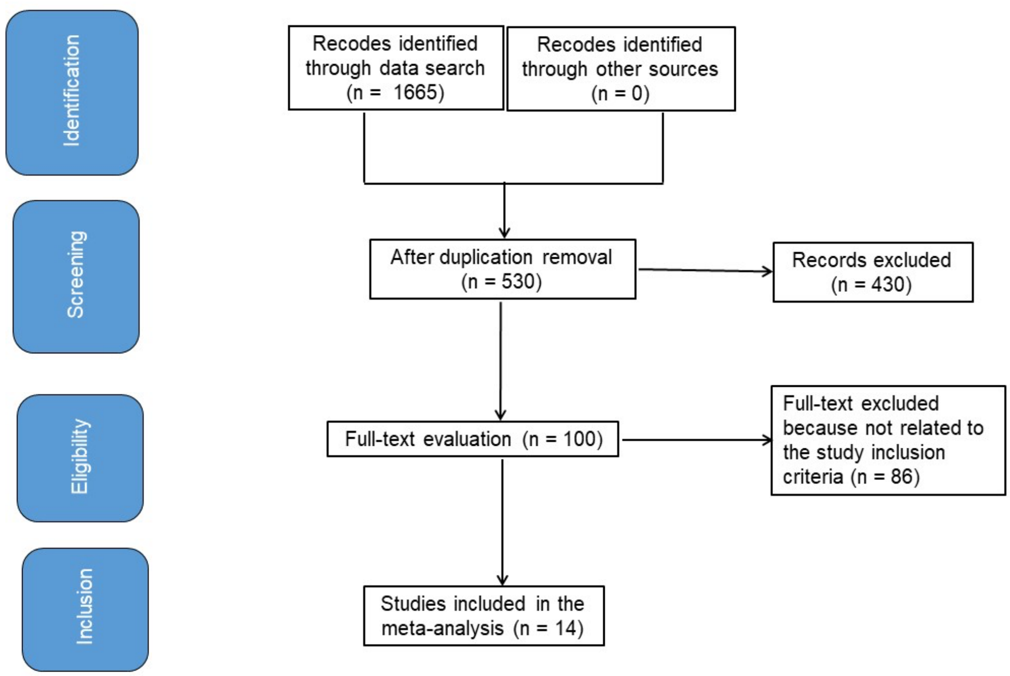

Fig. 1: The flowchart of the study selection process

Studies that did not evaluate the effectiveness of treatment of hypokinetic dysarthria in Parkinson's disease with speech and language therapy, studies on individuals with control treatment only, and studies with no comparison significance were also removed (30, 31).

Search strategy

The PICOS framework was used to identify a search protocol procedure, which I characterized as follows: the "population" contained individuals with hypokinetic dysarthria in Parkinson's disease;

speech and language therapy was the "intervention" and the "comparison" involved comparison between speech and language therapy and control treatment' variables; the "outcome" was the effect on variable parameters of sound pressure level; and the "research design" was unrestricted (32).
Using a set of keywords and other terms as shown in Table 1, I conducted a comprehensive search of the Cochrane Library, Google Scholar, Embase, PubMed, and OVID databases through October 2024 (33, 34). To prevent the inclusion of a study that was unable to establish a relationship between the effect of treatment of hypokinetic dysarthria in Parkinson's disease with speech and language therapy, the repetitions of papers were removed. The remaining studies were compiled into an EndNote file, and their abstracts and titles were re-evaluated (35, 36).

Table 1: Database Search Strategy for inclusion of examinations

Database	Search strategy
Google Scholar	#1 "hypokinetic dysarthria in Parkinson's disease" OR "phonation" #2 "reading" OR "monologue" OR "sound pressure level" OR "speech and language therapy" #3 #1 AND #2
Embase	#1 'hypokinetic dysarthria in Parkinson's disease' /exp OR 'phonation' /exp OR 'sound pressure level' #2 'reading'/exp OR 'monologue'/exp OR 'speech and language therapy' #3 #1 AND #2
Cochrane Library	#1 (hypokinetic dysarthria in Parkinson's disease):ti,ab,kw OR (phonation):ti,ab,kw OR (sound pressure level):ti,ab,kw (Word variations have been searched) #2 (reading):ti,ab,kw OR (monologue):ti,ab,kw OR (speech and language therapy):ti,ab,kw (Word variations have been searched) #3 #1 AND #2
Pubmed	#1 "hypokinetic dysarthria in Parkinson disease"[MeSH] OR "phonation"[MeSH] OR "sound pressure level" [All Fields] #2 "reading"[MeSH Terms] OR "monologue"[MeSH] OR "speech and language therapy"[All Fields] #3 #1 AND #2
OVID	#1 "hypokinetic dysarthria in Parkinson's disease"[All Fields] OR "phonation" [All Fields] OR "sound pressure level" [All Fields] #2 "reading"[All fields] OR "monologue"[All Fields] or "speech and language therapy"[All Fields] #3 #1 AND #2

Selection process
The procedure that followed the epidemiological proclamation was then arranged and was evaluated using the meta-analysis method (37, 38).

Data collection process
The first author's name, research data, publication year, country or location, population type, categories, quantitative and qualitative estimating methodologies, data sources, consequence estimation, medical and treatment physiognomies, and statistical analysis were some of the criteria used to collect data (39).

Data items
When a study reported multiple outcomes, I individually collected the data related to the effectiveness of treating of hypokinetic dysarthria in Parkinson's disease with speech and language therapy.

Research risk of bias assessment

The risk of bias in the research and the caliber of methods used in publications selected for further analysis were examined by the author. Each study's methodology was objectively reviewed by the author. The author appraised the methodology of selected studies to assess the potential for their bias. Technical quality was judged utilizing the "risk of bias tool" from Cochrane Handbook for Systematic Reviews of Interventions, Version 5. 1. 0. Upon classification of each study based on the assessment criteria, it was assigned one of the following bias risks: Studies were classified as having a low bias risk if all criteria were satisfied, and as having a moderate bias risk if one or more quality criteria were unmet. Studies were considered to have a high risk of bias if several quality criteria were met either partially or not at all.

Effect measures

Sensitivity analysis was restricted to studies that evaluated the effect of treatment of hypokinetic dysarthria in Parkinson's disease with speech and language therapy. A subgroup analysis was utilized to compare the relationship between speech and language therapy and control in diverse patients' variables in hypokinetic dysarthria in Parkinson's disease individuals' sensitivity.

Synthesis methods

The 95% CI, mean difference (MD), and odds ratio (OR) were calculated using a continuous and dichotomous approach and a random or fixed-effects model. To calculate the I^2 index, a range of 0 to 100% was employed. No, low, moderate, and high heterogeneity were seen at 0%, 25%, 50%, and 75% of the data, respectively (40). Additional structures that exhibit a high degree of resemblance with the relevant inquiry were also explored to ensure that the identical model was employed. If I^2 was less than 50%, the fixed-effects was chosen; if not, the random-effects was applied (40). By dividing the initial estimation into the predefined outcome groups, a subgroup analysis was carried out. The analysis used a *p*-value of less than 0. 05 to determine if differences between subgroups were statistically significant.

Reporting bias assessment

The Egger regression test and funnel plots, which show the logarithm of the ORs or MDs against their standard errors, were quantitative and qualitative methods used to assess bias in the studies. A *p*-value ≥0. 05 in Egger's test was interpreted as an absence of significant publication bias (41).

Certainty assessment

I used two-tailed testing to examine each p-value. Reviewer Manager (RevMan) Version 5. 3 (The Nordic Cochrane Centre, the Cochrane Collaboration, Copenhagen, Denmark) was used to construct the graphs and perform statistical analysis.

Results

Fourteen studies that met the inclusion criteria published between 1990 and 2024 were selected for the study from 1665 related studies (42-55). The results of these studies are presented in Table 2. There were 948 individuals with hypokinetic dysarthria in Parkinson's disease at the start of the investigations. The sample size of the selected studies ranged from 12 to 204 individuals.

Table 2: Characteristics of selected studies included in the meta-analysis

Study	Country	Total	Speech and language therapy	Control
Johnson, 1990(42)	UK	12	6	6
Ramig, 1995(43)	USA	45	26	19
Ramig, 1996(44)	USA	17	10	7
Ramig a, 2001(45)	USA	29	14	15
Ramig b, 2001(46)	USA	33	21	12
Halpern, 2012(47)	USA	16	8	8
Ramig, 2018(48)	USA	64	42	22
Sackley, 2018(49)	UK	72	44	28
Levy, 2020(50)	USA	38	19	19
Tamplin, 2020(51)	Australia	75	47	28
Schulz, 2021(52)	USA	77	58	19
Scobie, 2021(53)	UK	88	59	29
Maas, 2024(54)	Netherlands	178	92	86
Sackley, 2024(55)	UK	204	106	98
	Total	948	552	396

As illustrated in Fig. 2-6, in individuals with hypokinetic dysarthria in Parkinson's disease, speech and language therapy had significantly higher sound pressure level, phonation (MD, 7. 51; 95% CI, 3. 81-11. 20, p<0. 001) with high heterogeneity (I^2 = 94%), reading (MD, 8. 83; 95% CI, 4. 96-12. 69, p<0. 001) with high heterogeneity (I^2 = 93%), monologue (MD, 4. 28; 95% CI, 2. 47-6. 10, p<0. 001) with moderate heterogeneity (I^2 = 65%), and picture description (MD, 3. 64; 95% CI, 1. 78-5. 50, p<0. 001) with no heterogeneity (I^2 = 0%), and lower Voice Handicap Index (MD, -5. 61; 95% CI, -9. 05- -2. 17, p=0. 001) with no heterogeneity (I^2 = 0%) compared to control treatment.

The use of stratified models to assess the effects of specific factors was not possible due to the insufficient data, such as age, gender, severity, and ethnicity, on comparison outcomes. No evidence of study bias was found using the visual interpretation of the funnel plot and the quantitative Egger regression test (p = 0. 87). Nonetheless, it was demonstrated that the majority of the relevant RCTs had methodological limitations and that there was no bias in the selective reporting.

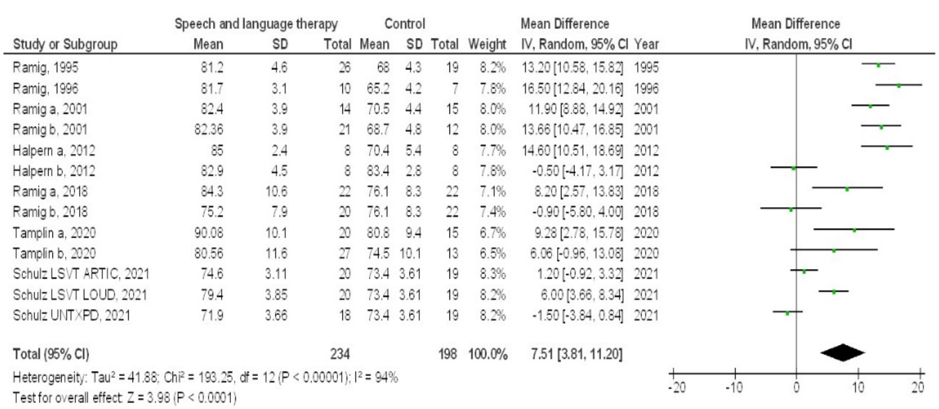

Fig. 2: Forest plot of speech and language therapy compared to control treatment on phonation in individuals with hypokinetic dysarthria in Parkinson's disease

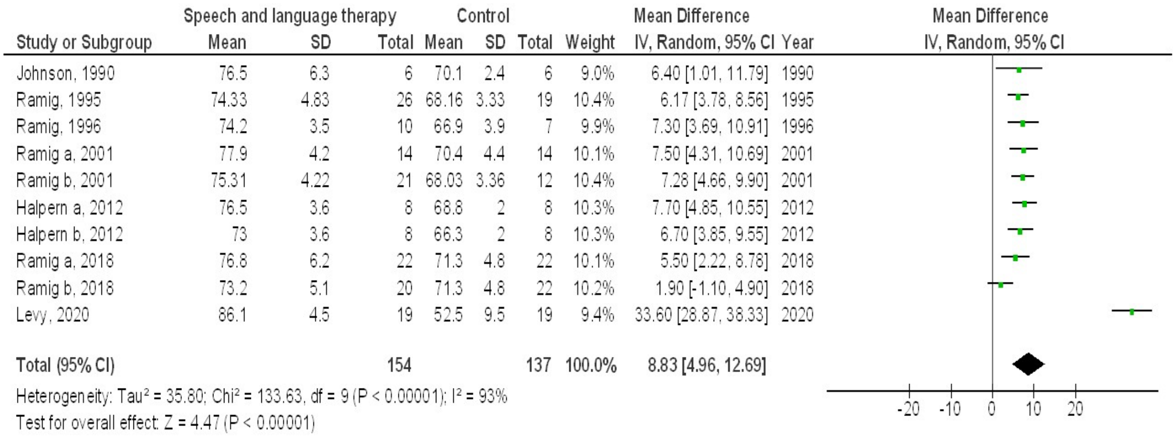

Fig. 3: Forest plot of speech and language therapy compared to the control treatment on reading in individuals with hypokinetic dysarthria in Parkinson's disease

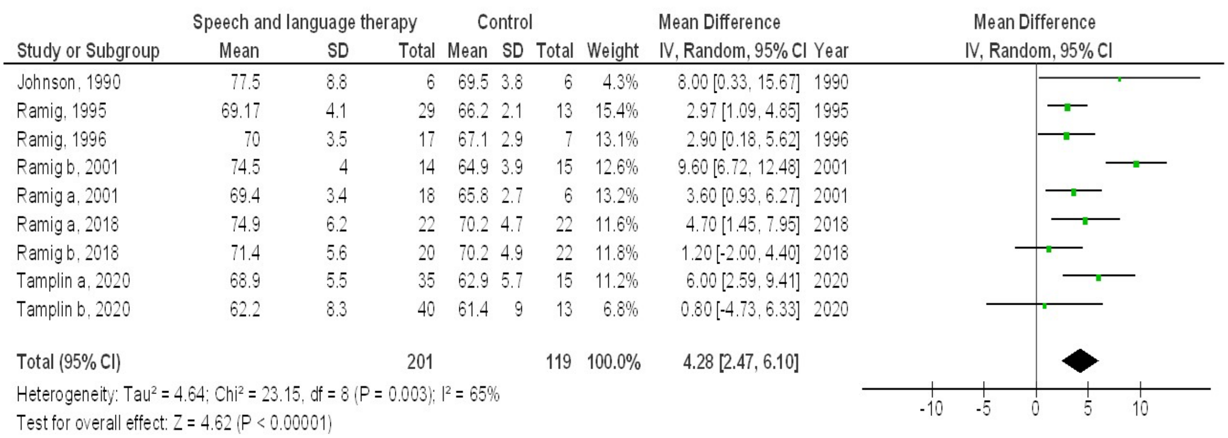

Fig. 4: Forest plot of speech and language therapy compared to control treatment on monologue in individuals with hypokinetic dysarthria in Parkinson's disease

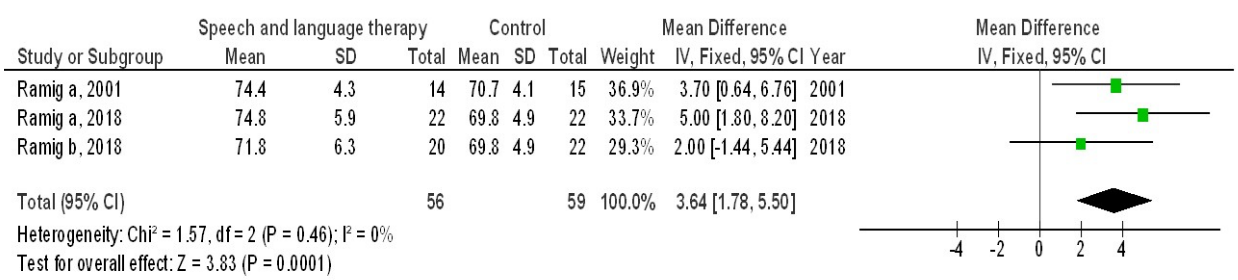

Fig. 5: Forest plot of speech and language therapy compared to the control treatment on picture description in individuals with hypokinetic dysarthria in Parkinson's disease

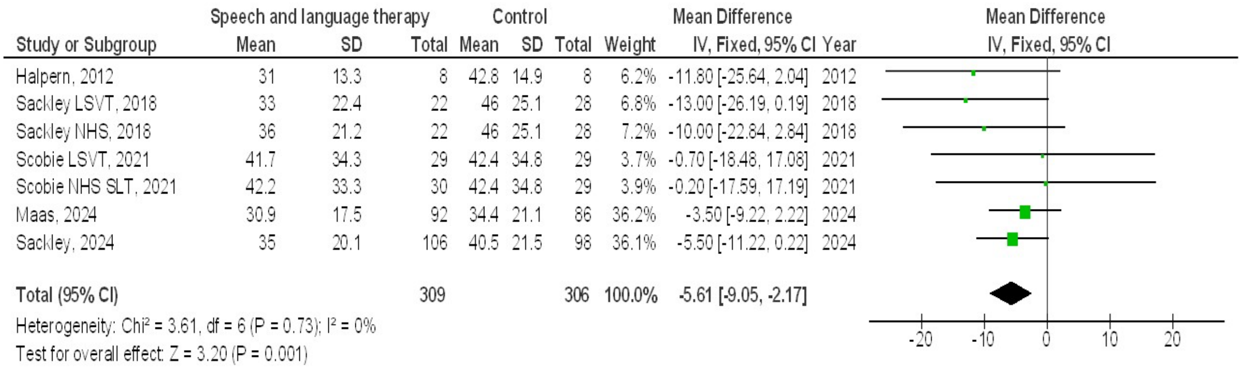

Fig. 6: Forest plot of speech and language therapy compared to control treatment on Voice Handicap Index in individuals with hypokinetic dysarthria in Parkinson's disease

Discussions

The studies included for the meta-analysis began with 948 individuals who had hypokinetic dysarthria in Parkinson's disease (42-55). In individuals with hypokinetic dysarthria in Parkinson's disease, speech and language therapy had significantly higher sound pressure level, phonation, reading, monologue, and picture description, and lower Voice Handicap Index compared to control treatment. More studies are needed to validate these findings, and caution is required when interpreting these results, since many comparisons had a limited number of selected studies. The significance of the reviewed assessments would be affected by that.

The Lee Silverman Voice Treatment program was the most popular speech and language therapy intervention, while respiratory training was the most often used control treatment. Comparatively speaking, speech and language therapy performed noticeably better across the board. This was maintained at various time points. Nevertheless, further investigation is required to ascertain the specific effects of speech and language therapy on various Parkinson's disease phenotypes (25, 26). Hypokinetic dysarthria is the primary cause of speech impairments. According to the findings of this systematic review, speech and language therapy may help with slurred speech, poor coordination, and hypophonia, among other symptoms of hypokinetic dysarthria. I did not find any impact on impaired muscle tone, though. This may be due to the insufficient data to examine the pooled effect. Other reviews that examined the results of comparing speech and language therapy to no treatment came to similar conclusions with limited data (26). The findings, however, demonstrated that speech and language therapy interventions do not incorporate the assessment of facial muscles into their designs when the analysis was conducted with consideration for the primary symptoms of hypokinetic dysarthria in Parkinsonians. Prior research, focused on the differential diagnosis of dysarthrias, have examined the significance of evaluating orofacial muscle tone (23, 24).

Assessing facial muscle tone in individuals with Parkinson's disease with hypokinetic dysarthria emphasizes the clinical value of normative data and standardized procedures (23, 24). My examination of the speech and language therapy interventions revealed that the suggested programs typically do not incorporate this element as a metric or component. These limitations result in conflicting results regarding the tone and activity of the facial muscles during speech and language therapy. The majority of reviewed studies demonstrated improvements that persisted at follow-up (25, 26). The duration of the follow-up varied from one month to two years. According to research on hypokinetic dysarthria in Parkinson's disease, it is necessary to monitor dysarthria symptoms to recomend treatments that target breathing, phonation, resonance, articulation, prosody, and facial muscles to address dysarthria symptoms. The results showed that speech and language therapy was superior to control treatments. The "Standard speech and language therapy intervention," which is not recognized as a tangible and structured intervention, is used in some studies (56, 57).

The standardized and reproducible intervention described by the Lee Silverman Voice Treatment enables the scientific validation of the evidence on speech and language therapy interventions for Parkinson's disease. Lee Silverman Voice Treatment Loudness and Lee Silverman Voice Treatment Articulation are the two approaches that are compared in the Dumer et al. study (58). It is challenging to compare them with other studies, though, because they do not assess voice volume or tone (26). The primary weakness of this study is that most interventions used the Lee Silverman Method as an intervention, with limited information provided regarding dosage, intensity, and treatment customization. Treatment times ranged from 45 to 240 minutes per session, session frequency ranged from 1 to 5 sessions per week, and the number of sessions ranged from 8 to 16 for various application modalities. Second, there was some variation in the outcome measures among the included studies. One of the included studies included tests to quantify upper airway characteristics, including the open quotient, maximum flow declination rate, estimated subglottal pressure, and electroglottographic signal pulse with adduction (43). None of the other reviewed articles made use of these measures. Consistent with these findings, a previous meta-analysis indicated a positive impact of speech and language therapy on addressing hypokinetic dysarthria in Parkinson’s disease, enhancing perceptual intelligibility, sound pressure level, and semitone standard deviation (59). To evaluate the impact of different types of speech and language treatment on more specific features affected by Parkinson's disease's hypokinetic dysarthria, further studies that evaluate these factors might be needed. Thirdly, these conclusions are influenced by notable variations in the outcomes of the meta-analysis. The number of included studies in the analysis conducted for each independent variable has been affected by the variability of results. Additionally, there are some clinical implications for rehabilitation practice from this meta-analysis. Speech and language therapy serves a variety of purposes in the treatment of hypokinetic dysarthria in individuals with Parkinson's disease. Speech and language therapy is considered a crucial component of a multidisciplinary treatment approach for increasing overall patient function, in addition to improving in dividual outcomes on standardized measurements. Specific speech parameters (sound pressure level, semitone standard deviation, and perceptual intelligibility) have been demonstrated by speech and language therapy. The therapy can have mid-term effects (3–6 months following intervention) when delivered every week using a personalized strategy. To determine the optimal timing and methods for speech and language therapy works best for treating hypokinetic dysarthria, future studies should focus on specific patient populations. Future studies should include large randomized controlled trials that provide precise protocols for speech and language therapy, including larger sample sizes, to strengthen the evidence supporting the benefits of this treatment.

The risk-of-bias evaluation indicated that the selected studies aimed to mitigate bias in the analytical outcomes. The studies were assessed as having a high risk of bias due to missing outcome data and selective reporting, indicating that these limitations must be addressed in future research. A key factor to the heightened likelihood of bias was the lack of blinding for participants during group allocation and assessment procedures. Initially, numerous research failed to disclose the specific methods employed in the randomization procedure. In many trials, allocation concealment and the blinding process were not feasible due to the inherent characteristics of the speech and language interventions; however, without effective blinding, the true effect of interventions cannot be accurately assessed. Furthermore, the implementation of a blinding assessment process, especially for subjective measures, proved not feasible in the majority of speech and language studies. The quality of life is inherently subjective based on an individual's evaluation. Outcome assessors may exhibit bias towards the experimental group, resulting in more positive evaluations that influence the results in support of the speech and language intervention. This bias may result in an overestimated treatment effect size. Future research should implement appropriate methodologies to minimize biases arising from randomization, blinding, selection, and measurement outcomes.

Limitations

There may be selection bias because some of the studies selected for the meta-analysis were excluded. However, the excluded studies failed to meet the requirements to be encompassed in the meta-analysis. Furthermore, insufficient data were available to assess the potential impact of age, severity, sex, and ethnicity on outcomes. The inclusion of incomplete or inaccurate data from past studies may have contributed to an increase in bias. In addition to their nutritional status, the participants' age, severity, gender, ethnicity, were potentially biased. Incomplete data and unpublished studies may result in unintentionally skewed results.

Conclusion

In individuals with hypokinetic dysarthria in Parkinson's disease, speech and language therapy had significantly higher sound pressure level, phonation, reading, monologue, and picture description, and lower Voice Handicap Index compared to control treatment. More research is needed to validate these findings, and caution is required when interpreting these results since many comparisons had a limited number of selected studies.

Journalism Ethics considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Conflict of Interest

The authors declare that there is no conflict of interests.

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