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The impact of music training on speech articulation among people with intellectual disability

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Abstract

Speech intelligibility plays a significant role in the effectiveness of overall communication. To gain a more comprehensive understanding, it is helpful to consider how a person is understood by a variety of different people. Various therapeutic interventions have been used to enhance speech and language outcomes, including performing art therapy, such as vocal music and instrumental music. This study compares the effectiveness of vocal music and instrumental music interventions in improving speech intelligibility among intellectually disabled adults.

The participants were divided into two groups based on the type of intervention: those who attended vocal music sessions and those who attended instrumental music sessions. Speech intelligibility was assessed using the Malayalam Articulation Test (MAT). It is a standardised tool for evaluating the articulation of Malayalam speech sounds. The assessment was conducted at two time points—prior to the intervention and after two years of regular participation in the respective sessions.

The intervention was structured to encourage rhythm, vocal expression, motor coordination (fine and Gross motor), pitch and tone, and interactive participation, based on the hypothesis that this may improve speech production and communication skills. Pre-and post-test scores obtained through MAT were analysed to determine changes in articulation and overall speech intelligibility in both groups. The study found the effectiveness of the intervention and helped compare which art-based intervention was more effective for enhancing speech outcomes.

Results showed that many of the students of the vocal music group had higher pre-MAT scores, mostly above 85. In the musical instruments group most of the participants had a baseline of less than 28. The study indicates that both music-based interventions (vocal, instrumental) showed improved speech intelligibility as measured by the MAT. Participants belonging to the vocal music group had the highest MAT score suggesting that vocal music is more effective at improving articulation. The instrumental music also helped the participants with significant improvement.

The study implies that both vocal and instrumental training can help the adults with intellectual disability improve in speech articulation.

Keywords: Speech intelligibility, intellectual disability, vocal music, instrumental music, speech articulation, Malayalam articulation test

Introduction

Intellectual disability is a condition in which the intellectual functioning level is well below average which makes it impossible for people to respond meaningfully to various social situations. Deficits in intellectual and adaptive functioning are the main characteristics of intellectual disability with a reported prevalence between 1% and 3% of the population with some regional variations (Dilip R. Patel *et al.*, 2020) ^[6]. By definition, the onset of intellectual and adaptive deficits has their onset during the developmental period from infancy through adolescence. The different parts of the brain control nearly every aspect of the human body ranging from physiological functions to cognitive abilities. Cognitive impairment can be caused by abnormalities in the functioning of the brain or structured defects. Intellectual disability is not the same for all of them. Therefore, their abilities may differ. The training programs will also vary according to these differences. The perspective on music was gradually replaced by a recognition that music interventions contribute positively to overall development in learners with ID (Brown & Jellison, 2012) ^[1] as well as their social and academic inclusion (Salvador, 2015) ^[8].

The music interventions seem effective on CB, anxiety, mood, self-esteem, management of emotions, cognitive measures, and QoL, it is worth noting that the type of music interventions used can vary widely, depending on the goal and the characteristics of the participant (Smeets *et al.*, 2024) ^[10].

Speech intelligibility can be defined as how clearly a person speaks so that his or her speech is comprehensible to a listener. Reduced speech intelligibility leads to misunderstanding, frustration, and loss of interest by communication partners. As a result, communication decreases or remains at a low level. Thus, to improve the quality of life of adults with ID, it is essential to enable them to make themselves understood. Impairment of speech production is among the most commonly reported difficulties in children, adolescents and adults with ID. The deficiencies are not resolved when growing up and speech intelligibility remains a problem throughout life. Yet, still little is known about the predictors of the reduced speech intelligibility in adults with ID.

Music is really good at helping people talk to each other better. The thing about music is that it has rhythm and melody and tempo and it keeps repeating. These things are a lot like the way we talk. Music has a rhythm that's like the rhythm of our voices. According to (Bruscia, 2014) ^[2] Music therapy is when a therapist uses music to help people reach their goals. These goals can be about thinking, feeling and talking to people. Music is good for people who have trouble learning because it uses a lot of senses. People can hear the music. Move their bodies to the beat. Music helps people learn. It also makes them feel things. This is why music is particularly good for people with disabilities (Després, Jean-Philippe *et al.*, 2024) ^[3].

Vocal music training is really good for people who want to improve their speech. When we sing we have to breathe and make sounds in a certain way. This helps our body and brain work when we talk. Singing is very helpful because it makes us pay attention to how we say things. Some people did a study where they used vocal techniques like beatboxing to help adults with intellectual disability. They found out that these people got a lot better at saying words clearly. This is because beatboxing makes people repeat sounds over which helps them get better at planning what they want to say and understanding the sounds they make. Vocal music training, like singing, is very good, for people who want to improve their speech. (Wan *et al.*, 2010) ^[12]

Instrumental music training helps with speech development in a way. It does this by improving how well people can tell sounds apart from their timing and how well they can move their bodies. When people play instruments they have to make sure what they hear and what they do with their hands or feet happen at the same time. This helps the brain get better at dealing with speech. Instrumental music training also involves rhythm and timing which can improve how well people can understand when things happen in time. This is important for saying words. Playing instruments can also make people pay more attention, be more motivated and participate more. This makes it easier for people with disabilities to learn. Instrumental music training is really good for speech development. (Van Telling *et al.*, 2023) ^[11]

Objective

The present study aimed to compare the vocal music and

instrumental music, Malayalam articulation performance using pre intervention and post intervention score.

Methodology

The study included 26 participants who were divided into two groups (vocal music, instrumental music). Malayalam Articulation Test MAT (Maya, & Savithri, 1990) ^[5] used for the assessment to evaluate the speech among the persons with intellectual disability. The baseline assessment was conducted two years prior. After baseline assessment, the participants attended continuous therapy over two years. After two years of therapy sessions the participants were reassessed using the same MAT protocol.

Table 1: Equal distribution of vocal and instrumental participants.

Group	Number of Participants
Vocal Music Participants	13
Instrumental Music Participants	13
Total	26

Statistical methods used the following statistical analysis carried out, descriptive statistics were used to find the mean score, standard deviation and gain scores. Paired sample t-test to compare pre and post intervention scores within each group. And finally an independent sample t-test is done to compare improvement (gain scores) between the two groups. The level of significance was fixed at $p < .05$.

Results

Table 2: Vocal Music Training Group

Variable	Mean	Standard Deviation
Pre-Intervention Score	89.61	9.05
Post-Intervention Score	98.92	2.66
Mean Improvement (Gain Score)	9.31	6.92

Table 3: Instrumental Music Training Group

Variable	Mean	Standard Deviation
Pre-Intervention Score	61.15	24.43
Post-Intervention Score	70.46	22.57
Mean Improvement (Gain Score)	9.31	6.46

A paired sample t-test was conducted to compare Malayalam articulation scores before and after Instrumental music training.

Table 4: Effectiveness of Instrumental Music Training

Comparison	t-value	df	P-value	Interpretation
Pre vs Post (Instrumental Group)	5.19	12	.0002	Significant

In the instrumental music training group the results shows, statistically significant improvement in Malayalam articulation following the intervention ($t = 5.19$, $p < .001$). The improvement shown, may be attributed to the enhanced auditory discrimination skills, rhythm synchronisation, improved timing and sequencing better auditory motor integration and increased attentional regulation. The finding indicates that instrumental music activities indirectly facilitates speech articulation and phonological processing.

A paired sample t-test was conducted to compare Malayalam articulation scores before and after vocal music training.

Table 5: Effectiveness of Vocal Music Training

Comparison	t-value	df	p-value	Interpretation
Pre vs Post (Vocal Group)	4.85	12	.0004	Significant

There is a statistically significant improvement in Malayalam articulation following the intervention among the vocal music training group ($t = 4.85$, $p < .001$). The increase in the articulation skill post intervention indicates that vocal music training contributes positively through articulation performance. The findings established that vocal exercises, rhythmic speech production, breath control, auditory feedback and melodic vocalization enhance phonological clarity and speech articulation. Both post score and pre score were compared to understand the gain score for determining which intervention was more effective, for both groups. then both groups were compared to using an independent sample t-test.

Table 6: Comparison between vocal and instrumental training

Comparison	t-value	p-value	Interpretation
Gain Comparison	Score 0.00	1.00	Not Significant

While comparing the Gain score there is no statistically significant difference between vocal music group and instrumental music group ($p = 1.00$). This shows that both the interventions were equally effective and neither vocal music training nor the instrumental music training has superiority over the other. Participants in both groups showed meaningful improvement in articulation. The data showed that the vocal music group had a higher baseline score before the intervention. The amount of improvement achieved after training was nearly identical in both groups. This shows that both forms of music intervention appear to be beneficial for enhancing articulation.

Discussion

It is known that music base interventions stimulate multiple neural systems involved in auditory processing, temporal sequencing, breath regulation, motor planning, rhythm perception, prosody and speech-motor coordination. The vocal music training have the capacity to facilitate the oromotor coordination, phonemic clarity, auditory self monitoring, vocal resonance and articulation precision. Research Studies highlight the neural plasticity and functional integration can be improved through music training which enhance the cortical and sub cortical networks. (Patel, 2011; Schlaug *et al.*, 2009) ^[7,9].

Instrumental training could have improved the capacity for auditory attention, bilateral coordination, timing and sequencing, sensory motor synchronisation and cognitive regulation supportive speech outcome. The above findings suggest that music intervention can be an effective adjunct for rehabilitation of speech.

When considering clinical and rehabilitation implications the present findings support the inclusion of vocal music intervention, instrumental rhythm training, and structured musical activities, in adjunct to conventional speech and language therapy and other neuro developmental interventions. This kind of approach may be particularly used for children with neuro developmental disorders, speech sound disorders, developmental language delays and motor speech difficulties.

Conclusion

The present study elucidates the effectiveness of both vocal music training and instrumental music training that significantly improved the Malayalam articulation skills. The study evidence that both vocal and instrumental interventions are equally beneficial for participants.

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