Assistive listening devices for Chinese children with dyslexia: abridged secondary publication

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KEY MESSAGES

1. In our study, most Chinese children with dyslexia have significant difficulties in speech-in-noise perception and Cantonese tone identification and have significant language impairment.
2. Using assistive listening devices in classrooms for one academic year may improve literacy and auditory processing abilities in Chinese children with dyslexia.
3. Provision of such devices to students with dyslexia in schools may be considered, similar to provision of frequency modulated systems to students with hearing impairment in schools.

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Introduction

Dyslexia is defined as difficulty of learning to read and write despite adequate intelligence and education and in the absence of sensory impairment and neurological damage. It affects 5% to 10% of school-age children.[1] Dyslexia can result in poor academic performance and psychological distress.[2] Up to 10% of students in Hong Kong fall within the diagnostic criteria for dyslexia.[3]

Evidence to support a special intervention approach for dyslexia is limited.[2] Auditory-processing deficits in the dyslexic population have prompted the use of auditory approaches for intervention. Assistive listening devices are a promising intervention or management strategy for dyslexic children with auditory-processing deficits.[4] Dyslexic Chinese children commonly manifest auditory processing deficits. Enhancement in auditory processing ability may positively affect speech perception and phonological awareness; such positive effects may improve reading and language abilities. We hypothesised that dyslexic Chinese children may benefit from the use of assistive listening devices (frequency modulated systems) in classrooms.

Methods

First to fourth grade children who were diagnosed with dyslexia by professional psychologists were invited to participate. After obtaining written informed consent, participants were randomly assigned to either the intervention-control group or the control-intervention group. The intervention-control group received real device fitting in the first study period, followed by sham device fitting in the second study period, whereas the control-intervention group received sham device fitting in the first study period, followed by real device fitting in the second study period. Both study periods lasted for 10 months (one academic year). The assistive listening device was fitted monaurally and monitored according to the American Speech-Language-Hearing Association guidelines.[5] Assessments were performed at The Education University of Hong Kong by research assistants under supervision of speech therapists, audiologists, and a psychologist. Assessors were blinded to the intervention. Participants were assessed before and immediately after each of the two study periods. Primary outcome measures included literacy abilities (measured by a set of literacy tasks) and neural representation of speech (measured by consistency of auditory brainstem responses to sound). Secondary outcome measures included speech and language abilities.

Statistical analysis was on an intention-to-treat basis. Between-group differences at baseline were assessed by Fisher's exact test or Chi squared test. Repeated measures analysis of variance (ANOVA) was conducted for each outcome measure to evaluate intervention efficacy with assistive listening devices. Post hoc analyses for within-subject effects (repeated measure: time) were conducted for outcomes with significant time × group interactions to identify the two successive time points on which a significant difference was found. Statistical significance was set at $P<0.05$. Bonferroni corrections were applied for multiple comparisons with repeated measures ANOVA.

Results

27 girls and 48 boys (mean age, 9.1 years) were randomly assigned to one of the two groups. The

two groups were comparable in terms of baseline demographics and outcome measures.

First study period

At baseline assessment, the control group scored significantly higher in nonword repetition (P=0.029) and nonsense word repetition (P=0.046) than the intervention group. Repeated measure of ANOVA demonstrated a significant interaction effect between time and group in syntactic skills (F=5.002, P=0.029), Cantonese tone perception (F=6.630, P=0.13), and phonological awareness (F=5.144, P=0.027). The intervention group showed significantly more improvement in syntactic skills (P=0.029) and Cantonese tone perception ability (P=0.013) than the control group, whereas the control group showed significantly more improvement in phonological awareness than the intervention group (P=0.27).

Second study period

At baseline assessment, the intervention group scored significantly better in speech perception in noise (P=0.033), textual comprehension (P=0.010), nonword repetition (P=0.003), and nonsense word repetition (P=0.004) than the control group. Repeated measure ANOVA revealed significant interaction effect between time and group in auditory brainstem response (ABR) consistency to the speech sound /da/ (F=5.550, P=0.023), phonological awareness (F=5.442, P=0.024), Hong Kong Cantonese grammar (F=5.508, P=0.023), and word definition (F=4.394, P=0.041). The intervention group showed significantly more improvement in ABR consistency to /da/ than the control group (P=0.023), whereas the control group showed significant more improvement in Hong Kong Cantonese grammar (P=0.023), word definition (P=0.041), and phonological awareness (P=0.24) than the intervention group.

Discussion

The improved literary performance (sentence reconstruction) and auditory processing ability (tone perception) after the use of assistive listening devices supported our hypothesis that dyslexic Chinese children may benefit from assistive listening devices in classrooms. The intervention group showed significantly higher ABR consistency to the speech sound /da/ in the second study period, but no significant improvement in ABR consistency to any speech sounds was observed in the first study period. This study does not provide strong evidence to support long-term frequency modulated systems usage to reduce the variability of subcortical responses to sound and to improve the neural representation of speech. As literacy achievement and auditory processing abilities were enhanced in the first study period, the enhancement in acoustic clarity and stability in auditory processing may play a more critical role.

Most children showed significant difficulties in speech-perception-in-noise and Cantonese tone perception, compared with normative data. Future research to explore whether such tasks can be used as screening tools for dyslexia in children is warranted.

Conclusion

Assistive listening devices could enhance literacy abilities and auditory processing abilities in Chinese children with dyslexia. Provision of such devices to students with dyslexia in schools may be considered, similar to provision of frequency modulated systems to students with hearing impairment in schools.

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