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Research Report**

**The Effects of Singing-Based Voice Training on
Vocal Functions and Quality of Life of Older People with Visual Impairments**

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The Effects of Singing-Based Voice Training on Vocal Functions and Quality of Life of Older People with Visual Impairments

Introduction

Population ageing is now and has been for years a pressing issue in Hong Kong, with the expected proportion of older people aged 65 or above surging from 20.5% in 2021 to 36% in 2046 (Census and Statistics Department, 2023). In 2020, based on the presenting visual acuity value using World Health Organisation's definition, 5.1% of Hong Kong's population has visual impairment, with the prevalence increasing significantly with older age (You et al., 2020).

27.7% of older people perceived themselves as having voice problems, such as hoarseness, reduced loudness, and effortful to talk (Wong & Ma, 2021). Voice problems among older people are attributed to atrophy of laryngeal muscles and reduced elasticity of vocal fold (Gregory et al., 2012), and it is believed that this is also a common issue in older people with visual impairment. The presence of voice problems adversely affects one's quality of life, leading to issues such as depression and social isolation (Wang et al., 2023; Wong & Ma, 2021). Therefore, it is crucial for speech-language pathologists (SLPs) to develop interventions to help older people with visual impairments attain a better voice quality, enhancing their quality of life.

Voice problems in older people are typically intervened using the Lee Silverman Voice Treatment (LSVT). Clients are asked to sustain and glide vowels to high and low frequencies, repeat functional phrases, and read single words, phrases, sentences, and conversational speech (Ramig et al., 2018). A review of the literature has proven LSVT effective in improving voice quality in older people, such as increased vocal loudness and increased intelligibility (Nakayama et al., 2020; Pu et al., 2021).

LSVT is a reliable framework for voice intervention in older people, and such a technique can complement singing-based voice training, an alternative voice intervention approach. In recent years, research surrounding the effectiveness of singing-based intervention in managing voice problems has proliferated. Singing is a complex physical activity consisting of longer phrases and wider pitch ranges than speaking, also constantly activating structures essential for voice production, such as larynx, tongue, lips, fascial and respiratory muscles (Pingel et al., 2022). Previous research has proven such intervention beneficial for alleviating voice problems, ranging from improving respiratory capacity and support to increasing pitch and voice intensity ranges, enhancing voice capabilities among individuals (Pingel et al., 2022; Siupsinskiene & Lycke, 2011; Tamplin, 2008; Yinger & Lapointe, 2012).

Past research on the implementation of singing-based training for voice management targeted populations such as people with dysarthria resulting from traumatic brain injury or stroke (Tamplin, 2008), older people with Parkinson's disease (Benedetto et al., 2009), or people with quadriplegia due to spinal cord injury (Tamplin et al., 2014), yet little focused exclusively on older people with visual impairment. Therefore, the purpose of this study was to explore the effectiveness of singing-based voice training as an intervention in improving 1) vocal functions, including maximum phonation time (MPT) and maximum phonational frequency range (MPFR), and 2) voice-related quality of life, including score in Aging Voice Index (AVI) and perceived phonatory effort rated using the OMNI-scale on older people with visual impairments. It was hypothesised that participants'

MPT and MPFR would increase, while the score in AVI and rating of OMNI-scale would decrease after receiving singing-based voice training.

Methods

Participants

Six older women with visual impairment aged between 66 and 91 years ($M = 81.33$, $SD = 10.84$) were recruited from the Kowloon Home for the Aged Blind under the Hong Kong Society for the Blind (HKSB). All participants were Cantonese native speakers. Older people with scores lower than 12 marks in the MOCA-VI assessment were excluded from the study due to the presence of moderate to severe cognitive impairment. Participants' demographic information is presented in *Table 1*.

Table 1

Participants' Demographic Information

Participant	Age	Gender
1	71 years	F
2	90 years	F
3	66 years	F
4	91 years	F
5	80 years	F
6	90 years	F

Procedures

This study utilised a one-group pretest-posttest design. Approval to conduct this study was obtained from the Faculty of Education Human Research Ethics Committee at The University of Hong Kong (FREC Reference number: EAU24077) and HKSB.

To assess changes in vocal functions and voice-related quality of life, participants were assessed at two timepoints at the Kowloon Home for the Aged Blind: 1) before the first training and 2) immediately after the last training. The student researcher first explained the nature of the study to the participants and obtained their informed consent. For both the pre-test and post-test data, participants were asked to complete the Chinese version of the AVI and indicate their perceived phonatory effort using the OMNI-Scale. After that, audio recordings was performed. Participants were asked to read aloud a Cantonese sentence, sustain the vowel /a/, and perform pitch glide of the vowel /a/ to low and high frequencies. Recordings were made using Audacity 3.6.1 with a AKG410 microphone connected to a MacBook Pro, with Focusrite Scarlett Solo external sound card connected.

Participants in this study attended eight 30-minute voice training sessions at the Kowloon Home for the Aged Blind, once to thrice weekly in four weeks, depending on the centre's and participants' availability. Cantonese song excerpts were practiced in each session, targeting the vocal mechanisms 'endurance' and 'coordination'. Examples of songs included 鮮花滿月樓, 分飛燕, 舊夢不須記, 月亮代表我的心, 上海灘, and 問我. Participants were asked to sing phrases in one breath, with phrase lengths adjusted depending on participants' MPT obtained in the pre-test assessment. Furthermore, as songs generally have wider pitch ranges than speech, participants also practiced pitch alteration when singing. Throughout the singing-based voice training, verbal instructions of the lyrics and audio tracks of the song excerpts were given to the participants as reminders.

Data Analysis

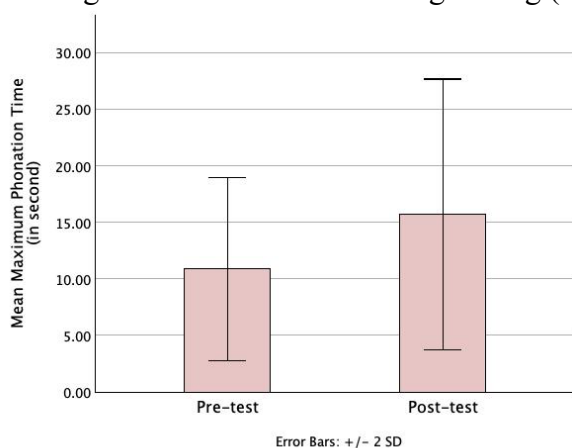
Voice recordings were analysed using the Praat software, which gave the participants' MPT, minimum frequency and maximum frequency. Participants' maximum phonational frequency range (MPFR) in semitone was calculated using an online calculator by inputting participants' minimum and maximum frequencies. Data of MPT, MPFR, score in AVI and rating on OMNI-Scale were input to an Excel file. All data was then analysed using the SPSS software.

Results and Discussion

The present study had a small sample size, data collected was thus not normally distributed. Therefore, 4 non-parametric related-samples t-tests were used to compare pre-test and post-test measures of MPT, MPFR, score in AVI, and rating on the OMNI-Scale.

Effects of Singing-Based Training on Vocal Functions

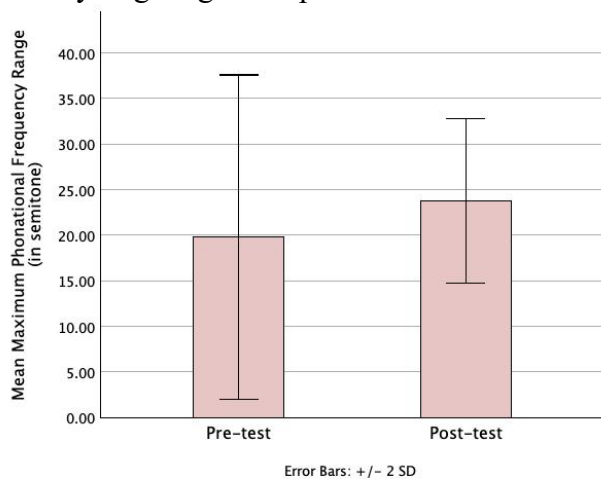
Maximum Phonation Time. The mean and standard deviation of participants' MPT are shown in *Figure 1*. Results indicated that participants' MPT was significantly higher after singing-based voice training ($M = 15.68$, $SD = 5.99$) than before training ($M = 10.88$, $SD = 4.05$), $W = 21.00$, $p = .028$, and represented a large-sized effect ($r = .64$). The result of participants' change in MPT was in line with the findings of Benedetto et al. (2009). This result is particularly important, as running out of air when talking is a common issue encountered by older people (Wong & Ma, 2021). Similarly in the current study, among the six participants, one chose 'Usually', and two chose 'Sometimes' in the statement 'My voice problem causes me to run out of air when I talk' in pre-test AVI measurement. Therefore, it is promising to know the effectiveness of singing-based voice training for improving MPT in older people with visual impairment. This helps older people improve their breath support and allows them to say longer phrases less effortfully using an intervention that is relaxing and self-confidence strengthening (Eidevall & Leufstadius, 2013).



	M	SD
Pre-test	10.88	4.05
Post-test	15.68	5.99

Figure 1. Comparison of mean maximum phonation time of participants

Maximum Phonational Frequency Range. The mean and standard deviation of participants' MPFR are shown in *Figure 2*. Results indicated that participants' MPFR was higher after singing-based voice training ($M = 23.75$, $SD = 4.50$) than before training ($M = 19.79$, $SD = 8.89$), yet the change was insignificant, $W = 15.00$, $p = .35$, and represented a small-sized effect ($r = .27$). This result was inconsistent with Siupsinskiene & Lycke (2011)'s study, which found an increase in participants' highest frequency and mean pitch range after singing training. One possible reason for the discrepancy is that the participants in Siupsinskiene & Lycke (2011)'s study were vocally healthy adults below the age of 45. Older participants in the present study, in contrast to those below 45, had reduced elasticity in vocal fold muscles, hence limiting their increase in MPFR (Ptacek et al., 1966). Furthermore, the insignificant change may also be attributed to the lack of components directly targeting the expansion of MPFR during singing-based voice training in the present study.



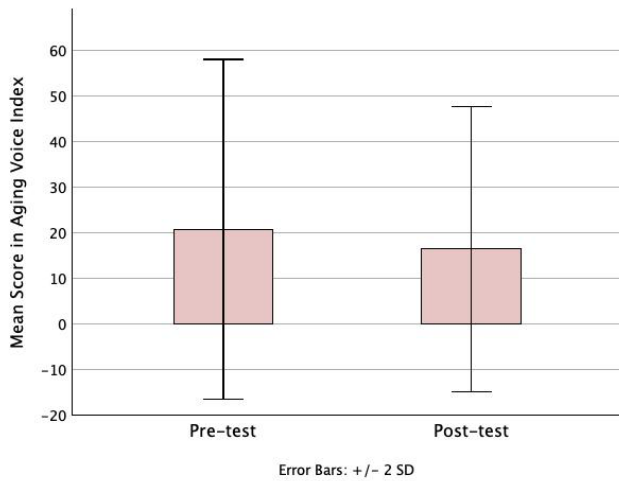
	M	SD
Pre-test	19.79	8.89
Post-test	23.75	4.50

Figure 2. Comparison of mean maximum phonational frequency range of participants

Effects of Singing-Based Training on Voice-Related Quality of Life

Ageing Voice Index. Participants' pre-test and post-test scores in AVI were analysed to investigate the effect of voice on participant's quality of life. The total score of AVI is 92, and a score of 12 or above suggests that voice impacts one's quality of life (Liao et al., 2023), and higher scores reflect more negative impact.

The mean and standard deviation of participants' scores in AVI are shown in *Figure 3*. Results indicated that participants' scores in AVI decreased after singing-based voice training ($M = 16.33$, $SD = 15.62$) than before training ($M = 20.67$, $SD = 18.62$), yet the change was insignificant, $W = 4.00$, $p = .35$, and represented a small-sized effect ($r = .27$). The decrease in total score suggested that singing-based voice training reduced the impact of voice on participant's quality of life, such as feeling less hindered because of their voice and feeling more satisfied with the way their voice sounded (Etter et al., 2019), yet only to a small extent. This is not surprising as participants' pre-test mean AVI score of 16.33 was only marginally above the cut-off score of 12, suggesting that participants perceived their voice as having minimal negative impact on their quality of life. Therefore, a significant decrease in scores after singing-based voice training may not be seen.

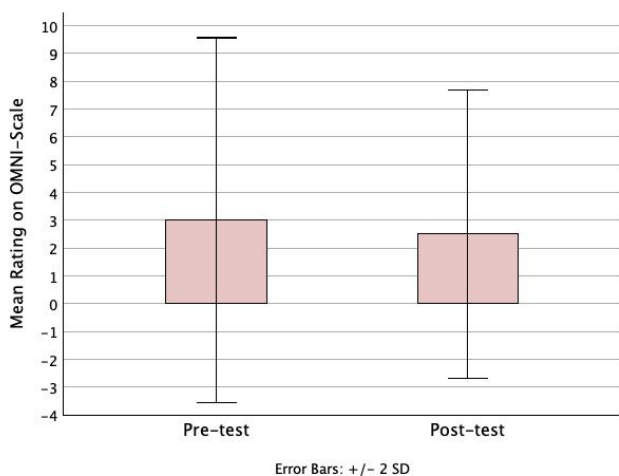


M **SD**

Pre-test	20.67	18.62
Post-test	16.33	15.62

Figure 3. Comparison of mean score in Aging Voice Index of participants

Perceived Phonatory Effort. Finally, ratings of the OMNI-Scale were analysed to determine participants' perceived phonatory effort. The OMNI-Scale ranges from 0-10, and participants were asked to choose a score from the scale, with a higher score indicating that phonation is more effortful. The mean and standard deviation of participants' ratings on the OMNI-Scale are shown in *Figure 4*. Results indicated that participants' rating of OMNI-Scale was lower after singing-based voice training (M = 2.50, SD = 2.59) than before training (M = 3.00, SD = 3.29), yet the change was insignificant, $W = 2.50$, $p = .79$, and represented a very small effect ($r = .079$). Similar to the case of AVI, participants did not perceive themselves as requiring much effort when speaking before singing-based voice training, thus participants' perceived phonatory effort may not be significantly reduced after the training.



M **SD**

Pre-test	3.00	3.29
Post-test	2.50	2.59

Figure 4. Comparison of mean rating on OMNI-Scale of participants

Conclusions, Limitations, and Future Research

The findings provide valuable insights into the effect of singing-based voice training on older people with visual impairment, recognising the effectiveness of singing-based voice training as a potential intervention strategy in the field of speech-language pathology, especially for enhancing clients' breath support with increased MPT.

To maximise participants' improvement in MPFR, future studies may consider choosing songs with richer melody lines that have bigger alterations in pitch, directly targeting the expansion of MPFR and potentially contributing to a more significant increase in MPFR among participants. In addition, the present study was conducted within a small sample size. Having similar research with larger samples is needed to ensure the generalizability of outcomes measured in the current study. Finally, the sustainability of the changes in vocal functions and quality of life in participants in the present study was not investigated. Follow-up measures are important in future studies to ensure the sustainability of outcomes.

It is hoped that further research related to singing-based voice training can be conducted so that it can be effectively used in voice interventions in the future, improving the vocal functions and quality of life in older people with visual impairments as a result.

Reflections

Conducting research on the topic of voice intervention this summer was valuable for me as an undergraduate student majoring in speech and hearing sciences. I not only gained research experience but also practiced my clinical skills which are important for becoming a future SLP. In the aspect of research, I treasure the experience of conducting voice assessments with participants before and after singing-based training. I learnt about different voice assessments, such as the questionnaires AVI and OMNI-scale, as well as parameters commonly measured in voice research, such as MPT and MPFR. The most arduous task was to elicit participants' MPFR, as some participants were unable to perform pitch gliding to low or high notes even after I provided a few times of demonstrations. This may be due to participants' inability to discriminate between different pitches. I thus solved this issue by singing two notes with different pitches and asking participants to choose the one with a higher pitch, then asking participants to do the same, aiming to increase their awareness of notes with different pitches. Participants performed pitch glide once again after that and most had better performance in controlling their voice and singing high and low notes.

Alongside research experience, I developed my clinical skills as well. I am glad that I can gain hands-on experience in conducting singing-based voice training for older people. As the participants in my research have visual impairments, written lyrics could not be used. In the first few training sessions, I was unfamiliar with ways to assist participants when singing. I solely reminded them of the lyrics one time before starting, yet participants were confused as they could not remember the lyrics of the second line after singing the first. I then noticed the inadequacy of my cues, thus started reminding them of the lyrics before each sentence. Participants then mastered the song excerpt much better, and I could then proceed with adding elements of training their MPT. I also trained my flexibility from the experience. Although I had prepared a list of song excerpts, those may still be inapplicable to some of the participants. For instance, one participant was older in age and was mostly familiar with Cantonese opera. Another participant mainly listened to songs in Mandarin. Facing these situations,

I learnt to adjust the content of the training sessions flexibly and allow them to choose songs that they were familiar with, thus maximising their participation and performance in the sessions. These clinical skills gained are valuable for me as I will start my clinical practicum this academic year. I will apply the strategies learnt and continue to improve my clinical skills so that I can be a more competent SLP in the future.

Overall, from doing background research and brainstorming my research methodology to doing voice assessments and conducting singing-based voice training, my knowledge of voice and its interventions as well as my clinical skills expanded. I believe this is useful for bridging me to my upcoming academic year, as I will be attending the course on voice and its disorders and having my clinical practicum. I also hope that further research related to voice interventions can be conducted so that SLPs can be more confident in treating voice disorders in the future using new intervention strategies such as singing-based training, improving our client's quality of life as a result.

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