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The Effect of hydration and vocal rest on vocal quality and function
after Karaoke singing among people

Chan Mei Mei, Rainy

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(Speech and Hearing Sciences), The University of Hong Kong, May 10, 2000
ABSTRACT

Karaoke singing is a popular entertainment among young people. It is not uncommon for Karaoke singers to experience vocal fatigue after Karaoke singing. Ten male and ten female subjects who reported experienced vocal fatigue after singing were selected to participate in a Karaoke singing task. Half of them were given hydration and vocal rest during singing and the other half of them were not given any water or rest. The amount of singing time before the subjects reported vocal fatigue was compared. Voice recordings were taken before, during and after the singing for acoustic and perceptual analyses. Phonetogram analysis was also carried out to analyse the vocal function. The results revealed subjects with hydration and vocal rests were able to sing significant longer before reporting vocal fatigue. Subjects with vocal rests and hydration also demonstrated better vocal quality and vocal function for a longer period of time.

Key words: Karaoke singing-vocal fatigue-vocal quality-vocal function-hydration-vocal rest-acoustic measure-perceptual measure-phonetogram measure
The Effect of hydration and vocal rest on vocal quality and function after Karaoke singing among young people

INTRODUCTION

Karaoke singing is a popular entertainment for young people in South East Asia, especially in Hong Kong. It is a singing activity with the provision of background music, and video with captions of the songs shown on screen. This system, which consists of television, Karaoke music video and amplifier, is called the Karaoke system. People sing through a microphone with the background music and the captions shown on screen. The Karaoke system mixes the voice and music and with special effects, such as echo, through the output of an amplifier.

It is common for people to sing continuously for more than three to four hours each time they go to Karaoke singing. They have to sing against a loud background music. It has been demonstrated that continuous use of the voice in a wide range of pitch and high intensity level may lead to the development of dysphonia (Stone and Sharf, 1973). These often happen in Karaoke singing. Other environmental conditions at Karaoke singing, such as holding conversation against the noisy background when they are waiting for their turns of singing, smoking, and consumption of alcohol may worsen the condition.

Most people sung at Karaoke are amateur singers. Not many of them received formal training in singing. Without training to sing in a proper way, these amateurs may be more susceptible to developing voice problems after intensive use. Gelfer, Andrew and Schmidt (1991) found that after 1 hour loud reading, trained singers had little effects on their voice while untrained singers demonstrated poorer voice quality. Akerlund, Gramming and Sundberg (1992) compared the vocal function between female singers and non-singers using phonetogram using sound pressure levels and fundamental frequencies. They found singers demonstrated a wider frequency range and
required less strain on their voices but, for untrained Karaoke singers, they may strain their voices in singing. Such behaviours may cause them to face higher risk of developing voice problems. Therefore, it is not uncommon for Karaoke singers to complain of vocal fatigue afterwards.

Although vocal fatigue is a term used by many investigators in previous research reports to describe the vocal condition after prolonged use, the term itself may have different meanings. It is generally taken to mean tiredness of voice (Sander and Ripich, 1983; Stemple, Stanley and Lee, 1995) and had been used to describe the feeling of actors and actresses after theatre performance (Novak, Dlouha, Capkova and Vohradnik, 1991). Singers often relate vocal fatigue to changes in the ability to project or to sustain voice, the power of voice, the pitch and loudness range, the hoarseness level, the effort to push voice, and a general vocal constriction (Kitch and Oates, 1994). Subjects sometimes reported the feeling of laryngeal aching, throat fullness or thickness, neck tightness, and pharyngeal/laryngeal dryness following talking after two hours of reading (Stemple et. al, 1995). In summary, vocal fatigue refers to vocal tiredness after prolonged voice use and require more effort to continue speaking (Eustace, Stemple and Lee, 1996). It is characterized by changes in vocal quality, loudness, pitch, or effort of voice production and feeling of laryngeal discomfort (Gotaas and Starr, 1993).

**Definition of vocal fatigue in this study**

The term “vocal fatigue” in this study was defined to the subjects as the feeling of changes in ability to project or to sustain voice, or the changes on pitch and loudness range, or the feeling of any kinds of throat discomfort such as pain or dryness.

**Possible causes of vocal fatigue**

Vocal fatigue is considered as a result of voice misuse or overuse such as use of an unhabitual voice quality (Stone & Sharf, 1973), laryngeal strain, abnormal pitched and intensity
phonation (Sander & Ripich, 1983), loud reading for more than an hour (Gelfer, Andrews & Schmidt, 1991), or two hours (Stemple, et al, 1995). It has been shown that vocal fatigue is also associated with a high level of anxiety (Gotass, et.al. 1993), sometimes a change in weather, lack of sleep, and an increase in physical activity (Long, Williford, Olson and Wolfe, 1998).

Quantitative and qualitative measurements of vocal fatigue

It was expected vocal quality, that was the characteristics of voice, and vocal function, that was the performance laryngeal muscle during voice protection would be changed during vocal fatigue. Different quantitative and qualitative measurements for their changes following prolonged voice use and during fatigue had been reported. These measurements included acoustic, aerodynamic, videostroboscopic, vocal dynamic, perceptual analyses as well as subjects’ self-report.

Acoustic analysis. Changes in fundamental frequency in sustained vowel phonation and during reading had been reported after prolonged voice use (Novak, Dlouha, Capkova, and Vohradnik, 1991; Gelfer et. al, 1991; & Stemple et. al, 1995). Stemple et. al, 1995 found that there was a significant increase in fundamental frequency and decreased in jitter percent in connected speech after experimentally induced vocal fatigue in untrained speakers. In another study, jitter ratio was found to have increase in untrained subjects and decrease in singers, in addition to the decreased signal-to-noise ratio in both groups (Gelfer et. al, 1991) after an-hour loud reading. Novak et. al, (1991) studied the voice changes using acoustic method on a group of well-trained theatre performers after their performances. The result showed that there were non-significant changes in the fundamental frequency, increased in men and decreased in women. These results suggested that there were changes in acoustic parameters during vocal fatigue.

Aerodynamic analysis. Stemple et. al (1995) found there were no significant differences in increase in phonation volume, flow rate and maximum phonation time in subjects’ phonation at
comfortable pitch following prolonged reading. Eustace et. al, 1996 compared the aerodynamic parameters of subjects after prolonged voice use with the normative data concluded from several previous research studies. Eustace et. al, 1996 found that the means of maximum phonation time for all subjects after prolonged voice use were significantly lower than the normative data, and the flow volume were within normal limits. According to the result of these studies, they used aerodynamic analyses differently, however, there were few significant changes on the parameters at the moment of vocal fatigue. It was suggested that aerodynamic analysis might not be a good measurement to chase vocal function changes from time to time in this study.

_Videostroboscopic analysis._ When videostroboscopic examination was used, anterior glottal chink (Stemple et. al, 1995; Eustace et. al. 1996), abnormal spindle-shaped closure and abnormal posterior chink (Eustace et. al. 1996) were noticed in subjects who complained of vocal fatigue.

_Photetogram analysis._ Phonetogram, or "voice range profile" (VRP) measures the fundamental frequency range in hertz (Hz) and the loudness range in decibels (dB) (McAllister, Sederholm, Sundberg, and Gramming, 1994). The total area of the phonetogram displays the sound pressure level of the softest and loudest phonation in Y-axis throughout the fundamental frequency range in X-axis. As suggested by McAllister, et. al (1994), lower contour of Y-axis reflected the vocal folds' vibration at low driving pressures which was the softest phonation; and the upper contour reflected the muscular capacity of vocal fold to cope with high pressure which was the loudest phonation. The changes in voice range profile, as measured by the fundamental frequency range and loudness range reflect the changes in vocal function. According to the study of time-of-day effect on VRP performance in ten 18 to 35 year-old, vocally untrained and healthy female by Van Mersbergen, Verdolilin and Ingo (1999), there was no significant difference in VRP
performance between morning and evening. This suggested that phonetogram analysis was stable regardless of time.

*Perceptual voice changes.* Human voices are perceptual. Perceptual voice analyses were used in many studies to evaluate voice changes. The voices of teachers who complained of vocal fatigue showed more breathiness and strain (Gotaas et al, 1993). Some researchers may query the reliability of perceptual voice analyses. In Gotaas et al, 1993, the mean intra-rater reliability for the eight listeners was 0.74. And, in McAllister, et al, 1994, the mean inter-rater reliability and intra-rater reliability coefficients for the parameters in perceptual voice evaluation by seven listeners were 0.805 and 0.81 respectively. Although the reliability was not high, it was acceptable and perceptual analysis was still important in voice evaluation in this study.

*Subjects' self-perception of their vocal quality and function during vocal fatigue.* Vocal fatigue highly depended on self-feeling. According to Kitch & Oates, 1994, actors and singers reported to have increased feeling of soreness and pain level at their throat when they experiencing vocal fatigue. They also felt that they required greater amount of energy to push their voice out. Ninety percent of actors reported their pitch range and loudness range were restricted.

*Other findings*

Some studies had shown that vocal rest (keep silence) and hydration (drink water) improve voice quality. Chan (1994) studied the efficacy of vocal hygiene education and the suggestions included “hydration” and “pause more often during speaking” among kindergarten teachers. The subjects demonstrated improvement in voice quality after using these suggestions. Solomon and DiMattia (1999) suggested that prolonged loud reading caused changes in the vibrating characteristics of the vocal folds, the phonation threshold pressure (PTP), and these changes can be delayed by drinking water in three of the four untrained speakers. And as PTP increased after
loud reading for 2 hours, after having 15 minutes vocal silence, PTP returned to baseline level. They suggested that hydration and voice rest reduced the negative changes in vocal fold vibration.

Limitations of previous study

For the studies on changes during vocal fatigue, they induced vocal fatigue experimentally by asking the subjects to read aloud for one (Gelfer, et al., 1991) or two hours (Stemple, et al., 1995). However, no one confirmed vocal fatigue occurred sharply at either one or two hours of vocal use. At the moment of the measurement, they were possibly before or already after the feeling of vocal fatigue, and so they changes revealed were not accurate enough.

And, for vocal hygiene suggestions, Chan (1994) had not studied the effects of particular vocal hygiene suggestions systematically, the use of suggestions was not controlled and ensured by the researcher. In addition, in Solomon et al., 1999, vocal silence was used to return PTP to baseline level after vocal use, this suggested vocal silence could relieve vocal fatigue, however, this finding did not help voice protection as vocal fatigue already occurred.

Objectives of this study

For the untrained Karaoke singers, it may be unrealistic for all of them to receive formal voice training. So, in this study, it tried to determine some useful suggestions for untrained singers for their voice protection. It tried to find out the approximated amount of time people could sing before the feeling of vocal fatigue occurred and whether vocal rest and hydration could delay the feeling of vocal fatigue and reduce the negative changes.

The objectives of this study were 1) to determine the amount of singing that would lead to the feeling of vocal fatigue and changes in vocal quality and function in untrained amateur singers, 2) to determine whether frequent brief vocal rests and hydration between songs would alternate the vocal quality and function change according different voice parameters.
The hypothesis of this study was that there would be vocal quality and function changes during vocal fatigue, but, a combination of vocal rest and hydration during continuous Karaoke singing would reduce the negative effect of prolonged voice use on vocal quality and function changes. And, several types of measurements would be done to chase the subtle changes before and during the subjects’ self-report of feelings of vocal fatigue.

According to the findings in the previous studies and the reliability of the measurements, the measurements that reported to have significant changes and reliable were selected for this study. So, among the measurement for different voice parameters, acoustic analysis, phonetogram analysis, perceptual voice evaluation and self-perception of vocal fatigue were used in this study for the measurement of vocal quality and function changes after Karaoke singing.

METHODS

Pilot study

Subjects

Twenty five males and 25 females aged between 20 to 25 with the mean of 21.76 (male, \( x = 21.8, S.D. = 1.26 \) and female, \( x = 21.72, S.D. = 0.94 \)) were recruited from the Mongkok district.

Procedures

Subjects recruited were asked to fill in a nine-items long questionnaire (See Appendix 1) to ascertain the subjects’ participation in Karaoke singing. The questions covered information on the frequency and duration of their Karaoke singing, the perception of their voice quality, the frequency of vocal fatigue, the duration and effect of vocal fatigue on their lives, and their knowledge of vocal hygiene.
Main Study

Subjects

The ten male and ten female subjects involved in the main study were age ranged from 20 to 23 with a mean of 21.5 and standard deviation of 0.85 for both gender group. For the occupation, 70% of subjects were students, 10% of them were engineers, 15% of them were clerks and 5% of them was merchandiser. They reported having normal vocal quality, required to talk occasionally in daily work and experienced vocal fatigue after singing at karaoke in the pilot study were invited to participate in the main study. All the subjects:

1. Were non-professional singers.
2. Participated in regular Karaoke singing for at least two days a week.
3. Had no formal voice or singing training.
4. Had no chronic medical problems.
5. Had no history of voice problems.
6. Had no respiratory diseases.
7. Were not on regular medication which may affect voice.
8. Had no respiratory tract infection on the day of assessment.
10. Were not alcohol drinkers.
11. Were determined by the author to have normal voice on the day of assessment.

In addition, if the subjects were female, they

12. were not menstruating at the time of the study;
13. were not taking contraceptive pills.
Procedures

*Karaoke Singing Task.* Each subject was asked to sing in a room with another subject. A Video Compact Disc (VCD) player with Karaoke function (Panasonic SL-VP35) was used to provide the background music and echo effect. Male and female subjects were given songs with different tunes that suit the pitch range of a male or female voice. The songs were presented in the same sequence for each gender group, and the volume of background music and echo effect were controlled similarly across all subjects. They were required to sing continuously until they reported they had the feeling of vocal fatigue and could not sing anymore.

There were two experimental conditions. One condition involved hydration and voice rest while the other did not. All subjects were randomly assigned to one of the two condition, with ten in each condition. In the hydration with voice rest (HR) condition, the subjects (five males and five females) were asked to take a one-minute vocal rest and drink 100ml of water after singing every song (HR group). In the second condition, subjects were not given voice rest nor hydration during singing (non-HR group).

*Voice Recordings for acoustic and perceptual analysis.* Recordings were carried out before singing (Time 1), after singing ten songs (Time 2), after singing another five songs (Time 3), and finally after finished singing (Time 4). The recordings included production of /a/ and a phrase /pa₁ pa₂ ta₂ pɔ₂/ (Father hits the ball) at the subjects' most comfortable pitch and loudness level. The subjects' were asked to keep the distance between the mouth and the microphone at 10cm measured by a ruler. Both the sustained vowel and the phrase were recorded twice. The better one which was agreed by both the experimenter and the subject was used for subsequent acoustic and perceptual voice analysis.
Phonetogram analysis. Phonetogram recordings were also carried out. This required each subject to produce low and high pitches at different loudness level (Huang, Lin and Brien, 1998). A hand-band type microphone was used with the microphone-to-mouth distance kept at 10cm, and the subjects were asked not to move the microphone during the data collection process. The male subjects first produced the vowel /a/ at C (131Hz) following a generated tone; while the female subjects produced the vowel /a/ at C1 (262Hz). The subjects produced the pitch first at their comfortable loudness level, then reduced the loudness to the lowest level. The subjects then increased the pitch through the musical scales until the highest pitch level was reached. They then started from the initial tone again and decreased the pitch until they reached the lowest pitch. The recording procedures repeated again, with the vowel produced first at comfortable loudness level and then increased to the highest level. The limits of these loudness and pitch levels produced could indicate the vocal range information.

Data Analysis

Total amount of singing time. During the subjects’ self-perception of vocal fatigue, the total amount of time was measured by the total number of songs they sung and the total length of the songs. The length of each songs were recorded by the timer of the VCD player.

Acoustic analysis. Kay’s Computerised Speech Lab (CSL) was used to extract the values of average fundamental frequency, absolute jitter, jitter percent, and shimmer in dB, shimmer percent and noise to harmonic ratio on the vowel of /a/ and the phrase /pa1 pa1 ta2 po1/.

Phonetogram analysis. Tiger Electronic’s Dr. Speech Phonetogram was used to measure the voice range profile.
Perceptual analysis. For perceptual voice evaluation, three final year speech pathology students with three hour of perceptual voice evaluation training were recruited as listeners to rate the roughness and breathiness of the production of the phrase /pa1 pa1 ta2 po3/ using a computer-based visual analogue scale. Roughness and breathiness of phonation were evaluated since these two vocal quality parameters were commonly used in perceptual voice evaluation and as descriptions of vocal quality. A written definition of the term “roughness” and “breathiness” were given to the listeners (Table 1). Reference natural voice samples representing just noticeable and severe roughness and breathiness were given as anchors to assist the listeners to rate the voice samples. The listeners were allowed to listen to each voice sample and anchor for as many times as they liked.

Table 1 The definitions of “roughness” and “breathiness” adapted in this study for perceptual voice analysis.

<table>
<thead>
<tr>
<th>Vocal quality parameter</th>
<th>Definition in this study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roughness</td>
<td>Audible irregular or uneven quality, lack of clarity or hoarseness</td>
</tr>
<tr>
<td>Breathiness</td>
<td>Audible air emission, sound of expiration or friction noise during phonation</td>
</tr>
</tbody>
</table>

After listening to the voice samples, they were required to drag the pointers of two unmarked 10cm scroll bars with the right boundary labelled as severe roughness or breathiness. One-fifth of the samples were repeated and included in the presentation for assessing the intra-rater reliability. All the voice samples, with a total 96 (four samples for each of the 20 subjects together with 16 repeated samples for intra-rater reliability test) were presented in a random order to the listeners. The inter-rater reliability was calculated between the three listeners. The ratings
made by the scroll bars were measured to the nearest 1/10 mm. The ratings given by the three
listeners were averaged for each voice sample for the final data analysis.

Statistical analysis

Two-independent sample test, Mann-Whitney test was used to analyse the difference on
the amount of singing time between two subject groups. For inter-rater reliability and intra-rater
reliability for perceptual voice evaluation, bivariate correlation test, the Pearson test was used.
Non-parametric Friedman tests were used to analyse the vocal quality and function changes for
each voice parameter in acoustic, phonetogram and perceptual voice evaluation over time. Post-
hoc two-related sample Wilcoxon signed ranks tests were used to analyse the difference between
any two measurement times if significant difference was found in using Friedman tests.

RESULTS

Pilot study

Seventy percent of subjects questioned were students, and the rest were clerk (12%),
engineer (8%), insurance agent (6%), and merchandiser (4%). Among the subjects, 90% of them
reported they sometimes required talking for daily work. And, 80% of subjects described their
daily voice quality were normal.

Ninety percent of subjects reported they sang for at least once per week and 76% of
subjects sang for four to five hours each time. Eighty-four percent of subjects reported have
experience of vocal fatigue after singing at Karaoke and 85.71% of subjects reported the
occurrence of such experience was quiet often. After singing, 70% of subjects described their
voice quality as “hoarse”. Eighty percent of subjects reported they took one day or more for their
voice to return to normal. Most of the subjects reported experienced vocal fatigue found that the presence of vocal fatigue affect their daily communication (90.48%).

For the voice protection methods, 90% of subjects suggested honey drinks and 86% of subjects suggested throat candy would be useful, and 6% of subjects reported they did not know any methods to protect voice (Table 2).

<table>
<thead>
<tr>
<th>Voice protection methods (can suggest more than one)</th>
<th>Percentage(%)</th>
<th>No. Of subjects (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Honey drinks</td>
<td>90</td>
<td>45</td>
</tr>
<tr>
<td>Throat candy</td>
<td>86</td>
<td>43</td>
</tr>
<tr>
<td>Choose songs which are appropriate for own ability</td>
<td>44</td>
<td>22</td>
</tr>
<tr>
<td>Reduce the frequency of Karaoke singing</td>
<td>16</td>
<td>8</td>
</tr>
<tr>
<td>Reduce the loudness of voice during singing</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Don’t know</td>
<td>6</td>
<td>3</td>
</tr>
</tbody>
</table>

**Main Study**

**Amount of singing done before the feeling of vocal fatigue**

For the HR group and the non-HR group, the mean duration of singing done before the subjects' self-report of vocal fatigue were 101.93 minutes, ranged from 96.47 to 105.47 (standard deviation 3.66) and 85.48 minutes, ranged from 78.02 to 92.40 (standard deviation 4.62) respectively.

The amount of singing was statistically significant different between the two groups (Mann-Whitney $U= 0$, $Z= -3.79$, $p< 0.001$).
Acoustic analysis

For the sustained vowel production /a/, there were no significant changes for both HR group and non-HR group before, during and after singing (p>0.05).

Table 3 presented group means for the production of the phrase /pa1 pa1 ta2 pa2/ for HR group and non-HR group for each gender, Chi-square ($x^2$) and significance level (p) of changes across time. There were significant changes in acoustic parameter in both HR group and non-HR group.

**HR group.** The reduction in absolute jitter in HR group was statistically significant across time by Friedman Test ($x^2 = 10.20, p = 0.017$). It was statistically significant in male ($x^2 = 9.24, p = 0.026$) but not in female ($x^2 = 2.28, p = 0.52$). When the absolute jitter in each measurement time slot was compared by using Wilcoxon Signed Ranks Test, there were significant difference in absolute jitter value between Time 1 and Time 4 ($Z = -2.4, p = 0.017$) and Time 2 and Time 4 ($Z = -2.29, p = 0.022$). For male subjects, the differences were significant from Time 1 to Time 4 ($Z = -2.02, p = 0.043$), from Time 2 to Time 4 ($Z = -2.02, p = 0.043$) and from Time 3 to Time 4 ($Z = -2.02, p = 0.043$). Besides, there were also non-significant increase in fundamental frequency, jitter percent, shimmer in dB, shimmer percent and noise-to-harmonic ratio (p>0.05).

**Non-HR group** There was significant increased and then decreased back in percent jitter in male subjects ($x^2 = 9.24, p = 0.026$). By using Wilcoxon Signed Ranks Test, the increase between Time 1 and Time 2 ($Z = -2.02, p = 0.043$), decreased between Time 2 and Time 3 ($Z = -2.02, p = 0.043$), and Time 2 and Time 4 ($Z = -2.02, p = 0.043$) were statistically significant. There was non-significant increased in percent jitter in female subjects (p>0.05). There were some non-significant changes in other acoustic measures including increase and decrease in fundamental frequency, increased in absolute jitter, and decrease in absolute jitter, shimmer percent and noise-to-harmonic ratio.
Table 3. Means of the acoustic measures of /pa1 pa1 ta2 pɔ1/ for groups under the two singing conditions for each gender, Chi-square ($\chi^2$) and significance level ($p$) of changes across singing time (n=5).

<table>
<thead>
<tr>
<th>Time</th>
<th>Male HR group</th>
<th>Female HR group</th>
<th>Male non-HR group</th>
<th>Female non-HR group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>131.03</td>
<td>240.42</td>
<td>133.57</td>
<td>242.59</td>
</tr>
<tr>
<td>Mean absolute jitter (us)</td>
<td>3.00</td>
<td>3.24</td>
<td>2.52</td>
<td>4.20</td>
</tr>
<tr>
<td>Mean percent jitter (%)</td>
<td>0.39</td>
<td>0.36</td>
<td>0.47</td>
<td>0.24</td>
</tr>
<tr>
<td>Mean shimmer (dB)</td>
<td>160.47*</td>
<td>127.10</td>
<td>110.38</td>
<td>98.72</td>
</tr>
<tr>
<td>Mean percent shimmer (%)</td>
<td>0.026</td>
<td>0.017</td>
<td>0.32</td>
<td>0.56</td>
</tr>
<tr>
<td>Mean Shimmer (dB)</td>
<td>2.07</td>
<td>3.00</td>
<td>1.38*</td>
<td>2.32</td>
</tr>
<tr>
<td>Mean percent Shimmer (%)</td>
<td>1.74</td>
<td>2.75</td>
<td>2.08*</td>
<td>2.19</td>
</tr>
<tr>
<td>Mean Noise-to-Harmonic Ratio</td>
<td>1.86</td>
<td>2.96</td>
<td>1.38*</td>
<td>2.49</td>
</tr>
<tr>
<td>Noise-to-Harmonic Ratio</td>
<td>1.76</td>
<td>2.28</td>
<td>1.38*</td>
<td>2.43</td>
</tr>
<tr>
<td>Noise-to-Harmonic Ratio</td>
<td>1.56</td>
<td>2.28</td>
<td>9.24</td>
<td>1.56</td>
</tr>
<tr>
<td>Noise-to-Harmonic Ratio</td>
<td>0.67</td>
<td>0.52</td>
<td>0.026</td>
<td>0.67</td>
</tr>
<tr>
<td>Noise-to-Harmonic Ratio</td>
<td>4.44</td>
<td>0.6</td>
<td>2.04</td>
<td>1.65</td>
</tr>
<tr>
<td>Noise-to-Harmonic Ratio</td>
<td>0.22</td>
<td>0.90</td>
<td>0.56</td>
<td>0.65</td>
</tr>
<tr>
<td>Noise-to-Harmonic Ratio</td>
<td>7.60</td>
<td>6.10</td>
<td>6.93</td>
<td>5.73</td>
</tr>
<tr>
<td>Noise-to-Harmonic Ratio</td>
<td>8.12</td>
<td>6.71</td>
<td>6.21</td>
<td>5.59</td>
</tr>
<tr>
<td>Noise-to-Harmonic Ratio</td>
<td>6.64</td>
<td>6.21</td>
<td>5.68</td>
<td>5.29</td>
</tr>
<tr>
<td>Noise-to-Harmonic Ratio</td>
<td>6.74</td>
<td>5.68</td>
<td>5.25</td>
<td>5.30</td>
</tr>
<tr>
<td>Noise-to-Harmonic Ratio</td>
<td>7.32</td>
<td>1.32</td>
<td>1.08</td>
<td>2.28</td>
</tr>
<tr>
<td>Noise-to-Harmonic Ratio</td>
<td>0.06</td>
<td>0.72</td>
<td>0.78</td>
<td>0.52</td>
</tr>
<tr>
<td>Noise-to-Harmonic Ratio</td>
<td>0.31</td>
<td>0.32</td>
<td>0.25</td>
<td>0.32</td>
</tr>
<tr>
<td>Noise-to-Harmonic Ratio</td>
<td>0.27</td>
<td>0.28</td>
<td>0.28</td>
<td>0.26</td>
</tr>
<tr>
<td>Noise-to-Harmonic Ratio</td>
<td>0.24</td>
<td>0.24</td>
<td>0.21</td>
<td>0.26</td>
</tr>
<tr>
<td>Noise-to-Harmonic Ratio</td>
<td>3.96</td>
<td>7.08</td>
<td>6.12</td>
<td>0.31</td>
</tr>
<tr>
<td>Noise-to-Harmonic Ratio</td>
<td>0.27</td>
<td>0.07</td>
<td>0.11</td>
<td>0.96</td>
</tr>
</tbody>
</table>

a. Recording time: Time 1 = pre-singing; Time 2 = after singing 10 songs; Time 3 = after singing 15 songs; Time 4 = the subjects’ self-report of vocal fatigue, after singing all songs.

b. Singing conditions for each group: HR group = hydration and vocal rest group (with one-minute vocal rest and 100ml water between every song); non-HR group = non-hydration and vocal rest group

c. Significant changes across time within group were indicated by an asterisk (*), significant increase were indicated by red colour and significant decreases were indicated by blue colour.
Perceptual voice evaluation

Table 4 presented group means of perceptual measures for HR group and non-HR group for each gender, Chi-square ($\chi^2$) and significance level ($p$) of changes across time.

**HR group.** There were non-significant increases in both breathiness and roughness after singing ten to fifteen songs (Time 2 and Time 3). After the singing (Time 4), the ratings of breathiness and roughness dropped non-significantly to more or less the same as those in Time 1 ($p> 0.05$).

**Non-HR group.** There were significant increases in breathiness ($\chi^2= 9.24$, $p= 0.026$). The increases in breathiness were significant from Time 1 to Time 4 ($Z= -2.02$, $p= 0.044$) and from Time 3 to Time 4 ($Z= - 2.55$, $p= 0.011$). However, the increases were not significant in either gender group separately, and, there were no significant increases in roughness in both gender groups ($p> 0.05$).

Table 4. Means of the perceptual measures /pa, pa, ta, pə/ for groups under the two singing conditions for each gender, Chi-square ($\chi^2$) and significance level ($p$) of changes across singing time ($n=5$).

<table>
<thead>
<tr>
<th>Time</th>
<th>Male HR group</th>
<th>Female HR group</th>
<th>Male non-HR group</th>
<th>Female non-HR group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Breathiness 1</td>
<td>0.23</td>
<td>0.70</td>
<td>0.26</td>
<td>0.56</td>
</tr>
<tr>
<td>2</td>
<td>0.46</td>
<td>1.31</td>
<td>0.27</td>
<td>0.49</td>
</tr>
<tr>
<td>3</td>
<td>0.27</td>
<td>1.47</td>
<td>0.15</td>
<td>0.51</td>
</tr>
<tr>
<td>4</td>
<td>0.24</td>
<td>0.75</td>
<td>0.49</td>
<td>1.03</td>
</tr>
<tr>
<td>$\chi^2$</td>
<td>0.47</td>
<td>4.92</td>
<td></td>
<td>9.24</td>
</tr>
<tr>
<td>$p$</td>
<td>0.93</td>
<td>0.18</td>
<td></td>
<td>0.026</td>
</tr>
<tr>
<td>Mean Roughness 1</td>
<td>1.21</td>
<td>0.94</td>
<td>1.35</td>
<td>0.73</td>
</tr>
<tr>
<td>2</td>
<td>1.44</td>
<td>1.87</td>
<td>1.32</td>
<td>0.56</td>
</tr>
<tr>
<td>3</td>
<td>1.28</td>
<td>1.76</td>
<td>1.58</td>
<td>0.81</td>
</tr>
<tr>
<td>4</td>
<td>0.96</td>
<td>1.02</td>
<td>1.90</td>
<td>1.15</td>
</tr>
<tr>
<td>$\chi^2$</td>
<td>7.16</td>
<td>0.43</td>
<td>7.08</td>
<td>0.6</td>
</tr>
<tr>
<td>$p$</td>
<td>0.07</td>
<td>0.93</td>
<td>0.07</td>
<td>0.90</td>
</tr>
</tbody>
</table>

a. Recording time: Time 1= pre-singing; Time 2= after singing 10 songs; Time 3= after singing 15 songs; Time 4= the subjects’ self-report of vocal fatigue, after singing all songs.
b. Singing conditions for each group: HR group = hydration and vocal rest group (with one-minute vocal rest and 100ml water between every song); non-HR group = non-hydration and vocal rest group
c. Significant increase were indicated by red colour.
Rater Reliability

*Intra-rater reliability.* Pearson Correlation Test revealed Pearson’s $r$ for intra-rater reliability of the listeners for male and female voice recordings was 0.823 and 0.894 respectively and were statistically significant ($p< 0.001$).

*Inter-rater reliability.* Mean Pearson’s $r$ for inter-rater reliability among the three listeners for male and female voice recordings was 0.75 and 0.85 respectively and were statistically significant ($p< 0.001$). And, the ratings from each listener were defined as agreed if the difference between each two values were ranged from $-1$ to 1. The agreement between listeners for male and female voice recordings was 0.86 and 0.82 respectively.

Phonetogram analysis

Table 5 presented group means of phonetogram measures for HR group and non-HR group for each gender, Chi-square ($\chi^2$) and significance level ($p$) of changes across time. Some changes were significant in both HR-group and non-HR group.

*HR group.* Friedman Test revealed that there was statistically significant change in total area in HR group over time during Karaoke singing ($\chi^2 = 7.20$, $p = 0.027$). The values were decreased in Time 2 and then increased back to more or less the same as those in Time 1. By Wilcoxon Signed Ranks Test, there was significant increase from Time 2 to Time 3 ($Z = -2.8$, $p = 0.005$), but, the reduction from Time 1 to Time 2 was not significant ($p > 0.05$). The were also non-significant increase in fundamental frequency range, maximum fundamental frequency and maximum loudness in male subjects ($p > 0.05$).
Table 5. Means of the phonetogram measures for groups under the two singing conditions for each gender, Chi-square ($\chi^2$) and significance level (p) of changes across singing time (n=5).

<table>
<thead>
<tr>
<th>Time</th>
<th>Male HR group</th>
<th>Female HR group</th>
<th>Male non-HR group</th>
<th>Female non-HR group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>657.60</td>
<td>834.60</td>
<td>873.40</td>
<td>710.40*</td>
</tr>
<tr>
<td></td>
<td>Fundamental frequency</td>
<td>664.20</td>
<td>669.60</td>
<td>849.80</td>
</tr>
<tr>
<td>2</td>
<td>3.90</td>
<td>0.40</td>
<td>8.90</td>
<td>8.40</td>
</tr>
<tr>
<td>3</td>
<td>879.20</td>
<td>723.80</td>
<td>741.60</td>
<td>508.60*</td>
</tr>
<tr>
<td>$\chi^2$</td>
<td>0.14</td>
<td>0.82</td>
<td>0.012</td>
<td>0.015</td>
</tr>
<tr>
<td>$\mu$</td>
<td>45.84</td>
<td>42.92</td>
<td>45.60</td>
<td>41.04</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>116.54</td>
<td>114.06</td>
<td>119.56</td>
<td>113.38</td>
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<td>118.58</td>
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<td>114.20</td>
<td>119.28</td>
<td>111.34</td>
</tr>
<tr>
<td>$\chi^2$</td>
<td>0.20</td>
<td>0.95</td>
<td>0.35</td>
<td>0.047</td>
</tr>
<tr>
<td>$\mu$</td>
<td>62.00</td>
<td>117.20</td>
<td>72.80</td>
<td>117.96</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>65.20</td>
<td>122.80</td>
<td>57.00</td>
<td>114.16</td>
</tr>
<tr>
<td>2</td>
<td>68.00</td>
<td>109.80</td>
<td>60.40</td>
<td>145.80</td>
</tr>
<tr>
<td>3</td>
<td>0.93</td>
<td>0.40</td>
<td>2.36</td>
<td>5.16</td>
</tr>
<tr>
<td>$\chi^2$</td>
<td>0.63</td>
<td>0.82</td>
<td>0.31</td>
<td>0.08</td>
</tr>
<tr>
<td>$\mu$</td>
<td>70.70</td>
<td>71.22</td>
<td>73.94</td>
<td>72.26</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>75.14</td>
<td>73.40</td>
<td>75.46</td>
<td>71.32</td>
</tr>
<tr>
<td>2</td>
<td>71.94</td>
<td>71.94</td>
<td>75.78</td>
<td>75.64</td>
</tr>
<tr>
<td>3</td>
<td>2.80</td>
<td>0.40</td>
<td>0.32</td>
<td>5.20</td>
</tr>
<tr>
<td>$\chi^2$</td>
<td>0.25</td>
<td>0.82</td>
<td>0.85</td>
<td>0.07</td>
</tr>
<tr>
<td>$\mu$</td>
<td>676.08</td>
<td>687.34</td>
<td>701.60</td>
<td>637.82*</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>491.16</td>
<td>590.34</td>
<td>556.00</td>
<td>559.24*</td>
</tr>
<tr>
<td>2</td>
<td>691.26</td>
<td>683.04</td>
<td>498.64</td>
<td>414.06*</td>
</tr>
<tr>
<td>3</td>
<td>7.20</td>
<td>12.20</td>
<td>7.60</td>
<td></td>
</tr>
<tr>
<td>$\chi^2$</td>
<td>0.027</td>
<td></td>
<td>0.020</td>
<td>0.022</td>
</tr>
<tr>
<td>$\mu$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. Recording time: Time 1= pre-singing; Time 2= after singing 10 songs; Time 3= the subjects' self-report of vocal fatigue, after singing all songs.

b. Singing conditions for each group: HR group = hydration and vocal rest group (with one-minute vocal rest and 100ml water between every song); non-HR group = non-hydration and vocal rest group

c. Significant changes across time within group were indicated by an asterisk (*), significant increase were indicated by red colour and significant decreases were indicated by blue colour.
Non-HR group. The decreases in fundamental frequency range ($\chi^2 = 8.9$, $p = 0.012$) and total area ($\chi^2 = 12.2$, $p = 0.02$) were statistically significant by Friedman Test. For fundamental frequency range, there was significant decrease from Time 1 to Time 3 ($Z = -2.09$, $p = 0.037$). And, the changes in fundamental frequency were significant in female subjects rather than in male subjects ($\chi^2 = 8.4$, $p = 0.015$), across time, the changes were significant from Time 1 to Time 2, and from Time 1 to Time 3 ($Z = -2.02$, $p = 0.043$). And, for total area, the significant decreases were occurred from Time 1 to Time 3 ($Z = -2.6$, $p = -0.009$) and from Time 2 to Time 3 ($Z = -2.8$, $p = 0.005$). Again, the changes in total area were significant in female subjects rather than in male subjects ($\chi^2 = 7.6$, $p = 0.022$) from Time 1 to Time 3, and from Time 2 to Time 3 ($Z = -2.02$, $p = 0.043$). There was also significant decrease in maximum fundamental frequency ($\chi^2 = 6.13$, $p = 0.047$) in female subjects.

DISCUSSION

Karaoke singing among young people in Hong Kong

According to the result revealed from the pilot study, it was found Karaoke singing was an important entertainment among young people aged from 20 to 25 in Hong Kong. The special promotion prices given by the Karaoke lounges and frequently updating of popular songs were attractive for young people. The frequent participation (one or more times a week and sung for two to five hours each time) in Karaoke singing would lead them to higher risk in voice problem. People always complaint to have feeling of throat sore or dry throat during singing. If people continued singing after the feeling of vocal fatigue, this would lead to a risk of vocal damage.
After Karaoke singing, 84% of subjects experienced the feeling of vocal fatigue, and, the impacts of vocal fatigue on daily life were not small. Eighty-eight percent of subjects reported that vocal fatigue occurred after Karaoke singing affect their daily communication.

Vocal protection knowledge

The subjects' knowledge on voice protection was fair. Ninety percent of them suggested intake of honey drinks may nourish their throats and improve their voice, and, this suggestion was traditional and typical among Chinese people. However, its effectiveness was still unknown. Honey drinks may be good as a kind of hydration to relief the feeling of throat dryness. But, the thickness and the concentration of honey drinks may irritate the throat even more. Again, 86% of subjects suggested throat candy may be useful for improving their throat discomfort although the effectiveness was unconfirmed. Fortunately, there were still some good suggestions on voice protection by the subjects. For example, to choose suitable songs for their own-selves, and, to reduce the frequency of Karaoke singing and the loudness of voice during singing were good for voice protection.

According to the frequent participation in Karaoke singing and experience of vocal fatigue afterward among young people, and their fair voice protection knowledge, education on proper voice use and voice protection for the public is important.

Main Study

This study allowed us to draw some conclusions and a number of trends on the vocal quality and function changes during vocal fatigue and the effects of frequent brief hydration and vocal rest on such changes, and so, we can suggest people to do them for voice protection.
Amount of singing before vocal fatigue

The first objective of this study was to determine the amount of singing that would lead to the feeling of vocal fatigue and changes in vocal quality and function in untrained amateur singers.

The result of this study suggested frequent brief hydration and vocal rest were useful in delaying the occurrence of vocal fatigue during Karaoke singing in vocal untrained subjects. HR group subjects were able to sing significantly longer than those in non-HR group, with a mean 101.93 and 85.48 minutes respectively. However, even with frequent vocal rest and hydration, the longest time they able to sing was only 105.47 minutes. It was suggested that untrained Karaoke singers may face the feeling of vocal fatigue after this amount of prolonged singing.

In addition, in this study, the background environment manipulated was already better than that in rooms of Karaoke lounge. It took place in a highly sound-proofed room with appropriate loudness of background music, microphones and echo effect, non-smoky air condition, and, the subjects were not given alcoholic drinks and nuts. So, under real Karaoke lounge, people may face vocal fatigue after Karaoke singing even earlier than what revealed in this study, so, it was suggested people should limit the amount of singing within this amount of time or less.

Vocal quality and function changes during and after vocal use

The second objective was to determine whether frequent brief vocal rests and hydration between songs would alternate the vocal quality and function changes during and after vocal use. The result revealed significant differences in the changes between HR and non-HR group.

Hydration and vocal rest group (HR group)

In HR group, there were significant positive changes in vocal performance after singing.
**Acoustic measures**

This study revealed that HR group demonstrated significant reduction in absolute jitter in their connected speech during the time of vocal fatigue. For the rest of acoustic voice parameters, there were no significant changes. Gelfer et al. (1991) and Stemple et al. (1995) also revealed decreased jitter ratio and jitter percent respectively in their studies on subjects with vocal fatigue. The decreases in absolute jitter suggested improvement in vocal performance.

**Phonetogram measures**

There were significant increases in the total area of vocal range in phonetogram analysis from Time 2 to Time 3. There was reduction in total area at Time 2, but the significant increases in total area of vocal range at Time 3 and returned to more or less the same as Time 1. This suggested adaptation in vocal functions. There was also non-significant increases in fundamental frequency range, in male subjects. Similarly, there was non-significant increases in fundamental frequency range found in subjects during vocal fatigue in Stemple et al., 1995.

**Vocal warm up effect in HR group**

The improvement or adaptation in vocal performance revealed in both acoustic and phonetogram analysis was possibly as the result of vocal warm-up. This phenomenon was suggested as normal and was used to explain the improvement in vocal performance after voice use (Van Mersbergen et al. 1999 and Rantala and Vilkman, 1999). They suggested that vocal warm-up was the adaptation of the vocal apparatus, and so, vocal and physical changes took place. During warm-up, blood perfusion to muscles increased, and so increased the nutrient deposition to muscles used. So, the activation potential of the muscle increased, then the muscle mobility and control would also increase and so to the vocal performance. This was just like what happened during long-run, you may feel stress on your leg muscles firstly, after that, your
performance improved as increased rate of blood flow and nutrient transportation to the activated muscles. And, so you would be able to continue running after you had warm-up.

For the increases in fundamental frequency range, this can be explained by Greene's speculation on the role of thyroarytenoid muscle (TA muscle) in vocal function. Generally, it was suggested that TA muscle aided in vocal fold adduction, lowering, shortening and thickening. Warm-up of TA muscle and cricothyroid muscles can lead to an increase in control of vocal fold vibration and so to fundamental frequency and the fundamental frequency range.

Non-Hydration and vocal rest group (non-HR group)

In non-HR group, there were significant negative changes in vocal performance after singing.

**Acoustic measures**

For acoustic analysis of connective speech, in male subjects, there were significant increase in percent jitter after singing ten songs (Time 2), then, decreased significantly back to original after singing five more songs (Time 3) and after the singing task (Time 4). The significant increase in percent jitter suggested decreases in vocal quality and performance. The significant decrease in percent jitter back to original suggested adaptation occurred.

**Phonetogram measures**

There was significant decrease in subjects' fundamental frequency range and total area of vocal range in phonetogram analysis. And, in female subjects, there was also reduction in maximum fundamental frequency. Reduction in all these parameters indicated decreased vocal performance.

**Perceptual measures**

For the perceptual analysis, there was significant increase in breathiness in non-HR group subjects. Generally, the adduction features of vocal fold, approximated either laxly or tightly
together, determined the vocal quality. A breathy voice was produced by laxly approximation of vocal fold, so that there was an excessive escape of air and perceived as breathiness.

**Reduction in vocal performance in non-HR group**

The changes in acoustic, phonetogram and perceptual measures in non-HR group suggested reduction in vocal performance. In acoustic measures, the significant deterioration in vocal quality at Time 2 was possibly due to the spontaneously reaction of vocal apparatus towards sudden increases of vocal demands. The sudden increases in laryngeal muscular effort leaded to rigidity of muscles, and disturbed normal vocal quality. After that, the value returned to the original. This return suggested adaptation of laryngeal muscle occurred. However, there was no further improvement in vocal quality like that in HR group. It was due to the continuous vocal demands without relieves, such as vocal rest, hydration and nourishment.

The reduction in vocal function revealed in phonetogram measures was as the result of prolonged vocal. The reduction included decreases in laryngeal muscle contraction ability and coordination, and the loss of vocal folds' elastic properties during phonation. And, the reduction in fundamental frequency range included decreases in maximum fundamental frequency and increases in minimum fundamental frequency, which suggested that there was a reduction in TA muscle function which responsible for vocal fold vibration during the time of vocal fatigue.

Perceptually, breathy voice would appear after prolonged hyperfunctional voice use. Hyperfunctional voice use included phonating a lot, especially phonating with great deal of effort, or under stressful environment, or against high level of background noise. In this study, after Karaoke singing, which was a kind of hyperfunctional voice use; during the subjects' feeling of vocal fatigue, there was tiredness in their laryngeal muscles. Such tiredness caused the muscles
reduced in contraction, and so reduced the approximation of vocal fold, consequently, non-HR group subjects had increases in breathiness perceptually.

The role of Hydration and Vocal rest during voice use

According to the vocal quality and function changes in the two subject groups, there were different vocal symptoms and changes during the time of vocal fatigue after Karaoke singing task. This suggested that, there should be vocal quality and function changes during vocal fatigue, but the manner (positive or negative) and extend of changes would highly depend on the changes in anatomy and physiology of laryngeal muscles which was affected by the blood flow and nutrient transportation to the muscles and the mass and mobility of vocal fold. In this study, it was found that hydration and vocal rest did alternate these changes and were useful in delay vocal fatigue. This suggested that hydration and vocal rest might alternate or reduce the changes in anatomy and physiology of vocal muscles.

Difference between Male and Female subjects

For the changes in absolute jitter and jitter percent, it was found that there were significant changes in male subjects rather than female subjects. For female subjects, they had significant reduction in fundamental frequency range, maximum fundamental frequency and total area of vocal range. This result was consistent with that revealed in Smith, Kirchner, Taylor, Hoffman and Lemke (1998), it found that female teachers reported significantly more vocal discomfort symptoms and poorer vocal quality and had higher rate of having a tired or an effortful voice than male teachers. This result revealed difference between male and female subjects in vocal functions. This was possibly due to the differences in anatomy and physiology of muscles, and voluntary responses towards vocal demands. Generally, it was believed that males may try hard to maintain the vocal function so to overcome the fatigue while females tend to escape from fatigue.
Evaluation of Measurements

Among the measurements, phonetogram was useful in detecting subtle changes in vocal function. Significant changes were revealed in both groups, increased total area in HR group, and decreased total area and fundamental frequency range in non-HR group. It was useful because it required subjects to produce phonation with extreme pitch and loudness, which was demanding.

And for acoustic analysis, changes in vocal quality were significant in connected production rather than sustained vowel. Possibly, during the production of connected phrase, the subjects had to use the voice in a more natural way. On the other hand, during sustained vowel production, subjects may manipulate their voice in order to compensate the changes in vocal quality they perceived, and so, the changes in voice parameters were not significant.

Although the reliability of perceptual measure was still a big query by many researchers, the result of this study suggested that perceptual measure was important for vocal quality analysis.

Clinical implication

There may be some clinical applications of these findings. Firstly, untrained subjects were able to sing continuously for about 78.02 to 105.47 minutes, this was possibly the vocal endurance of untrained people in prolonged voice use. People were suggested to limit the amount of voice use within this limit. Secondly, for future studies, this length of time would be a useful reference for inducing vocal fatigue experimentally. In addition, as the occurrence of vocal fatigue and the vocal quality and function changes during vocal fatigue would be different under different conditions of vocal use, this suggested that these changes could be used to evaluate the effectiveness of voice therapy strategies. Finally, as concluded in the previous section, total area of phonetogram measure, acoustic analysis of connected production and perceptual measure were useful in investigating subtle changes in vocal quality and function.
Future studies

Generalisation of the present result to other population is suggested. Firstly, as there are reasons to expect different results might be obtained from trained singers or professional voice users such as able to sing longer and have less negative changes. For them, the vocal endurance and vocal adaptation ability might be better due to more frequent use of laryngeal muscles. As suggested by Ericsson, Krampe, and Tesch-Romer, frequent use of muscles may alter muscle anatomy and physiology due to increases in muscular capillary architecture that might enhance the vocal warm-up effect. Secondly, the changes in vocal quality and function were not the same in the two gender groups, it possibly suggested that female and male react differently during intensive vocal use. Thirdly, vocal quality and function was suggested to be different in people in different age because of difference in anatomy and physiology of laryngeal muscle, it was possible that different result would be revealed from people in different age group. Further study on larger group of untrained and trained or professional of single gender subjects in different age group under different voice use conditions will help to give evidence to the relationship between warm-up effect and vocal fatigue after vocal use.

Besides, in this study, subjects were assigned into one of the two groups, HR and non-HR group, hydration and vocal rest were found to be useful. It was interesting to confirm their function by doing repeated measures on the same subjects under the two conditions.

CONCLUSION

Several conclusions can be drawn concerning the results of this study. Firstly, this study provided general picture in Karaoke singing among young people in Hong Kong, and their knowledge on voice protection. It was suggested that proper voice protection education should
be done to the public in order to increase their awareness and knowledge on voice protection, and so to minimise the occurrence of vocal damage. Secondly, this study suggested that untrained people would face vocal fatigue after 78.02 to 105.47 minutes of vocal use. Thirdly, this study also provided experimental evidence to suggest that subjects received frequent brief hydration and vocal rest appeared to have less negative vocal quality and function changes, and delayed the feeling of vocal fatigue on Karaoke singing task. So, hydration and vocal rest during singing should be a useful suggestion for voice protection. In addition, the acoustic, perceptual and phonetogram measures were useful for locating vocal quality and function changes. Finally, the findings should be useful in implication and future studies were suggested to explore our knowledge in voice use, vocal warm up and vocal fatigue.

ACKNOWLEDGEMENT

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REFERENCES


Appendix I

Questionnaire on singing at Karaoke among young people in Hong Kong

Name: __________  Age: __________  Occupation: __________

1. How much do you talk at work? 你日常工做需要說話的時間有多少呢？
   □ Little很少    □ Sometimes間中    □ Quite often頗多    □ Very often很多

2. How would you describe your voice quality? 你怎樣形容你日常的聲線？
   □ Normal正常    □ soft細聲    □ loud大聲    □ high pitch高音
   □ low pitch低音    □ hoarse沙啞    □ breathy沙啞帶氣
   □ strained好緊    □ others其他__________

3. How frequent do you go to Karaoke? 你平均每多久去一次卡拉OK？
   □ Everyday每日    □ more than 3 times a week—一星期多過三次
   □ 1-2 times a week—一星期一至兩次    □ once every two weeks—兩星期一次
   □ once a month—一個月一次    □ less than once a month—少過一個月一次

4. On average, how long do you sing each time at the Karaoke? 你去卡拉OK每次平均唱多久時間？
   □ 1 hr or less—一時或以下    □ 2-3 hrs—二至三小時    □ 4-5 hrs—四至五小時
   □ 6 hrs or more—多過六小時

5. a) Have ever experienced vocal fatigue/ voice changes/ throat discomfort after singing at Karaoke?
   你有沒有試過在卡拉OK唱完歌後感到聲線疲倦/改變/喉部不適？
   □ Yes有    □ No無

   b) If yes, how often do you have voice change? 唱完歌後感到聲線疲倦/改變/喉部不適的機會有幾多？
   □ Every time每次    □ ¼两次有一次    □ 1/3 三次有一次
   □ ¼ 四次有一次    □ less than 1/5 五次少於一次
6. How would you describe your voice quality after singing 你怎樣形容你唱完歌後的聲線?

- Normal正常
- soft細聲
- loud大聲
- high pitch高音
- low pitch低音
- hoarse沙啞
- breathy沙啞帶氣
- strained好緊
- others其他

7. On average, how long does it take for your voice to return to normal 你的聲線平均需要幾耐才能回復至正常一樣?

- Less than 1 day少過一日
- 1 day一日
- more than 1 day多過一日

8. How does vocal fatigue affect your daily life 你覺得聲線疲倦改變喉部不適對你生活有什麼影響?

□ No無

9. What do you know about voice protection 你知道哪些方法是可以保護聲線的?

For example 例如 1.

2.

3.

4.

5.

□ Don't know 不知道